

**International Expansion of Small
High Technology Based Firms: The
Role of External Linkages in
International Growth and
Development.**

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Abstract

This thesis examines the internationalisation of small firms in high technology sectors based in England and Scotland. The conceptual stance taken is that internationalisation is part of the growth and development process of small firms and needs to be viewed holistically. Internationalisation processes are examined chronologically by tracking the external links made by the sample firms from their inception until the date of the survey. The theoretical approach is eclectic, drawing on internalisation/transaction cost, network, internationalisation and resource-based approaches to explanation of firm growth and specifically, their international development. The constructs of the research, the external links, are constructed on the dimensions of internal and external links, inward and outward links and are differentiated by strategic value chain activities research and development, production, and marketing/distribution. The findings of the research indicate that most small technology based firms do not internationalise in an export-based evolutionary pattern. Rather, internationalisation processes are diverse and complex, often reflecting areas of specialisation of the firm, or its internal growth processes. The research indicated that internationalisation is accelerating for the small firm sector, at least in high technologies, with first international links occurring immediately or soon after inception. The factors influencing internationalisation tend to be firm specific and associated with the capabilities, competencies and resources of the associated firms. The major contribution of this thesis is in its development of a conceptual approach which allows the heterogeneity of small firms to be taken into account in the research design, focuses on the holistic growth and development of the firm rather than a functional perspective, and makes a significant advance towards the integration of different theoretical approaches to the development of small international firms. There are important implications in the findings, amongst which is evidence that small firms in certain sectors are subject to influences from international, if not global, industries at an early stage. These firms need to be prepared to compete at international level, and become involved in cross border activity at very early stages in their development. At policy level, the imperative is to provide appropriate infrastructural support and advice which goes beyond the encouragement of exports and recognises that small firms may be involved in additional or alternative internationalisation processes than to the conventional export route broadly recognised within the policy framework.

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Chapter 1

Introduction

Chapter Objectives

- *To introduce the reader to the topic and discuss some of the issues which initially triggered the researcher's interest in small firm internationalisation.*
- *To provide a brief statement of the aims and objectives of the research, conceptual framework and context.*
- *To explain how the thesis has been structured and provide a brief overview of the contents and purpose of each chapter.*

Introduction

This thesis is concerned with the early growth and international expansion of small firms in high technology sectors. Initial interest for the thesis derived from the author's chance contact with several small high technology firms which were apparently operating and competing globally in the first couple of years of their existence. At that time (the early 1990s) such activity was generally considered to be unusual and the gradual, sequential process of small firm development from a purely domestic firm through several stages and modes of export activity was widely accepted. The search for a literature on the "internationalisation" of small firms indicated that despite a plethora of export studies, knowledge on the early stages of the international development of small firms and about the process of international growth was very fragmented.

Writing in 1992, Coviello and Munro claimed that the development of the literature on the internationalisation of smaller, entrepreneurial firms was in an early stage of development and that even with regard to larger firms literature on internationalisation processes was embryonic. Approaching the same issue from a multinational development perspective, Buckley et al. (1988) identified the transitional stage of firm development between small/domestic and large/multinational as a gap in extant knowledge and one worthy of future research. A literature search conducted during the early stages of this thesis revealed a similar picture. There were few studies of the internationalisation process of small firms which took a holistic view of the international expansion process of small firms. At that time, foreign market entry modes as a research topic was seen as a frontier issue and studies of exporting, licensing and foreign direct investment respectively included work which examined small firms in relation to a specific foreign market entry mode (see Young et al., 1989 for a comprehensive review). The perspective taken generally tended to focus on the behaviour and performance of small firms in relation to individual and specific forms of foreign market entry, rather than on the international growth and development of the firm of which market entry is but a part.

The international expansion, or international growth and development process of small firms, appeared to be an area much in need of empirical research and offered exciting possibilities for the development of an appropriate conceptual approach (see also doctoral work by Lindqvist, 1991; Bell, 1994; Gannon, 1995). Internationalisation seen as a "growth" process for small firms demanded a research design encompassing a much more comprehensive range of cross-border business activity than studies of

export development. For that reason, a major part of this thesis consisted of a review and synthesis of theoretical approaches to firm growth from small firm studies, studies of innovation and technology and studies on the growth and development of the multinational. The review provided the theoretical insights and constructs on which the conceptual approach to the research problem was developed.

Since the launch of this research project, a number of papers and articles have been emerging from researchers around the world which have identified “global start-ups”, “new international ventures” and the “international entrepreneur” as small firms which deviate from the accepted norm of sequential or incremental export development. Knowledge however is still patchy, the majority of studies in this area tend to be small scale and qualitative and therefore the rapidly internationalising firm still tends to be seen as the exception rather than the rule. This thesis adds to a small number of survey based studies of internationalisation and was influenced to a great extent by work first done by Luostarinen (1979) on the internationalisation of Finish firms. Significant contributions to the conceptualisation of the internationalisation process have been made by the same author and others (Luostarinen, 1979, 1980; Luostarinen et al., 1994; Welch and Luostarinen, 1988, 1993). It was also influenced in its later stages by pioneering work on new international ventures discussed above.

Coinciding with the completion of this project was the publication of an OECD report (OECD, 1997) which was commissioned to determine the extent to which small and medium sized firms were globalised across OECD countries. The report (OECD, 1997) established that there was widespread recognition of a small but rapidly growing group of small firms in most countries which were extensively internationalised or internationalising very rapidly. What was also evident from the report however was that a great deal of the research drawn on for the report tended to concentrate on exporting firms, and samples were frequently drawn from export directories, thus screening out firms involved in other modes of international activity. Also apparent was that empirical evidence was very fragmented and often incomparable due to widely differing research designs and conceptual approaches and in emphasis of the previous point, evidence was often of a secondary nature concerned with export development to a greater extent than the international growth and development of the firm.

Background Issues and Importance of the Topic

The importance of small firms in the development of new technology is widely recognised and there is a substantial literature on the role of small firms in innovation, on the determinants and impediments to their growth, and on issues relating to their competitiveness (see review Chapter 3). It has been noted that small firms in high technology sectors are export intensive and internationalise rapidly, but detailed academic work on the triggers and processes of internationalisation has yet to catch up with industry practice. The fact that technology and technology markets have been subject to tremendous globalisation forces over the last couple of decades has been extensively researched in relation to multinational business. Advances in technology, transport and communications, regionalisation, and deregulation of industry are amongst forces which have shifted the competitive focus of the multinational firm in high technology markets from local to regional or global. Changes in organisational structure, modes of cross-border activity, subsidiary location etc. have been well catalogued and significant changes in international business theory have emerged as a result of multinational research (see for example Dunning (1993), and Caves (1996) for comprehensive reviews).

The influence or impact of such changes on the small high technology firm has been less adequately researched, and despite emerging evidence to the contrary, small firms are often still expected, at least in early stages of their existence, to be confined to domestic activity or experimental export. There are a number of arguments which suggest that small firms in high technologies, should be international, or at least prepared to become international. A few of these arguments are outlined here as the background to sources of interest for this thesis.

A collection of papers published when this research project was embryonic, edited by Granstrand, Hakanson and Sjolander (1992) explored the internationalisation of R&D and Technology. Significant in this collection is the absence of empirically based research on the role of small firms in such internationalisation processes. This was considered surprising taking into account the emphasis placed on the innovatory capacity of the small firm by national and EU technology programmes at the time (see also Chapters 2 and 3).

Literature on the growth and development of firms has long emphasised the attributes of the entrepreneur and flexibility of small firms in the invention and development of new products and processes. Rothwell (1993, 1991), Williamson (1975), Penrose (1959)

amongst others have widely discussed technology transfer between small and large firms, the former being more adept in invention while the latter are better able to manufacture, develop, market and distribute the outcome of innovation.

Accelerating the internationalisation of technology and technology intensive firms is the race for new technologies in which both MNEs and governments are competing. Recent national and international technology policy has turned its attention to the development of new technologies and in so doing has devised policies which are attempting in various ways to harness the innovative potential of small firms. Requisite for participation in a number of these programs is willingness to become involved in cross-border technological cooperation.

New technologies tend to be complex, involve knowledge from a number of specialised technical areas of expertise, and tend to have very high developmental costs. These factors amongst others have resulted in much collaboration between firms at various stages of technological development, and frequently such collaborations tend to be international. Collaboration for small firms may provide access to resources such as knowledge, expertise, research facilities and equipment, complementary technology and ultimately partners and contacts for the exploitation of results.

New technology based firms, generally considered to be those which are actively innovative at the leading edge of their technology, may have been established specifically for the purpose of developing an innovation. Evidence suggests that such firms, and small high technology firms in general have higher export propensity and intensity than small firms in other sectors.

Other literature has emphasised changes in the structure of MNEs and international industries, and in particular, recent attention has been paid to the down-sizing of MNEs and concentration on core products (Jones, 1996; Caves, 1996; Dunning, 1993). Linked to this is a greater tendency for MNEs to contract out R&D, production and service activities to small firms. There is evidence that multi-national networks draw smaller firms into international markets and networks of activity, but in the international business literature at least, the focus has tended to be very much on the large, experienced multinational organisation.

The dearth of empirically based knowledge on the internationalisation of small firms or the extent to which the internationalisation of industries, technologies and markets has affected the small firm triggered the OECD report into the globalisation of the SME.

The importance of the small firm in innovation would suggest that that particular gap in knowledge should be explored as a matter of some urgency.

The life expectancy of small firms is another issue which may effectively screen out small independent firms from studies of internationalisation. Small firms often cease to exist, or rather cease to fall into the category of small firms where they are subject to merger or acquisition activity or any means by which growth is not strictly organic. In cases where the firm making the acquisition is foreign (inward investment) the acquired firm becomes international due to ownership links, capital investment and involvement in foreign markets through the parent. Internationalisation therefore has inward and outward directions which are frequently not addressed in studies of internationalisation where the focus is on the outward movement of products or production processes.

This absence of focus on small firm internationalisation processes is to some extent not surprising since the small firm is after all a large firm which has not yet grown up. Since a large proportion of small firms do not grow to significant size or survive as small firms into the next decade, it makes sense to focus on firms which are already involved in international activities to an extent sufficient that they will appear in a directory of international firms. Most studies of exporting which have attempted to differentiate between small and larger firms have used such sources of data thus effectively screening out the very new or very small firm which may be involved in international activity. Often, comparison is made broadly between small firms of, for example, less than 200 employees and larger firms with little differentiation of firms within the former size category.

The above arguments suggest that some of the reasons for the dearth of empirically based research on small firm internationalisation are practical problems. Most databases and directories do not provide any information on whether a firm has any international involvement or not. Export directories which do provide such information tend to be limited to firms involved specifically in exporting as opposed to any other form of economically gainful international activity, and will generally not include firms which export in an ad hoc fashion or through intermediaries.

Firms established specifically to exploit a scientific or technological innovation may depend on contract R&D work, consultancy or other service activities for an initial period until production is established. Studies of internationalisation focusing on exporting firms, may not include such firms since definitionally, export involves the transfer across national borders of goods or services, by implicit implication, products.

As mentioned above, most small firms are not expected to survive into the next decade, apparent amortisation due to ceasing to trade, merger or acquisition, the latter two of which result in the absorption of the small firm into a larger one effectively removing it from the small firm category. Since literature on internationalisation tends to assume implicitly or explicitly that international activity takes place once the firm is relatively well developed in domestic markets, the population of internationalising firms becomes difficult to pin down since it represents a brief and transitory phase in firm development between small-domestic based firms and large internationally involved firms. Survey research has therefore tended to be limited to firms appearing in international directories or to very large, general surveys of small firm activity which attempt to determine the extent of small firm activity overseas, most frequently measured by export ratios. General surveys of small firm growth and competitiveness, although providing a useful bench-mark for more in-depth studies of small firms are generally limited by the very heterogeneous nature of small firm activity. Even the largest of these have addressed the internationalisation question very superficially (Bolton, 1971; SBRC, 1992; Cosh and Hughes, 1996).

The need for more comprehensive, empirically based studies of small firm internationalisation, is at the end of the 1990s, the age of technology, information and global industrial restructuring (Dicken, 1998), more pressing than ever. The most immediate attention arguably, needs to be paid to small firms in high technology sectors especially in new technology sectors, where global opportunity and exposure are high (Crick and Jones, 1998a). In new technologies, where firms are young and small, markets and industries are still in the early stages of development. The knowledge intensity of the innovation process here and the need for highly specialised but multi-technology inputs suggests that there is likely to be cross-border activity between firms in very early stages in their development (Crick and Jones, 1998b). Such international links in fact may be forged by founder members before the inception of the new technology based firm since there is a strong likelihood that founders will have emerged from previous employment in university, industry or government based laboratories with strong international connections or involvement in cross-border R&D or technical development projects.

These types of firms may begin life as global start-ups or “new international ventures” (Oviatt and McDougall, 1994; Oviatt et al. 1994; McDougall and Oviatt, 1991; McDougall et al. 1994). Even where small new technology firms do not begin life as new international ventures (NIVs), development processes, i.e. firm growth,

innovation and internationalisation are more likely to occur concurrently than sequentially as would be the case in the traditional model where internationalisation takes place only after significant development of the firm in the domestic market.

The Aim of the Research

The aim of the research is to describe and analyse the international expansion process of small technology based firms. The approach taken is based on two important assumptions which can be stated succinctly as:

- International expansion, or internationalisation is considered to be part of, and to a large extent inseparable from the overall growth and development process of small firms.
- The conceptual approach is based on the assumption that international expansion can be tracked through the firms' establishment of external links over time.

The rationale for this approach is developed fully in Chapter 5. Essentially the basis for choosing the external link as the main focus of the research has an eclectic theoretical basis. The four main theoretical explanations of firm growth: transaction costs/internalisation approaches, knowledge and resource-based approaches, network approaches and internationalisation or export development approaches indicate, for differing reasons, that early growth is more likely to take place through external links and transactions than through internal means. *The purpose of the research is exploratory with a view to theoretical development.*

Focus, Constructs and Research Design

Reiterating the points made in the previous paragraph, the main focus of the research is on the international growth and development of small high technology firms through the establishment of external links over time. The types of external link included in the study are those which are economically viable, i.e. they have a commercial basis. The link types have been constructed and interpreted on three dimensions. These are, a value chain basis (R&D, production and marketing/distribution) a directional basis (inward, outward and reciprocal cooperative), and a consolidation basis (integrated/internal and transactional/external).

The main part of the fieldwork consists of a sample survey of small high technology firms in England and Scotland. The focus of the research is on early internationalisation activity and therefore the focus was specifically on small firms (≤ 200 employees) and reflecting the high technology industries from which the firms were drawn, most were relatively young. Analysis was quantitative but took an interpretative, inductive reasoning approach utilising statistical model building techniques, and drawing on theory for their interpretation.

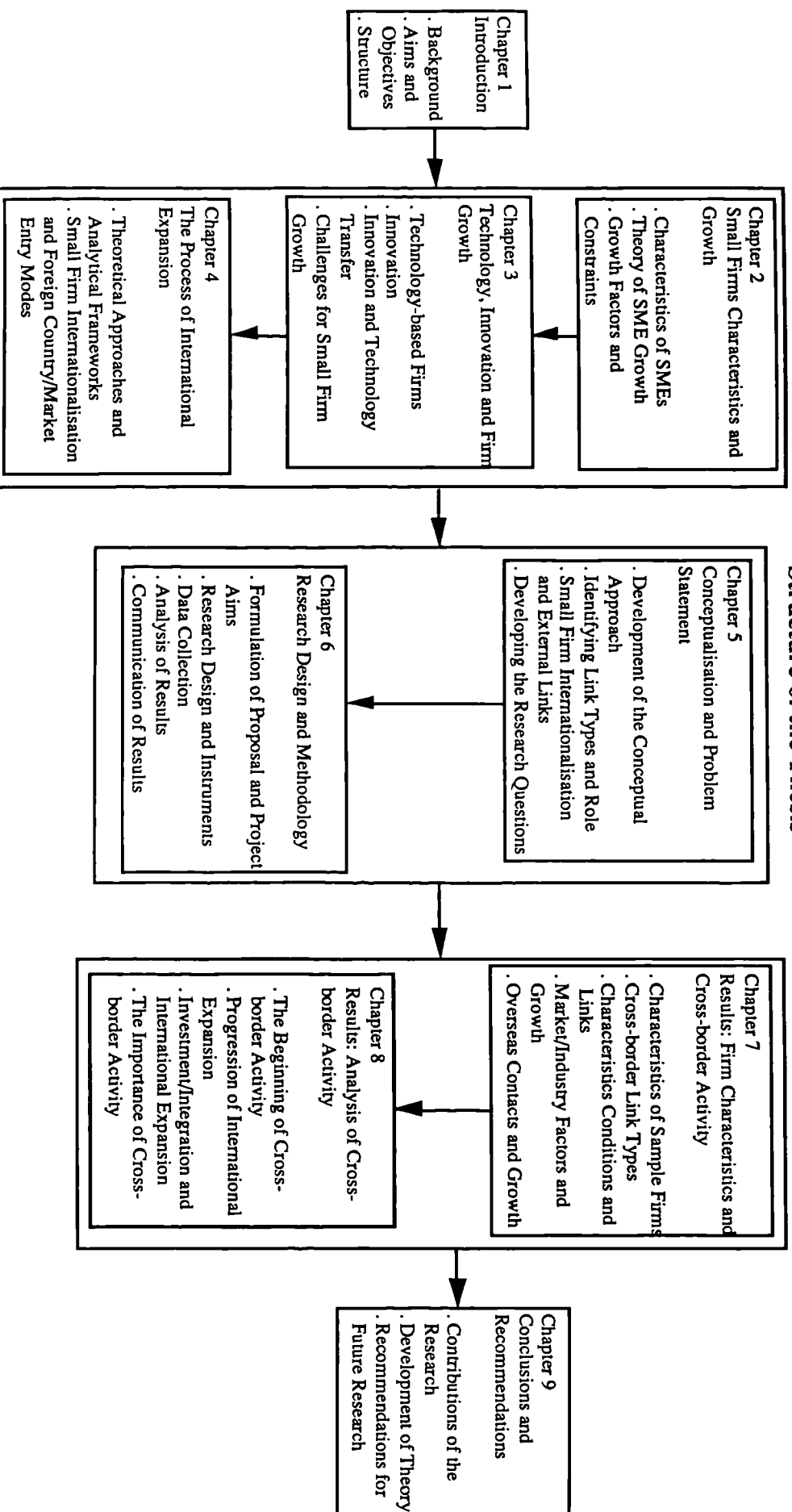
The Research Objectives

The research objectives which are stated explicitly in Chapter 5 are concerned with the identification of the types of cross-border links formed by small, high technology firms, ascertain their importance to international growth and development, and identify factors which, alone, or in combination, influence their international growth and development process. In addition to an examination of the factors influencing international expansion, the study examines the internationalisation process as a series of cross-border events over time. The final objective is to comment on existing theory and assess the contribution of this work to current knowledge. The objectives are further broken down into research questions, listed at the end of Chapter 5, which determine the structure for the data analysis and the presentation of the results. The research is essentially exploratory and theory-building, and therefore presents the research problem as a series of open questions rather than hypotheses.

Structure of the Thesis

This thesis approaches the international growth and development of small firms by taking a step back from the currently accepted, but much criticised “internationalisation” approach and examining the more fundamental components of firm growth as building blocks for a more holistic conceptual approach. It recognises that the limited resource base of small firms inhibits growth processes including the development of technological and innovatory capability and expansion into foreign markets. The major premise is that firms can develop their resource base by accessing and utilising external resources through the development of links with overseas based bodies and organisations and by establishing an international orientation within the firm. The thesis identifies the types of cross-border links made by small technology based firms, examines the effects of linkage activity on performance and establishes typical patterns of cross-border linkage activity.

Structure of the Thesis



The stance taken here is that the international expansion of small firms is a holistic process and, at least in the early stages, is not functionally delineated as is the case of export development which is concerned primarily with the expansion of downstream marketing and distribution activities of firms. Conceptually then, the thesis is very much grounded in literature pertaining to the growth of the firm and treats technological development and international expansion as two major components in the growth process of the firm.

The thesis contains nine chapters inter-related as illustrated in Box 1.1. This, *the first chapter* introduces the topic, the perspective taken and outlines some background issues from which interest derived. The first part of the research consists of an evaluative review of relevant literature. The main focus or theme running through the research is the international growth and development of the small technology based firm. This theme is reflected in the selection and evaluation of the literature which is discussed over three chapters on small firm growth, technology, innovation and firm growth, and the process of international expansion respectively.

Chapter 2. Taking the view that internationalisation for small young firms is part of a more holistic growth process, this first literature review chapter takes a step back from the international aspect of growth and examines fundamental explanations of firm growth. The first part of the chapter examines theory in relation to firm growth while the second discusses recent empirical work on the growth and development of small firms.

Chapter 3. In recognition of the importance of technology in firm growth and its influence on international business, this chapter examines a number of key issues. The innovation chain (R&D, production and marketing/distribution) is the theme around which the chapter is structured. The first section examines small firms which are established specifically to develop a scientific or technological innovation. These firms are not only the beginning stages of a number of growth processes, e.g. firm growth, technological development and internationalisation, but they have been found by research to internationalise rapidly. The second section of the chapter examines the innovation process and considers the role of the small firm in innovation as well as the role of innovation within the firm. The final two sections of the chapter discuss technology transfer between firms and the challenges of particular importance for small technology based firms.

Chapter 4 narrows the focus to international expansion, which is the central interest of the thesis. The chapter concentrates on the theory of firm growth in an international

context and examines contributions from economic and behavioural approaches to the topic. The chapter begins by discussing some of the classic theories and moves to recent developments and integrations of theoretical approaches which are of particular relevance to the thesis.

Chapter 5 is the most important chapter of the thesis. In this chapter the conceptual approach to the research problem is developed, the underlying theory identified and the constructs explained. The chapter presents explicit statements of the aims and objectives of the research, the assumptions made in the construction of the research design, and finally, it details the questions to be addressed by the research.

Chapter 6 discusses the research design and methodology. The chapter picks up the conceptual ideas discussed in the previous chapter and outlines the process to be followed in the practical operationalisation of the research. In addition, the rationale for the chosen research design is discussed and supported with reference to previous research and debate on methodological issues. The chapter ends with a presentation and analysis of the results of the pilot study and recommendations for the final research design.

Chapter 7 is the first of two chapters presenting and discussing the results of the survey research. Presentation of the results is structured from the simple, descriptive to the more complex analytical. The results in Chapter 7 are concerned with the identification of important variables and trends among the sample firms. Analytical procedures include simple, univariate frequency distributions and bivariate cross-tabulations and correlations between dependent and independent variables.

Chapter 8 is much more analytical and draws heavily on theory for the interpretation of statistical models. Interest in this chapter is in exploring the causal factors behind different types of cross-border link, and in the determination of patterns in the internationalisation processes of the sample firms. In respect of the first issue, logistic regression models are constructed, in the second the construction of event matrices facilitates chronological investigation of the internationalisation process.

Chapter 9, the final chapter discusses the findings in relation to the aims and objectives of the study and makes appropriate conclusions and recommendations. This chapter also includes an evaluation of the research and its contribution in relation to the development of a theory of small firm internationalisation.

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Chapter 2

Small Firms: Characteristics And Growth

Chapter Objectives

- *To describe the nature of small firms, their characteristics and conditions, and means of categorisation, and establish the small firm as the central focus of the thesis.*
- *To present an attempted synthesis of a very fragmented literature on the growth of the firm from multi-disciplinary perspectives.*
- *To examine and evaluate theoretical explanations of firm growth, and empirical evidence from small firms research.*
- *To provide a foundation chapter examining the fundamental growth and development determinants of small firms irrespective of whether expansion is functionally or geographically delineated.*

Small Firms: Characteristics and Growth

Introduction

The purpose of this first literature review chapter is to provide a solid characterisation of the small firm, its growth processes, and factors influencing its growth, thus providing a foundation of knowledge on which this study will build. The chapter begins by describing the nature of small firms and their definitions and then discusses theoretical approaches to an explanation of small firm growth. A review of the elements and barriers to growth reaches the conclusion that growth is determined by the extent of the resource base of small firms and the capabilities of management to coordinate resources towards growth. Evidence is presented which suggests that small firms' resource base may be extended by recourse to resources held by external bodies and organisations and that growth may continue where the firm develops the ability to manage external resources effectively.

Technology is discussed in this chapter to the extent that it represents a means to growth and development for all small firms. As the thesis is concerned with the growth of firms in technology sectors however, the following chapter, (Chapter 3) takes a different perspective and presents the small firm as part of a larger value chain process in which it may take part in any or all of R&D, production, marketing and distribution processes. New technology based firms (NTBFs¹ - those established specifically to develop and commercialise an invention) are discussed as a special case in the third chapter.

Internationalisation, or the international growth and expansion of the small firm seldom features in the literature which is specific to small firm studies. The international growth process is in fact a major theme in the international business and international economics literatures which have to some extent explored the role of the small, young firm. This chapter explores the fundamental nature, characteristics and growth processes of small firms. International expansion, which has tended to be treated in the literature as a special case in terms of firm growth, is examined in Chapter 4.

¹ An NTBF, new technology based firm, is one which has been founded primarily to exploit a technologically innovative idea, is totally independent, and has a small nucleus of founders. A full discussion of the characteristics of NTBFs is given in Chapter 3.

Characteristics of Small Firms

The small firm sector is very diverse in the characteristics exhibited by its members. Small firms may be found in most industry groupings in both manufacturing and service sectors. SMEs also take a number of legal forms. The SBRC (1992) report, based on a sample of over 2000 British firms of 500 employees or less reported that almost 90% of all SMEs in the sample were companies, around 8% were partnerships, and 4% were sole proprietorships. (SBRC, 1992). While most definitions require small firms to be independent in terms of ownership, they are often dependent on large firms or the networks of suppliers, buyers and competitors in which they operate.

Small firms in general tend to be small businesses (McGee, 1989) often with only a small share of their market, managed by owner-managers in a personalised way and without access to the capital market (Bannock, 1981). Small firms often survive through specialisation, performing a small part of the activities in the value chain, for example sub-contract manufacturing, distribution, management, technical or marketing services or consultancy, or they may be specialised by product, by specific industry applications or specialised market segments. Small firm strategies therefore tend to be niche strategies depending on the firms' ability to recognise and respond quickly to changes, threats and opportunities in the market. In international studies, small firms tend to be seen as beginning and developing through exports (see Chapter 4).

Chief executives of SMEs typically have strong personal connections with their organisations and as such growth may be restricted by the social costs of both start-up and subsequent expansion. The time involved in running a business, early financial sacrifices and the intermingling of business and home life represent significant personal cost for the owner manager and often the spouse (Scase and Goffee, 1980). Entrepreneurs are often fiercely independent and while growth opportunities may be sought they may equally be rejected if personal control of the organisation is likely to be undermined.

Survival of individual small firms may be relatively short and while some evolve and transform into large organisations, others continue to be niche players and some 'cease trading'. Recently, a Dunn and Bradstreet Survey reported over 62 000 business failures during 1992²

² The Guardian, 31st Dec. 1992, p12.

Categorisations of SMEs

Comparison between studies of small firms is often problematic because of different definitions of what constitutes a small firm and differences in size categories applied in research reports. Amongst many characterisations however, a few have emerged as "standards" in research reports on small firms, and for the purposes of policy.

One of the most important studies of small firms in the UK, the Bolton Report 1971 suggested that:

"-- a firm could not be adequately defined in terms of employment or assets, turnover, output, or any other arbitrary single quantity, nor would the same definition be appropriate throughout the economy --- most appropriate to our inquiry was a definition which emphasised those characteristics of small firms which might be expected to make their performance and their problems significantly different from those of larger firms". (Bolton Report 1971, p1).

For the purpose of their report, the Bolton Committee decided that a small firm is one which:

1. has a relatively small share of its market,
2. is managed by its owners or past-owners in a personalised way, and not through the medium of a formalised management structure,
3. is independent in that it does not form part of a larger enterprise and that the owner-managers should be free from outside control in taking their principal decisions. (p1)

This was described as an "economic definition", in addition, the committee also used a "statistical definition", (Table 2.1). In the latter case manufacturing firms were considered small if they had an upper limit of 200 employees. Arbitrary size limits for other categories of firms, or firms within specific sectors were applied as appeared appropriate, in most cases involving both turnover and number of employees as measures of size.

Table 2.1 Bolton Committee Definitions of Small Firms	
Sector	Definition
Manufacturing	200 employees or less
Construction	25 employees or less
Mining and Quarrying	
Retailing	Turnover of £50,000 or less
Miscellaneous Services	
Motor Trades	Turnover of £100,000 or less
Wholesale Trades	Turnover of £200,000 or less
Road Transport	Five vehicles or less
Catering	All excluding multiples and brewery-managed houses
Source: Bolton (1971)	

This classification was adopted by the Wilson Committee (1978), which emulating the Bolton approach attempted to distinguish between industry sectors in setting size classes.

Other definitions have emphasised the financial status of firms and have used annual turnover as the criterion for classification. The 1981 Companies Act for example classifies a firm as medium-sized if for the financial year and the year immediately preceding it two of the following three conditions apply:

- 1). turnover did not exceed £5.75m.
- 2). balance sheet total did not exceed £2.8m.
- 3). average weekly number of employees did not exceed 250.

The same stipulations apply in the case of small firms for which the conditions are that:

- 1). turnover did not exceed £1.4m
- 2). balance sheet total did not exceed £0.7m.
- 3). average weekly number of employed did not exceed 50.

While definitions based entirely on the number of employees may distinguish between capital and labour intensive firms, definitions based on turnover diminish in usefulness with the passage of time and changing value of money. However neither method distinguish between high volume/low value or low volume/high value, value adding processes. The 1981 Companies Act combines both number of employees and turnover in its classification criteria but makes no distinction between firms in different industries or involved in different activities.

There are advantages in differentiating between groups of firms in this way and studies focusing on a particular industry or type of firm would tend to use a size classification reflecting the norm in the industry sector under study. Such a system would be less useful in cross-sectoral studies however and blanket definitions may be more useful here. More recently, the EU's characterisation of small firms has been used fairly extensively. The EU stipulates that to be classified as a small or medium sized enterprise (SME) a firm should be independent and employ less than 500 employees. This definition is based only on the numbers employed and is not related to turnover, nor does it vary by sector (with the exception of craft firms). The SME sector is further broken down under the EU definition into:

- micro-enterprises (between 0 and 9 employees),
- small enterprises (those with 10-99 employees),
- medium enterprises (those with 100-499 employees).

Researchers using this definition have tended to introduce variations to the basic model according to their research purposes, for example, the Cambridge report on the State of British Enterprise (1992) differentiates between micro firms which were classed as employing less than 10 employees, small firms employing between 10 and 99 employees, medium-sized firms with 100 to 199 employees and larger firms with between 200 and 500 employees.

Storey (1994) points out that the EU definition is an improvement on previous approaches as its subdivision of the SME sector goes some way towards recognition of its heterogeneity. In addition he suggests (Storey, 1994, p13) that the "break-points" represent stages, identified by research, in the development of small firms. For example Lyons (1991) and Atkinson and Meager (1994) have found that firms tend to formalise their organisation between 10 and 20 employees in the adoption of formal contracts with customers, and the appointment of non-owning managers.

Barber, Metcalfe and Porteous (1989), introducing a collection of review papers on innovative small firms suggest that a flexible approach to small firm definitions be adopted since rigid criteria based on measures such as employment or turnover can be misleading.

Their summary comment on the debate was:

" 'How small is a small firm?' It depends on the relevant technological and market environments and whether or not one takes an international or domestic perspective". (Barber et al., 1989, p8).

In survey based studies of internationalisation, categorisation has tended to be crude. Surveys of export development for example have tended to distinguished between firms by size, age, and experience. Size however is often in categories of small, medium and large, with no further break-down of the SME sector which would distinguish between firms within the 200-500 employees category, or within the 20 employee category.

The size of firms, their age, experience and their resource base are factors which have been seen as the basis of their growth possibilities. These core factors are also sometimes seen as limiting factors which may inhibit or prevent the growth of small firms. In reality and as the next three chapters will show, the growth and development of small firms is much more complex and involves many more factors than are apparent from the definitions and categorisations which have been discussed in this section.

Theoretical Approaches to SME Growth

Introduction

Review of the literature on small firm growth found little reference to theoretical explanations or models of growth. This lacuna is partially filled by attempts to relate various aspects of small firm characteristics and behaviour to indicators of firm performance, survival or growth. Such approaches to the understanding of small firm growth have been categorised and reviewed by Gibb and Davies (1990) who suggest that literature on small firm growth be grouped into four broad categories:

- Personality Dominated Approaches
- Organisation Development Approaches
- Business Management Approaches to Growth
- Sectoral and Broader Market-Led Approaches

Conspicuous in its absence from Gibb and Davies review is any detailed mention of any economic approaches to firm growth on which most modern approaches are founded. The following review introduces some of the fundamental and evolving economic thoughts on firm growth. In addition to rational cost/ risk economic perspectives, the importance of resources in the growth and survival of small firms has received

attention. Resource and knowledge based approaches appear to be becoming the current orthodoxy in studies of firm growth and, as hybrid approaches, draw together contributions from economics and other disciplinary areas. This review, having identified the most pertinent themes from economics, moves into resource-based approaches before moving into more specific approaches which reflect the concerns of the disciplines from which they have been abstracted.

Economic Approaches to Firm Growth

An Early 1970s Synthesis of Economic Explanations

Theories and explanations evolve over time and ideas from a number of conceptualisations may merge or gel to form a few durable approaches to a particular phenomenon or problem. Writing in the early 1970s, Devine et al. (1974), expressed the view that modern economic theories of the firm have their roots in "value" theory. This, they suggested evolved around the concept of "equilibrium" and was concerned primarily with the distribution and allocation of resources and questions related to prices, outputs and incomes (Devine et al., 1974, P109). Value theory was founded on assumptions of perfect knowledge and perfect competition. Under such assumptions firms were expected to operate at optimum size as pressures from the industry under perfect competition would ensure returns to equilibrium. This approach could not therefore explain firm growth and advances were made in this direction with the development of the theory of imperfect competition, generally attributed to Robinson (1933).

Rather than focus on value, Robinson's approach attempted to demonstrate that analysis of output and price of a commodity "could be conducted by a technique based on the study of individual decisions" (Robinson, 1933, as cited in Devine et al. (1974), p111). In this approach firms were seen as rational decision-makers intent upon profit maximisation. The firm however was considered unable to control the external environment in any way and effectively was a decision-taker. Market imperfections however provided the basis for a vast assortment of theoretical works attempting to explain the existence of monopoly, oligopoly, multi-divisional (M-form) organisations and multi-nationality (see also Chapter 4).

In a perfectly competitive market the assumption is that all firms have perfect knowledge of the market and all produce homogeneous goods. The market imperfections approach however sees firms as able to develop competitive advantage through product differentiation, marketing skills, technical knowledge and barriers to

entry. These are the roots to the theory of the firm. Growth of the firm is not fully explained here and economic studies have drawn heavily on organisational approaches to explain the growth phenomenon. Devine et al. (1974, p177) considered the foundations for an explicit theory of the growth of the firm to have been laid down by Downie (1958), Penrose (1959), and Marris (1971). A more recent collection of works, (Putterman and Kroszner, 1996) attributed amongst others: Coase (1937), Williamson (1975), and Chandler, (1977). Significant contribution to the theory of the development of the multinational enterprise has been attributed to Coase (1937) by, inter alia, Hood and Young (1979) and Dunning (1993), (see the review of international expansion approaches in Chapter 4). Putterman and Kroszner (1996) position current approaches to firm growth within the “new institutional economics school”, which in their view, benefits from much cross-fertilisation of ideas from a number of disciplines. A few of the classic contributions are reviewed below.

Downie (1958)

Downie's main proposition is that within an industry defined by a similarity of technical process, there will exist firms with different levels of efficiency. Differences in efficiencies between firms, in Downie's view result from advantageous access to superior technological products or processes arising from prior innovation, patent protection or industry secrecy. The firm develops its advantage through accumulating skill and experience in the technological activity, a process possible, in the opinion of Devine et al. (1974, p180), because of the existence of widespread ignorance in the industry about what other firms are doing.

As all firms in Downie's theory have maximum growth as their objective, they utilise their gained advantage to encroach on the market share of less efficient firms. The means for growth in this model are capacity and customers. Increasing capacity requires access to finance which is dependent on profitability, and increasing customers requires price reduction (which eventually will affect the rate of profit). The interaction of financial restraints (ability to raise funds to acquire capacity) and demand restraints (need to attract customers) therefore determine the maximum rate of growth, in this model. More technology efficient firms will be in a better position to grow fast than less efficient firms. This situation would be insoluble except that Downie suggests that less efficient firms will have more incentive to improve their efficiency and are more likely to produce the next innovation. This "innovation mechanism" consequently serves to prevent a continuous drive towards industry concentration.

Contributions of Downie's approach are the recognition that there is a two-way relationship between growth and profitability; growth of capacity is directly related to the rate of profit and the rate of profit is inversely related to the growth of demand. His other contribution lies in his recognition of the interdependence between firms in an industry although his view that innovation stems from inefficient firms attempting to improve their competitive position has been widely criticised (Devine et al., 1974, p182).

Penrose (1959)

Penrose' basic assumption is that the objective of owner/managers is to increase total long-run profits and the association here is between investments and profitability. In Penrose' theory, firms expand through diversification, the incentive for which arises from "the changing opportunity cost to the firm of its own resources" (Penrose, 1959, p105). Diversification, when the firm embarks on the production of new products sufficient to make a difference to the firm's production or distribution systems, comes about when existing markets become less profitable than other opportunities for new investment. Interesting in Penrose' approach is that opportunities are seen to arise from both internal and external changes. In order to remain competitive the firm needs to keep abreast of technological innovation and is likely to engage in some R&D. Diversification is seen as taking four basic forms:

1. additional products within the firm's technological bases and market areas,
2. products involving the same technological bases but new market areas
3. products involving new technological bases but the same market areas
4. products involving new technological bases and new market areas.

Penrose' explanation of growth evolves from her emphasis on "internal" or "managerial restraint". Resources required for expansion, she assumes, are available at a price and therefore the growth problem is vested in management. Growth, she maintains, needs to be planned and the plans implemented, and thus can only be organised by management who know each other and the organisation. The collective experience and abilities of management form the "productive service" which together with productive resources will determine the nature and extent of growth. Over time, as learning takes place and experience is accumulated, the productive service increases, changes its nature and expansion may take place. Although the managerial resource may be

increased by acquisition or recruitment, it will take time for collective experience to assimilate the new addition. The rate of growth therefore is related to the extent of managerial experience and firm efficiency will suffer if growth is allowed to take place at a faster rate than the accumulation of the managerial services available to the firm. The ability to grow rests on the ability of management to combine productive services which will meet the need of new opportunities. If there is sufficient slack in the productive service, there will be incentive to grow. Growth will ultimately be limited by internal and external obstacles to expansion.

Penrose' theory accommodates growth through merger or acquisition in that once a firm has reached the maximum rate of profitable growth through internal expansion, i.e. it is prevented from further internal growth by "managerial restraint", further expansion may take place externally through acquisition or merger.

Devine et al. (1974, p189) contend that despite criticism for lack of rigour, Penrose has made major contributions in her treatment of the role of innovation in the growth process and her discussion of merger as part of the growth process of the firm. Her approach is arguably more behavioural than economic as her main emphasis is on managerial activity, the ability of management to deal with the environment and changes in management perceptions with accumulating experience. Currently there has been renewed interest in Penrose work which has been cited over the years in a number of explanations of international firm growth and development (e.g. Johanson and Vahlne, 1977; Hood and Young, 1979; Turnbull, 1987). Penrose' four forms of diversification can be seen echoed although not explicitly cited in Luostarinen's (1979) model of international expansion. Extant work by Buckley (e.g. Buckley, 1989, 1995) on the internalisation approach to multinational development has made numerous citations of Penrose' (1959) discussion, as has Caves (1996). Citations have also been made in studies of the growth and development of small firms (e.g. Storey, 1994; Bosworth and Jacobs, 1989; Hughes, 1989). While earlier citations emphasised her thoughts on the role of technology in innovation and firm growth processes, more recent citations have explored her discussion of knowledge, managerial capabilities and competence and resources.

Marris (1971)

While Penrose placed emphasis on "managerial restraint", Marris' contribution lies in his explanation of the "financial restraint". Based on financial analysis of funding available to firms, Marris attempted to develop a theory of firm takeover. In Marris' approach, shareholders are assumed to want to maximise return on investment (i.e.

maximise its market value) while managers wish to maximise the rate of growth subject to a "security restraint". Marris attempted to determine the relationship between market value and rate of growth by considering the alternative ways in which funds may be raised for expansion. These he identified as: borrowing, new share issues and retained profit. Marris theory of take-over revolves around the proposition that a firm will be taken over if its actual valuation ratio falls below the subjective valuation ratio placed on it by a potential bidder, subject to expectations by that bidder of better performance under new ownership than currently realised by existing management.

In Marris' approach, profitability and growth are inversely related, a phenomenon which he explains as being due to the need to decrease price and hence profitability to attract new customers. As with Penrose, Marris suggests that growth restraints caused by demand may be overcome by diversification and innovation. Paradoxically however, as the rate of diversification increases, profitability, according to Marris, will eventually fall and the firm become subject to threat of takeover. In this approach the rate of growth is seen as being limited by threat of takeover.

Perspectives from a 1990s Synthesis of Economic Contributions

Putterman and Kroszner (1996) attempted to bring together 'core sources' from the emerging literature on the theory of the firm. That collection attributed the contribution of Ronald Coase (1937) whose distinction between the *firm* and the *market* and between *transactional* and *internal* exchange has influenced a number of subsequent writers whose work is currently influential in studies of firms in a number of disciplines. Coase' basic argument, that firms provide a coordinating mechanism determined by competition, provided a fundamental explanation of why firms grow (Putterman and Kroszner, 1996, p14). While his ideas provided a foundation for a number of economic approaches to firm growth including those authors already discussed, they also provided a foundation for network approaches which challenge the boundaries of the firm, and studies of inter-firm collaboration from a number of disciplines.

One of the clearest and probably the most frequently cited development of Coase' thesis is Oliver Williamson's (1975) transaction cost approach. The transaction cost approach describes growth as taking place through integration, based on the costs and opportunism involved in transacting with external markets. In later work, Williamson (1985) emphasised management incentives for growth to a greater extent than the costs involved and thus forged links between his early theory and approaches based on strategic management and entrepreneurial decision.

Williamson (1975)

The transaction cost approach to an explanation of firm growth emerged from the dissatisfaction of theorists with the perfect competition approach. Perfect competition cannot explain the existence of the firm as an institutional unit. Under perfect competition the market organises the exchange of resources and payments efficiently and therefore there should be no need for the firm and its internal organisation to exist (Dugger, 1983, p96). This deficiency was recognised by Coase (1937) who attempted to explain economic organisation within two separate types of governance structure, the firm (hierarchy) and the market. He postulated that:

"Outside the firm, price movements direct production, which is coordinated through a series of exchange transactions on the market. Within a firm, these market transactions are eliminated and in place of the complicated market structure with exchange transactions is substituted the entrepreneur-coordinator, who directs production. It is clear that there are alternative means of coordinating production". (Coase, 1952, p333).

Under Coase' postulation firms come into existence because there are costs involved in market transactions such as negotiation costs, knowledge-seeking, contracting and administration. Firms exist in order to minimise the cost of making transactions where this may be done more economically within the boundaries of the firm than in the open market. The concept of transaction costs was developed further by Williamson (1975) in an extensive theoretical discussion in which he attempted to explain the alternative structures of market and hierarchy, the decision as to whether transactions should be internalised or externalised (which has implications for integration, make or buy decisions, and currently interest in the approach has been resurrected in attempts to explain cooperative activity, networking and multinationality) and the development of the M-form, or conglomerate organisation (see also Chapter 4).

Dissatisfied with existing economic explanations of the firm and "rational man", Williamson drew on organisation theory to develop an elementary appreciation for "human nature as we know it" based on assumptions about human economic behaviour. Williamson's decision-maker was depicted as characterised by "opportunism" and likely to have self-interest as a motive. The behaviour of this individual was however subject to "bounded rationality" which limited otherwise

rational behaviour within his knowledge, information processing ability and ability to solve complex problems.

Bounded rationality and opportunism are, in Williamson's view, the two factors which explain the existence of the firm. Within the firm, transaction costs are eliminated and opportunism is confined to firm members, whose opportunism is more controllable under hierarchical organisation than in the open market. Linking the dimensions together, internalisation may occur where uncertainty is high (i.e. insufficient information is supplied by the price mechanism) in an attempt to minimise the risks inherent in the bounded nature of rational decision-making. This would be insufficient alone to explain internalisation however and to this Williamson adds the suggestion that whereas individual transactions may involve large numbers of bidders, repeat, or frequent transactions probably involve fewer numbers. The combination of "small-numbers bargaining" with opportunism and the frequency of transactions, contends Williamson, increase risk, uncertainty and the costs of transacting and the result is likely to be internalisation (Williamson, 1975, pp9-10).

Important also however is the third dimension of transactions and that is the extent to which transactions are supported by transaction-specific investments. This Williamson explains by discussing a number of different types of asset which he views as being specific to investments in transactions. Asset specificity refers to the extent to which assets or investments are specialised amongst users. Unspecialised assets do not represent a problem since they are readily transferred amongst a number of buyers and sellers. The more specialised an asset or investment is to particular users or suppliers, the more it is likely to affect the nature of the transaction and the type of governance structure within which the transaction takes place. Asset specificity arises in three ways:

<i>Site Specificity</i>	Where there is close proximity of for example buyer - supplier premises to save on transportation costs.
<i>Physical Asset Specificity</i>	Which occurs for example where specialised equipment is required to produce a particular component for a buyer.
<i>Human Asset Specificity</i>	Which arises due to the learning process the participants go through in the course of the transaction.

It is the specialised nature of these assets which prompts buyers and sellers to design an exchange which is durable and will justify investment in the assets. It follows that high

asset specificity will lead to attempts to internalise transactions, especially where information between transacting parties becomes "impacted", i.e. freely available to one party but to the other only at a cost, and there are opportunities for opportunistic behaviour. The result of internalisation is that a hierarchical, vertically integrated structure is formed which carries out most of its transactions internally in an attempt to eliminate external markets.

Williamson's theory explains the growth of the firm through the internalisation of transactions and assets and therefore provides an explanation of the development of large and conglomerate firms. The main criticisms of this approach are based on its naïve and rather negative view of human behaviour (see discussion of economic approaches to international expansion in Chapter 4). Identification of different types of assets and the need to protect these assets under different conditions has provided a useful and durable framework around which growth related decisions may be made.

Economic approaches, based on cost and efficiency considerations are frequently criticised precisely for that emphasis. In their support however, firms which are inefficient tend not to survive and grow and therefore economic approaches provide the benchmark or framework on which strategic and behavioural approaches can build. A number of studies of the international development of the firm are rooted in internalisation and transaction cost frameworks, see Chapter 4 for discussion. The next section discusses some approaches which have featured in small firm growth literature.

Resource-Based Approaches: A Hybrid and Integrating Perspective

Resource-Based Approaches

Resource-based approaches to firm growth have emerged in a number of disciplinary areas. Penrose (1959) and Teece (1982) suggested convincingly that firm growth would take place where the firm had unused or under-utilised knowledge or resources which were subsequently brought into play. Diversification would tend to take place where knowledge and resources were combined in different ways to different ends. The knowledge resource in the firm increases as learning takes place but can be lost or partially lost with the transfer of individuals or technologies to other organisations. Growth may be facilitated or inhibited by the way the knowledge resource is managed. Industrial R&D activities may require that knowledge is concealed which ultimately may limit growth while external exchange of knowledge increases learning opportunities and growth through diversification (Teece, 1982). Ultimately however, the need to protect proprietary technology or organisational knowledge may result in transactional

difficulties (Kirzner, 1973), (see also the discussion on internalisation and system theory in Chapter 4).

Often resource exchange/dependency approaches explain the survival and growth of small firms as being related to their ability to gain access to critical resources (Westhead et al., 1995, p65). Critical resources may be held by organisations or individuals in the environment such as customers, suppliers, competitors and private and public institutions, and may consist of information, finance, capital equipment etc..

In the resource dependence approach small firms need to access such externally held resources and may do so either proactively or reactively through transactional exchange (Child, 1974; Pfeffer and Salancik, 1978; Pennings, 1982). In this approach, growth is secured through the utilisation of external links and is in contrast to, or rather presents the alternative to the transaction cost approach which advocates growth through the internalisation of assets. Westhead et al. (1995) suggest that this approach emphasises growth through diversification and differentiation. Limits of growth through this approach would appear to be that a lack of basic resources would render further transactions or exchanges impossible. Garnsey and Wilkinson (1994), on the other hand, see networks and industry structures as external sources of resource to which firms can tap. From that perspective they explain the survival and growth of firms involved in 'flexible specialisation' i.e. diversification of the firm's economic and business operations around a narrow and specialised value chain activity.

The basic premises of resource-based approaches are often cited in network studies. Network approaches emphasise the exchange of resources within networks through cooperation as well as transactional exchange. Easton (1992, p5) sees the resource-dependence model of inter-organisational relationships (Pfeffer and Salancik, 1978) as being fundamentally different to the network or interaction approach. The former, he suggests assumes that organisations use relationships with external sources such as banks, consultants, associations, shareholders, customers, suppliers and distributors to gain access to resources required for their continued existence and growth. Easton describes the later approach as being concerned with the management of relationships, and the balance between internally generated goals and motivations and the external requirements of *resource holders* (terminology author's own).

The distinction between various resource-based approaches is fuzzy and treatments strongly reflect the focus of the researcher and unit of analysis. For example, resource based explanations have been used in the late 1980s early 1990s to account for the

divestment of peripheral activities by MNEs and a greater concentration on core competencies, assets and resources such as knowledge and technology (see also Chapter 3 and Chapter 4). Resource-based explanations have been widely acknowledged as major drivers of foreign direct investment for certain multinational enterprises (Behrman, 1972; Dunning, 1993, p57). In addition, the internal transfer of knowledge and other resources within multinational enterprises is widely recognised as a source of competitive advantage enabling international growth (Bartlett and Ghoshal, 1989).

Although resource-based considerations are fundamental to many explanations of firm growth, a robust resource-based theory of firm growth has yet to be developed.

Approaches from Other Disciplinary Areas

Personality Dominated Approaches

Gibb and Davies (1990) in their review paper, suggest that many approaches have evolved from the economists' view of the entrepreneur as a risk-taker who is willing to speculate and is able to incorporate risk and uncertainty, innovation, perception and ability to cope with change (Kirzner, 1979; Carland et al., 1989). While the small business in traditional economic thought is essentially a price-taker and rational decision-maker, the entrepreneur who effectively uses strategy and innovation is generally viewed in such approaches as the key to small firm growth. From this perspective, a number of attempts have been made to link the characteristics and abilities of entrepreneurial or innovative managers/owners with small firm growth. Links between characteristics of the owner/manager and strategic management have been identified in studies by Kets de Vries (1977) and Gupta (1984). Mintzberg and Walters (1982) apparently view strategy as evolving from the entrepreneur's personal goals while Miller and Toulouse (1986) found links between strategy and innovative behaviour in relation to the owner's degree of autonomy.

Other authors have attempted to link behavioural traits of managers with planning and performance with mixed results (Atkinson and Feather, 1966; McClelland and Winter, 1989). Conflicting evidence has been found linking performance with, need for achievement, locus of control, and risk-taking propensity (Carland, Carland and Abey, 1989; Brockhaus, 1982). The obvious criticism of such work is that while entrepreneurs are clearly a central, important and driving force in the small firm, they are likely to operate in different circumstances with different resources.

Stanworth and Curran (1986) identified two types of owner-manager, the artisan and the entrepreneur. These types were found to hold different attitudes to growth. The former type emphasised customer satisfaction, quality and the avoidance of bureaucracy which had the effect of inhibiting growth. Frohlic and Pichler (1988) as cited by Gibb and Davies, in fact hypothesised that there are four types of entrepreneur:

- the all-rounder (the versatile responsive entrepreneur)
- the pioneer (the innovative, dynamic and creative entrepreneur)
- the organiser (the analytical and planning entrepreneur)
- the routiner (the non-spectacular risk bearer).

Attempts have also been made to link business growth with the educational level of the entrepreneur and other indications of knowledge or competence such as professional qualifications or specialisations. Such attempts are particularly prevalent in studies of high-technology firms (Davidson and Brynell, 1988), in which managers have been found to be better educated and more growth orientated than managers of low-tech firms. It is not clear however whether the possession of an education and orientation towards growth is the cause of growth in such firms, or whether high growth industries or firms attract or require managers with such attributes. A number of studies however have examined the nature and role of founders of new technology based firms - empirical evidence from which is discussed below in the section on elements and characteristics of small firm growth. While theoretical or analytical models based on entrepreneurial personality have not been developed, understanding of entrepreneurial behaviour is fundamental to studies of firm strategy.

Organisation Development Approaches

This group of literature has been divided by Gibb and Davies (1990) into three sub-categories, all of which emphasise organisational development or management approaches to firm growth. The first of these sub-categories is concerned with the relationships between the personal goals of the entrepreneur and the goals of the organisation. While evidence has been found that the goals of the entrepreneur influence the growth of the firm (Simon, 1964), there is also evidence to suggest that in general most small business managers do not see business growth as one of their personal objectives (Stanworth and Curran, 1976). Clearly, what is important here is that for firms to grow, both the ability and competence of the owner-manager and attitude towards growth are important factors.

Of particular interest here however is the second sub-category of organisation-development approaches which consists of attempts to identify "stages of growth" in SME development. Since this thesis is concerned with SME growth through internationalisation and innovation, some indication of stages in firm development at which international expansion may take place is of particular interest. The emphasis of this group of literature is on the evolution of the firm through different management, functional and organisational forms, with corresponding changes from individual management to management by teams or committees and the requisite functionalisation and development of departments.

A classic article by Greiner (1972), suggested that firms pass through five stages of growth in their development from small young businesses to larger, older businesses. Each growth stage in Greiner's model is followed by a crisis stage which triggers a move into the next stage of growth. For example, at birth and shortly after, the firm founders are technically or entrepreneurially motivated and while all energies are fed into making and selling a new product, communication with workers is frequent and informal. As the firm grows such an arrangement is inadequate in terms of leadership and a crisis ensues which needs to be solved by the establishment of more formal management. The process of evolution followed by revolution is depicted by Greiner as continuing through the stages in Table 2.2.

Evolution Stages are:	Revolution Stages are:
1. growth through creativity	1. crisis of leadership
2. growth through direction	2. crisis of autonomy
3. growth through delegation	3. crisis of control
4. growth through coordination	4. crisis of red tape
5. growth through collaboration	5. crisis of ?

Source: Adapted from Greiner (1972)

The rate of movement through the stages of growth, in Greiner's view is related to the growth of the industry and its market environment. That collaboration is seen as one of the later stages in the transition process is interesting. Greiner uses the term collaboration in relation to the inter-

relationships between the top executives of large organisations and suggests that while personal goals and motives may have been more important at earlier stages of growth, at stage five there is more spontaneity and action through teams while formal control mechanisms are replaced by social control and self-discipline. Greiner suggests that there are likely to be other revolution and evolution stages beyond stage five. While this model is useful in establishing the types of problems managers may encounter at

different stages in development, it does not consider external factors in firm development and is concerned with the organisation and management style of the organisation rather than the development of the firm's real business. Its use lies in its identification of crucial stages in firm development where decisions related to strategy and structure may be made.

Another general model of the growth stages of SMEs has been developed by Scott and Bruce (1987) from analysis and integration of other theories and models of growth of both firms and industries, including large firm models. Using the concept of the product life cycle, this model suggests that firms go through five stages of growth: inception, survival, growth, expansion and maturity. Growth in absolute terms, e.g. size, is not built into the model since this is seen as being unique to each firm. Basic features or characteristics of the firm are identified at each stage. In order to survive and progress to the next stage the firm has to adapt, in order to cope with crises occurring at various stages in its development. The model, Table, 2.3, suggests that the firm undergoes changes in management, organisation, financial structure, orientation and task emphasis. The stages through which the firm passes are portrayed in the model as being associated with the stage of development in which the firm operates.

The main criticism of this model is that it is normative rather than positive since it has been derived from the literature rather than directly from empirical evidence. The authors do however claim success in using it for small business analysis. As with all step-stage models, iteration is not considered, nor is the possibility of stepping over one or a number of stages. While useful as a tool for planning, the model fails to consider outside influences in the growth process such as mergers acquisitions partnerships or other coalitions. Another problem with such approaches is that they are largely descriptive, retrospective and provide little in the way of explanation or strategic alternatives to the responses typified in the models. The incremental approach illustrated in the above models is to some extent enhanced by business management approaches which add strategic choice to the step-stages firms may encounter.

Table 2.3

A Model for Small Business Growth

	Stage 1: Inception	Stage 2: Survival	Stage 3: Growth	Stage 4: Expansion	Stage 5: Maturity
Stage of Industry	Emerging, fragmented	Emerging, fragmented	Growth, some larger competitors, new entries.	Growth, shake-out	Growth/shakeout or mature/declining
Key Issues	Obtaining customers, economic production	Revenues and expenses	Managed growth, ensuring resources.	Financing growth, maintaining control.	Expense control, productivity, niche marketing if industry declining.
Top Management Role	Direct supervision	Supervised supervision	Delegation, coordination.	Decentralisation.	Decentralisation.
Management Style	Entrepreneurial, individualistic	Entrepreneurial, administrative.	Entrepreneurial, coordinate	Professional, administrative.	Watchdog
Organisation Structure	Unstructured	Simple	Functional, centralised	Functional, decentralised.	Decentralised functional/product.
Product and Market Research	None	Little	Some new product development	New product innovation, market research.	Production innovation.
Systems and Control	Simple bookkeeping, eyeball control	Simple Bookkeeping, personal control	Accounting systems, simple control reports.	Budgeting systems, monthly sales and production reports, delegated control.	Formal control systems, management by objectives.
Major Source of Finance	Owners, friends and relatives, suppliers leasing.	Owners, suppliers, banks.	Banks, new partners, retained earnings.	Retained earnings, new partners, secured long-term debt.	Retained earnings, long-term debt.
Cash Generation	Negative	Negative/break-even	Positive but reinvested	Positive with small dividend.	Cash generator, higher dividend.
Major Investments	Plant and Equipment	Working capital	Working capital, extended plant	New operating units.	Maintenance of plant and market position.
Product Market	Single line and limited channels and market	Single line and market but increasing scale and channels	Broadened but limited line, single market, multiple channels.	Extended range, increased markets and channels.	Contained lines, multiple markets and channels.

Source: Scott and Bruce (1987)

Business Management Approaches to Growth

Such approaches have been characterised by Gibb and Davies (1990) as emphasising market performance and profitability and the ability of the firm to operate at maximum efficiency levels. To that extent the economic maxim of rational-decision-making and optimisation is clearly the underlying paradigm. In the view of Gibb and Davies, strategy and business planning seem to be the key elements in this type of approach with advice given as to *how* and *where* the firm should direct its growth efforts. In terms of growth *strategy*, there is an overlap and linkage between general business strategy and marketing strategy, the latter seen by marketing theorists as being at the forefront of, and driving business growth and development.

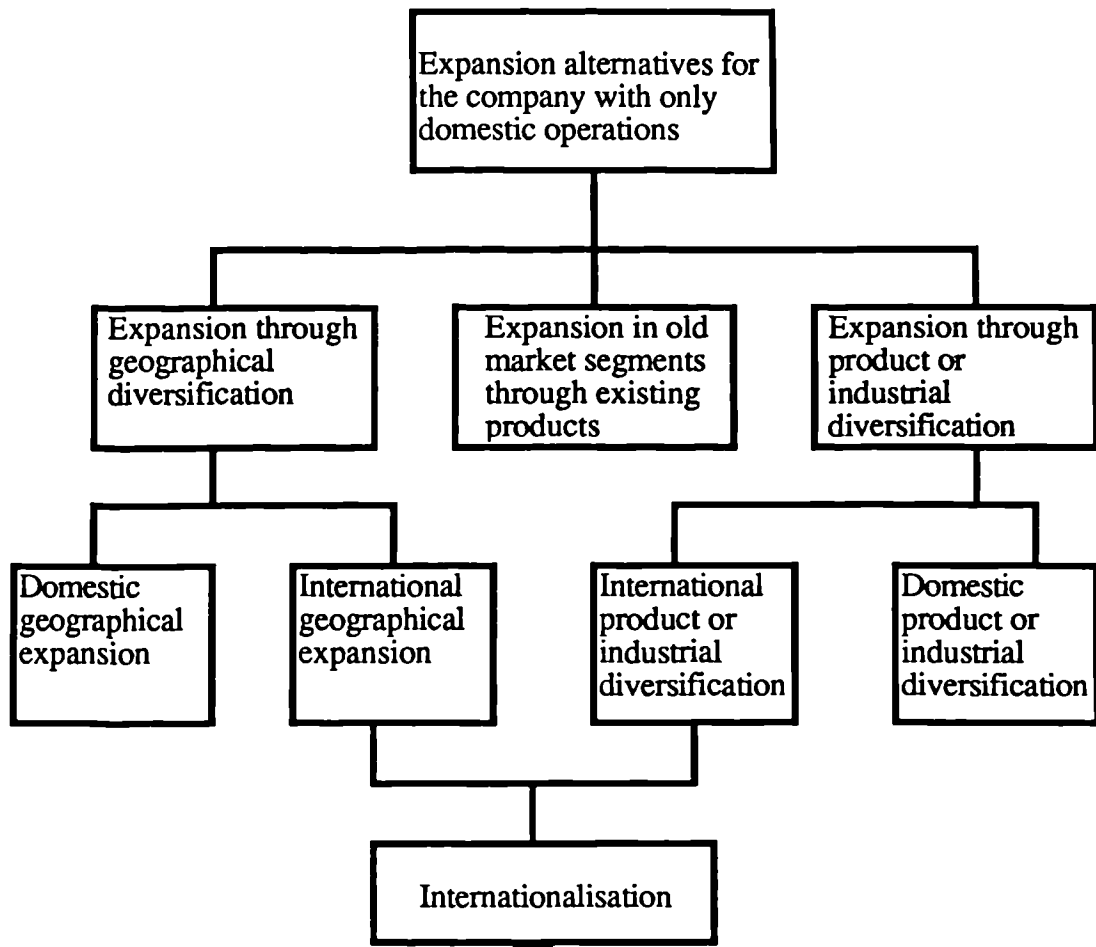
Typifying such approaches the afore mentioned Gibb and Davies (1990) cite Igor Ansoff's (1965, 1987) product/market expansion matrix. This suggests that firms may expand through 1. market penetration, 2. product development, 3. market development, and 4. diversification. These alternatives are associated with the degree to which competitive position may be changed or improved, and the importance of the make or buy decision. This approach is similar to that proposed by Katz and Kahn (1966) which is however more concerned with the expansion and deployment of personnel than with the expansion of products and markets.

Katz and Kahn (1966), from an organisational psychology perspective suggest that there are at least five types of growth:

1. Growth by unit size (adding one or more staff to an existing unit)
2. Growth by parallel units (opening another similar unit)
3. Growth by differentiation
4. Growth by specialisation (which involves the redesign and re-allocation of work functions)
5. Growth by merger and takeover.

The extent of organisational change required to facilitate growth increases over the five categories so that if the owner-manager is unwilling to adapt the organisation of the firm, growth may be limited to the first two categories and ultimately the firm's growth potential may be limited.

Box 2.1



Product(s)/ services Market(s) Functions Technology Entry and development methods

Source: Luostarinen (1979).

Looking specifically at international expansion, Luostarinen (1979) in an apparent development of the Ansoff model, classifies the alternative modes of internationalisation (international expansion) as either international geographical expansion and/or international product or industrial diversification (Box 2.1). The internationalisation (international expansion) decision in Luostarinen's model involves consideration of the firm's products and services, market selection and assessment, role and nature of functional activities, the nature the firm's technology, or technology required for international expansion, and finally alternative modes of foreign market entry and development (International expansion is discussed fully in Chapter 4).

Such models (Katz and Kahn, 1966; Ansoff, 1987; Luostarinen, 1989) outline some of the strategic choices available to firms in growth decisions. The extent to which strategic choices are available to small firms would tend to be based on resources available to them and their ability to manage and coordinate resources towards an appropriate growth strategy. From the perspective of business management approaches, the firm is seen not so much as a 'decision-taker' as in early economic approaches discussed above, but as a conscious 'decision-maker'. Decision making may be tempered by forces and conditions internal to the firm and its industry, market and broader external environmental forces (Porter, 1985; Root, 1987).

Network Explanations of Small Firm Growth

Recent explanations of growth have been built around the concepts of networks and other external linkages. Many authors (e.g. Penrose, 1959; Drucker, 1985) have suggested that small firms may find it difficult to pursue a consistent growth strategy due to their lack of resources (differences between network and resource-based approaches have been discussed above). Such a lack of resources may or may not act as a barrier to growth strategy and firms themselves display different perspectives or orientations to growth. Astley and Van de Ven (1983) produced a model proposing four perspectives of organisations which suggest different approaches to firm growth.

LEVEL		ORIENTATION	
		Deterministic	Collective Action
Macro		Inactive acceptance of fate	Interactive change of conditions
		System Structural	Strategic Choice
Micro		Reactive adaptation to constraints	Proactive enactment of opportunities

Source: Asley and Van de Ven (1983).

The perspective, deterministic or voluntaristic, defines the growth potential and management capabilities present in new business individually (micro) or as part of a group (macro). Johannisson (1990) suggests that whilst most writers dealing with the

entrepreneurial firm focus on strategic choice and see the focal firm as a proactive agent, the natural selection view reflects more appropriately the high failure rate amongst small firms in the first few years of their life. This model therefore proposes that there are at least two dimensions to the growth equation, the resources and capabilities of the firm and the strategic use of these assets by management. This leads back to the question of whether or not the entrepreneur wants the firm to grow (personality dominated approaches discussed above). Growth ultimately is limited by restricted size and resource base and the capabilities, attitudes and orientation of the entrepreneur.

Johannisson (1990) argues somewhat convincingly that a "growth concept" must encompass both quantitative and qualitative changes. Qualitative growth in this instance refers to an increased ability to diagnose and deal with structural changes in the environment and also changes in the entrepreneur's value system. Growth, he suggests, has two dimensions, internal and external. External growth is the replacement of ownership control with "cooperative means of getting access to resources needed to fulfil commitments" (Johannisson, 1990, p34).

Where organisation development approaches to SME growth (above) have emphasised a change from entrepreneurial management to more "professional" or organised forms of management, Johannisson suggests that the entrepreneurial mode may be expanded to accommodate growth through the development of social networks of the entrepreneur. As an example he offers Benetton which has grown to international dimensions through the development of networks of suppliers and buyers. Network approaches to international expansion are discussed in Chapter 4 and a full critique is given at that point.

Sectoral and Broader Market-Led Approaches

There are a large number of studies in this category which tend to take the form of surveys of specific sectors, industries, markets etc.. One of the best known of this type of study is the report of the Bolton Committee (1971), and more recently the Cambridge report (1992) and the DTI report on the constraints of growth facing SMEs. These studies tend to reflect strongly the purpose for which they were undertaken, e.g. for the purpose of selection of firms with growth potential to which assistance may be targeted, or identifying the extent to which financing is a barrier to growth as in the DTI report, part of which consists of a survey by financial institutions.

There is much value in this type of study in that they look specifically for differences between types of firm in terms of age, size, rate of growth, sector or industry etc.. Another consideration is that such broad-based studies tend to reflect the circumstances and environmental conditions of firms at the point of time at which the survey is carried out. Comparison of different survey results over time may be particularly useful e.g. comparison of the results of the Bolton report (1971) and the Cambridge reports (SBRC,1992; Cosh and Hughes, 1996) give some indication of the effects of policy and other changes in the external environment over the intervening period. Other studies can build their hypothesis from and compare results with the empirical base provided by such studies. Overall however, they tend to be descriptive and analytical, and seldom discuss any theoretical constructs.

Storey (1994) in a comprehensive textbook on the small firm sector drew extensively on the results of the SBRC (1992) survey to support his arguments. Broad-based surveys such as those conducted by the University of Cambridge (in the SBRC, now ESRC centre for business research) are particularly useful in providing a benchmark for other smaller studies. This is especially the case where the literature is fragmented and suffers from a lack of unifying frameworks. Also where differences in sample sizes and performance measures make synthesis of the literature and comparison of results difficult.

Dimensions of Small Firm Growth: Summary of Theory

A number of theoretical approaches to firm growth have been reviewed in this chapter. Some of the core theories of firm growth have been developed in relation to international expansion and to technology and innovation. Where relevant, these are discussed within the specific contexts of Chapters 4 and 5. For example, in Downie's approach can be seen the basis for the technological accumulation approach to the

internationalisation of R&D. Downie however linked innovation with inefficient firms in their attempt to improve their competitive position, a postulation with which most modern theory, emphasising links between entrepreneurship, scientific and technical skills in the innovation process with success, would heartily disagree. The complementarities between efficient and less efficient firms in an industry and the importance of accumulation of technical skill and experience as functions of growth are extremely important in the current emphasis of knowledge-intensity in firms, industries and markets.

Penrose' approach may be criticised for its over-emphasis on the "management restraint" as the most important factor in growth, with its implicit assumption that resources, if not available, may be bought at a price. Important from Penrose' approach however is the link made between the resources available to the organisation and the skills and management in combining and utilising these resources in the most effective way. Like Downie, an important construct in her theory was the accumulation of knowledge and skills in the organisation which formed a major contributing factor to the process of innovation and ultimately growth. Penrose positioned her theory within the boundaries of the firm: managerial slack was seen to stimulate growth, while a firm working to the full extent of its resources and managerial capabilities would resort to acquisition or merger for growth.

Penrose' approach however has sown the seeds for explanation of modern organisational forms involving cooperation and network activity, where accumulation of knowledge takes place amongst a group of firms rather than within the boundaries of one firm. More importantly, going back to Penrose' link between the resource base and management's growing ability to effectively combine its resources, the resource base has spread beyond the boundaries of the firm. Successful innovation and hence growth may now depend on management's ability to combine and effectively utilise resources from both internal and external sources.

Marris' contribution is important in its links between profitability and the possibility of takeover. The major criticism of Downie's approach is its over-emphasis on price as the factor influencing demand. Important however is the emphasis of finance for expansion as a major restraint on the growth of firms, especially small firms, and has major implications for providers of loans and financial policy at infrastructural levels. The basis for choice between growth through the internalisation of assets or through external trading has been laid down by Coase (1937) and Williamson (1975) as the transaction cost approach.

While transaction cost or internalisation approaches have had an important influence on the development of multinational theory (see Chapter 4), problems have arisen from its rational cost-based perspective which acknowledges human behaviour as purely opportunistic. The network approach is almost diametrically opposed in perspective, assuming trust to be the basis of behaviour in and amongst firms. Cost and efficiency are however almost overlooked. Transaction cost economising has to some extent provided a basis for business management approaches which have emphasised strategic choice and competitive capabilities as underlying the growth process. Strategic capabilities together with resource exchange or dependence approaches have in turn contributed to the development of a network or cooperation approach to firm growth through the utilisation of externally held resources.

Directions of growth have been identified by a number of authors and while some, e.g. Katz and Kahn (1966), have focused on internal aspects of firm growth such as the increase in size and scope of the firm's organisation, others e.g. Ansoff (1965; 1987) and Luostarinen (1979), have identified modes of external expansion into new product markets and industries and new geographical areas. Studies of the growth process itself have resulted in incremental or step-stage models describing the internal development and structure of the firm. These approaches have been developed in the internationalisation literature to explain the expansion of firms into foreign countries/markets through specific stages of export development (see Chapter 4).

The literature on the growth and development of the firm is large and this review has attempted to select and synthesise the major classic and current approaches seen as most relevant to this study. Much research on small firms tends to suffer from an absence of theoretical frameworks or theory, and reference to theory is invariably implicit rather than explicit. Underpinning current small firm studies however can be seen a few converging themes or theoretical approaches to an explanation of small firm growth. These appear to be:

- A resource/competence based approach,
- A behavioural approach i.e. entrepreneurship or networks, and
- An internalisation/transaction cost perspective.

Although there are a number of approaches to the understanding of small firm growth, what is lacking in the literature is any clear statement of the determinants of SME

growth. While there are attempts to explain why firms grow, how firms grow, the barriers to growth and attempts to differentiate between firms experiencing different growth rates, there are no definitive statements of "what" makes firms grow. This to some extent is not surprising since the literature on SME growth shows that there are many variables influencing or associated with firm growth. It is also unclear in many cases what is meant by growth, which often defies definition. There is also little evidence of models or hypotheses of SME growth either generally or in specific sectors. Most SME studies tend to implicitly emphasise organic growth, the possibility of growth through horizontal or vertical integration by merger or acquisition being almost exclusively in the domain of the large firm theorists.

The apparent absence of useful models or frameworks in studies of SMEs is attributed by Gibb and Davies (1990) to a number of broad conceptual issues including:

- "lack of even partial attempts to use theory in identifying parameters for investigation thus ensuring from the outset that potential for "explanation" is limited,
- emphasis on formalistic deductive rather than inductive heuristic approaches,
- the influence of the values of the researcher in designing methods of data collection and failure to recognise that owner-manager respondents have different approaches to providing information than professional managers, and
- the use of research paradigms and constructs drawn from work done in large bureaucratic organisations".

It is also surprising that although most models of small firm growth rely on concepts and constructs from economic theory, few small firm studies make specific reference to economic approaches to firm growth. Part of the problem lies in that economic studies of firm growth for the most part have emerged from studies of price, markets and competition.

Whereas economic studies of firm growth have tended to view the firm as a component of an industry or market, small firm studies have tended to approach the problem of growth from the opposite direction and focus on the internal characteristics of the firm which influence its growth within the limitations of, or as influenced by factors in the external environment. This however does not explain the apparent unwillingness of

small firm theorists to incorporate theoretical models in their explanations of small firm growth.

Gibb and Davies echo criticism of the micro-economic approach to firm growth as being overly concerned with the entrepreneur as the rational decision-maker attempting to maximise or satisfice performance. Such approaches together with approaches emphasising financial ratios and cost/price relationships, they feel, have failed to predict growth largely because they emphasise "outputs" from the performance of the firm rather than "inputs". The micro-economic approach, they point out, also leads to emphasis on resource constraints on the growth of the firm, a topic which is discussed in some depth in the section on factors and barriers to the growth of small firms below. Business approaches have tended to deal with small firm resource constraints by emphasising the role of operational and strategic planning.

In the view of Gibb and Davies however, studies which have attempted to find correlations between planning and performance tend to suffer from methodological weaknesses in their definitions of planning or undue use of cross-sectional data. These authors feel that the traditional view in industrial economics of the role of the small firm in the marketplace have very limited use in predicting growth, but do usefully describe the relationship between large and small firms. It is difficult to find from Gibb and Davies view any theory of small firm growth from any discipline which has predictive ability. Arguably the life-cycle based model of Scott and Bruce attempts to do just that but is, like any life-cycle model open to criticism as being a self-fulfilling prophesy, and lacking in predictive ability.

Growth Factors and Constraints: Empirical Studies

Introduction

Literature on small firms is vast and, as discussed above, suffers from a lack of unifying frameworks. Interest here is primarily on development and growth processes of innovative firms, with growth potential. While many barriers to growth are specific to small firms in general, where possible, the literature and discussion which follows will concentrate on the innovative firm.

Despite the abundance of literature which has emerged since the Bolton Committee Report in 1971, little is known about the ways in which firms are able to realise their innovative and growth potential (Barber, Metcalfe and Porteous, 1989, p1) More is known about the barriers or impediments to small firm growth, much of which knowledge has been brought together in a series of literature review papers originally prepared for the ACARD study (Advisory Council for Applied Research and Development) on barriers to growth in small firms. Other important small firm research has been summarised by Storey (1994), Stanworth and Gray (1991), and useful empirical data is provided by the SBRC (1992) nationwide survey of SMEs, and the follow-up report (Cosh and Hughes, 1996). These reviews have been drawn on extensively in the following summary of recent empirical research in the area. The review considers the role and nature of small firm entrepreneurs, firm characteristics and strategy, the firm's position in the external environment and financial and policy perspectives in relation to growth.

Management Forms and Characteristics

Ritchie, Eversly and Gibb (1982) found that most small businesses tend to be run by owner-managers which for the most part, tend to be male, middle-aged and in general exhibit a lack of basic management education. Storey (1994) however found extensive evidence to suggest that gender is not associated with firm growth. An extensive, cross-sectoral survey of UK small firms (SBRC 1992) found its sample to be characterised by "relatively younger, smaller, faster growing firms run by younger chief executives and increasingly older, bigger, slower growing firms run by older executives". Storey (1992) however suggested that while younger entrepreneurs have more energy, they have less credibility and may be financially constrained. Older entrepreneurs on the other hand have experience, credibility and access to resources. He came to no firm conclusion on the connection between entrepreneur age and experience and firm growth. Ritchie et al. (1982) found that most owner-managers had

received no formal training in management. Woo et al. (1989), Jones (1991) and Wynarczyk et al. (1993) found no association between training and firm growth.

Whilst owner-managers tend to be aware of their limitations in management expertise, problems arise in many firms when faced with the need to make expansion decisions or cope with the requisite changes. Management's attitude towards growth, towards changes in management style or organisation, or managerial inadequacies themselves, especially in the area of forward financial planning have all been associated with expansion problems (Scase and Goffee, 1980; Boswell, 1973). Firms with entrepreneurs who express a positive motivation for firm growth have been found to be associated with growth in some studies (Barkham, 1992; Kinsella et al., 1993; Johnson, 1991; Storey et al. 1991). Other studies however have found no association between a positive motivation at firm start-up and firm growth (Wynarczyk et al., 1993; Westhead and Birley, 1993). State of mind however may influence the likelihood of firm growth as a few studies have found that in firms with founders who were unemployed at firm start-up were less likely to grow than those with founders who were previously employed (Wynarczyk et al., 1993; Storey, 1982; Storey, 1994; Reynolds, 1993). Education of entrepreneurs is also likely to affect the growth of the firm and Storey (1994) in a review of 17 quantitative multivariate studies came to the conclusion that higher levels of education are generally associated with higher rates of growth. This general association is likely to vary between sectors and the nature of the firm's business.

Stage theories of small firm growth (see above) suggest that an entrepreneurial management style will ultimately be replaced by a professional management style (Flamholtz, 1986). MacNabb (1995) however believes that professional managers need not be less entrepreneurial, rather entrepreneurs need to develop as the firm grows. A study of 62 business founders/owners (MacNabb and McCoy, 1992; MacNabb, 1995) categorised firms into four stages of development: pre-start-up, post-start-up, established, and professionally managed businesses. The study found that a belief in growth as a pre-requisite for the success of the business became stronger among owners as the business develops. A minority felt that growth should be restricted in the interests of maintaining control. While attitude is important here there are clearly implications for management style and organisational form. The belief amongst the professionally managed group was that the building of a strong management team is essential to growth while some members in the 'established' group felt that a strong leader could "grow the business just as efficiently'. While results in

this study are not associated with growth rates, implications are that attitudes and management style have to evolve simultaneously to support sustained growth.

Attitudes and Motivations

Another reason for the lack of growth experienced by some small firms has been put forward as the motivations and aspirations small firm owner-managers and the rewards systems experienced (Wildsmith, 1973; Williamson, 1967; Gill, 1985, Ritchie et al. 1982; Clutterbuck and Devine, 1985). Underlying this train of thought are recognised differences between the rational, profit-maximising manager, and the manager whose attitude is tailored not only by financial remuneration but also security, status, power, prestige, social service and professional excellence (Wildsmith, 1973, pp68-9 as discussed in Bosworth and Jacobs, 1989, p23). Emerging from this is the empirically backed view that owner-managers, emphasising customer/client satisfaction and the ability to control working life and environment, together with avoidance of bureaucracy or large firm ethos, may be inhibited from pursuing growth objectives (Stanworth and Curran, 1986; Scase and Goffee, 1980; SBRC, 1992). The view has been advanced however that there are two types of owner-manager: the "artisan" reflecting the above philosophy, and the "entrepreneur" (Stanworth and Curran, 1986) who may have a more favourable attitude to growth.

Associated with management attitude to growth is the ability of managers to adapt to the requirements of growth and managerial attitudes towards such changes. The owner-manager may fear the effects of increased layers of management on the implementation of his decisions (Sawyer, 1981, p55) or with inability to delegate authority, loss of ownership or control (MacNabb, 1995; MacNabb and McCoy, 1992).

Clearly however there is some difficulty in the reconciliation of growth with the continuation of an owner-manager structure. The 1992 SBRC report on small firms found that ownership patterns evolve over time. As company size and age increase, the share ownership was found to become diluted by dispersion amongst family members, to outsiders recruited to join the board or by the issue of stocks. The report found that changes of ownership observed in the survey of 2028 UK small manufacturing firms added support to the stage models of SME growth.

Ability or willingness to adapt to the requirements of growth may also be connected to the motivations for small-business ownership. Although the hope of financial or material gain is a significant motivation for business ownership, Gill (1985) found that such issues are seldom prioritised by small-business owners. Ritchie et al. (1982) and

Clutterbuck and Devine (1985) found that owner-managers are motivated by desire for independence and the ability to control their life and working environment. Bosworth and Jacobs (1989, p23) also found that there was a fear of loss of control where the company reaches sufficient size to require flotation on the stock market. Another factor suggested by the same authors (p26) is a general fear of bankruptcy amongst SME owner-managers which could adversely affect the propensity to take risks. Anything which threatens independence, or control of the organisation is therefore likely to act as a barrier to growth including the introduction of layers of management or bureaucratic procedures which might result in loss of control (Gill 1985; Stanworth and Curran, 1986; Williamson, 1967; Sawyer, 1981). Research has also found that negative attitudes towards trade-union activity, which tends to increase with firm size, may adversely affect attitudes towards growth (Bain and Elias, 1985; Sawyer, 1981, p55). MacNabb (1995) suggests that continued growth of small firms may potentially be hampered by reliance on family support, unwillingness to change, lack of vision for the future, or an autocratic management style coupled with an unrealistically high level of self-confidence.

Some firms accept their own managerial inadequacies (Scase and Goffee, 1980; Boswell, 1973), yet some studies report an unwillingness amongst small firm managers to recruit specialist staff or use management consultants (Boswell, 1973; Gill, 1985). In a similar vein, fear of and negative attitudes towards technological change may inhibit growth and development. Bosworth and Jacobs, (1989, p27) suggested that SMEs tend to be reluctant to use information retrieval systems which may ultimately limit the knowledge of business or market developments. Inadequate knowledge of complex new technology according to these authors, results in fear which again may inhibit investment decisions. Alternatively, the introduction of new technology may require changes in organisation structure which may be seen by owner-managers as a threat to their autonomy (Gill, 1985; Stanworth and Curran, 1986; Williamson, 1967; Sawyer, 1981).

Despite widespread evidence in the literature which suggests negative attitudes to growth however, the 1992 Cambridge report found that most firms expected to grow and over 63% of the sample stated that their objective was to grow moderately over the next three years. While micro and new firms expected substantial growth, expectations of growth in general were found to increase progressively with firm size. These results echo those of Hakim (1989) who also found a positive association between firm size and growth expectations. Preliminary interviews by the researcher found that in two leading edge technology firms, the owner/managers had no direct aim for firm growth,

rather, they claimed, the firms were established to support research and their goals were largely 'hedonistic' and associated with the development of science.

Financial Factors

A number of studies have shown that most small firms are predominantly founded at start-up by internally generated funds (Wilson Committee, 1979; Binks and Vale, 1984), although Hall (1989, p42) found little evidence as to the extent to which entrepreneurs are forced to rely on their own resources. Recent research, summarised below suggests that while there has been tremendous deregulation in the financial sector, the only major change in the way small firms are funded is in a much heavier reliance on hire purchase and leasing arrangements (Cosh and Hughes, 1996).

The SBRC survey of small firms found that where external capital was sought, banks were by far the most frequently used source with over 80% of firms which had sought finance in the preceding three years having used this source. While survey results suggest that lack of finance is frequently cited as a constraint on the start-up and growth of SMEs, the SBRC survey found that only 65% of SMEs had sought external finance in the previous three years compared to 39% in the Bolton sample (adjusted by the SBRC authors for comparability). Of the 65% in the SBRC sample seeking external finance, only a very few firms were found to have been unable to attain any finance.

Banks however have been criticised for charging small firms too much and for requiring too high a level of security. In addition, the Wilson Committee (1979) felt that banks were too conservative in the purposes for which they made bank loans and tended to be inefficient in their credit assessment procedure. Bank managers themselves have been criticised for their lack of skill in appraising business propositions and in particular it was found that there was "---limited technical expertise amongst branch managers in analysing business propositions" (Robson Rhodes, 1984, p81).

Robson Rhodes (1984, p83) also suggested that "--many of the businesses we have studied have been under-financed. The under-financing of a new business starts it as a cripple". That new businesses are particularly disadvantaged in their dealings with banks is discussed by Hall (1989, p44) who suggested that in general the younger and smaller the company, the less willing a bank would be to enter into a long-term commitment. Under-financing however may be partially due to over-optimistic expectations by entrepreneurs as to how little capital they need.

While de-regulation of the financial sector has resulted in increased competition between financial institutions and a greater availability of loan capital, Hughes (1992) found the financial structures of small companies to be little changed from previous research findings in the 1960s and 1970s. Small firms were found still to be reliant on short term loans and overdrafts from banks with relatively low levels of financing by shareholders' equity. Berry et al. (1990) and SBRC (1992) found that new types of finance were being utilised by small firms, particularly leasing and hire purchase agreements.

Storey (1994) in a review of the literature on small firm growth, suggests that fast-growth businesses have indicated a willingness to share equity and were more likely to grow or to have grown than those who were reluctant to do so (Storey et al., 1989; Solem and Steiner, 1989; SBRC, 1992; Kinsella et al., 1993). Storey cautions however that external investors may only be interested in firms with growth potential which may account for the above results. Firms' willingness to share equity may affect their perception of venture capital as a source of finance.

Venture capital³ is another form of finance suitable for innovative small firms. Various changes and inducements in the venture capital industry have led to a widespread belief that venture capital may become more important in SME innovation and growth. In return for accepting the considerable risk involved in backing an innovation, venture capitalists usually demand a share in the equity of the firm or project rights. While venture capital intuitively presents an ideal solution to the growth problems of innovative small firms, a number of problems have been associated with this type of finance.

- Venture capitalists seem unwilling to invest at levels below £100 000 and more usually the threshold is £250 000.
- Venture capital would seem to be an ideal source of funding for innovating SMEs but Hall suggests that venture capitalists seem to be shifting the balance of their portfolios towards the service sector.
- The UK Venture Capital Journal (1986) reported that 60% of venture capital companies at that time had been based in London and these firms accounted for 75% of capital invested in 1985.

³ Shilson (1984) defines venture capital as "A way in which investors support entrepreneurial talent with finance and business skills to exploit market opportunities and thus to obtain long term capital gain".

- Berry, Hall and Lewis (1986) in a survey of venture capitalists in Greater Manchester, found the venture capital market to be rather closed. In other words, once turned down in an application to one venture capitalist, an SME would be unlikely to succeed with others. (Hall, 1989, p47).

The SBRC (1992) survey however found that less than 10% of SMEs seeking external finance sought venture capital. Even more significantly, the survey found that venture capital accounted for less than 3% of additional funding supplied to the sample firms. The NEDO report claimed that only 2-3% of applications for venture capital were successful. In conclusion it would seem that venture capital is of very limited use as a source of funding for innovatory small firms in general. Storey (1993) however felt that the small proportion of firms using venture capital make a major economic contribution and tend to be rapidly growing businesses. This is corroborated by Cosh and Hughes (1994) who found that the most likely users of venture capital are medium sized but fast growth businesses.

Another possible source of investment capital is corporate venturing⁴. An estimated 20% of investment capital in the US is generated from corporate venturing (Hickman et al., 1985) but very little is known of the situation in the UK. Hickman et al. reported that British Steel, British Petroleum, Ferranti, ICI, Pilkington and Thorn EMI were known to be involved in this type of enterprise in the UK. Storey (1994) estimated 3I to be the UK's major venture capitalist. Harrison and Mason (1992, 93) estimated private venture capital in the UK to be around £2-4bn. They estimated the investment of the informal venture capital industry to be around 1.5 to 3 times the estimated £1.25bn investment by the formal sector. Overall, data on the venture capital industry in terms of its role in funding small firms is patchy. Although the provision of venture capital is growing it would appear to be a relatively small source of funds for UK SMEs.

Training Skills and Manpower

Reviewing the literature on barriers to small firm growth arising from aspects of the labour market, Bosworth (1989, pp58-60) identified a number of crucial points in relation to small firms. Bosworth argues that as there are direct links between the capital intensity, level of technology and skill structure of the firm, small firms need to be able to raise the quality and expertise of their workforce in order to meet the challenge of changing market conditions and technological advances from larger

⁴ Venture capital may be provided formally through the financial sector, or less formally by individuals or other firms. Where venture capital is invested by other firms, it is usually termed "corporate venturing".

competitors. Small firms however are either less able, or less willing than their larger counterparts to attract high-quality personnel. Small firms are also disadvantaged in their willingness or ability to upgrade the skills of their workforce by undertaking training programmes. What training is undertaken, according to Bosworth's review, tends to be undertaken in external training establishments, is not firm specific and SMEs therefore suffer the disadvantage of less effective and less appropriate training whilst running the risk of losing employees who are not "locked-in" to the firm by highly specific training (Bosworth, 1989, p59). Small firms reportedly also make more use of peripheral workers which may give more access to external skills, but where the ratio of periphery to core workers is high, Bosworth contends that the average quality of the workforce will be below that of large firms. While the UK government has introduced a number of policy initiatives to provide training for SMEs, their effectiveness is still unclear (see section on policy perspectives below), and there is the argument that formal external training is irrelevant to the needs of small firms. Wynarczyk et al. (1993) suggest that small firms rely on 'poaching' workers from large firms which do provide the training.

Small firms not only begin with a lower skill base but tend to lack the ability to, or are inhibited from developing it. The importance of skill and training is that if a firm is to adopt technical and organisational innovations, it needs to have a reasonable level of skills present in the firm which it is subsequently able to develop. The importance of this lies in the widely held belief that an increase in the rate of diffusion of technology into a firm will increase its growth rate (Nelson and Winter, 1978; Pavitt and Soete, 1980; Barras and Swann, 1983; Stoneman, 1984; Wilson, 1984; Whitley and Wilson, 1986; all as cited by Bosworth, 1989, p60). Skill and training in the workforce or the availability of suitably skilled personnel are crucial in the introduction of new technology into the firm. Strong suggestions have also been made that lack of training may hinder growth (Curran and Stanworth, 1981; Bosworth 1989, p74).

Relationships and associations between employment, skill and profitability have been well documented in the literature on employment economics and need not be repeated here. However, of more general interest is the effects of trends and structural issues on the skill-base available to firms or the ability to increase skill levels within organisations. Bosworth cites studies carried out in the early 80s which indicate a general shortage of skilled or qualified manpower especially in the area of micro-electronics (Wilson, 1984, p40; Northcott and Rogers, 1982; Atkinson, 1984, 85; Wilson and Bosworth, 1986). The latter two authors suggest that trends in self-employment and the casualisation of the workforce especially amongst smaller firms

may create new difficulties in maintaining and increasing the skill level of the workforce.

In general, training of employees in small firms is inhibited by higher labour turnover in small rather than large firms and the fact that small firms tend to be more labour intensive and offer more general training tends to lead employees to seeking their own training (Bosworth, 1989, p74). Another important issue here is the training of owner-managers themselves. While higher education levels have been associated with high growth, it is clear from the discussion above that negative attitudes and fears of managers which hinder growth could be addressed through appropriate training and/or access to advice.

Planning and Strategy

Small firms in high technology sectors have been found to grow more rapidly than firms in more traditional sectors, although Storey (1994) questions the testability of that hypothesis due to different definitions and measures of technological sophistication. In most studies of high technology firms, measures include frequency of patenting, investment in R&D, and employment of qualified scientists and engineers (Monck et al., 1988). On balance, Storey found technological sophistication to be positively associated with rapid growth. The measures used suggest that membership of a high technology sector alone may not stimulate growth but rather, technology strategy is an important growth factor.

The introduction of new products has been widely associated with firm growth (Woo et al., 1989; Dunkelberg et al., 1987; Kinsella et al. , 1993; Wynarczyk et al., 1993; Storey et al., 1989). Less radical forms of innovation have also been associated with growth but these are often difficult to define or to separate from other issues such as niche strategies or product line extension.

Storey et al. (1987) found that firms with a poor understanding of their competitors are likely to be slow-growing. The nature of competition also requires different strategies for successful growth. Firms which are flexible and willing to take risks have been found to be more successful in hostile or highly competitive environments, while those which emphasise rules and formality are the ones most successful in benign environments (Covin and Slevin, 1989).

Studies of fast-growth small firms (Storey et al., 1989; Solem and Steiner, 1989; SBRC, 1992; Kinsella et al. 1993) have indicated that firms which are willing to share

ownership (equity) with other organisations individuals or financial institutions are more likely to grow, or to have grown than those which are less willing. This supports findings reported in Chapter 3 which suggest that high technology firms experience higher growth rates where entrepreneurs are willing to cooperate with other firms and institutions. Such studies indicate that willingness to 'link-up' or 'cooperate' with other organisations may be important to small firm survival and growth. Market positioning (as a strategy) may also be important in small firm growth but while Storey (1994) suggests, from a review of extant knowledge, that positioning is "a key ingredient of growth amongst smaller firms", due to differences in measures and perspectives by different researchers, it merits further examination.

Industry Structure

McGee (1989, p175) hypothesised that small firms in young developing industries and markets are more likely to be disadvantaged by their own inability to take advantage of market opportunities than by the structural characteristics of these markets and the inherent power of existing competitors. The same author confirms the widespread belief that the most pervasive problems facing small firms are internal to the firm and lists the technical skill base, management systems and processes, appropriate organisation structures, and the ability of skilled managers as the main problems (McGee, 1989, p192). Again the point is made that such firms will have difficulties in expanding simultaneously in technical, product, market and managerial fronts, a point which has extremely important implications for the development of small, young technology based firms where firm development and growth is to some extent synonymous with the development of technical innovation.

Problems however may emerge from aspects of industry structure. Hughes, as discussed above, suggested that a concentration of large firms may result in uncompetitive behaviour towards small firms. Large firms, and concentration of industry however, may only emerge where it is possible to achieve economies of scale, division of labour and capital intensity. Schlerer et al. (1975) argue that technical economies of scale can only be achieved where the size of the market is sufficient to sustain large-scale technical output. New industries and new technology sectors are likely to be characterised by a proliferation of small firms. Hughes (1989) contends that innovation takes place in a sequential process in which small firms may be suited to activities at the invention stage, while Williamson (1975) has pointed out that large firms are more suited for large scale production manufacturing and distribution. Clearly the small firms' role in the value chain and its position vis-à-vis other firms is likely to have some impact on its growth and development.

The presence of large purchasers in an industry is likely to affect the competitiveness of small firms and their ability to grow. Large purchasers are present in both public and private sectors, e.g. central government, local authority and public corporations and large firms in the private sector. Such buyers tend to be very active in aerospace, electronics, ordinance, shipbuilding, pharmaceuticals and medical equipment (Hartley and Hutton, 1989, p106).

The importance of this is that small firms, especially those in high-technology industries (as classified by Butchart, 1987 and including those above with the exception of shipbuilding) may operate in a highly concentrated industry vulnerable to the power of large buyers. Martin (1983, as cited by Hartley and Hutton, 1989, p106) has provided evidence to suggest that industries which are characterised by either a few buyers or a few suppliers tend to be less profitable than less concentrated industries.

The Bolton report (1971) suggests that small firms may be disadvantaged in respect of government procurement. Firstly because competitive tendering tends to favour firms which have proved their competence with the buyer. New firms, particularly small firms, may therefore find it difficult to become included on the list. Secondly, because procurement officers were found to prefer large, established, well-known firms in avoidance of risk, a finding which was upheld by Cunningham and White (1974) who found that large purchasers in particular preferred to purchase from suppliers with whom they had previous experience. The Bolton Committee also found a trend towards larger sized contracts which would exclude small-sized firms.

Small firms themselves may be reluctant to enter industries dominated by large purchasers and particularly government departments. Hartley and Hutton (1989) found evidence that small firms tended to be inhibited from entering the defence industry due to lack of information on market opportunities, not knowing where to ask for such information and a reluctance to become involved in complicated procedures or meet the costs of approved quality standards.

Other problems related to procurement practices in the defence and medical equipment industries were, fears of delays in payments from large customers, the cost of tendering where there is uncertainty over the outcome, and the cost of creating buyer confidence. In addition, Hartley and Hutton felt that the advantage in innovative ability held by small firms may be neutralised by the adoption of conservative specifications by large purchasers which may exclude innovative products, by requirement for exhaustive

product testing procedures, by delaying decisions and requiring detailed tender submissions. The effect of such procurement policies is to increase the costs of small firms and over-stretch already tight resources.

Where the market is dominated by large purchasers, it is by synthesis of the above accounts, appealing to suggest that small firms may not only be disadvantaged in attempting to sell their products to large buyers, but may be inhibited or discouraged from developing new products in the first place as the cost of marketing these may further erode resources available for R&D.

Paradoxically, decentralised decision-making by large procurers, thought to improve the market entry chances of small firms, were reported by Hartley and Hutton (1989, p117) to cause problems for subsequent expansion in some cases. This, they suggest, is due to imperfect exchange of information amongst the units of a large customer, forcing the small supplier to repeat its marketing efforts to a number of buying units. Storey (1994) in review of current evidence suggests that whether a small firm is disadvantaged by being dependent on one or a few customers is unclear. While small firms have been found typically to depend on a single customer (Bolton, 1971), the effect of this concentration on growth does not appear to have been measured. A few studies (Kinsella et al., 1993; Storey et al., 1989) found that customer concentration was not associated with growth while Westhead and Birley (1993) found a negative association between these variables. Concentration though, has been found to diminish as firms grow (SBRC, 1992).

In terms of innovative ability however small firms are not thought to be disadvantaged in relation to large firms but rather have abilities and competencies which complement those of large firms. Williamson (1975) suggested that technology transfer will take place from small firms to large firms at a stage where heavy investment in product development and marketing is required. Small firms he argued, are better able to act as a seed-bed for innovation due to their flexibility and entrepreneurial capabilities, while large firms have resources, experience and market presence more suited to large scale production and distribution than their smaller counterparts. Rothwell and Zegveld (1982, 1985) present a similar argument. Their identification of advantages and disadvantages of small and large firms in innovation suggested that small and large firms are complementary components in an industry characterised by innovative activity (see Chapter 3).

Policy Perspectives

Recognition of the small firm sector as a creator of employment together with widespread recognition of the problems and barriers facing growth oriented small firms has resulted in the development of policies specifically aimed at the small firm sector. In the UK, specific policies for small firms really only emerged after the publication of the 1971 Bolton Report (Stanworth and Gray, 1991). Policy for small firms developed in a piece-meal fashion until the government attempted to coordinate the 64 existing schemes into four main groups - investment, innovation, export and advice - under the Department of Trade and Industry (DTI). This structure continued until the launch of the Enterprise Initiative in 1988. During the early 1980s, small firm policies were geared to stimulate and increase the number of start-ups, which was largely achieved by removing financial, bureaucratic and administrative barriers to start-up and growth. Recently, since the mid 80s, small firm policy has placed more emphasis on supporting small firms and encouraging their growth through training, advice and consultancy. The onus of these programmes has shifted from central government to local enterprise agencies and Training Enterprise Councils (TECs).

The three main aims of UK government policy towards small firms are to free-up bureaucratic impediments to small business, improve and support more positive attitudes towards the small business sector and fill gaps in supply by providing commercial services for small firms to improve their access to finance, information, professional advice and training. Research on the take-up of government schemes and the effects of SME policies in general is patchy and it is difficult to come to an overall conclusion on their effect (Storey, 1994; Stanworth and Gray, 1991).

Much of the policy affecting small firms is macro-economic policy concerned with trade and industry at national and regional levels. While this thesis is not specifically concerned with policy and its impact, it is important to review the main policy initiatives which have been established to trigger and support the growth of small firms. Storey (1994) felt that macro-economic policies to keep interest rates down and to reduce personal and corporate taxation had not had as much impact on small firm growth as the government had hoped. Policies aimed at deregulation are particularly difficult to assess as impact is an indirect consequence of a removal of barriers to business to increase competition. While such moves have been welcomed by small firms (e.g. the lifting of statutory audit requirements for firms under £90,000 annual turnover, or reduction of employment rights for employees of small firms), the effect on the overall economy is unknown. Storey (1994, p268) expressed the opinion that small firms

cannot always be treated separately in macro-economic policy , but government should ensure that such firms are adequately represented at policy level.

Policies which provide financial support have been criticised for their almost exclusive focus on the creation of employment through business start-ups (Storey, 1994, p286). A number of researchers have found that financial support for small firms has a positive impact on the economy (Owen, 1992) and on job creation (Wren and Waterson, 1991). In general, the financial measures such as those listed in Table 2.5 provide temporary support during the formative period during which small firms are at their most vulnerable and, coupled with deregulation and the greater availability of loan capital, these policies together provide a more favourable climate for the establishment of small firms. Financial support provides a kick-start for small firms but does little to ensure their survival.

Name	Imple-mented	Main Provision
Loan Guarantee Scheme (LGS)	1981	Govt provides guarantee to banks for loans, to viable small firms without security.
Business Expansion Scheme (BES) / Enterprise Investment Scheme (EIS)	1983 1993	Provision of tax relief to individuals investing in qualifying unquoted companies (abolished 1993). Virtually the same provision as BES, investors now allowed to exercise management in the firms they invested in.
Enterprise Allowance Scheme	1982	Allowance of £40 per week paid for one year to individuals starting their own business. Transferred to TECs 1991-92 as BSU.
Business Start-Up Scheme (BSU)	1993	TECs allowed to establish own entry criteria and vary level and duration of payments.
Source: These examples summarised and tabulated from Storey (1994) Ch 7&8. Storey (1994) provides a full discussion of the impact and estimated success rates of the above schemes.		

More relevant here are policies aimed at specific groups of small firms, or sectors in which small firms are prevalent (Table 2.6). Since the early 1980s the UK government has introduced a number of schemes to help specific projects, especially in the development of technology. These policies represent a link between the government's concern for international technological competitiveness of British industry and the potential role small firms may play in innovation (see Chapter 3). This type of policy usually provides support for specific projects most usually at the pre-commercialisation stage of innovation, but, in the case of small firms, this has, in a couple of initiatives,

(e.g. SMART and SPRINT), been provided for production, marketing and distribution at the competitive or commercialisation end of the innovation chain.

Name	Imple-mented	Main Provision
Support for Innovation (SFI)	1982	Provided 33% grants for innovation projects.
LINK (superseded SFI)	1986	Provided 50% grants for pre-competitive R&D where firms collaborate with universities and other businesses.
Small Firm Merit Awards for Research and Technology (SMART)	1986	Provided 75% funding for small research projects at commercialisation stage.
Science Parks	1980s	To establish centres of innovation, technology transfer and collaboration.
Source: These examples summarised and tabulated from Storey (1994) Ch 8. For full review of the impact and effectiveness see Storey (1994).		

In addition to financial support and specific project support, the government has established a number of schemes aimed at helping improve the capabilities of owner managers through subsidised training. Advice is provided through various schemes which provide counselling and consultancy, financial support for the use of external advice or consultancy and referral to external expertise in the private sector (Table 2.7). These measures and schemes provide a degree of initial support in terms of training and subsidised access to consultants. The long-term aim however is to increase the long-term awareness of small firms of sources of information and advice and the importance of external expertise.

Table 2.7 Indirect Support for SMEs in the UK	
Initiative	Remit
Small Firms Counselling Service	Provides a referral service directing small firms to providers of advice in the private sector.
Business Growth Training (BGT)	Provides training for the owner/manager and subsidies for the use of external expertise.
Consultancy Initiative (CI)	Provides financial assistance to subsidise the cost of external consultancy in marketing, design, manufacturing assistance, business planning and financial and information systems.
Training and Enterprise Councils (TECs)	Have local responsibility for enterprise training in small firms within their wider responsibility for the labour market in specific regions.
Source: These examples summarised and tabulated from Storey (1994) ch8.	

The small firm initiatives, listed in Tables 2.5 to 2.7 above, reflect changes in regional industrial policy. Regional industrial policy has shifted its emphasis from one concentrating on the attraction of industry to assisted areas, to one which promotes indigenous development supplemented by foreign direct investment (Wren, 1990; Stanworth and Gray, 1991). Thus, small and medium sized enterprises have been recognised as important in regional development, but emphasis has moved from subsidised employment creation towards improved competitiveness and resultant job creation (Wren, 1990). In general, Stanworth and Gray (1991), note a shift away from 'hard' assistance towards 'soft' assistance whereby government schemes provide a facilitating and intermediary role to a greater extent than its role as a provider of hard financial backing.

The 1994 UK Government Competitiveness White Paper⁵ outlines a number of new initiatives and actions directly concerned with the competitiveness, performance and growth of small firms. These include a Skills for Small Business initiative launched in April 1995 and concerned with the training of key staff in firms of less than 50 employees. In addition, under the auspices of the TECS, selected large firms were asked to offer training advisors to their small suppliers. Several initiatives were launched to provide guidance for small firms seeking ISO 9000 accreditation and advice on design issues. Other initiatives, launched through Business Links, are concerned with management training, benchmarking of best practice and the promotion of quality awards. In innovation, arrangements were put into place to improve awareness and

⁵ Summarised in HMSO, Competitiveness: Forging Ahead, pp206-231.

access to EU technology programmes, in particular the EU R&D Fourth Framework Programme (see also Chapter 3).

Overall, current initiatives are geared to improving the quality, recognition, capability and therefore sustained success of UK small firms. This is to be achieved largely through policies which create links between small firms, large firms and other institutions including TECs and LECS (Scotland). The policies in general aim to improve the supporting infrastructure from small firms rather than the provision of grant aid.

In such a policy climate, small firms are encouraged to be more self-supporting and independent. Probably the most important aspect of small firm policy, in the view of this author has been the development of a more supporting business environment - supporting in the provision of an infrastructural framework through which small firms may contact other firms, service providers, customers, buyers and public and private R&D units. Hopefully, what the package of policies will do in the long term is to enhance the natural networking tendencies of small firms by providing the means by which external links may be established and developed.

Reduction in the auditing requirements of small firms may assist indirectly in the development of business by loosening up the boundaries around the firms required by traditional auditing practices which separate the firm's economic activities from those of the external environment.

De-regulation may play an important role in the blurring of these boundaries where firms cooperate in development projects, the sharing of capital equipment, knowledge and management expertise. Testing such hypotheses is beyond the scope of this thesis and remains an interesting proposition for future research.

The success of government initiatives on the development of the small firm sector, or the economy overall, is difficult to assess, but Stanworth and Gray (1991) and Storey (1994) present the results of a number of studies on particular aspects of some of the initiatives. Take-up and impact of small and medium-sized firm support measures have found to vary between regions particularly in the rate of new-business start-up (Keeble, 1990; Mason and Harrison, 1991). There are also differences between regions in the development and performance of small firms subsequent to start-up (Mason, 1985, 1989; Barkham, 1987). The danger here is that policies designed to assist small firms may prove to be "regionally divisive" (Storey, 1982; Stanworth and Gray, 1991) and

may benefit the most prosperous parts of the country the most, especially the south-east. There are serious implications here if the onus of small firm support continues to shift to the private sector, firms within areas with an already established infrastructure may be much better served than those in less developed industrial or rural areas.

Storey (1994, p283) suggests that subsidy of small firms through the EAS may in fact represent an inefficient use of public funds due to the relatively high failure rate of participants. Success, in his opinion, could have been improved by the provision of training alongside the subsidy. Some research has indicated that of the firms subsidised under the EAS, those which subsequently did not survive tended to be the ones which made most use of the Small Firms Service (Corry, 1987). The National Audit Office (as cited by Storey, 1994, p283) found that 60% of jobs created in firms surviving after 3 years were in only 4% of those originally starting.

While there is clearly a need for effective targeting of assistance here, Storey suggests that identifying potentially successful entrepreneurs is difficult and certainly the review of literature on founder characteristics above did not provide a list or combination of factors associated with success. What is of importance however is the 'quality' of the small firms which are developed which leads Storey (1993) to question whether policies which increase the rates of new firm formation are in the best interests of the economy. Coleman et al. (1991) found that the provision of grants by government was not rated highly by SMEs, in comparison with other factors, as important in helping small business.

Policy for specific projects, and in particular innovation, is discussed in Chapter 3. In a review of studies of indirect assistance, Storey (1994) found that the usage of publicly funded advice by small firms tends to be low (Coleman et al. 1991; SBRC, 1992), but that usage increases as awareness grows. Manufacturing firms were found to use the services to a greater extent than other firms and there were regional differences in usage (Smallbone et al., 1993). Impact of such policies is not clear as it tends to be measured in terms of rate of usage rather than effect on performance. Research on initiatives providing training for small firms has produced mixed results. Storey reports that Wynarczyk et al. (1993) were unable to find a link between firm performance and training provision. Corry (1987) was unable to link firm survival with the use of public advisory services, neither were Tremlett (1993) nor Maung and Erens (1991) able to link training with survival. SBRC (1992) however found a positive association between firm growth and training, and the National Audit Office (1988) found only 2% of trainees to have failed after 3 years. Measuring the effects of the CI and the TECS is

more difficult, in the former case because of problems connected to assessing the extent to which small firms apply consultancy advice given, and in the latter due to difficulties in separating the effect of small firm initiatives from the wider remit of the TECS.

The above section has reviewed some of the SME policy initiatives introduced by the UK government since 1980. A full review and discussion is provided by Storey (1994) which has been drawn on heavily here. Of particular interest for this thesis is the general trend of policy to more targeted assistance and the emphasis on links between private sector service providers and small firms and between firms themselves in aiding growth and development. In addition to Storey's recommendations that research needs to look more closely at the effects of deregulation, training and the provision of information and advice on small firm growth and development, it is felt here that a closer look needs to be taken at the use small firms make of external sources and links outwith those initiated or supplied by government (see Chapter 5).

Conclusions and Implications

The purpose of this Chapter was to review existing knowledge on the growth of small firms. Review of theory found that there are a number of different approaches to small firm growth from diverse disciplines. Approaches tend to offer prescriptive advice, description of different patterns of growth and explanation though the latter does not adequately address causality. The small firm literature in general is fragmented and lacks common unifying frameworks.

Literature which provides empirical evidence on the performance and characteristics of small firms is vast and very difficult to synthesise into either a unifying framework, or to provide a blueprint of characteristics which will ultimately lead to successful growth. Part of the problem is the heterogeneity of the small firm sector. Comparison between studies is difficult due to differences in performance measures, definitions and perspectives used by different researchers in different disciplines, and compounding that is the unpredictability of entrepreneurial behaviour and the effect of industry structure and competitiveness. There is general agreement in the literature however that small firms may be hindered in efforts to grow by their limited resource base, inadequate or inappropriate managerial capabilities and attitudes, and a generally unsupporting environment or infrastructure.

Recent policy initiatives in the UK have attempted to remove bureaucratic impediments to firm growth, improve access to finance, education and training and provide

subsidised and/or directed access to information, consultancy and start-up or development finance. Determinants of growth are less readily assimilated than barriers to growth partly due to the different measures of growth itself, for instance fast versus slow growth, diversification versus concentration, quality versus quantity of output and survival versus expansion, and in part due to the possibly infinite combinations of internal and external factors, characteristics and events which could stimulate and support growth. The SBRC survey (1992) has associated a number of factors with fast-growth small firms which provides a useful benchmark for comparison with other small firm studies.

The process of reviewing the literature on the development and growth of small firms has identified a number of points of major importance.

1. The small firm sector is immensely diverse and although small firms are found in virtually every corner of economic life, they differ on dimensions such as:

- ownership structure and leadership style,
- industry sector and product market,
- business activity,
- technology and product/service capability,
- management attitude, orientation and goals,
- experience, age and life cycle,
- competitive strategy and industry role,
- performance and growth.

2. While individual characteristics have been associated with firm growth, specific growth factors have for the most part not been identified. Firms exhibiting specific combinations of factors may experience growth rates, directions and patterns resulting from their own unique combinations.

3. While the identification of growth factors has proved problematic, there is considerable agreement in the literature on what issues and problems prevent or inhibit small firm growth, these may be summarised as:

- resource based,

- competence based, and
- infrastructural based problems

4. Finally, the issues and problems may be divided into two main categories:

- Internal barriers including lack of resources, inability to manage resources effectively, and inappropriate attitudes or motivations towards growth, and
- External barriers resulting from infrastructural failure or the competitive structure of the industry.

Growth factors in general include the ability to increase or access resources and the ability to manage these towards growth oriented goals. Much attention has recently been paid by researchers to the role of external resources in overcoming barriers to firm growth or development. The major contributions and empirical findings from studies are discussed in Chapter 5 which is focused specifically on the external links of small firms and develops the conceptual approach to this research study.

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Chapter 3

Technology, Innovation and Firm Growth

Chapter Objectives

- *To discuss the specific growth, processes, barriers and determinants of small firms established specifically to exploit a scientific or technological innovation.*
- *To discuss the nature of the innovation process as it takes place within firms and, more importantly, the role small firms might play as specialists in an innovation value chain.*
- *To develop the previous objective vis-à-vis technology transfer processes between small and large firms, and between firms over national borders.*
- *To evaluate challenges and problems facing small technology based firms with emphasis on resource considerations and infrastructural issues.*

Technology, Innovation and Firm Growth

Introduction

The development and renewal of technology in firms is generally held to be a major factor in their survival, development and growth. Firms which are active in innovation, invest in new technology, or which are operating in high technology industries have been associated with rapid growth, rapid internationalisation and export success. In addition, competitiveness of small firms has been widely associated with technology based factors including investment in technology and strategies encompassing the accumulation and exploitation of technological knowledge. Small firms in new and/or high technology sectors face the challenge of rapid and often turbulent change, and markets which are international or global rather than local. Such an environment creates additional problems for small firms but also poses additional challenges and opportunities.

Arguably, the challenge of such environments may be the opium of the intrepid entrepreneur, the inventor, explorer, scientist, gambler or hedonist and others who thrive on risk, change and personal fulfilment. For these reasons and others discussed in this chapter, small firms in high technology sectors may differ in their expansion routes and patterns from small firms in general. As change agents, they may determine and clear those routes and patterns for other firms and provide benchmarks for the success of small firms in general.

This chapter emphasises the case of small firms which operate in sectors characterised by new and emerging technologies, and are likely, especially where they are small firms, to have their growth linked to the process of technological development itself whether this process takes place entirely within the firm, or whether the firm plays a specific role in the innovation or development of a technology. Linked to the innovation process is the process of technology transfer between firms, between stages in the development process and between countries.

The purpose of this chapter is to discuss small firms and their involvement in technological innovation, and the effect of technology on firm growth. The nature and characteristics of technology intensive firms are discussed followed by a description and critical discussion of the innovation process and the evolution of innovation process models. Finally, technology transfer and the role of technology in the development and growth of firms is discussed and relevant UK and European technology policy reviewed.

Technology-Based Firms

Small firms in high technology sectors are often classified as *high-tech* by merit of their membership of the sector in which they operate. Generally speaking, these firms are likely to face the same problems and difficulties in their growth and development as other small firms. Not all firms in high technology sectors however can be said to be technology based and may vary widely in their technological involvement and innovative capability and activity as well as in their growth experience.

Small firms which are active in the development of technology itself tend to exhibit characteristics slightly different from SMEs in general, face different or additional challenges in their development and may require a different mix of resources and entrepreneurial skills in order to grow and survive. There is also a difference between firms which operate in high technology sectors but have little to do with the development of technology itself, those which are highly active in technological development, and those which are embedded in a wider process of innovation.

Maillat (1988, p71) whilst acknowledging that definitions of innovative enterprises vary, suggests that in traditionally industrial regions, innovative enterprises are considered to be those *capable of technological change*, either through the development of new products and production processes or through the purchase of new machines, licenses and so on which incorporate the latest technology. 'Innovation' in a more specific sense refers to *the process of "creating and developing new technical possibilities"* (Thomas, 1988, p44). Innovative firms therefore, especially those in emerging technologies, tend to be more R&D intensive and employ a higher proportion of technologists and scientists than other firms (Thomas, 1988, p44).

Since the early 1980s, a considerable volume of work has emerged on firms in new and emerging technology sectors such as biotechnology, robotics, new materials, information technology and, in the late 1990s, genetic engineering. New technologies, because of their knowledge intensity and trend towards ever increasing miniaturisation (micro-technology), offer very attractive opportunities for small firms and the types of individual mentioned in the introduction to this chapter. New technology based firms (NTBFs), i.e. those established to exploit a scientific or technological innovation, are more likely to be concerned with *radical innovations*.

In Thomas' (1988) view, radical innovation refers to the beginning of the commercial phase of a specific product. *Incremental innovation*, on the other hand, refers to subsequent innovations on the radically new product. Incremental innovation may be undertaken by the same firms at a later stage, or by other firms, independently or in

collaboration. In new and emerging technology sectors radical innovation represents a whole new world of possibilities for the innovating firm including the prospect, if not need for rapid internationalisation.

As the concern of this thesis is with the development and internationalisation of small firms in new technology sectors, it is anticipated that technology, and the firms' involvement with it, will influence the nature and direction of that development. Firms founded to develop or exploit an innovation, are likely to develop and grow in a manner characterised by the innovation process itself. Such firms begin small and are therefore likely to be dependent on external linkages and co-operative arrangements throughout much of the early stages of their development and these arrangements may be specifically related to R&D or technological development. Some of these arrangements may be international, and part of the firm's activities and expansion processes transnational. Technology intensive firms concerned with incremental innovation are less likely to have the need for external links in R&D and their links and activities may be related to a greater extent to production, marketing and distribution.

Distinguishing amongst firms based on their involvement in technology is difficult and goes beyond definitional distinctions. A particular group of firms has been identified by a number of theorists as consisting of small firms in new, often leading edge technologies which are often highly competitive and experience rapid growth. These firms are highly R&D intensive and are concerned with the conversion of science to technology. On the continuum of technological involvement these firms (NTBFs) are probably at the extreme end and for this reason their particular characteristics and development processes are explored in this chapter for insight into the links between technology and internationalisation.

High Technology Industry Sectors

Specific sectors have been identified as *high technology* by a number of researchers. Keeble (1992, p173) suggested that NTBFs are relatively newly founded firms in the high-technology sectors as defined and listed into UK SIC sectors by Butchart (1987), (Table 3.1).

Table 3.1 UK Standard Industrial Classification Activity Code and Industry Description	
2514 Synthetic resins and plastics materials	3453 Active components and electronic sub-assemblies
2515 Synthetic rubber	3640 Aerospace equipment manufacturing and repairing
2570 Pharmaceutical products	3710 Measuring checking and precision instruments and apparatus
3301 Office Machinery	3720 Medical and surgical equipment and orthopaedic appliances
3302 Electronic data processing equipment	3732 Optical precision instruments
3420 Basic electrical equipment	3733 Photographic and cinematographic equipment
3441 Telegraph and telephone apparatus and equipment	7902 Telecommunications
3442 Electrical instruments and control systems	8394 Computer services
3443 Radio and electronic capital goods	9400 Research and development
3444 Components other than active components mainly for electronic equipment	
SOURCE: Butchart, R.L. (1987) "A New UK Definition of High Technology Industries", <i>Economic Trends</i> , 400, pp82-88.	

Other studies have been less explicit in giving precise SIC sector codes but have more generally listed or grouped technologies into broad categories. Rothwell (1991, p95) provided the following list of emerging technologies by which NTBFs may be identified. Rothwell's categories are similar to the five "generic" technologies identified by Freeman (1987) as those which have led to the development of new technology systems in the economy. These are, information technology, biotechnology, materials technology, energy technology, and space technology, the last three of which tend to be dominated by large firms. The OECD (1992) takes a broader perspective discussing new technology in three groups, IT, new materials and biotechnology.

New Technology Based Firms (NTBFs): A Special Case?

Biotechnology	single cell protein, bio-engineering, bio-mass, diagnostic kits, pharmaceuticals
Energy Technologies	heat pumps, solar energy devices, coal gasification and liquefaction, renewable energy sources, monitoring and control equipment
Advanced Materials Technologies	biocompatible materials, advanced composite material, advanced electronics materials, superconducting materials
Information Technologies	electronic office equipment, fibre optic systems, satellite communications, scientific and medical instruments, advanced computing, software developments, IT in the home etc., IT for existing and new applications
SOURCE: Rothwell, R. (1991) "External Networking and Innovation in Small and Medium-sized Manufacturing Firms in Europe", <i>Technovation</i> , 11,2,p95.	

The literature is not always clear as to whether the new in NTBF refers to the firm itself or to the technology. Usually however the firm itself is new (within around 20 years old) and is in the high-technology or the "new and emerging technologies" sectors. In a comprehensive review of the existing literature on NTBFs in 1983, Bollinger, Hope and Utterback asserted that there was no clear definition of NTBFs, but most studies used certain common characteristics to distinguish NTBFs from other types of firm. These characteristics, which differ little from those used in the Arthur D. Little (1977) report on NTBFs are as follows:

- "That a small nucleus of people, usually between 1-5 can be identified as founders of the organisation.
- The company is totally independent in that it is not a part or subsidiary of a larger firm.¹

¹Establishing whether a firm is independent could be problematic and in the case of "spin-out" firms i.e. project teams which are externalised and set up as independent firms by a parent organisation but receive parental support, these would be eliminated by such stringent criteria. (see Cutting, 1988)

While the Bolton definition of the SME required that the firm be independent, in practice it is difficult to establish. Aydalot (1988) developed a spectrum characterising SMEs according to their degree of independence from large enterprises.

Independent SMEs	Wholly independent
	Supervised
	Linked with a large enterprise (sub-contracting)
Originally Independent SME	Partial (up to 20% of the capital held by a large company)
	Integrated (majority control to total control)
Joint Venture	
Subsidiary of a large enterprise.	

- The primary motivation for founding such an enterprise should be to exploit a technologically innovative idea, and this should be the first time that such an idea is used." (BHU, 1983, p2 and ADL, 1977, p2).

The above criteria exclude non-independent firms. In addition the ADL study confined itself to manufacturing firms which excluded "soft-start" companies and spin-out firms which could not clearly be identified as wholly independent. The more recent FSI/SQW study of NTBFs in Britain and Germany (1988) give a broader but similar description of the characteristics of NTBFs.

- "NTBFs develop, produce and market goods and services which embody a significant element of recent science. The primary distinguishing feature, relative to other firms, is their conversion of science to new technology.
- In order to achieve the conversion of science to technology, research, development and design (RD&D) are necessarily a central activity of NTBFs. RD&D intensity is thus above average and employment structures are characterised by a high proportion of qualified scientists and engineers. (It may be noted that NTBFs at the research end of the RD&D spectrum are usually referred to as "leading-edge" firms and those at the development and design end as "application engineers").
- In addition to the normal commercial risks attendant on start-up and development of any firm, NTBFs added technological risks in the sense that the know-how concerned is not yet proven in actual performance, let alone in market acceptance,
- It is usually possible to identify a nucleus of people as founders of such firms". (FSI/SQW, 1988, pp2-3).

Studies of NTBFs tend to establish criteria for identification of such firms on variations of the above sets of characteristics determined by the nature of the research study and limitations imposed by data availability and quality. Neither of the sets of characteristics listed above mention the age of the firms yet this is clearly important.

Source: Aydalot (1988, p169-70).

The ADL (1977) study of NTBFs in Britain and Germany was based on an empirical survey of technology-based manufacturing firms established since 1950. The FSI/SQW (1988) study examined firms established since 1970, a good average is probably around 20 years.

From both sets of characteristics it is clear that NTBFs are innovative, having been set up specifically to exploit a technological innovation. Any study of NTBFs may include firms at a number of different stages in the innovation process including those which have not yet reached the stage of manufacturing and those which are operating at early stages of the value chain where technology is transferred between firms as the innovation progresses from idea generation to commercialisation of a process or product.

This thesis is concerned with the early stages of development in small firms in both technology and international expansion and therefore it is important to note here that not all firms begin manufacturing from inception but may experience a "soft-start". Soft-start NTBFs may begin life through *soft* low-risk activities such as consulting or contract research, or by distributing other firms' products. As resources become available the firm "hardens" through development and involvement in higher risk activities as opportunities arise to develop standardised products and eventually volume production, (Bullock, 1983). Allesch (1988) typifies the development of a "soft-start" firm as passing through a number of stages:

- Stage 1 starting from research,
- Stage 2 development work for individual clients on a contractual basis,
- Stage 3 concentration on a narrow range of customers (industry and government),
- Stage 4 increasing number of clients,
- Stage 5 standardised products for several large customers,
- Stage 6 production for a general market.

One of the differences between studies of NTBFs and studies of high technology firms in general is that the firm samples in the former tend to include soft-start firms. The FSI/SQW (1988) study of British and German NTBFs does include soft-start firms in its sample and established its criteria for the selection of NTBFs as firms established in 1970 or later which were independently founded even if subsequently acquired. The sectors selected for the study were sectors generally recognised as high technology by virtue of RD&D intensity. In broad terms these sectors were computer hardware and software, electronics including telecommunications, instrument engineering, materials,

chemicals, biotechnology/life sciences, scientific consultancy and R&D, (FSI/SQW, 1988, P3).

An important issue in relation to the international expansion of small firms emerges from the above discussion. High technology firms in general have been found to internationalise rapidly and it is likely that the high growth rates experienced by firms in new technology sectors are partly attributable to the international nature of the technologies themselves. Studies of small firm international expansion have tended to use export or manufacturing directories as their sampling frame. The implications of this point are discussed in Chapter 6 on the methodology of the research. Here it is suggested that studies of the international growth and development of small high technology firms would need to include soft-starts if early expansion activity is to be captured in the data.

Characteristics of NTBF Founders

NTBFs are R&D intensive, which indicates the importance of scientific and technical input in the start-up of such firms in comparison to firms in general. In a study of firm start-ups in Germany (cited by Klandt, 1988, p37), 32% of new business founders in general possessed university degrees whilst 88% of NTBF founders possessed the same qualification.

Such highly qualified firm founders tend to emerge from universities and other research institutions. In a survey of 322 high technology firms in the Cambridge area, 17% were found to have been founded by individuals straight from university (SQW, 1985). In a similar study of computer firms in the Cambridge area 31% of all new firm founders were previously engaged in university research. The sample also revealed founders to have high levels of education since 85% were university graduates and 52% possessed PhDs (Keeble and Kelly, 1985, pp30-32).

The scientific and technical background typical of NTBFs has important implications for the founding and subsequent development of NTBFs. Firstly, there is the importance of the incubator organisation which is discussed below in the section of foundation processes. Secondly, and more immediately important here is the characteristics of the founders themselves which may have implications for the development and success of the NTBF and ultimately for the direction and nature of the internationalisation process where that takes place.

Research, as cited above, shows that there is a concentration of academics amongst NTBF founders, to some extent surprisingly there is also evidence which suggests that

in general "an academic education reduces the need for vocational independence" (Klandt, 1988, p34). In a survey of scientific and technical employees which might potentially become NTBF founders, on being asked "Have you ever seriously considered starting your own business?", 75% replied "No never" or "Yes occasionally". These results were confirmed in another study by the same author and another, in which 75% of engineers with higher degrees and 60% of engineers with other degrees gave the same answer (Szyperki and Klandt, 1981).² By way of contrast 35% of master craftsmen, 53% of tradesmen, 55% of managers and executives and 56% of MBAs gave the above answers to the same questions (Szyperki, Nathius, 1977, p304).³ In general, academics have been found to be less likely to start businesses than people in other employment.

Klandt (1984, pp127,129)⁴ found that the motives of scientific and technical employees for starting their own business were:

- being economically independent and
- the possibility of promoting their own ideas

Such esoteric motivations were hampered in actual business start-up by a number of inhibiting factors which are listed here in rank order according to the perceptions of the scientific and technical personnel in the sample:

- Lack of start-up capital
- fear of risk
- "only having specialised abilities but no commercial or managerial experience"
- "not being an entrepreneurial type".

While the first two points are common to most potential small firm entrepreneurs, such attitudes or perceptions, particularly the last two, are likely to hinder rather than promote subsequent growth, development and especially important here international expansion. During informal discussion with firms at a Scottish Enterprise Seminar on innovation this researcher discovered that hedonistic goals were not uncommon

²As cited in Klandt (1988) p91, original study in German.

³As cited in Klandt (1988) p91, original study in German.

⁴As cited in Klandt (1988) pp34-35, original study in German.

amongst NTBF entrepreneurs and in some cases the business existed to fund research rather than to expand the firm or increase its profitability. This type of firm may increase its technological and geographical scope without necessarily increasing its size.

Manimala (1994) in a study of NTBF founders in Britain and India found that most founders developed a special interest in the product or technology of their choice and that their goals were likely to be linked to those choices. He also found a marked reluctance of founders to move to other products and technologies even when faced with clear opportunities. Earlier studies of NTBF founder characteristics (Klandt, 1988, p35) found that money or profit were considered to be important measures of the quality of entrepreneurial activity but not the purpose of it. Founders tended to be motivated by achievement, and enjoyed difficult but soluble problems which gave direct feedback of their achievement. Manimala's more recent study (1994) indicated that founders of NTBFs tend to be less entrepreneurial than founders of other high technology firms. Founders of the former tended to be "scientists, professionals, inventors" first and "entrepreneurs" second. An earlier study by the same author (1992) found NTBF founders to be risk averse and chose new products which avoided competition. In a study of high technology firms Oakey (1991) found slow employment growth to be associated with risk-averse founders and expansion tailored to the level of self-generated profit in a given year. An approach, he suggests, which avoids the need to turn to external funding.

Characteristics of NTBF founders associated with success are both interesting and somewhat surprising. They tended to exhibit a strong need for independence and tended to avoid situations typical of large, established, hierarchical organisations. Generally business founders tended to be more dominant and more enthusiastic than less successful ones. However, and this is especially interesting, *less* successful business founders were found to have a *higher* degree of self-sufficiency, resourcefulness and preference for their own decisions than the *more* successful founders (Klandt, 1984, p201).⁵

"This temperament trait may be of significance for the success of NTBF founders. Creating innovative technology related ideas needs a high degree of self sufficiency; on the other hand this self-sufficiency should not be so high that founders do not relate at all to the thoughts and behaviour of their social environment" (Klandt, 1988, p38).

⁵ As cited in Klandt, 1988, p38, original study in German)

Klandt cites empirical evidence from the German studies which indicate that there is a better chance of success for team-based foundations and suggests that qualifications and motives of partners need to complement each other and especially emphasises the need for partner complementarities in technology and marketing applications. The fact that NTBF founders tend to be "technicians" rather than entrepreneurs may indicate the likelihood of an early growth crisis and the need for importation of "professional" management (see development stage models, Chapter 2, especially Greiner (1972) and Scott and Bruce (1987)).

Literature on small firm success has suggested that it is market-led firms which are more successful. Implications for this study, by inference suggest that NTBFs may be technology-driven rather than market-led, resulting in less successful expansion. Although NTBFs are thought to have considerable growth potential, the characteristics of founders indicate that such firms may not grow significantly in terms of business and market development but may concentrate efforts instead on the early stages of innovation.

The strong independence needs of founders may indicate reluctance to cooperate with other firms and institutions which otherwise might help support growth. Of some importance, and by deduction from the entrepreneurial characteristics discussed above, NTBFs may expand internationally through modes associated with technology transfer rather than through the traditional export routes (see Chapter 4). One plus point for this thesis is that firm founders with a strong academic background may be more interested in, sympathetic towards and therefore more inclined to participate in this research than firms from the general population.

NTBF Foundation Processes

Most NTBFs can trace their development back to universities (FSI/SQW, 1988). Universities are clearly highly qualified to act as "incubator" organisations for NTBFs which is evident from the fact that so many NTBF founders come from university backgrounds (Allesch, 1988). Linking this to the previous discussion of the apparent unreadiness of scientists to found businesses, questions emerge as to the growth potential and success of such firms. Keeble (1989) found such firms to be located predominantly in the vicinity of research universities, government research laboratories, and to a lesser extent, around multinational enterprises, but in the latter case attractive residential locations were an important factor. In general, choice of location tends to reflect resource-based needs and hedonism.

NTBFs however may also emerge from large firm spin-offs where entrepreneurs leave a larger firm to set up business independently, or from spin-outs. A "spin-out" occurs where a large firm, rather than develop a project internally, may externalise the technological development by putting key individuals together and establishing them as an independent company which will receive guidance and support from the "parent". Such spin-out firms may remain independent, cooperate with the "parent", or eventually be bought back into the parent organisation (Cutting, 1988).

Firms have pursued different strategies with regard to innovation processes and in the US, CDC is known to have assisted as many as 72 spin-out companies over a 20 year period whereas the 3M company has consistently kept its project teams within the parent organisation. The extent to which organisations, especially MNEs are "spinning-out" technological development to new firms is a very recent area of research and at present empirical evidence, at least in the UK, is patchy. Firms established in this way are often associated with corporate venturing which is discussed in the section on funding below.

There are a number of different ways in which NTBFs may come into existence and whereas some may begin manufacturing immediately, others, as discussed above, may opt for a "soft-start" through initial involvement in contract R&D, consultancy or distribution arrangements (Bullock, 1983; FSI/SQW). Recent studies (Garnsey and Cannon-Brookes, 1993; Garnsey et al., 1994) however found little evidence in a soft - hard development amongst small high technology firms in the Cambridge area, rather, these firms exhibited "flexible specialisation" i.e. resilience and responsiveness to change without the encumbrance of vertical integration.

Formation processes of NTBFs is important because of the links which may be brought to the new enterprise either through the founders' connections or through continuing ownership, investment, project or contract links which may provide important access to expertise and resources and provide routes for technology transfer. Location affords the opportunity of establishing networks of firms and other contacts which in the case of Cambridge allows small but diverse firms to exist successfully in a developed and supporting infrastructure (Garnsey et al., 1994), although Keeble (1992) demonstrated the existence of successful small, high technology firms in remote but attractive locations.

Funding of NTBFs

Lack of capital and other financial resources have been cited by Klandt (1988) as an inhibiting factor in the formation of NTBFs and as a barrier to subsequent growth and development. The reportedly explosive growth in the start-up of NTBFs between the mid 1970s and mid 1980s (FSI/SQW, 1988, pp3 and 8), particularly in the Cambridge area, has to some extent been due to concerted efforts by the government to induce changes in the financial environment which have made investment more attractive for both founders and external investors (FSI/SQW, 1988, p10). This is discussed further in the section on policy below.

While this thesis is not immediately concerned with the funding of NTBFs there are a number of important issues here. Firstly, lack of funding, as evidence suggests, may inhibit the development and hence international expansion of these firms. Secondly, as will be shown below, the nature and source of funding differs at various stages in the development of the firm and therefore growth may be inhibited by a number of hurdles, or alternatively may be stimulated by an influx of investment at appropriate points of development. Thirdly, the nature of funding or source of investment may have significant implications for the direction of firm development in terms of its position in the value chain and whether expansion is domestic or international, and also for the ownership and organisation of the firm.

Intuitively, venture capital should provide a good source of funding for the innovative, and especially high technology firm. Firms involved in the development of radically new technologies and products represent a higher risk for the investor since the outcome of the investment is unpredictable, especially at early stages of technological and/or firm development.

Technology-based SMEs have been described as passing through four stages of growth (Roberts, 1990, 1991; Mason and Harrison, 1993, (see also Allesch, 1988, discussed above)) at each of which funding requirements are likely to differ. The stages are: pre-start-up or R&D stage, start-up stage involving initial product development, initial growth stage in which the product line is developed and sales are expanding, and the sustained growth stage during which the firm is growing rapidly.

Mason and Harrison (1993, 1994) suggest that at early growth stages financing needs can be met by family, friends, loans and overdrafts. It has been suggested that further expansion of technology-based firms may be hampered by the inability of bank managers to distinguish between high technology firms with growth potential (Vyakarnam and Jacobs, 1991; Philpott, 1994) and those without. Growth may

therefore be limited to loans and overdrafts, or through private investors, venture capital companies or public venture capital companies.

Empirical research on the funding of NTBFs shows some interesting results. Oakey (1984) and Oakey, Rothwell and Cooper (1988) provide evidence which suggests that high-technology and NTBF firms are dependent on banks as a major source of external capital. Venture capital on the other hand seems to be limited as a source of funding for the small NTBF. In 1991 only 15% of venture capital funding went to the high-technology industry (Ives, 1993).

Private investors, sometimes known as 'business angels', are reported to be the largest sources of external equity in the US (Wetzel, 1986; Gaston, 1989, as cited by Mason and Harrison, 1994). While less of this type of capital is available in the UK, a significant proportion of what is available has been invested in high technology based firms with most being directed towards business start-ups and firms at early growth stages. Venture capital companies tend to prefer firms at later stages of growth. The BVCA (1992, 1993) reports that one half to two thirds of venture capital investments are in leveraged buy-outs while less than 10% of investments were in start-ups or early growth stage firms. In general, UK venture capital firms have been reluctant to invest in technology related companies and according to Mason and Harrison (1994), only a minority of venture capitalists have undertaken this type of funding as a specialist activity since the 1980s.

Public venture capital funds are provided in the UK by Scottish Enterprise, the Welsh Development Agency and other local authority enterprise boards. Again however, the bulk of these funds go to firms at later stages of development and especially management buy-outs (Mason and Harrison, 1991). Corporate venturing, where large companies provide venture capital to smaller firms, tends to be undertaken to supplement the in-house R&D of larger firms and to provide them with a "window on technology". This type of financing is relatively common in the US (Winters and Murfin, 1988; Mast 1991), but less so in the UK (ACOST, 1990). McNally (1994, 1995) however suggests that the picture in the UK is actually more positive than supposed and what corporate venturing there is tends to be directed towards early stage and technology related investments.

Philpott (1994) cites empirical evidence which shows the venture capital industry to have moved away from financing high and new technology based firms, favouring instead management buy-ins and buy-outs. Evidence is cited which suggests that entrepreneurs are reluctant to relinquish control of the firm to venture capitalists (Myers

and Majluf, 1984; Vickery, 1989; Burns, 1992). Venture capital is often granted on the transfer of ownership whereupon the venture capitalist takes equity in the business and/or is granted ownership of the intellectual property itself (Ives, 1993).

Venture capital may also be unavailable to small, or young NTBFs since venture capitalists tend only to be interested in investments of around £250,000 or more. The FSI/SQW study (1988) found that of 120 venture capitalists operating in 1988 in the UK, only 10 were heavily involved in NTBFs. A more recent study of 63 high technology manufacturing firms (Mason and Harrison, 1994) found that the vast majority of the firms had not raised any external equity through venture capital sources, a finding which supports the results of earlier studies (Monck et al., 1988; Moore et al., 1992; Moore and Sedeghat, 1991), (see also Chapter 2). This trend is likely to be indicative of a major impediment to the growth of individual NTBFs.

Firm Size and Growth Potential

As studies of NTBFs tend to focus on firms of less than 20 years old, the firms tend to be small, although growth may be rapid. Rogers and Larson (1984) in a survey of 3000 electronics-related manufacturing firms in Silicon Valley, California found that 70% of firms had fewer than 10 employees and 85% fewer than 50. A later study, Segal Quince and Wickstead (1985) found that of all the high technology firms established in the Cambridge area after 1974 the average employment was around 20 employees.

Although most NTBFs are small, a few firms have achieved remarkable growth, for example Digital Equipment (founded in 1958) and Intel (founded in 1968), (Rogers and Larson, 1984). Other examples are IBM (USA), Motorola Inc. (USA) and Xerox Corp. (USA) founded in 1911, 1928 and 1906 respectively. A much more recently founded firm, Intel (1968) is an example of an NTBF which has experienced phenomenal growth during the 25 years since its inception to become in 1993, the dominant firm in the world's semiconductor business, competing with IBM, Digital Equipment and Advanced Micro Devices. (see Box 3.1).

Growth and Development of INTEL

In typical NTBF style, the firm was founded in 1968 by two individuals, Gordon Moore and Robert Noyce who left Fairchild Semiconductor to set up Intel and develop and manufacture silicon chips. The firm has retained its innovative culture through which it invented high speed memory (D-Ram) and developed the microprocessor in 1971. The firm continues to innovate, and in 1993 spent around US\$2.5bn on research and development. Important in the development of INTEL as one of the leading world chip makers is its links with IBM which uses Intel microprocessors in its PCs, and central to this was Intel's decision to refuse to license out manufacturing rights to its most powerful chips. (FT 15.11.93, p40). The question of whether or not to license out technology may be crucial in the development and growth of smaller NTBFs, the question going beyond the simple "should we license out" to "what should we license out, to whom, and with what expected return?". According to Intel (from Cane's interview with the founders FT 15.12.93, P40) the decision to internalise the development and manufacture of its most powerful chips has been a key strategy allowing the firm to dominate a rapidly expanding global market. Intel's supply links to IBM have been a major feature in the firm's development thus in this particular case an external link or cooperative agreement has been a crucial factor in the corporate strategy of both firms. The following table shows important landmarks in the company's development.

Intel Company File

- 1971 Intel introduces the world's first microprocessor, the 4004
- 1977 Intel hires its 10000th employee
- 1981 IBM pc based on Intel microprocessor launched
- 1984 Company breaks \$1bn sales barrier
- 1987 Intel returns to profit after its first ever loss in 1986
- 1990 Intel's first \$1bn quarter
- 1993 Intel's first \$2bn quarter

Source: FT 15.11.93, p40

Following the explosive growth of new technology based firms in the USA in microelectronics and computers, many governments have attempted to trigger similar patterns of growth in their own economies. Much emphasis has been placed on small

high technology firms in the hope that they would contribute to economic growth and especially employment growth. The two main ways in which small firms can make such a contribution is in individual growth, where small firms become large firms, and in the number of small firm start-ups (Oakey, 1991).

Oakey indicates that Britain has been unable to replicate the success of the US in producing global giants such as Intel, Mostec and Texas Instruments. British firms which were expected to become high volume, high technology output manufacturers such as Acorn Computers, Sinclair and Inmos have failed to live up to growth expectations (Oakey, 1991, p32). Research on the contribution to employment growth has produced mixed results, while the number of new firm start-ups has continued to be seen as a major contributory factor to employment growth, especially in the high technology sectors. Keeble and Kelly (1988) provide evidence which suggests that the average employment per firm is low and the growth of start-ups misleading as an indication of employment gain.

This thesis is more concerned however with the growth of individual firms and not with the growth or change in sectoral composition, but evidence cited here suggests that while there has been an explosion of NTBF start-ups, the growth potential of individual firms has not been realised. In part this may reflect the overemphasis of government policy on small-firm start-ups (see Chapter 2) at the expense of their subsequent growth.

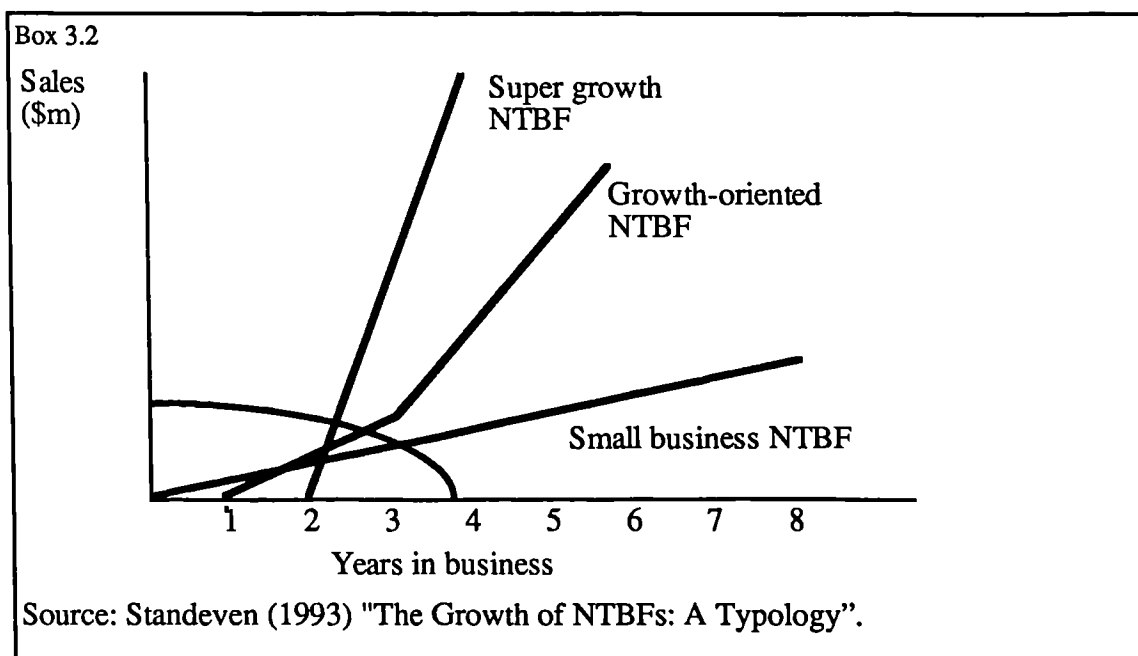
Sharing the same start-up and growth problems of other types of small firm, high technology firms which have been established specifically to develop a new scientific or technological idea may reach an early growth crisis. This arises for a number of reasons, for example, new technologies have not been tested in the market, the market itself may be undeveloped and therefore a risky investment for any potential provider of funds. Initial funding for NTBFs may be provided by the entrepreneurs own funds, or project funding for government sources for R&D. Problems occur when initial funding runs out but more capital is required to establish or launch production and undertake marketing and distribution.

The problem may be more acute due to the higher costs of marketing where radically new products are concerned. The growth of the venture capital industry may offer a solution to this problem to some extent (see above). Certainly, Oakey (1991) found that the three fastest growing US firms in his sample had benefited from venture capital funding. He also found in an earlier study of biotechnology firms that a high level of technical sophistication and R&D spending does not assure rapid firm growth.

This latter scenario however, may attract larger firms and there is always the danger of takeover. Twelve percent of Oakey's (1990) sample of 43 independent biotechnology firms had been absorbed into larger pharmaceutical and chemical firms by the end of his study. Garnsey and Cannon-Brookes (1993) in a study of Cambridge NTBFs since 1985 found that there had been substantial investment in these companies through acquisition, including many foreign acquisitions. In general however, firms remained small with only 10% having more than 50 employees.

As with Oakey's (1990) sample however, Garnsey and Cannon-Brookes (1993) found that a considerable proportion of their original data-set companies (34%) had become subsidiaries of other organisations and in the biochemical sector as high as 71% had become members of corporate groups. While incremental or organic growth therefore did not move firms out of the small firm sector, there was a high likelihood of corporate takeover of small high technology firms.

New technology based firms however are not homogeneous in their growth potential and patterns of growth. These differences, according to Standeven (1993) may be at least partially due to a lack of external financing (see Box 3.2). Discussion of founder characteristics above however suggests that there are more factors involved here than financing considerations, although the lack of external funding clearly presents a major growth impediment.



While some innovative or NTBFs may experience phenomenal growth as illustrated in the case of Intel, most firms will remain relatively small in comparison to such global giants. What is more important here is the pattern and process of growth and international expansion of innovative SMEs in a more general rather than exceptional sense. Central to the growth of small technology intensive firms is their relationship with technology and technological innovation. The next section of this chapter discusses innovation and understanding of the innovation process.

Innovation

Having examined the characteristics and behaviour of small firms which are at the leading edge of innovation and technological development, the purpose of this section is to examine the innovation process itself in relation to small firms. The approach taken is an examination of models of innovation. The assumption is made that innovation and technological development are processes which are fundamental to the growth of the firm and that decisions and stages in those processes may indicate the nature and direction of firm growth.

The characteristics and barriers to the development of technology intensive and new technology based firms discussed above indicate that firms involved in innovation may go through a development process which is commensurate, if not parallel with the innovation process taking place within. Literature on the innovation process has produced models which have evolved over time from very simple "linear" or "black box" type models to sophisticated representations of innovation as a complex iterative and cyclical process.

Whether the evolutionary development of innovation models reflects a deepening of understanding, or an evolution of the process itself is not clear. Recent models and explanations however, attempt to represent external influences on the innovation process, opening out the earlier view of innovation as a process taking place almost entirely within the boundaries of a firm.

The Nature of Innovation

Innovation may be distinguished from invention in that invention may be defined as the conception of the idea whilst innovation refers to the use to which the invention is put, specifically "the process by which an invention or idea is translated into the economy" (Twiss, 1986, p3). Essentially, innovation involves the conversion of an invention into a commercial product or process and the successful marketing of the same. As with a number of terms discussed in this thesis however, "innovation" is subject to different uses and interpretations.

Zaltman, Duncan and Holbeck (1973, pp7-9) suggest that "innovation" usually refers to either one of three separate concepts:

1. The process of developing the new item or idea
2. The process of adopting the new idea or item
3. The item itself

While such a breakdown emphasises the fact that there are different stages of the innovation process and that the object of attention may also be referred to as the innovation, a more succinct statement of the R&D -> market conversion process was made by Roberts (1988, p13).

"Innovation = invention + exploitation"

This equation suggests that there are two components of the innovation process adding up to a whole. This is interesting in light of new technology firms which may be more concerned with invention than the exploitation. In fact different phases in the innovation process have been identified which may be divided roughly into a pre-commercial phase and a commercial phase (OECD, 1992). McGee (1989, 174) goes further and suggests that the spectrum of innovative activity may take place through either or both of:

1. *Inter-firm channels* in which merger activity may take place and
2. *Intra-firm channels* which may alternatively be referred to as organic growth.

As is apparent from the discussion of innovation models below, the process of innovation tends to be discussed independently of firm growth and development.

Types of Innovation

There are a number of different ways of categorising innovation. Zaltman et al. (1973 pp17-32) suggest that there are three types of classification scheme:

1. Innovations based on the state of the system
2. Types of innovation based on the initial focus
3. Types of innovation based on their effect or outcome

In the first group, innovations have been categorised according to the extent to which they are planned in advance. Programmed innovations are those which are planned (Knight, 1967, p484), while non-programmed innovations might occur because there are available funds (slack innovations), or as a result of defence reaction where the firm is less successful (distress innovations), (Knight, 1967; Cyert and March, 1963, pp278-9). Underpinning such a classification system is the motivation or stimulus for innovation.

Box 3.3 A Product Innovation Matrix		
	Customer's View (increased benefits)	
Manufacturer's View (technological change)	1. Incremental Innovation	2. Technical Innovation
	3. Application Innovation	4. Radical Innovation

Source: Gobeli and Brown (1987).

The second category evolves around the initial focus of the innovation and classification schemes have been devised by a number of authors. Three categories were proposed

by Dalton (1968) as 1. technological innovations, 2. value centred innovations and 3. structural innovations. Similarly, Knight (1967) suggested four groups; 1. product or service innovations, 2. production process innovations, 3. organisation structure innovations and 4. people innovations. Important here is the distinction between product and process innovations emphasised by Utterback and Abernathy (1975) as discussed below.

The third category of innovations is classified according to the outcome or effect of the innovation. Biemens (1992, p11) established that most of these classifications describe two extremes of innovation, i.e. *radical and routine innovations*. The extent to which an innovation is seen as being *radical* depends on whether it is viewed from the perspective of the user, or of the developer. A useful categorisation of this type has been advanced by Gobeli and Brown (1987, pp25-7) which categorises innovations along two dimensions, the manufacturer's view and the customer's view (Box 3.3).

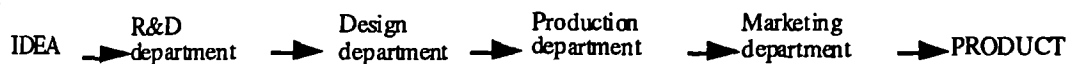
The Process of Innovation

The concern in this thesis is primarily with innovation as it affects, or is affected by, the development of the firm, and in particular, its international development. The purpose of this section is to discuss models of the innovation process for their relative usefulness in understanding the growth process of small technology-based firms.

Models of innovation may be categorised in various ways depending on the perspective of the researcher. Saren (1984, p11) categorised models of the product development process under the following headings:

1. Department stage models.
2. Activity stage models.
3. Decision stage models.
4. Conversion process models.
5. Response models.

Box 3.4



Source: M. A. Saren, 'A classification and review of models of the intra-firm innovation process', *R&D Management*, 14, 1984, pp. 11-24.

As stated however, these categorisations are concerned with "product" development and while the latter groups include diffusion in the conversion process, the perspective is clearly limited to the product and production process with little emphasis on the transfer of technology to the market. A more useful and broader taxonomy of innovation models, the structure of which will be used here, has been provided by Forrest (1991) as follows:

1. Stage models
2. Conversion models and technology-push / market-pull models
3. Integrative models
4. Decision models

Stage Models

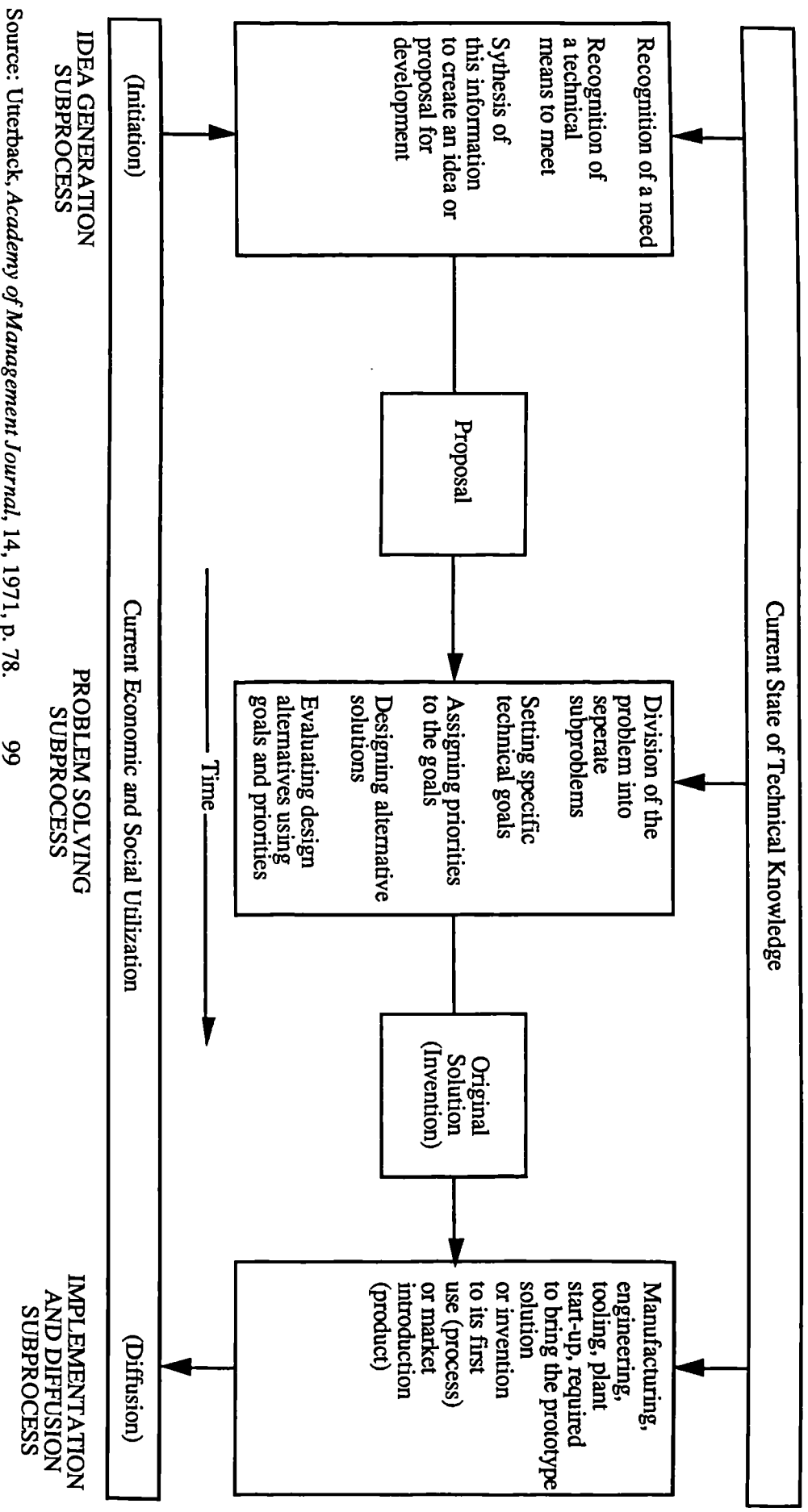
Early models of the innovation process tended to consist of linear representations of

sequential stages in the process. The simplest of these models showed the progression of the innovation through various functional departments of an organisation, for example Saren (1984) provided a linear representation of the innovation process (Box 3.4).

This fairly typical black box type model does not represent the activities performed in the innovation process but there are a number of "activity stage" models which do just that. Utterback (1971) portrayed innovation as taking place in 3 stages: idea generation, development and implementation and diffusion. The model listed the activities involved at each stage of the process and as such provided a framework for an innovation planning tool (Box 3.5).

Another activity model (During, 1986) developed an innovation model based on individual learning stages: 1. creative phase, 2. selection phase, 3. design phase, and 4. application phase which are depicted as cyclical rather than linear stages. Earlier, Booz, Allen and Hamilton (1968) developed a six stage model of the innovation process

linking company objectives to product success through six sequential stages which are interdependent i.e. exploration, screening, business analysis, development, testing and commercialisation.

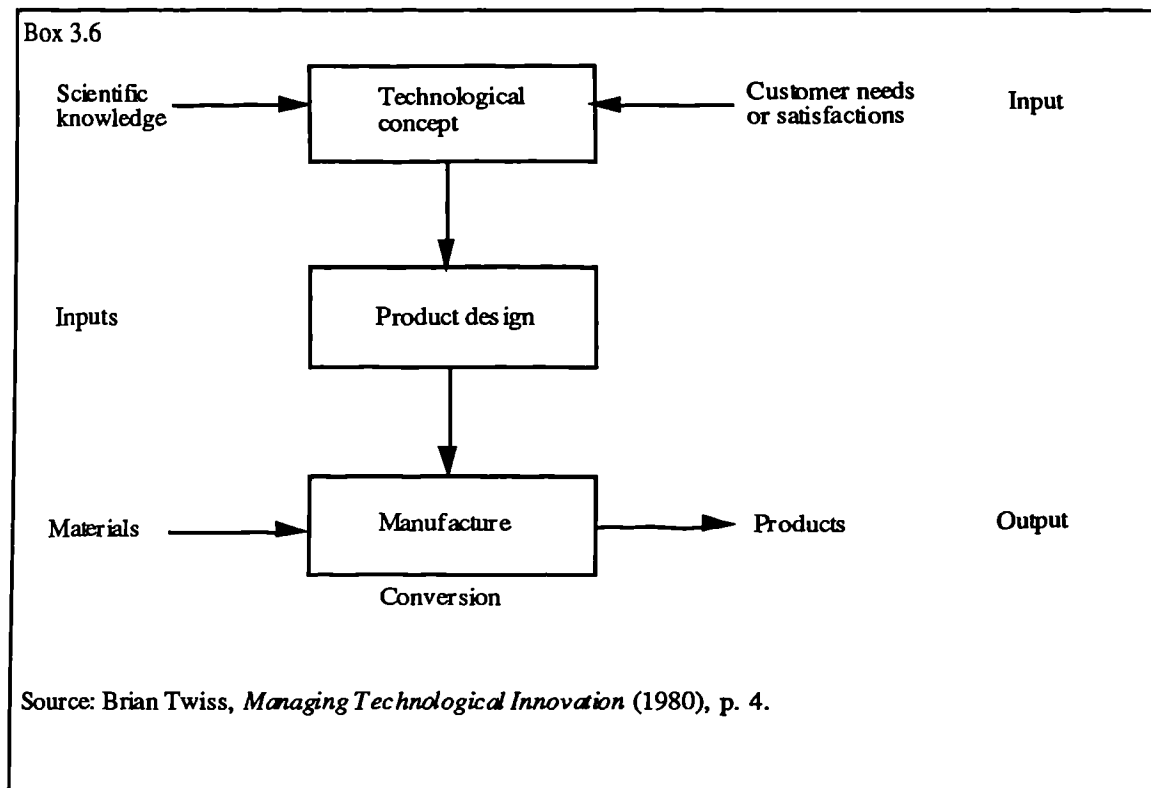


Source: Uterback, *Academy of Management Journal*, 14, 1971, p. 78.

The so-called 'department stage' models in general have been criticised by Biemens (1992, p29) as lacking insight into the actual process of product development. In most cases the progression of the innovation is shown from department to department without mention of the activities involved or the forms the innovation itself takes at various stages in the process. The models assume a sequential progression through departments but offer little comparability between firms which may be differentiated in organisational form or departmental functions.

Activity models offer some improvement on the departmental models since the focus is on the actual performance of activities in the innovation process but, in general, all sequential models have been criticised by Moore (1984, p11) for being unable to link the various activities in the new product development process and for their general assumption that each stage must be complete before the next begins. An important point with respect to such models is that the innovation process itself has undergone change over time, relying more on external inputs into the process (Takeuchi and Nonaka, 1986, pp137-8; Rothwell, 1993). Several authors have criticised stage models for their sequential approach which fails to represent the complexity of the innovation process (Kelly and Krantzburg, 1978; Forrest, 1991, p441). Sequential stage models in general fail to represent interdependencies between stages in the process which may occur in parallel, reversal, and importantly here, inputs from outside the firm (Forrest, 1991).

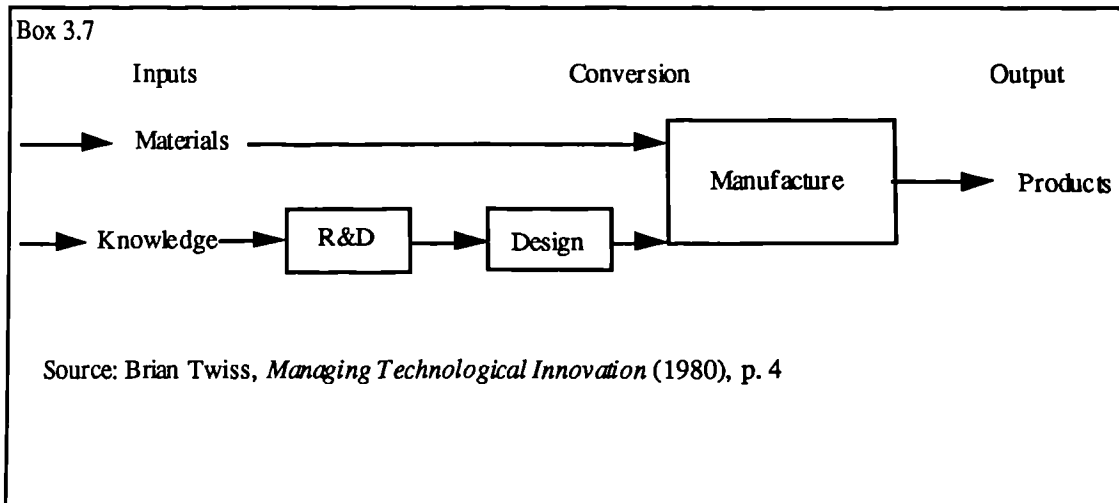
Twiss (1980) improved on the simple stage model of innovation by including external inputs from the body of scientific and technical knowledge and from the market. Innovation in this model however was still portrayed as a smooth step-stage progression from one set of activities to another and again changes in the innovation itself were not reflected (Box 3.6).



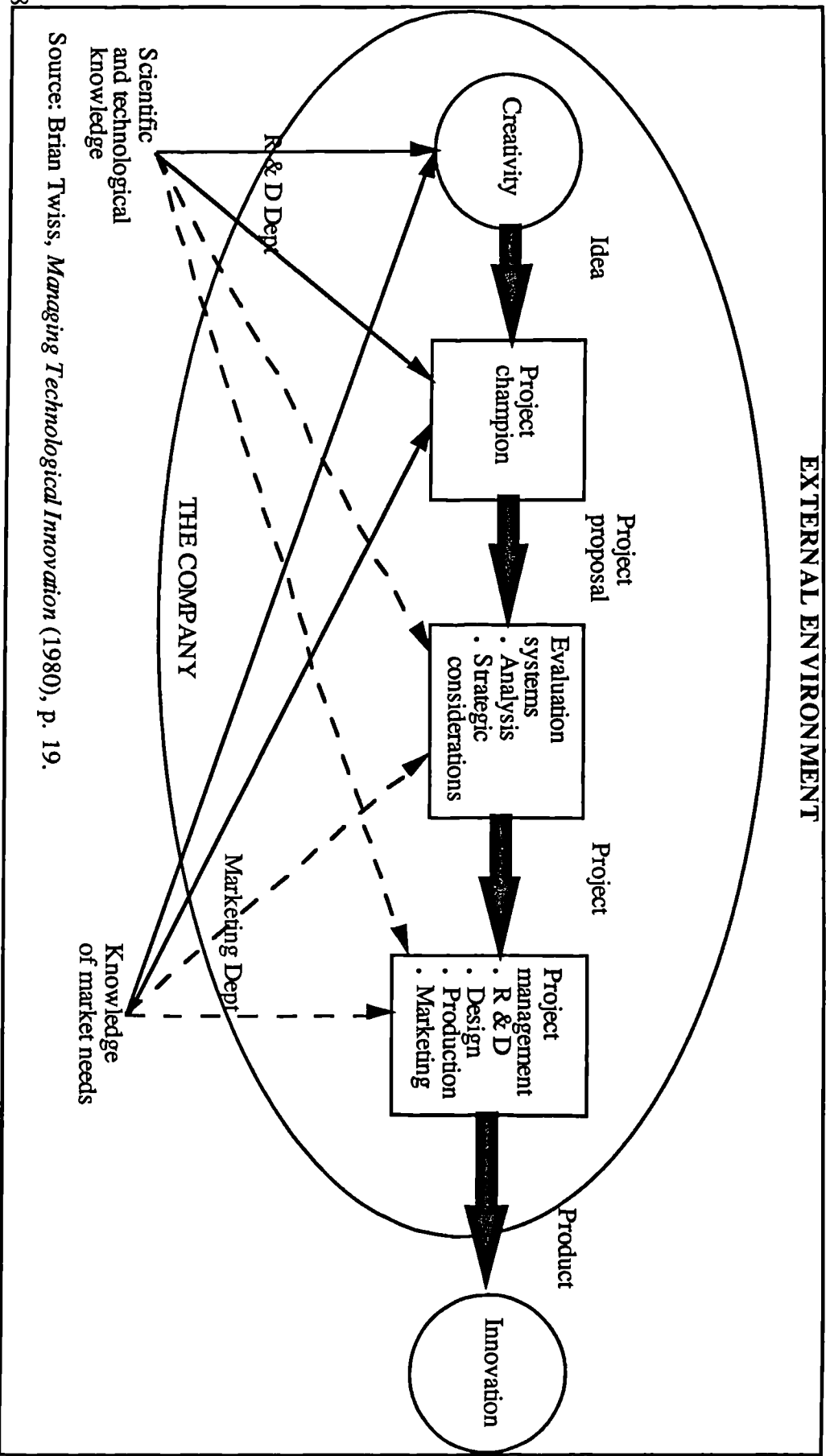
The importance of iteration in the innovation process has been recognised by a number of authors (Moore, 1984; Cooper, 1983; Kline, 1985). Kline (1985, p38) for example, emphasised three types of feedback loop which might occur in innovation. The first is where work is passed from one group of people to another as the innovation progresses from one stage to another and interaction occurs. The second type is where the innovation is passed back to previous stages in the process for correction or modification (reversal) and the third is feedback from the market after product launch for the purposes of adjustment of competitive position and future design and development.

Conversion Models and Technology-Push / Market-Pull Models

The models discussed in the above section tend to view innovation in production or product development terms. Essentially, what is happening is a conversion process whereby a number of inputs, e.g. materials and scientific and technical knowledge are converted into products, i.e. "transferred into the economy" (Twiss 1980). Models of this conversion process have been subject to two forces, technology-push on the one hand and market-pull on the other (Forrest, 1991, p442). A simple "black-box" type conversion model by Twiss (1980, p4) reflected the conversion process from its inputs of materials and knowledge through R&D, design and manufacture into output in the form of products (Box 3.7). The same author developed a similar "black-box" model emphasising the market-pull influence on the conversion process (Box 3.8).



Gardiner and Rothwell (1985) suggested that both technology push and market pull elements need to be taken into account in the innovation process, a point which Twiss (1980) realised and built into his activity stage model discussed in the section above. Such models however still suffer from the omission of important aspects of the process and in particular, the role played by the customer and other bodies was often omitted.



Source: Brian Twiss, *Managing Technological Innovation* (1980), p. 19.

Box 3.8

Integrative Models

According to Forrest (1991, p444), what is required by the modern organisation is:

"--a model which integrates all the facets of the innovation process that should be recognised by those responsible for facilitating innovation within the firm".

She also suggests that such a model should be useful throughout the life of the organisation from infancy to maturity and should be applicable to product and process innovations. Since this thesis is concerned with aspects of development in the early life of potential multinationals, such models are of particular interest here.

Such a model, developed by Utterback and Abernathy (1975) focused on high technology industries. This model suggested that the character of the innovation process changes as the firm grows from a small firm to a high volume producer. As the industry matures, Utterback and Abernathy found that the focus on new product development moved to "process optimisation and cost reduction" (Forrest, 1991, p445).

Other authors have attempted to represent the integrative nature of the functions or activities of the innovation process. Three broad activity stages were identified by Miaoulis and La Placa (1982) as *assessment, development and execution*. These stages were related to the dimensions of market, product and technology and a large number of activities were seen to take place at each stage. This differed from the simple stage models in that the model portrayed them as being cyclical and included a number of feedback loops.

Similar in its identification of three main functions in the innovation process as; the *research function, the technical function and the commercial function* is the Concomitance Model of Schmidt-Tiedemann (1982). The name of the model derives from its treatment of these three functions as processes which interact throughout the life of the project. The advantage of this model over the step-stage models discussed above is its recognition of the three main phases in the innovation process, *exploration, innovation and diffusion* during each of which, activities involving research technical and commercial functions take place. This model is particularly useful as a planning tool since both activities and decisions are allocated at the appropriate phases in the innovation process to one or more of the three functional areas.

The model succeeds in recognising both technology and marketing aspects of innovation, in acknowledging cyclical processes through a number of feedback loops, and in identifying changes in the innovation itself and major decision stages in the process. Forrest (1991, p446) however criticises the model for its lack of specific inputs/outputs and its lack of criteria by which the effectiveness of the innovation process may be measured. In addition, although activities include both technical and market research and as such interaction with the environment is acknowledged in a limited sense, links with external bodies are not identified.

Decision Models

A number of authors have broken the innovation process down into decision stages. The premise of such models is whether or not the innovation should progress to the next stage in the development process which is divided into stages separated by evaluation points. The decision taken at such points is generally referred to as the GO/NO GO decision (Biemens, 1992, p34). Such decision points may be categorised by their overall importance in the process, for example Balchandra (1984, p96) divided decision criteria into two categories "Red Light" variables which were absolutely critical and "Yellow Light" variables which were considered cautionary but less critical.

Cooper (1983) presented a decision model which distinguished between technical and marketing activities over a temporal but interactive innovation process consisting of a number of stages: *idea generation, initial screening, preliminary evaluation, concept evaluation, prototype evaluation, pre-commercial business analysis and post-launch evaluation and control*. The model benefits from its integration of technical and marketing activities.

Similar models have been presented by Ronkainen (1985), consisting of five phases; *concept, feasibility, product and process development, scale-up and standardisation*; and by Van der Kooy (1983, p53)⁶ consisting of three stages, *definition, design and preparation*.

Cooper and Moore's (1979) decision model suggested that at each decision stage, four activities take place:

1. information gathering to reduce uncertainties
2. evaluation of information,

⁶ as cited in Biemens (1992 p35), original in Dutch.

3. decision-making, and
4. identification of remaining key uncertainties.

Decision models are to some extent a development of activity or functional stage models which in general tend to be represented in the form of flow process charts and are eminently useful for planning and control. Again in such models specific inputs and outputs are not shown and interaction with the environment where acknowledged is minimised.

Comments on Innovation Models

The growing complexity of the innovation models discussed above suggest that the innovation process is extremely complex and to date, no one model reflects all the facets of the innovation process, or is general to all industries. Amongst criticisms of models of the innovation process Forrest (1991, p447) points out that with a few notable exceptions, e.g. Twiss (1980), most models fail to include the important pre-innovation stages of idea generation and screening, i.e. early market and technical evaluation. Also missing from most models in Forrest's view is the post innovation stage after the product has reached the market, an important exception being the Schmidt-Tiedemann Concomitance model (1982). Other models, e.g. Gardiner and Rothwell (1985), recognised that feedback from users was important for a re-innovation stage for future innovation or product modification. Other deficiencies include the general lack of criteria for the measurement of evaluation of success in the innovation process, the absence of a time element and the general inability of models to reflect the many environmental inputs and influences on the innovation process.

As reviewed above, developments in innovation models reflect attempts to produce a general model of innovation which began with simple or naive models to more complex representations of a number of facets of the innovation process. All models appear to be deficient in some respect or fail to be useful for some purpose, and none are general to all firms or all industries. Doubts have been expressed as to whether it is possible or even desirable to produce an all-purpose model of innovation because of the multiplexity of the variables involved and the different perspectives from which the process may be viewed. In Forrest's view:

"A comprehensive, generalised model of innovation should include such factors, among others, as a definite pre-analysis and pre-evaluation stage, definite feedback loops, both internally within the firm, and externally with the environment; an identification of decision points throughout the process; the lifestage/maturity of the industry and life

stage of the organisation within the industry; a recognition of the environmental variables - not only the marketing and technological, but socio-cultural and political environmental variables and the internal environment (culture) of the firm; and the important dimensions of time and cost/resource commitment. At the same time the model must not be industry specific, should be of use with both product and process innovations, and must take into account the effects of both market-pull and technological push on the process of innovation. In addition, it should incorporate strategic alliances.---

(Forrest, 1991, pp449-450).

Forrest herself questions the feasibility and desirability of producing a general model, when innovations take a variety of forms, and the process may be distinguished by type. Citing evidence to make her point, she quotes Uhlman's findings which found 11 classes of innovation from a factor and cluster analysis of 218 innovations, and of another study by Cooper (1983) which identified seven distinct types of process from a sample of 58 Canadian innovations.

Although ideally innovation models should be holistic, inevitably any model or theoretical representation of a process as complex as has been suggested will reflect the focus, level and perspective of the research for, or from which it was produced. From the perspective of this thesis the models above in general are deficient on a number of points:

- With the exception of Utterback and Abernathy the models do not depict the growth or development of the innovating firm.
- In general, models focus on stages of innovation *between* idea generation and diffusion with these beginning and end stages almost forgotten.
- There is an implicit and general assumption that the innovation process takes place almost entirely within the focal firm thus ignoring the possibility of multiple firm involvement either through horizontal linkages or vertical integration (value chain effect). Such an implicit assumption to some extent precludes the role of small firms in innovation.

- In most cases only lip-service is paid to inputs and outputs to the process and reference to external linkages is absent.

The four points above reflect two basic assumptions: 1. that while innovation is seen as a dynamic process, all other variables are held static (the basic premise of model building), 2. the focus in general has been on aspects of innovation internal to the firm. However a few models of innovation have taken a broader perspective are more specifically of use here. Moreover, recent studies of innovation strongly reflect interest in innovation as an inter-firm or network activity and as an activity which may take place across national borders. To Forrest's categorisations of innovation it is therefore useful to add a fifth category including models which are dynamic with the development process of the firm and which attempt to integrate external aspects of the innovation process.

The Development of Dynamic and Externally Integrated Models

Adding a fifth categorisation to Forrest's taxonomy, a number of models acknowledge the inter-relatedness of the innovation process and firm development and others recognise that while innovation may take place within a firm, equally the firm may exist and develop within an innovation process, or innovation value chain.

Utterback and Abernathy (1975) suggested that there are relationships between the pattern of innovation, the development of the firm's production process and its basis of competition (p639). Their study of 567 successful innovations from 5 industries and 120 firms empirically tested the hypothesis that "the characteristics of the innovation process will systematically correspond with the stage of development exhibited by the firm's production process technology and with its strategy for competition and growth". While most of the models discussed above treat the innovation process almost in isolation from other dynamic processes happening in the firm, this theoretical model attempts to position innovation as an integral part of the development process of the firm. As this thesis is concerned with development processes in new technology based firms, more attention will be paid to this model than those discussed above.

Utterback and Abernathy suggest that "a productive unit's capacity and methods of innovation depend critically on its stage of evolution from a small technology-based enterprise to a major high-volume producer" (Abernathy and Utterback, 1978). The contention here is that the small entrepreneurial unit and the larger, high-volume

producer of standardised products are at opposite ends of a continuum which may also describe the evolution of a unit.

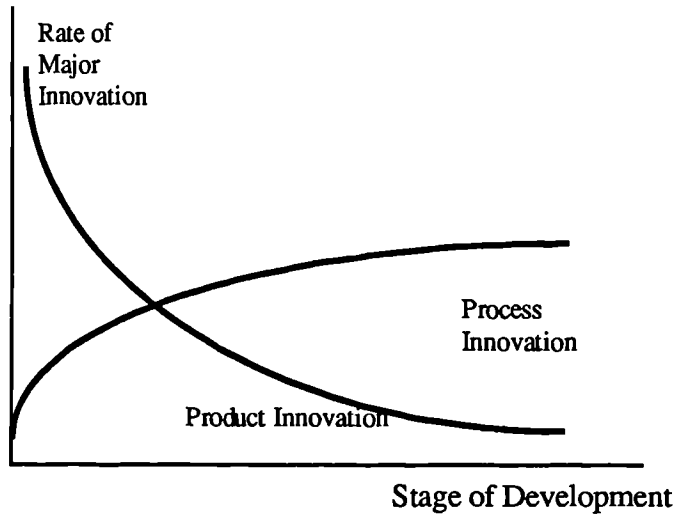
The basic premise of the model suggests that a production process develops over time in a characteristic evolutionary pattern becoming more capital intensive, increasing its division of labour and specialisation over time, standardising the product design and increasing the scale of the process (Utterback and Abernathy, 1975, p641). From this the authors go on to suggest that there are definite stages of development, similar across industries and economic sectors that can be identified by productivity factors and by such changes as: *organisational structure, the development of a supplier industry for special materials and technology-based capital goods*. Product innovation is seen as developing over time in a predictable manner with the firm's initial emphasis on product performance, moving to product variety and eventually to product standardisation and costs as the industry matures and competition increases.

Types of innovation are distinguished in this theoretical model. Where there are well-established, high-volume products with well-defined markets and standardised product design and production systems, e.g. light bulbs, combustion engines etc. innovation is described as incremental - having a "gradual cumulative effect on productivity" (Abernathy and Utterback, 1978). Where there is a system of incremental innovation, production systems tend to become increasingly specialised, dependent on scale production and mass markets and vulnerable to changes in demand and technical obsolescence. Within this type of innovation process the authors suggest, major products do not emerge.

Radical innovation on the other hand is seen as more likely to originate outside organisations with such specialised and restrictive production systems, and if developed inside may be rejected. Such innovations have been seen to occur in companies located near affluent markets where there are science-based universities or other research-based institutions and "entrepreneurially oriented financial institutions" (see also Keeble and Kelly, 1985, 1988). Products developed from radical innovations are characterised by Abernathy and Utterback as having superior functional performance to their predecessors and offer higher profit margins.

Evolutionary innovation, where a radical innovation shifts to evolutionary product innovation where changes in innovation pattern, production process and scale and kind of production capacity all occur together is the basis of the model. The figure below shows changes in the rate of product and process innovations over time.

Box 3.9



Source: Abernathy and Utterback (1978).

The figure suggests that the role of product innovation decreases after the initial phase while process innovation increases, then both continue fairly evenly. Rapid evolution of the process however, according to the authors, may achieve high productivity but at the expense of decreased

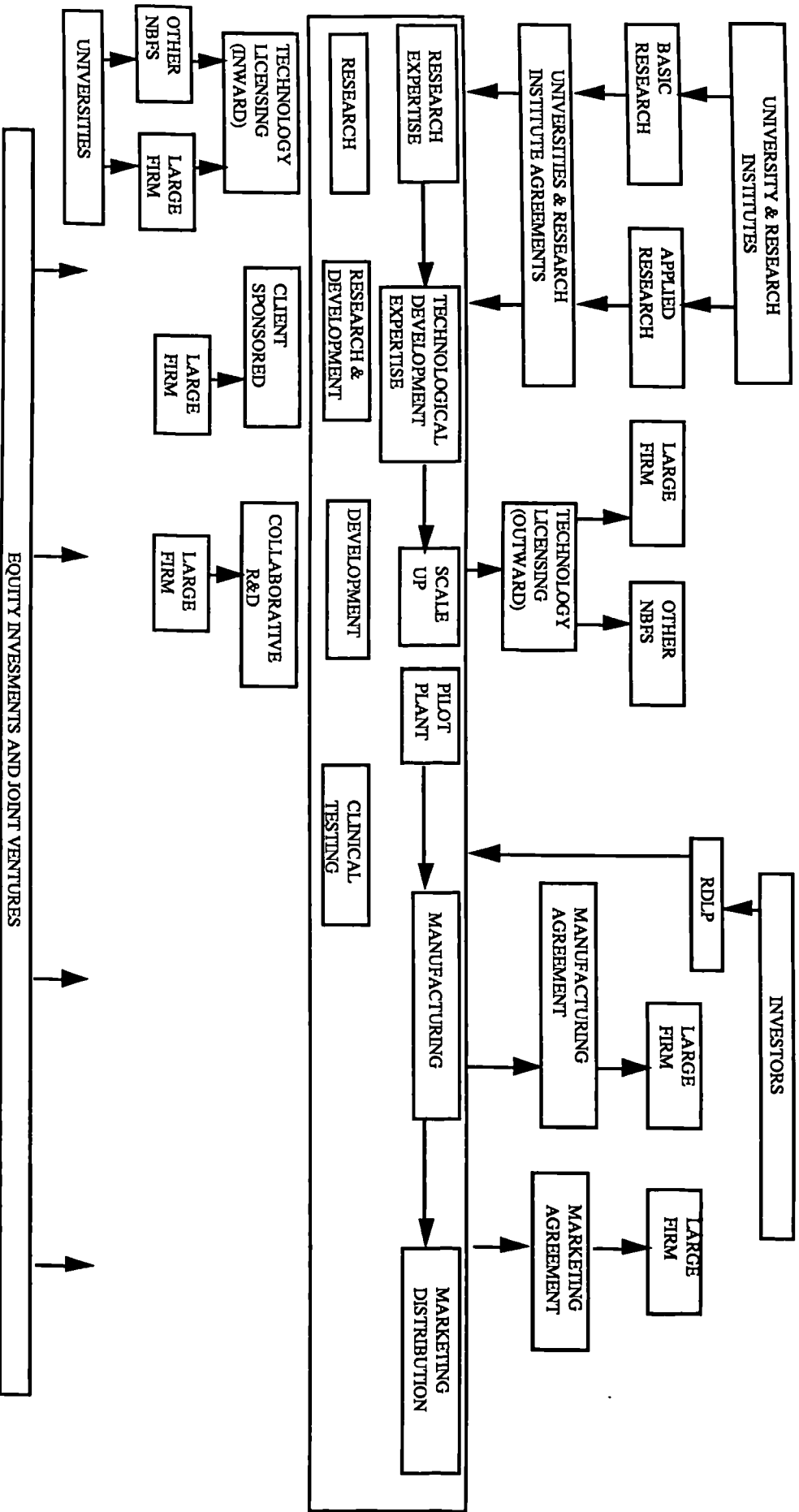
flexibility and innovative capacity. This finding would tend to be supported by Rothwell (1993) who found that successful, long established NTBFs retained their competitiveness by continued investment in R&D and product development. In the initial stages firms tend to be small, production is pioneering and innovation goals tend to be ill-defined and uncertain. There is a lot of emphasis on product performance and design criteria at this stage. As the firm or unit matures, uncertainty about markets is reduced and larger investments in research and development are made. Firms at this stage tend to be seen as science based because of heavy investments in research and engineering departments, emphasis on process innovation and product differentiation through functional improvements. Continued evolution sees the firm developing process equipment innovations and integrated production systems are introduced. Major process equipment at this stage is likely to originate from outside the firm.

Interesting is the Utterback and Abernathy's observations that as products and processes become completely standardised, methods of coordination and control change particularly in the way a firm handles and processes information. Information systems are developed and project groups may evolve into formal planning groups. The structure of the organisation itself may become more formal with a greater number of levels of authority.

The main prediction of the model is that as the firm or unit matures through different stages, the type of innovation will differ in response to different stimuli. In addition there will be different barriers to innovation or development at different stages which

must be overcome if transition to systematic standardised production is to be achieved. A model such as the above is useful in its interpretation of innovation in the dynamic development of the firm.

Business research in general has recently turned its attention to two aspects of business activity which previously tended to be glossed over if mentioned at all, those are, relationships, and the role of external linkages in business activity. Generally, as discussed elsewhere in this thesis, boundaries between business units have become less distinct and a number of new organisational forms are emerging which have also had some impact on the generally held perspective of innovation as an intra-firm activity. Rothwell (1991, 1993) and others have emphasised the importance of external technology in the success and development of NTBFs and there is a growing body of literature on innovation networks (Biemens, 1992; Wissema and Euser, 1991; Shaw, 1991), see Chapter 5. Research on strategic alliances has shown that R&D and other forms of technical links are frequently characteristics of this type of cooperation. Forrest (1991, 1989) in her PhD thesis and a paper on strategic alliances and innovation processes in new biotechnology firms, developed a linear-sequential model of innovation in such firms. This model portrays innovation in the typical research -> manufacture -> marketing chronology, but as a substantial step forward in the understanding of this process she identifies possible linkages, with various external bodies at different stages in the process (Box 3.10).



Box 3.10. Strategic Alliances and The Process of Innovation in the New Biotechnology Industry. NBFS, new biotechnology firms.

The model however as its predecessors, is still limited by its concentration on innovation within the focal firm, possibilities for changes in ownership through merger or acquisition are not acknowledged although the possibility of technology transfer at given points in the process is. In the same vein, there is an implicit assumption that firms progress through the three main stages and the possibility that firms may specialise on specific stages in the innovation process preferring to transfer technology contractually at appropriate stages is not addressed. Another criticism is that the model does not take parallel processes into account and ignores the possibility of integrated functional linkages between firms. The model is however useful in its identification of the types of strategic links at specific points in the process.

Implications for Small Firms

During the last 20 years there has been increasing interest in the role played by SMEs, particularly NTBFs, in the innovation process and the national economies in which they operate (OECD, 1992, 1993). The environment in which such firms operate has become more competitive and turbulent, life cycles of technology have shortened and there is a race to develop new technologies. Such changes, together with economic recession and rising costs of R&D and technical development have resulted in firms forming both horizontal and vertical alliances, networks of external linkages, and partnerships of various kinds with other firms and institutions.

These changes have led Rothwell (1993) to suggest that leading edge innovators have adopted a new style of innovation which he has called the 5th Generation or 5G innovation process. The previous four generations correspond roughly with Forrest's (1991) 2nd and 3rd categories of innovation process models, as follows:

- 1G the technology push argument
- 2G the need - pull argument
- 3G innovation as a techno-market coupling process
- 4G the shift from the perception of innovation as a sequential process to one which sees it as a parallel process. (Rothwell 1993, p3).

Citing evidence of the increase during the 80s in the number of horizontal strategic alliances and R&D consortia, and a change in vertical relationships at the supplier interface towards the more strategic and intimate. Demands for fast innovation in part facilitated by developments in IT, in Rothwell's view, have shifted leading edge innovations towards the 5G innovation process of which the key features are:

- integration
- flexibility
- networking
- parallel (real-time) information processing

The central feature of the 5G innovation process is the strategic fostering of external linkages and the forging of networks, together with systems integration, effective use of IT and linked CAD (computer-aided design) systems. Such a process requires strong linkages with leading edge customers and integration with primary suppliers.

Underlying the 5G process, Rothwell (1993, p13) has found specific strategic elements. These included a time-based strategy to speed up the product development process, a strong customer focus and focus on the development of quality and other non-price factors; *strategies for integration with primary suppliers and for horizontal technological collaboration*. There is also an emphasis on corporate flexibility, strategies for electronic data processing and policies for total quality control.

In order that such strategies may be developed and implemented, Rothwell (1993, p13) indicates a number of features necessary. The first is that there should be greater overall organisational and systems integration including integrated (cross-functional) development processes, early involvement of both suppliers and leading-edge users in product development and the establishment of horizontal technological collaboration. Other conditions include flatter and more flexible organisational structures to facilitate rapid and effective decision-making, fully developed internal data-bases and effective data links.

Rothwell suggests that because of the high costs involved in shifting to 5G type innovation systems, it is likely to be mainly large firms which will make the move. This suggestion he admits however, is based on available literature which to date is scant, and what does exist tends to focus on large firms. There is evidence in the network literature that small firms are involved in networked or collaborative R&D, although the focus tends to be more on the structure of the network than on the innovation process itself (see Chapter 5). Emergence of EU and national technology programmes requiring co-operation may also influence a shift to integrated and networked firms in innovation (see section on technology policy below).

Innovation models have developed and improved over time, evolving from simplistic linear, black box type models to much more complex representations of reality.

Innovation itself has changed over time with the trend currently for specialisation by individual firms within networks of intimately and strategically linked firms. Models such as Abernathy and Utterback's and Forrest's have to some extent become superseded by theoretical models which recognise innovation as a process which is increasingly taking place amongst a network of independent firms. While Utterback and Abernathy's model of firm development from radical innovation through to standardised production systems may still be true of the evolution of some firms, others may stay at the leading edge of innovation while production systems and manufacturing processes are established and developed in others. General purpose models have limited value in explaining or predicting processes as complex and dynamic as innovation, but provide useful frameworks for planning and analysis. No one model discussed above is entirely suitable for this thesis, but aspects of Utterback and Abernathy, Rothwell and Chesnais models contain useful concepts and representation.

Innovation and Technology Transfer

The review of innovation process literature revealed that although innovation is recognised as fundamental to a firm's growth, very few models attempt to link the innovation process with the growth of the firm. The chronological approach taken in the above review, and Rothwell's historical account of corporate strategy and technological processes indicate that while the process of innovation has become more complex, involving partners, external links, interdisciplinary knowledge and access to a wider range of resources, understanding of the processes has also evolved. The most recent innovation models reviewed here (Forrest, 1991; and Rothwell, 1993) indicate that innovation, far from being a process confined to the boundaries of the firm, may require extensive links with the external environment and may involve both inter- and intra- organisational technology transfers at various stages in the innovation chain.

These recent developments in the understanding of innovation process bring this literature closer to another body of work usually classified as technology transfer. Use of the term technology transfer differs but in general this literature encompasses the transfer of technology between firms, and between firms and other public and private organisations, between countries and includes work on intellectual property rights and modes of technology transfer. Much of the recent discussions of technology transfer within and between firms, especially MNEs, is grounded in the theory of the firm, and in particular, the transaction cost approach (see Chapter 2) and the internalisation approach to the explanation of the MNE and FDI (see Chapter 4).

Transfer Between Small and Large Firms

Williamson (1975) attempted to explain technology transfer using the organisational and market failures argument to support his contention (Williamson, 1975, pp197-207). Recognising that the innovation process is not merely invention but a series of stages culminating in commercial production and distribution he divides the process into three stages: 1). invention, 2). development and 3). supply. From the transaction cost perspective the question is whether the entire innovation process can be internalised. Since not All firms will have the capabilities and assets necessary for the full range of processes involved in innovation, Williamson suggests that there should be a technology transfer process which allows firms to specialise in particular parts of the process in which they have competence. The question then becomes one of which parts of the process should be 'externalised' rather than whether the entire process should be internalised. Casson (1992) developed these ideas in a paper on developments of internalisation theory (discussed in Chapter 4).

From Williamson's perspective, technology transfer may occur where small firms "by chance stumble on an innovation", and lack the capability to complete it, or may be due to organisational failures. Large firms, he suggests, are disadvantaged in the development and invention stage of innovation due to inflexible structures, bureaucratic decision making and lack of reward systems for entrepreneurial research. Small firms on the other hand he sees as disadvantaged at the later stages due to market failures, i.e. the inability of small autonomous firms to share information effectively in the open market. He therefore suggested that technology be transferred from small to large firms for marketing and distribution, through licensing or merger.

The transaction cost approach is limited to a dichotomous solution largely because of its assumption of "opportunistic behaviour", which could be particularly problematic in the case of radically new technologies and small firms (with little market power). The problems are effectively presented by Dugger (1983, p10):

"It is very difficult to strike an acceptable bargain for transferring new technology between opportunistic parties. An opportunistic receiver will insist on having new technology demonstrated before offering an acceptable price. But if the demonstration is performed, the receiver will not have to buy the new technology because the duped seller has shown it free. On the other hand, an opportunistic seller will misrepresent the value of new technology to the buyer and refuse a demonstration. The buyer must either take the risk and pay for an unknown and untested technology or walk away from the transaction. These transaction

difficulties are overcome by the direct investment of a multinational corporation".

Small Firm Hurdles in Technology Transfer

A number of problems for small firms emerge from the above quotation:

- the difficulty of attracting funding for a buyer of radically new technologies (discussed in the section on funding above),
- the threat of loss of technological advantage where knowledge cannot be protected,
- the threat of loss of autonomy where the small firm is absorbed for its innovatory ability.

Picking up the second point, successful transfer of technology through licensing, exporting or other formal or informal modes such as contract-out R&D or contract manufacturing, may depend on the firm having patent design or copyright protection and the willingness and ability to defend their intellectual property rights (IPRs), (Young et al., 1989). Patents are rights given by governments to individuals or organisations which effectively exclude other parties from making, using or selling an invention for a period of up to 20 years. The patent covers the technological or scientific content of the invention while trade-marks, design registration, and copyright cover the software and tend to be renewable, whereas patents are not, and often cover shorter time periods. Generally speaking there is no international patent, although in Europe, patents filed under the European Patent Convention (EPC, 1977) are protected in all countries party to the agreement. The Patent Cooperation Treaty (PCT, 1978) gives the applicant priority for a period of 12 months, but subsequent registration must then be made in individual countries. While legal protection for IPRs is not a necessary condition for licensing deals or other forms of technology transfer, they are advisable if the firm wishes to make a long term gain from proprietary technology. Patent protection can be quite expensive.

Carstairs and Welch (1981) estimated the cost of protecting IPRs as being around 25% of the total costs of establishing an overseas licensing arrangement. In addition to registration costs, patents incur a maintenance cost which small firms may find onerous. Another problem for small firms is that the onus is on the holder of the patent to prove infringement, which could result in expensive litigation beyond the means of a small firm, especially where the offending party is a very large powerful firm or where the infringement takes place overseas requiring litigation in foreign courts.

Transfer Through Cooperation

Stages in the innovation chain have been used by Chesnais (1988) to categorise technical cooperation agreements between firms in Europe. The study, focusing on inter-firm cooperation rather than innovation per se, showed that arrangements vary considerably in variety and range. Arrangements were found to take place between firms, or between firms and other institutions at various points in the R&D to marketing and distribution spectrum of activity, or to cover part of, or even the entire process (Chesnais, 1988; OECD, 1992). The table produced by Chesnais (Table 3.3) indicates that cooperation and potentially technology transfer may take place at the pre-competitive stage involving research and development, or the competitive stage, involving technological, manufacturing or marketing cooperation.

Table 3.3
Inter-Firm Research, Technology And Manufacturing Co-Operation Agreements And The R&D, Production And Marketing Spectrum

PRE-COMPETITIVE STAGE			COMPETITIVE STAGE					
Research and development co-operation		Technological co-operation			Manufacturing and/or marketing cooperation			
A	B	C	D	E	F	G	H	I
University based co-operation research financed by associated firms (with or without public support)	Government-industry co-operative R&D projects with universities and public research institute involvement	Research and development corporations on a private joint-venture basis	Corporate venture capital in small high-tech firms (by one or by several firms otherwise competitors)	Non-equity co-operative research and development agreements between two firms in selected areas	Technical agreements between firms concerning completed technology, <i>inter alia</i> : technology-sharing agreements; second-sourcing agreements; complex two-way licensing; cross-licensing in separate product markets	Industrial joint venture firms and comprehensive R&D, manufacturing and market consortia	Customer-supplier agreements, notably partnerships	One-way licensing and/or marketing agreements (including OEM sales agreements)
Many partners		Several partners	Few or very few partners			Few or very few partners		Few or very few partners

Source: Chesnais (1988)

Technology Transfer and Foreign Market Entry

One of the most important studies of technology transfer (Davidson and McFetridge, 1984, 1985) found close relationships between the mode of technology transfer and the characteristics of the technology of the parent firm and some demographic and geographic characteristics of the receiving country. Focusing on innovations rather than firms, their research aimed to determine factors which might determine whether technology is transferred internally, or through licensing.

Specifically, they found that internal technology transfer is more probable where the technology is newer, where the technology has had fewer previous transfers, where the technology is closely related to the transferor's principle line of business, where the transferor is R&D intensive, where the transferor has an affiliate in the receiving country and for transferors with more prior technology transfers (Davidson and McFetridge, 1985, p11-13). Surprisingly, their hypotheses relating to receiving country characteristics, especially economic variables, received mixed results; while literacy rates indicated a relationship with internalised transfer, public policies showed a weaker result and no relationship was found between transfer mode and receiving country economic characteristics.

The authors suggest that the corporate technology transfer activities of the firms in their sample conform closely to the behaviour patterns derived from the theory of the firm (see Chapter 2, and Chapter 4 on MNE development). Contrary to the predictions of international market strategy theorists (e.g. Root, 1987), receiving country factors seemed to have no impact on the entry mode (in this case, mode of technology transfer).

Davidson and McFetridge's study is important in this thesis as it represents a link between the three areas of literature explored in this thesis: small firms and growth, innovation and technology transfer, and international expansion. While the latter authors indicate the relationship between the theory of the firm and technology transfer mode, there is also a strong link here between technology transfer and modes of foreign market servicing. Much of the theory of the MNE and FDI is based on the principles of 'internalisation' and recently especially, emphasis has been placed on the transfer of 'knowledge as one of the core determinants of foreign market servicing mode.

Challenges for Small Technology-Based Firm Growth

Competitiveness and Growth

An OECD report on technology and competitiveness in relation to SMEs (OECD, 1993) suggests that the competitiveness of an SME depends on: the basic role of the owner/manager and in particular, his drive, intangible investment or intelligent management, including the ability to tap information through the explicit monitoring of technological, competitive and commercial developments, some R&D capability, the quality of the firm's information and the training of its staff. In addition, suitable investment in technological equipment together with innovation and flexibility are important in determining the firm's competitiveness. While technology is important, the report emphasises the SMEs inherent flexibility as its major trump card. (OECD, 1993, p7).

The report indicates that one of the most pressing problems for SMEs is that owner/managers frequently do not understand the parameters affecting their strategic decisions, particularly when these are concerned with new technologies (OECD, 1993, p8). In particular, SMEs face the following problems in attempting to develop internal R&D capacity:

- lack of time and staff to deal with available information,
- the cost of access to information (particularly controlled information),
- the limited ability of internal R&D to produce scientific and technological information or to adapt outside information to the firm's situation (OECD, 1993, p8).

Innovation and Firm Size Effects

As with small firms in general, it would be expected that the small size of firms would tend to limit expansion capability, especially in innovation of high technology products which might require expensive production processes and knowledge intensive inputs. A number of research studies have found that small firms are not completely disadvantaged in innovation. Acs and Audretsch (1988) identified a number of studies which suggested that large firms may hold certain advantages in innovation, for example Galbraith (1956) suggested that as innovation has a high fixed cost, only firms with substantial resources will be able to carry out the process. Similarly Kamien and Schwartz (1975) felt that at least temporary market power would be needed in order for

a firm to be successfully innovative. Nelson (1959) felt R&D to be too risky for small firms to be able to invest in a single product only, whilst Penrose (1959), Williamson (1975) and Scherer (1980) suggested that economies of scale in production, marketing and distribution would be necessary for new products. Bureaucracy, management structure and style in large firms however may render large firm environments inconducive to invention that is essentially entrepreneurial (Scherer, 1980; Pavitt et al., 1987).

In an important and much cited study of small and large firms in innovation, Rothwell and Zegveld (1982, 1985) found that their respective advantages and disadvantages tended to be complementary. While small firms had advantages which were largely behavioural in nature such as flexibility in management and structure, dynamic entrepreneurial management and the ability to respond rapidly to changes in the market, large firms' advantages were associated with financial and political muscle and economies of scale and scope (Table 3.4).

	Small Firms	Large Firms
Marketing	Ability to react quickly to keep abreast of fast changing market requirements. (market start-up abroad can be prohibitively costly)	Comprehensive distribution and servicing facilities. High degree of market power with existing products.
Management	Lack of bureaucracy. Dynamic, entrepreneurial managers react quickly to take advantage of new opportunities and are willing to accept risk.	Professional managers able to control complex organisations and establish corporate strategies. (Can suffer an excess bureaucracy. Often controlled by accountants who can be risk averse. Managers may become mere "administrators" who lack dynamism with respect to new long-term opportunities)
Internal Communication	Efficient and informal internal communication networks. Affords a fast response to internal problem solving; provides ability to reorganise rapidly to adapt to change in the internal environment.	(Internal communications often cumbersome: this can lead to slow reaction to external threats and opportunities.)
Qualified Technical Manpower	(Often lack suitably qualified technical specialists. Often unable to support a formal R&D effort on an appreciable scale.)	Ability to attract highly skilled technical specialists. Can support the establishment of a large R&D laboratory.

External Communication	(Often lack the time or resources to identify and use important external sources of scientific and technological expertise.)	Able to plug-in to external sources of scientific and technological expertise. Can afford library and information services. Can sub-contract R&D to specialist centres of expertise. Can buy crucial technical information and technology.
Finance	(Can experience great difficulty in attracting capital, especially risk capital. Innovation can represent a disproportionately large financial risk. Inability to spread risk over a portfolio of projects.)	Ability to borrow on capital market. Ability to spread risk over a portfolio of projects. Better able to fund diversification into new technologies and new markets.
Economies of Scale and the Systems Approach	(In some areas scale economies form substantial entry barriers to small firms. Inability to offer integrated product lines or systems.)	Ability to gain scale economies in R&D, production and marketing. Ability to offer a range of complementary products. Ability to bid for large turnkey projects.
Growth	(Can experience difficulty in acquiring external capital necessary for rapid growth. Entrepreneurial managers sometimes unable to cope with increasingly complex orgs.)	Ability to finance expansion of production base. Ability to fund growth via diversification and acquisition.
Patents	(Can experience problems in coping with the patent system. Cannot afford time or costs involved in patent litigation.)	Ability to employ patent specialists. Can afford to litigate to defend patents against infringement.
Government Regulations	(Often cannot cope with complex regulations. Unit costs of compliance for small firms often high.)	Ability to fund legal services to cope with complex regulatory requirements. Can spread regulatory costs. Able to fund R&D necessary for compliance.
Source: Rothwell and Zegveld (1985) as abstracted from Rothwell and Zegveld (1982)		

Similar complementarities were found in between the disadvantages of small and large firms in the innovation process, implying that the firms may best perform specialised roles in the innovation process. Acs and Audretsch (1988) in a classic study of innovation in small (< 500 employees) and large (> or = 500 employees) US manufacturing firms, found that there are differences between industries in the extent to which the innovation advantages of small firms are important as compared to those of large firms. They found that in most innovating industries, the science-based industries, small firms appeared to suffer no disadvantages vis-à-vis large firms. They did find however that while large firms were able to support their own R&D programmes, small firms were dependent on linkages with research universities.

Those authors felt that research universities were central to the growth, and the direction of growth of innovative small firms. There is considerable evidence that small

innovative firms do emerge around university or industrial research centres e.g. Silicon Valley, and Route 128 in the USA, Cambridge in England, Baden-Wurtemberg in Germany and Silicon Glen in Scotland (Rogers, 1986; Klick and Krupp, 1987; Keeble and Kelly, 1988; Keeble, 1994) (see also the section on foundation processes above).

Flexible Specialisation and Location Effects

Recent research has indicated that small high technology firms operating in areas around research universities, MNEs and public institutions involved in R&D tend to be both flexible and specialised in their activities (Piore and Sabel, 1984; Florida and Kenney, 1990; Hirst and Zeitlin, 1991; Garnsey et al., 1994). Piore and Sabel (1984) used the term 'flexible specialisation' to describe districts in Italy where small firms form a closely linked network of local firms.

Within these networks a wide range of products for local and foreign markets were produced and continually altered to meet changing market opportunities. There was also "flexible use of increasingly productive, widely applicable technology" and local authorities actively balanced cooperation and competition amongst firms to encourage innovation (Piore and Sabel, 1984, p29). At firm level, Garnsey et al. (1994, p84) argue that firms which could be described as being involved in flexible specialisation tend to be characterised by "continual innovative change in products and services, the opening of new markets, the use of new and flexible technologies and highly specialised areas of activity", but that these characteristics vary and are sector specific.

Taking "flexible specialisation" to refer to firms at a specific stage in the production value chain (i.e. without vertical integration) these authors found high technology firms in the Cambridge area to be highly specialised in terms of the scope of their activity, industrial sector and stage in the production cycle. They were found to operate in niche markets, providing differentiated products and services (Pratten, 1991), specifically to reduce the number of competitors. Evidence from earlier reports (Segal, Quince and Wickstead, 1985; IRDAC, 1987) found firms in this and similar areas across Europe, as well as being specialised, tend to be involved in leading edge technologies, are export oriented and have strong global connections with USA and Japan. In short, Garnsey et al. (1994, p84) suggest that such small firms are potentially very attractive to companies seeking small innovative firms to acquire.

Acquisition, often seen as a threat to small firm owner/managers is a risk which they may have to take as the latter authors indicate strongly that more mutual interaction between smaller and larger firms and private and public sectors is needed to fulfil the industrial potential of new technology based industry in Europe. This theme is

common to a number of current and planned EU innovation programmes and policy initiatives discussed later in this chapter.

A Growth Paradox: Resource Dependence Perspectives

Small high technology firms may find themselves in a situation where their highly differentiated and specialised niche markets are global rather than local, forcing very small young firms to internationalise very quickly. Garnsey and Wilkinson (1994) caution that small firms collaborating in complex global joint ventures may find themselves locked into exclusive relationships with manufacturing and customer firms. This situation they suggest could result in diseconomies of scope in the development of new technologies. Manufacturing alliances, they warn, may actually prevent small firms from developing important technological competencies.

From the perspective of small firm growth this presents a paradox; links with large firms may be essential to provide the resources, know-how and established business and marketing systems to facilitate technology transfer and growth, while on the other hand, specialisation and links with large firms create dependencies which could stifle growth and present the risk of acquisition. Returning to the innovation process models presented earlier in this chapter, separation and division of the innovation process amongst firms could result in rigid and inflexible networks of highly specialised firms, each individually locked in and hence limited in opportunities for sustained individual growth.

Despite these potential hazards, there is sufficient evidence discussed earlier in this chapter and throughout this thesis which supports a broad division between early stage innovation (particularly suited to small firms) and the later stages of production, marketing and distribution better suited to large firms with more extensive resource bases and established production and marketing systems. From a policy perspective, links with global giants may be attractive where they represent an inflow of technology, financial and other investments but the imbalance of power between small firms and such partners could result in takeover, an inefficient transfer of technology from the small firm at early stages in its production.

Policy Perspectives

UK Technology Policy and SMEs

Chapter 2 discussed some of the main policy initiatives, including specific technology initiatives, which are likely to impact upon small firm development and growth.

Dodgson and Rothwell (1988) reviewed the development of small firm research and technology development (RTD) policy from its roots in the early 1950s. At that time policy initiatives emerged in two separate tracks, science policy and innovation policy, a division which was common across Europe (Rothwell and Zegveld, 1985; Rothwell, 1987; Rothwell and Dodgson, 1991). Science policy in the 50s and 60s was concerned for the most part with 'big science' such as astronomy, atomic energy and particle physics and tended to emphasise large firms, and especially national "flagship" companies (Dodgson and Rothwell, 1988, p232; Rothwell and Dodgson, 1992, p227). The emphasis of RTD policy shifted during the 1970s towards small firms and concentrated on providing grants for innovation.

The 1980s saw an intensification of the focus on small firms and, in particular, policy initiatives were directed towards the start-up of new technology-based firms. The increase in the number of NTBFs in existence during this period was 'explosive', with an estimated 7000 having been set up between 1970 and 1985 compared to 200 between 1950 and 1975 (Segal, Quince and Wickstead, 1986). The main thrust of UK RTD policy has been to provide a supporting infrastructure for small technology based firms and has involved deregulation (see discussion, Chapter 2), and indirect measures such as greater emphasis on science and technology education, technical knowledge and manpower, the R&D environment and financial resources (Dodgson and Rothwell, 1988, p232). A major imperative has been the development of the venture capital industry through the establishment of the Loan Guarantee Scheme (LGS) and the Business Expansion Scheme (BES) discussed in the previous chapter. In addition, the venture capital industry was boosted by the 1980 establishment of the Unlisted Securities Market (USM). The USM was intended to assist in the growth of innovative firms by allowing companies to be quoted with a three year rather than a five year trading record, with 10% rather than 25% equity, and no requirement for full accountant's reports. This effective deregulation of the securities market aimed to provide the much needed venture capital to support the development of innovating firms.

Cooksey (1988, pp142-143) listed key policy measures, which were intended to support and stimulate NTBF formation, as changes which will affect firstly the NTBF founder, and secondly, the investor.

Measures intended to benefit the NTBF itself included: "reduction of personal maximum tax rates from 98% to 60% including removal of the investment income surcharge, introduction of stock incentive schemes for management where the profits are taxed as capital gains, allowance of losses due to failure of a business against

personal income for tax purposes, the provision of government guaranteed bank loans to help provide early (near-equity) finance, removal of many restrictive labour laws which inhibit recruitment, reduction of corporate tax from 52% to 35% and to 30% for small companies, removal of the National Research Development Corporation's (now British Technology Group) rights to government-sponsored research which will increase the flow of innovation to the market place." (Cooksey, 1988, pp142-143).

Measures intended to stimulate investment in NTBFs included: "-The Business Expansion Scheme which allows tax deduction for the investment of NTBFs by individuals. This relief has now been extended from trading companies to research and development companies (see also Chapter 2), the emergence of the Unlisted Securities Market as an active secondary market for NTBF company shares, the emergence of a venture capital management industry." (Cooksey, 1988, pp142-143), (see also section on funding, above).

Initiatives concerned directly with the support of small innovating firms, such as SFI, Link, SMART and the Science Park Scheme have been listed in Chapter 2 as examples of policy initiatives emphasising SMEs, other relevant initiatives are more directly concerned with technology transfer (See Table 3.5).

Table 3.5 Technology Transfer Initiatives for SMEs in the UK		
Name	Imple-mented	Main Provision
Manufacturing Advisory Service (MAS)	1977	Provided subsidised consultancy on manufacturing problems. Eligibility gradually changed from firms of 100-1000 employees to firms of 1-500 employees in 1985.
Design Advisory Service Funded Consultancy Scheme (DASFCS)	1977	To assist manufacturers to improve the design of new and existing products and encourage the use of external specialists.
Small Firms Technical Enquiry Service (SFTES).	1977	To provide assistance relating to manufacturing techniques to manufacturing units of 1-200 employees.
The Microelectronics Application Project (MAP)	1978	To provide a microelectronics information centre, provide support for feasibility studies and financial assistance for product or process development.

Source: These examples summarised from Dodgson and Rothwell (1988, pp238-244). See this article for full discussion of the relative success and take-up rates of these and other technology transfer schemes.

The above schemes were rationalised under the DTI in 1985 into the four main areas already discussed in Chapter 2, namely:

- Business and Technical Advisory Services,
- Support for Innovation.
- Support for National and Regional Investment,
- Support for Exports.

As with other small firm initiatives the onus of support for innovation has tended to shift from central government to regional government, and as with other schemes, is likely to be regionally divisive. Dodgson and Rothwell (1988) claim that meaningful innovation policy in the UK has only emerged towards the end of the 1980s, and while grants and awards for innovation are available under a number of schemes, the trend in general has been towards the establishment of a supportive infrastructure and away from direct project based assistance. During the early 1990s, the UK government policy on innovation has aligned itself more closely to European technology policy which emphasises collaboration between firms, universities and public research laboratories to speed up the innovation and technology transfer processes. The 1994 UK Government Competitiveness White Paper makes specific reference to initiatives and actions intended to strengthen awareness and links with EU technology programmes (see also Chapter 2).

European Technology Policy for SMEs and Technology Transfer

UK policy towards innovation, despite coordination under the DTI, has tended to be fragmentary and has been criticised for its failure to address the entire innovation process as relevant to SMEs. Oakey (1991) suggests that a possible policy response to an environment difficult for small firm expansion is to offer "proactive assistance--- throughout the complete innovation cycle from the original programme of R&D, through production to the marketing of the final product" (Oakey, 1991, p41). This approach is reflected to some extent in the structure of the EU technology policy programmes and initiatives.

The European Community has initiated a number of policies designed to improve the competitiveness of European technology by attempting to harness and develop the innovative capabilities of SMEs. The OECD 1993 report identifies the three phases of the programme as:

- Phase 1: The formulation of research projects;
- Phase 2: Research and Technological development;
- Phase 3: Exploitation of results of RTD. (p115).

Phase 1 and Phase 2 are considered to be pre-competitive stages and although these stages represent the smallest number of SMEs, considerable support is available through various EU programmes. Stage 3 is the industrial application phase, i.e. production and marketing, and as this stage usually takes the form of product development and affects the competitiveness of individual firms, the EU provides less support and what is available is very specific in nature. The Framework programmes of the EU which are concerned with RTD, have established a number of programmes targeted at SMEs at each of the three RTD phases.

Phase 1

The pilot scheme under the Brite / Euram programme may provide financing of up to 75% of research costs involved in establishing the feasibility of an RTD project. The maximum funding available under this scheme is ECU 25 000 over a period of six months. More recently the EU has focused its attention on the establishment of a Europe-wide infrastructure to facilitate and support feasibility awards for proposals under certain industrial RTD programmes. One such measure is the CORDIS information search facility which amongst other services provides for the dissemination of research results, information on calls for proposals and a partner search facility. In conjunction with Relay Centres, CORDIS provides a Europe-wide network of contacts and research links into which small firms may link.

Phase 2

There are a number of initiatives available under Phase 2 for example, ESPRIT clubs. Support at this phase is characterised by the fact that it is based on shared-cost criteria. Funds are awarded to SMEs involved in active research partnership with larger firms, research centres or other small and medium sized firms. In addition to existing RTD programmes, the Commission has begun to address the problem of SMEs in research and technology by stimulating cooperation between large firms and SMEs in order to draw more SMEs into large research projects which have typically received project money. In addition, more attention is paid to the evaluation of small research projects and proposals (OECD, P117). For example, the launch of support measures such as GRAFT, which aims to link SMEs sharing a common technical problem, with institutions equipped with research facilities or capabilities.

Phase 3

The aim of third phase programmes is to create a supportive infrastructure for the successful transfer of research results rather than the support of actual product development. Typical of this type of programme is the VALUE programme designed to aid and support the dissemination and exploitation of research results from the 2nd Framework programme. A similar programme which gives preference to projects from SMEs is the THERMIE programme which is concerned with the promotion and dissemination of new technologies in the field of energy. STRIDE on the other hand, is a programme devised to improve the innovation and RTD capabilities in least-favoured regions of the EU. This is done through the provision of information and by strengthening cooperation networks within the Community. Under this programme, cooperation between research centres and firms is encouraged. In addition to initiatives such as CORDIS and the Relay Centre network through which results may be disseminated, efforts have been made to stimulate the transfer of technology. To stimulate technology transfer, efforts have been made to link sponsors of technological innovation projects with venture capital companies in an attempt to establish private investor clubs to finance projects with good prospects but which would not ordinarily receive funding through RTD programmes.

A Stage 3 programme which has gone through a number of stages of development and evolution is the SPRINT (Strategic Programme for Innovation and Technology Transfer, 1989-93). This programme, one of very few designed to support firms at the competitive stage of RTD, operates through the establishment of networks of science and technology organisations which, through transnational technology cooperation, promote technology transfer and the uptake of specific new technologies. Under this scheme, technology transfer is stimulated through technology transfer networks, technology transfer days, innovation management support and finance for innovation. Regional Technology Advisory Centres have been established, as have science parks and consultancy schemes.

The EU Green Paper 1996

Lack of coordination between innovation policies and other economic policies has been recognised at both national and European level and concern continues to be expressed concerning the innovation gap between Europe, Japan and the US. In response, the EU launched a Green Paper on Innovation (December 20th, 1995) to stimulate Europe-wide debate on potential European Innovation policy. The main concern was the declining performance of Europe which is significantly behind that of Japan and the US in expenditure on RTD, the number of research scientists in employment, and output in

manufacturing. These gaps are reported to have increased steadily since the early 1980s⁷ ⁸. One of the fundamental problems recognised in Europe was an unsustainable process of technology transfer. While scientific research was seen as strong in Europe, research results were not being converted into "competitive advantage".

Discussions resulted in a 35-point resolution from the European Parliament which covered: the dissemination and exploitation of R&D results, the monitoring of R&D, economic and financial considerations, administrative and legal constraints, social educational and training aspects, innovation task forces and the encouragement of SME innovation. While all of these factors have implications for small firms and innovation, discussion specific to SME innovation is most relevant here.

Table 3.6 EU Resolution on Innovation 1996: Encouragement for SME Innovation

- support for innovation at regional level and programmes to encourage SMEs to cooperate with universities, industrial research centres, and large enterprises,
- attention to be paid to the role of intermediary organisations such as banks, consultants, marketing cooperatives and technical colleges in helping small firms,
- Structural Funds to be oriented towards innovation,
- recognition that SMEs are not a homogeneous group - policy should respect their differences and be targeted on the basis of size and sector,
- help for SMEs to reduce the financial risks of innovation.

Source: Abstracted from European Commission Innovation Programme (1996) *Innovation and Technology Transfer*, 4, p6.

Discussion of the Green Paper revealed not only differences in levels of support for innovation across Europe, but also differences in opinion as to how innovation should be supported. Concrete results are expected to include better access to and use of technologies through schemes for information dissemination, better access to risk capital and simpler rules for company start-up and for patenting. Particular attention is likely to be paid to the patenting system which was widely seen as a process too expensive to benefit SMEs. The Irish seminar reported emphatically that:

"Patents are too expensive for SMEs to defend against companies which could be half the size of Ireland".

⁷European Commission Innovation Programme (1996) "European Commission Launches Green Paper on Innovation", special Issue of *Innovation and Technology Transfer*, February.

⁸European Commission Innovation Programme (1996) "Trends in Transport", *Innovation and Technology Transfer*, 4, July.

Coordination of national and European policies on research under the current Framework programme is to continue.

Conclusions and Implications

This chapter has examined small high technology and new technology based firms as specific types of small firms. It was determined that while such firms face similar barriers to growth as small firms in general, there are differences based on the characteristics of founders, attitudes and motivations towards growth, the extent and types of funding required and the nature and characteristics of technology itself. In general, it was found that high technology and specifically new technology based firms tend to experience more rapid growth rates and internationalise earlier than small firms in general. Problems faced by technology intensive firms were frequently found to be related to technology issues and the process of innovation.

It was determined that the growth of small firms may be associated with technology processes within the firm itself, such as innovation and new product development, but that equally, the firm may play a small part in the R&D -> production -> marketing value chain. Examination of models of the innovation process revealed an evolution from simple internal step-stage models to complex models incorporating multi-stage, multi-functional and sometimes multi-firm involvement. While understanding of the innovation process has clearly grown and developed over time, Rothwell (1993) has stated explicitly that the innovation process itself has evolved over time and the mid 1990s has moved toward a complex process involving significant collaboration, alliances and networking amongst firms.

In relation to the aims of this thesis, the generic R&D -> production -> marketing and distribution process is probably of more importance and practical usefulness than the very detailed and specific models of the innovation process reviewed in this chapter.

Emerging fairly strongly from the review is the oft repeated view that small technology based firms are limited or inhibited in their growth prospects due to resource constraints. This view has given rise to a number of different perspectives on the problems facing small firms:

- that they may be reliant on externally held resources for continued growth after the initial development stages of the firm and its technology,

- that small firms might concentrate on the early stages of the innovation process and transfer their technology to larger firms for production, marketing and distribution,
- that small firms may collaborate with other firms, universities, government research laboratories etc. to access knowledge and resources otherwise beyond their means,
- that small firms in knowledge intensive technologies may choose to specialise in a particular value chain activity where their technologies have wide applicability.

Overall these views and perspectives suggest that small firms in high technologies are likely to be *network intensive*, heavily reliant on external resources, industry structures and infrastructural arrangements and facilities. It is also clear that such firms may not experience *growth* as an increase in firm size so much as a development of the firm's expertise, technological and geographical scope. The emphasis that both UK and EU technology initiatives have put on inter-firm and particularly cross-border collaboration at the R&D end of the innovation process is likely to have had at least an indirect influence on the cross-border expansion of small technology based firms.

In terms of innovation and technology transfer, the general view seems to be that small firms are not so much disadvantaged in comparison to large firms, but rather have advantages that are particularly suited to specific activities in the value chain. In general the suggestion seems to be that small and large firms are likely to play complementary roles in the innovation and technology transfer processes.

Evidence was reviewed in the chapter which suggests that small firms in high technology sectors have recognised, and are capitalising on their specific advantages and capabilities. Such firms, particularly in the Cambridge area, have been found to practice *flexible specialisation* focusing on activities within a narrow band of the R&D - > marketing continuum but on technologies with wide applicability. The extent to which this type of arrangement is extended through overseas contacts and links is of particular interest to this researcher and is a theme returned to throughout this thesis.

Emerging from the literature in this chapter is the classic Davidson and McFetridge (1985) study on the choice of technology transfer mode in international business. The study is seen here as providing a particularly important bridge between the process of growth and development through technology, and through international expansion. Specifically, the latter authors determined that the choice of technology transfer mode was associated, in their study, more closely with the technology itself and the firms' previous experience in technology transfer than with host country factors.

Finally, the literature reviewed in this chapter suggests that while small technology intensive firms face additional problems in relation to growth than do small firms in general, they are never the less more likely to experience faster growth rates and earlier internationalisation than other small firms.

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Chapter 4

The Process Of International Expansion

Chapter Objectives

- *To present and review a cross-disciplinary literature with specific focus on the international growth and expansion of the firm.*
- *To evaluate the contribution of alternative theoretical approaches to the international expansion of the firm beginning with 'classic' contributions.*
- *To discuss recent integrations of theoretical perspectives with particular reference to small and/or technology based firms.*
- *To place the literature on small firm internationalisation, into the context of firm growth and development and assess its adequacy in respect of the latter.*

The Process of International Expansion

Introduction

Continuing the theme of firm growth and development, this chapter discusses the main issues involved in the international growth and expansion of firms. The chapter begins with a discussion of *internationalisation*, a term which aptly depicts a process of increasing involvement in, or exposure to international business. The same term has, in much of the literature, become associated with the incremental step/stage approach to export development, a process which has implicitly and sometimes explicitly been associated with the international growth and development of small firms.

Following the discussion of internationalisation, the chapter reviews theory based contributions to the international growth and expansion of firms. In the review, three main disciplinary areas are explored, economic approaches, process approaches which have emerged in the main from marketing and distribution studies, and network approaches which, trace roots back, in the main to behavioural schools of thought. The chapter first presents some of the core or classic studies in the above three disciplinary areas and following a critical evaluation, discusses recent integrative approaches and new perspectives relevant to the thesis.

Concluding that while there is relevance in a number of theoretical approaches for small firm international expansion, the specific issues and concerns of small firms expanding internationally are seldom addressed in theory based literature. The last section of the chapter attempts to synthesise a hugely diverse and fragmented literature on small firm internationalisation. It concludes that while specific issues such as the performance, characteristics and behaviour of small exporting firms have received considerable attention, the international expansion of small firms as a holistic process, with a range of possibilities in terms of direction, scope and form of cross-border activity has been largely neglected.

Theoretical Approaches and Analytical Frameworks

The Nature of Internationalisation

Internationalisation is a term often used in the literature with the implicit assumption of understanding on the part of the reader and is seldom clearly or succinctly defined. Welch and Luostarinen (1988) suggested that the term tends to be used in a very broad sense to describe "the outward movement in an individual firm's or larger grouping's international operations". A number of theorists (Bilkey and Tesar, 1977; Cavusgil, 1984; Johanson and Vahlne, 1977) have suggested that internationalisation is a process of increasing involvement in international operations by incremental steps. Casson (1992, p12) portrays internationalisation as the international expansion of the firm which he suggests is only one of several aspects of corporate growth. Internationalisation also has inward and outward components (Welch and Luostarinen, 1988, p36) as evidenced by studies of inward and outward investment, acknowledgement of the role played by unsolicited orders from overseas in stimulating export, and the two way, international buyer-seller interaction of the network approach.

The treatment of internationalisation in the literature tends to reflect the level of analysis and the background interests of the researcher. Economists tend to see internationalisation as a process of corporate or industry growth and such work emphasises the transfer of production activity across borders. Economic studies of internationalisation therefore tend to revolve around the development of the multinational enterprise (MNE)¹, and patterns, processes and strategies for foreign direct investment (FDI). Important for this thesis is the development of domestically based, small and medium-sized firms into firms with multinational involvement. Although much work has been done by economists on the development of the MNE, Buckley (1983) noted that the transitional phase whereby an SME becomes an MNE has received little attention in the literature "--this development from naive entrant to established multinational has been inadequately modelled and its implications for theory are as yet unassimilated" (Buckley, 1983, p48). In the early 1990s, Coviello and Munro (1992) suggested that there was still a major gap in the literature on the international development of small firms. An aim of this thesis is to go some way towards filling that gap by providing empirical evidence on the international expansion of small technology intensive firms.

¹ A general working definition of the multinational enterprise (MNE) has been advanced by Hood and Young, 1979 as:

"A multinational enterprise is a corporation which owns (in whole or in part), controls and manages income generating assets in more than one country. In so doing it engages in international production, namely production across national boundaries financed by foreign direct investment".

Studies concerned with growth through market expansion have tended to focus on an incremental expansion process beginning with least risk trade through export and progressing to greater risk and investment modes such as joint ventures and the establishment of wholly owned subsidiaries (Cavusgil, 1984; Johanson and Vahlne, 1977). Under-lying such studies is an implicit preoccupation with market entry and the development of exports as the predominant motive for internationalisation, which as noted by Young et al. (1989, p268) is only one of a number of possible motivations for the development of international markets or the establishment of international production which include profit, competitive and strategic-oriented factors.

A number of network studies of internationalisation have emerged in recent years. Network approaches differ from process approaches in that the latter concentrate for the most part on export development, whereas the former, concerned with network processes, embrace entry market entry methods within the larger framework of network development. Network theorists have tended to view internationalisation as an organic growth process underlying which is the development of relationships between firms and individuals within business networks which ultimately expand into foreign countries as bonds are forged between buyers and sellers in different national nets. The assumption is that networks grow as knowledge is developed and firms attempt to change or develop their network positions internationally.

Internationalisation is a term which has also been applied to technologies which either have international applications or which are dependent on international inputs for their development. The role of technology in the international expansion process of firms has been recognised as a strong driver or stimulus in some technology dependent industries. Several authors have recently attempted to develop a technology theory of the multinational (Cantwell, 1992, 1989; Patel and Pavitt, 1992). Casson (1992, p12) suggests that the uniqueness of international expansion as compared to domestic growth may be demonstrated by emphasising the difference between technical and market know-how. Technical know-how, he suggests, is potentially universal in its geographic coverage whereas marketing know-how is not.

This introductory section has outlined not only some of the different uses of the term internationalisation, but also some of the perspectives on internationalisation from researchers in various fields. As a very brief overview, the section illustrates the diversity of approaches to internationalisation and growing interest in the topic, which

(p3). More recent definitions are discussed in the next section.

needs to be expanded to encompass the early stages of the process and implications for small firms.

In this thesis international expansion is taken as being a dynamic process during which the small firm may metamorphose into a large multinational enterprise. It aims to explore the transitional or chrysalis stage in firm development identified by Buckley (1983) as having been largely neglected in the literature. As such, contributions from a broad spectrum of international studies need to be reviewed for explanation. The first main section of this chapter reviews the contributions from the main disciplines and pertinent integrations of approaches and theories.

Economic Approaches to Internationalisation

Taking internationalisation as referring to an international expansion or growth process of the firm (Casson, 1992, p12), relevant literature may be found in economic theories of multinational enterprise and micro-economic theories of foreign production. The multinational enterprise (MNE) tends to conjure up images of immense, global spanning organisations whereas many MNEs are relatively small firms with limited international involvement. Here interest is in the international expansion of SMEs during which process such firms may become multinational as in the broad description employed by Hood and Young (1979, p3) as "--- a corporation which owns (in whole or in part), controls and manages income generating assets in more than one country". In the sense that multinational activity involves some kind of production activity financed by foreign direct investment, not all firms of interest in this study of international cooperation will be, or become multinational, or to have invested in sales subsidiaries. Some SMEs may effect market entry and technology transfer through arms-length trade or for example through collaborative distribution agreements and will not achieve the traditionally defined status of multinationality.

More recent definitions of the multinational enterprise are still focused very much on foreign direct investment as the qualifying criterion, for example Dunning (1993, p3) defines the MNE as "---an enterprise that engages in foreign direct investment (FDI) and owns or controls value adding activities in more than one country". Determining whether or not a firm is an MNE however is more difficult and Raghunathan and Chandran (1991) suggest that the point in a firm's development where it becomes a multinational is bound to be arbitrary. Czinkota et al. (1996) believe that the behaviour of the firm is the determining factor in whether or not it is multinational. In their opinion, to be considered a multinational, the firm's management must consider it to be multinational and must act accordingly. Synthesis of the literature on multinationality or

transnationality (Dunning, 1993) identified a number of criteria on which the extent of a firm's multinationality may be assessed. Paraphrasing from Dunning, these are:

1. The number and size of foreign subsidiaries or associates owned or controlled.
2. The number of countries in which the firm engages in value-adding activities.
3. The proportion of its global assets, revenue, income or employment accounted for by its foreign affiliates.
4. The extent to which its management or stock ownership is internationalised.
5. The extent to which its higher value activities, e.g. R&D are internationalised.
6. "The extent and pattern of the systemic advantages arising from its governance of, and influence over, a network of economic activities located in different countries".

This list is almost exclusively concerned with internalised activities and the "ownership" of foreign located assets. The possibility of a firm reaching multinational dimensions in terms of scope and influence over external links, e.g. trade links, licensing, franchising, non-equity cooperation and other contractual arrangements is given insufficient emphasis in the above list though Dunning (1993, p4) acknowledges that MNEs are increasingly involved in international networks where transactional relationships are as binding as internalised links.

Implications here are that small firms may eventually develop into large multinational firms whether through the "ownership" and "control" of value adding activities, or as recent thought suggests, through the formation and management of international networks of external links. Study of small firm internationalisation therefore needs to be rooted in theories and explanations of corporate growth and multinationality.

There is a rich and well developed literature on economic approaches to the study of multinational enterprise and foreign direct investment, which has been reviewed comprehensively by Cantwell (1991) in a review of theories of international production, and more recently by Dunning (1993) in a review of theory concerned with the development of the multinational enterprise. This research is focused very much at the level of the firm and is concerned with internationalisation as part of the corporate growth process. This conceptualisation forms the focus of the following review which

concentrates on theoretical developments in the understanding of the emergence and international expansion of MNEs.

The Market Imperfections Approach

A number of theories of multinational development and foreign production have arisen from recognition that the market is not perfect, as suggested in neo-classical economics, but is imperfect in a number of dimensions which affect the behaviour and strategy of firms. In a perfect market firms are decision-takers and the individual firm's strategic behaviour is like a black box since it is controlled by market forces (Dunning, 1993, p72). Market imperfections give rise to strategy which determines the competitiveness of firms. This basic assumption is of particular importance in this study of smaller technology intensive firms which may be operating in monopolistic markets or very narrowly defined market niches. It is therefore useful to discuss such approaches to international expansion.

Market imperfections may occur in both domestic and international markets. In goods markets, imperfections may arise from product differentiation, branding, marketing and management skills and price collusion. In factor markets, imperfections may arise from firms' managerial abilities, differences in access to capital markets and the use of patent protection for technology. More generally, market imperfections may occur due to internal and external economies of scale and government policies with regards to taxes, tariffs, interest rates, exchange rates and other policies such as incentives, subsidies and development grants (Caves, 1996; Buckley, 1995; Hood and Young, 1979). Such imperfections in markets, appropriately exploited by firms, provide the opportunity to "make" rather than "take" decisions and increase the relative power and control of individual firms in markets. Attempted explanation of such processes has been made from a number of theoretical standpoints, evolving from aspects of imperfect competition. The most relevant for this thesis are the market power approach, the internalisation approach and the eclectic approach, all of which are discussed in the following sections.

The Market Power Approach

The market power approach views the firm as a means by which producers increase the extent of their power in the market (Hymer, 1976). In this approach firms increase their share of the market through merger, collusion or capacity extension. This results in industry concentration and as the firm increases its power, it also increases its profits. International expansion occurs when concentration is such that the domestic market is dominated by a few firms and it becomes difficult to increase concentration further. Profits earned from monopoly power in the domestic market are invested in

foreign production where the process of industry concentration continues. This approach sees firms as forming collusive networks in order to reduce competition and increase barriers to entry in the industry. There is however a trade-off since monopoly power may, in the long-run, reduce the efficiency of foreign plants (Cantwell, 1991, p21). This approach is therefore contrary to alternative thought which proposes that the central objective of the firm is to raise its internal efficiency which it does in foreign operations through coordination of different types of plant and technology. Cantwell contends that greater internal efficiency will increase competition between multinationals making the division of markets between them more difficult and reducing profitability (Cantwell, 1991, p22).

This thesis is concerned with small (predominantly non-dominant) firms and therefore the market power approach is of limited value except as an explanation of market structure and the competitive forces faced by smaller firms. What is more important here is Sugden's (1987) explanation of internationalisation. This author advanced the contention that internationalisation occurs not only to strengthen market power but to raise profits in two ways. The first is vested in the firm's ability to shift production between alternative international locations which strengthens the bargaining power of firms vis-à-vis conditions of work and wage rates. The second, which is of interest here is the suggestion that contracting out work to a network of sub-contractors reduces the power of unions within the firm and therefore increases its market power to the extent that the subcontractors are dependent on the monopsonist buyer. This process of externalising activities is important to the extent that it increases the dependence of SMEs on large firms and may lead to specialisation in the industry. International expansion of the oligopolistic firm may draw its network of SME suppliers and sub-contractors into foreign markets. The inward implications of such a process are for example where a foreign investor begins a process of industry concentration in which local SMEs supply newly established local plants, and over time extend their activities to supplying the headquarters or other foreign subsidiaries of the investing MNE.

The Internalisation Approach

Internalisation approaches originated in early work by Coase (1937), later articulated in a popular exposition by Williamson (1975) as the Transaction Cost approach to organisation analysis and economic efficiency, which was not however extended by these authors into an explanation of multinationality. The transaction cost approach operates on the premise that information is costly and due to imperfections in the market, it may become economically rational for transactions to be performed internally within the boundaries of the firm rather than at arms-length through trade in the open market. The transaction costs incurred through open market exchange are, for example,

the costs of negotiating price, of seeking buyers or sellers, of formulating and enforcing the contract obligations and external intervention such as taxes imposed on the transaction by governments.

This is the essence of the transaction cost approach (see also chapter 2 and chapter 3) which attempts to explain organisational form through efficient handling of transactions. These are explained as taking place in the bi-polar structures of "market" wherein buyers and sellers have perfect knowledge and exchange is performed through contracting in the open market, and hierarchy. The hierarchy or integrated firm occurs where market imperfections make it economically more efficient to perform transactions within the firm rather than externally in the open market.

The transaction cost approach offered an explanation for vertical integration whereby transactions concerned with physically intermediate products in the value chain are internalised. It was less successful in explaining the external linkages of innovative firms and did not address the issue of multinationality (Casson, 1992, p9).

Internalisation as an explanation of the firm has been attributed to ideas advanced by Coase (1937), Penrose (1959), and Williamson (1975), and advanced as an explanation of the MNE by Buckley and Casson (1976, 1985). Simply put, where transactions take place across national boundaries and the cost of performing external transactions becomes sufficiently high, firms internalise these transactions and in so doing become multinational (Graham, 1992, p74). Buckley (1990) postulates that central to the internalisation approach is the firm which is seen as "an internalised bundle of resources" which may be allocated between product groups and between national markets. The international expansion of the firm is determined by its internalisation decisions which rest on the balance of costs versus benefits in each decision (Buckley and Casson, 1976, 1985; Buckley, 1983; Casson, 1987; Buckley, 1988, 1990).

Essentially internalisation is an explanation of the organisation of cross-border transactions of intermediate products in the value-chain within the hierarchy or firm rather than in the open market (Dunning, 1993, p74). The main proposition of the approach is that firms are likely to involve themselves in foreign production when the benefits of coordinating both domestic and foreign production are greater than those of contracting in the open market through trade or technology agreements. The main objective of the approach is to identify situations in which internalisation of markets across national boundaries is more likely than external transactions. Specifically, the choice is between export or licensing, and foreign production (i.e. cross-border trade or internalised production activities). There are similarities between the market power

approach and the internalisation approach in the sense that both stress the internalisation of markets but for different reasons. In the former approach this occurs to exclude competitors and the emphasis is on the resulting industry structure, whereas in the latter, the emphasis is on profit maximisation through efficient exchange of intermediate products and industry structure is of only secondary interest (Cantwell, 1991, p25).

Methods of servicing national markets are dealt with by Buckley and Casson (1979) in two dimensions, "ownership effects" and "location effects", which are used to explain and predict the form market servicing will take. Four main methods are listed:

1. by indigenous firms
2. by subsidiaries of MNEs located in the market
3. by exports to the market from foreign locally owned firms
4. by exports from foreign plants owned by MNEs.

The first two methods involve production in the national market whereas the second two involve production abroad (location effects). Ownership effects are demonstrated in the first and third methods where ownership and control is held by domestic nationals and by foreign nationals in the second and fourth. Foreign production will take place in preference to trade where imperfections in the market location may be influenced by ownership effects exercised by the firm. Predictions as to which of the above four methods of market servicing will be employed requires information on the following four variables:

1. *Industry specific factors:* the nature of the product, the structure of the external market and the relation between the optimal scales of the activities linked by the market;
2. *Region specific factors:* factor costs in different regions, intermediate and raw material availability, the geographical and social distance between the regions involved;
3. *Nation specific factors:* political and fiscal factors of the nations involved;
4. *Firm specific factors:* the ability of management to communicate internally across national borders and other complexities of international ownership. (Buckley and Casson, 1979).

As with the transaction cost approach, the main emphasis is on information, or in this instance, knowledge, which is seen not as an imperfection in the market, but as an exploitable asset when concentrated in the industry or firm. The internalisation of knowledge or other exploitable assets such as technology are what gives the MNE its

unique advantage (Caves, 1996; Buckley, 1995; Hood and Young, 1979). This treatment of knowledge as an exploitable asset is important as the main explanatory factor in the form of integration undertaken by the MNE and the extent to which backward and forward vertical integration across borders might take place in preference to trade. The internalisation of intermediate product flows leads to vertical integration. The internalisation of intangible flows of know-how, on the other hand, are discussed by Casson (1992, p5) as leading to a combination of vertical and horizontal integration. In the innovation process vertical integration takes place where R&D and production are internalised, but horizontal integration also takes place as information is disseminated sideways to a number of plants. The dissemination of knowledge in this respect explains horizontal integration through internalisation, but does not sufficiently explain external cooperation, licensing or new forms of international organisation. Later developments of the approach attempted explanation of such arrangements. One of the major criticisms levelled at the internalisation approach is that it does not take sufficient cognisance of location specific factors in the foreign market which may influence the nature and direction of FDI. Location specific factors were built into the Eclectic Paradigm (Dunning, 1980, 1988).

The Eclectic Paradigm

The eclectic paradigm attempts to draw together strands of trade and location theories with the internalisation approach. Dunning (1988) suggests that neo-technology and other modern theories of trade implicitly assume that goods are exchanged between independent buyers and sellers across national borders, whereas theories of international production explicitly state that intermediate products are transferred within the same enterprise. The former assume perfect competition whereas the latter assume that there are imperfections in the market which, as discussed above, may arise from government intervention, scale economies, product differentiation, branding and patent protection. Dunning's proposition from this is that without market failures there could be no reason for international production to take place. While he accepts the internalisation model in principle, he suggests that its logic is insufficient to explain foreign production without the integration of location specific factors (Dunning, 1988, p76).

The eclectic paradigm states that in order for a firm to become involved in international production three conditions must be satisfied. The first is that the firm possesses some ownership specific advantages (O), which may be either tangible assets such as product innovations, or intangible assets such as organisation or marketing systems, but that these advantages are not possessed by firms of other nationalities in the markets under consideration. If the first condition is satisfied, it must be to the firm's advantage to

internalise (I) the use of these assets or advantages, i.e. it must be more beneficial to the firm to utilise these resources across national borders itself than to sell the rights to them to other firms (trade v. foreign production decision). The final determining factor, assuming the other two conditions have been met, is that the variables in the foreign location, e.g. investment incentives, infrastructure provisions or centralisation of R&D, marketing or production confer advantages (L) in the setting up of production specifically in that location rather than elsewhere.

Comments on and Criticisms of Economic Approaches

Economic approaches to the international growth and expansion of firms, such as market power, political economy, market imperfections and internalisation, are subject to general criticism as being static, too narrow in perspective and overly concerned with rational decision-making based on cost and efficiency criteria.

The market power approach, and the political economy approach implicitly assume that the firm involved in international business is relatively large with considerable power in its international decisions. While their explanatory ability in the context of small firm internationalisation is limited, these models do provide useful frameworks for the interpretation and analysis of industry concentration and its effects on small firms within different industry structures. The main problem with the market power approach is that it tends to be self defeating if industry concentration continues.

The internalisation approach has been criticised as being polarised and rigid, has inadequate explanation for instances of cooperation. Nor does it consider the locational or political power aspects of either home or host countries, although these issues have to some extent been addressed by Buckley and Casson (1979) as nation specific factors. There is overemphasis on investment in R&D as the source of ownership advantage. The approach does not adequately explain the internationalisation of the small firm to which the costs of internalisation would be greater in comparison to the large firm while paradoxically, the cost of information search in pursuit of the export route might be beyond its means.

One limiting factor in the internalisation approach is its focus on the MNE and its "internalisation" of intermediate goods or value chain activities, where internalisation is often analogous with 'ownership'. Control of foreign located production or assets is therefore exercised through 'ownership' which Hennart (1989) has suggested may be costly, risky and may subject the MNE affiliates to the foreign policy and politics of the host nation. In the late 1980s and early 1990s, competitive pressures culminating in corporate down-sizing, restructuring and concentration on core activities have brought

the concept of "ownership" of assets as an advantage into question. Privatisation of previously public owned industry and the contracting out by MNEs of peripheral activities including production, marketing, distribution and even R&D have shifted the emphasis of transaction cost theorists to external links where previously internalisation was the focal issue (Hennart, 1989; Buckley, Pass and Prescott, 1990; Casson, 1992). Recent research (Wheeler, Jones and Young, 1996) on importing in the UK machine tool industry has suggested that "ownership advantage" may have a limited shelf-life after which previously internalised activities may be carried out more efficiently through external links with independent agents and distributors.

From a network / behavioural perspective, approaches emphasising "ownership advantage" have been criticised for their inherently negative view of human economic activity (Thorelli, 1986). This school of thought challenges the underlying premises of the transaction cost approach (Coase, 1937; Williamson, 1975), also fundamental to internalisation approaches (Buckley and Casson, 1976; 1985) of opportunism and bounded rationality. Opportunism is seen in the latter approaches as the main motivating factor of individuals and firms and internalisation as the way of protecting assets from opportunistic behaviour. Bounded rationality suggests that knowledge is limited and coupled with internalisation the growth of the firm would be limited to its ability to internally generate or internalise new knowledge. The more positive premises of the network school of "trust" and "interfirm cooperation", although criticised for their apparent naiveté, suggest that firms grow through external linkages and cooperative activity with other firms; internalisation taking place where trust breaks down.

In general, economic explanations of the international expansion of the firm have paid scant attention to entrepreneurial factors (Cantwell, 1991, p49). He quotes Penrose (1959), in her discussion on growth and expansion of firms where she suggests that:

"---both an automatic increase in knowledge and an incentive to search for new knowledge are, as it were, 'built into' the very nature of firms possessing entrepreneurial resources of even average initiative----".
(Penrose, 1959).

On that point, Cantwell suggests that internalisation theorists have taken ownership advantages as given and have emphasised the transfer of technology within particular institutional forms rather than variations between firms in their ability to generate technology.

Kogut and Zander (1993) opened up what had become a rather closed argument by emphasising *knowledge* and specifically technology transfer as being at the heart of firm growth whether it is domestic or international. Those authors argued that emphasis on *market imperfections* as the main impetus for internalisation has obscured the importance of *ownership advantage* as the factor most responsible for the international growth of the firm. They suggest that firm growth can be explained without recourse to market imperfections and claim that the internalisation of a market offers a different explanation to FDI than that offered by the ownership of a firm specific advantage. In a critique of the latter authors' article McFetridge (1995) points out that a transfer of technology to another firm is a market transfer and therefore less economic than a transfer to a subsidiary and an indication of some kind of market failure. Dialectics aside, Kogut and Zander (1993) introduce a number of suppositions and suggestions which emerged principally from their reservations in respect of internalisation approaches. They suggest:

- that the firm is a social community where productive knowledge (technology) defines a comparative advantage,
- the mode by which technology is transferred is influenced by the characteristics of the advantage that motivates the growth of a firm across borders, and
- the more tacit the technology, the more likely it will be transferred within the firm.

In answer to the argument that external transfer indicates market failure, Kogut and Zander suggest that transaction costs fall with each subsequent transfer. Drawing on the findings of Teece (1977), they suggest that the determinants of transfer costs are: previous experience with transferring the technology, the age of the technology and the number of firms using similar technologies. Essentially, they suggest that it is a firm's ability to 'recombine knowledge' that determines its expansion into new markets (Kogut and Zander, 1992). They criticise Buckley and Casson for their failure to recognise the link between ownership advantage, knowledge and growth and state succinctly that:

“Technology transfer lies at the heart of the growth of firms domestically and internationally. Firms grow on their ability to create new knowledge and to replicate this knowledge so as to expand their market. Their advantage lies in being able to understand and carry out this

transfer more effectively than other firms. Horizontal direct investment is, therefore, the transfer of knowledge within the firm and across borders, and in this regard, such transfers are the primary expression of the growth of the firm.” (Kogut and Zander, 1993, P639).

but also,

“--- an important aspect would be the extent to which a firm has an advantage in specialized knowledge of cooperating with agents and the extent to which their shared knowledge will further accumulate and provide platforms for future opportunities.” (p639).²

Emerging from the critique and reasoning behind Kogut and Zander’s empirical study is the emphasis on knowledge, learning, transfer and the ability to recombine knowledge to competitive effect and firm growth. While contributing to the evolution of internalisation approaches to MNE development, there are clearly parallels here with small firm studies which suggest that small firms are bundles of competencies and resources mobilised by entrepreneurial foresight and ingenuity (see Chapter 2).

Internalisation processes however have been criticised as static and for their inability to adequately address the dynamic and often turbulent international business environment. In general too, the internalisation approach is not concerned with the process of international expansion, but about the driving forces behind internationalisation and static decisions concerning alternative generic market servicing modes (export, licensing and FDI) and the international transfer of resources. The model, in the view of Johanson and Mattsson (1988) is more concerned with static decision states than with expansion processes. Development of firm specific advantage in the internalisation model, they indicate, is implicitly assumed to take place within the firm. In the network and internationalisation approaches, development activities may take place through interaction or relationships with other firms, which, they suggest, further influences the development of products, production processes etc.. Kogut and Zander (1993) as discussed above, have clearly developed important links between the truly economic and the behavioural schools of thought.

Johanson and Mattsson (1988) suggest that while the internalisation model is useful in explaining multinational activity where the environment is not very internationalised, it becomes less relevant in explaining further internationalisation where both the firm and

² This approach would certainly provide an explanation for the phenomenal growth of INTEL who licensed out peripheral technology but retained their core chip technology within the firm. Expansion was reputedly

the environment are highly internationalised. Most FDI theorists assume that to invest in foreign production, a firm must possess an advantage not vested in firms in the foreign location (Hymer, 1960; Kindleberger, 1969; Dunning, 1980, 1988) an attribute which may be less easy to assimilate where the environment is highly internationalised and hence full of international if not global competitors.

Buckley himself points out that empirical testing of the model is problematic. One difficulty is that although lists and categorisations of transaction costs (information costs, enforcement costs, governance costs etc.) have been made, no estimates exist and there is no indication of how significant they are in relation to transportation costs, production costs, marketing costs and distribution costs (Buckley, 1988, p184). While information or knowledge is important in studies of the MNE and internalisation decisions, the entrepreneurial use of information may defy measurement. This may be tackled, suggests Buckley, by measuring the impact of information collection costs on strategy. In summary however, he indicates that the general theory cannot be tested directly, but specific aspects may be confronted with evidence.

The eclectic paradigm, intended to overcome some of the limitations of the internalisation approach is more of an analytical framework than a theory since the combinations and permutations of OLI variables are immense and therefore predictive power is limited. However, categorisation of conditions necessary for FDI make general predictions more flexible. This approach has been criticised for its lack of emphasis on strategy which has been rectified by Dunning in later expositions of his approach (Dunning, 1988, 1993). In criticism of Dunning's model, Carlisle (1993, p115) points out that it has little to say about the internationalisation process of individual firms. According to Carlisle, even if all the conditions for FDI are present, Dunning's model does not take into account the fact that firms may decline to participate in FDI. Dunning's model synthesises the variables which need to be taken into account but does not help in their evaluation. Thus, she suggests the "why" question is not addressed. Behavioural dimensions of willingness, entrepreneurial decision-making, strategic choice and corporate heterogeneity have not been sufficiently taken into account (Dunning, 1988; Welch and Luostarinen, 1988; Clark and Mallory, 1993; Carlisle, 1993).

Economic approaches have made significant contributions to understanding the development of multinational firms by providing analytical frameworks and by listing generic decision criteria on which rational and cost effective decisions can be made.

due to skill in managing their knowledge and in establishing and managing distribution deals world-wide.

More recently, attempts have been made to integrate transaction cost/internalisation approaches with contributions from other schools of thought. The most relevant of these integrations are discussed later in this chapter.

Process Approaches to Internationalisation

Process, internationalisation or establishment chain models of international expansion have evolved from studies of marketing and distribution and are in general, more concerned with the growth of a firm's exports and export markets than with the growth of the firm per se. These theorists have tended to view internationalisation as an incremental process whereby international involvement is increased in gradual steps over time. Bilkey and Tesar (1977) in a survey of 423 SME Wisconsin manufacturing firms proposed a six stage model of export development. The model suggests that the export development process takes place according to the following stages:

- Stage 1:* Management is not interested in exporting and would not even fulfil an unsolicited order.
- Stage 2:* Management would fill an unsolicited export order, but makes no effort to explore the feasibility of exporting.
- Stage 3:* Management actively explores the feasibility of exporting.
- Stage 4:* The firm exports on an experimental basis to some psychologically close country.
- Stage 5:* The firm is an experienced exporter to that country and adjusts exports optimally to changing exchange rates, tariffs etc.
- Stage 6:* Management explores the feasibility of exporting to additional countries that, psychologically are further away.

This model suggests that exporting may begin reactively since 60% of exporters' initial involvement was triggered by requests from foreign buyers. However, at stage 4, firms whose initial export orders were sought through their own efforts were found to be: much larger, had more favourable expectations regarding the advantages of exporting for their firm, had better and more dynamic managements and perceived fewer barriers to exporting (Bilkey and Tesar, 1977, p94). To the extent that a firm serves more than one country, and may have income generating assets in these countries in the form of sales subsidiaries, it is conceivable that multinationality may occur at stage 5.

(see also Box 3.2).

Cavusgil (1984) added weight to the evolutionary process model of internationalisation in a published study of 70 manufacturers classified according to their stage of export involvement: experimental exporters, active exporters and committed exporters. In this study the sequential nature of the internationalisation process was attributed to greater perceived risk associated with international business decisions, the tentative nature of managerial expectations and greater genuine uncertainty. As international experience increases, management may develop higher expectations, more rational and comprehensive policies and new organisational procedures. Thus in the second of the stages identified by Cavusgil an export department may be formed (Cavusgil, 1984, p197).

1. *Experimental involvement:* Management at this stage is uncommitted to export. Interest is reactive and export is prompted by unsolicited orders. Total export sales may be less than 10% of the total sales.
2. *Active involvement:* Management realises the potential of international business and makes long-term commitments to the development of export markets. Excess capacity is directed towards export markets and organisational changes are made to fulfil the requirements of this new regular activity. At this stage an export marketing department may be formed.
3. *Committed involvement:* At this stage the exporter searches for business opportunities worldwide. At this stage Cavusgil suggests other types of international involvement such as direct investment in foreign production may be undertaken.

The above stages were ascribed subjectively in the first instance but differences were found between firms at each of the stages of export development which supported the model. Specifically, the study found that experimental, active and committed exporters could be distinguished in terms of, company size (as measured by sales and percent of export profits), also in terms of their domestic market environment, the nature of international business involvement, policy aspects of international marketing and foreign market research practices.

The basic assumptions of the above two studies are that passive exporting for most firms is the first stage of exporting. The possibility of internationalisation through market entry modes such as FDI, licensing and other contractual arrangements were

simply not explored: although Cavusgil suggested that such entry methods may be embarked upon during the "committed stage" of export.

Where Bilkey and Tesar, and Cavusgil were concerned with internationalisation through the expansion of export markets, Johanson and Wiedersheim-Paul (1975) were more concerned with the effects of export expansion on the organisation of the firm. Their model, based on four case studies of Swedish multi-national firms; Sandvik, Atlas Copco, Facit and Volvo, also suggested that firms go through a number of stages in their international development:

1. No regular export activities
2. Export via independent representatives
3. Establishment of sales subsidiary
4. Production/manufacturing in previous export market.

(Johanson and Wiedersheim-Paul, 1975 p17).

The basic assumptions of this model are that the firm develops the domestic market first and then internationalises according to a series of incremental decisions, and that the major barriers to internationalisation are lack of knowledge and resources. Perceived risk of international investment decreases and experience and resources are gained through incremental decision-making and learning about foreign markets and operations. Successively larger commitments to foreign markets are made as the firm progresses through the four stages. The hypothesis that firms move through this "establishment chain" was based on studies of the four firms mentioned above.

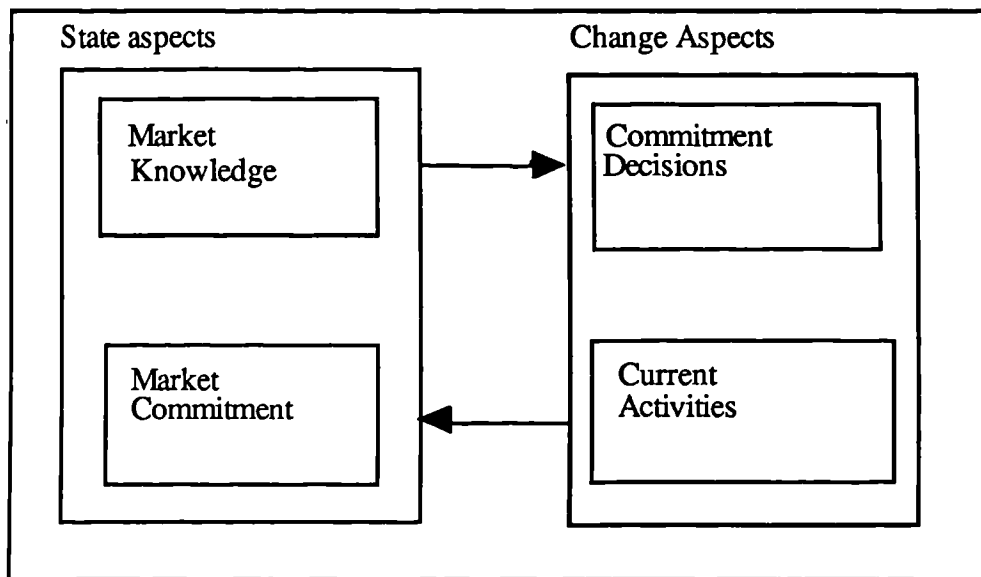
Perhaps the best known and most frequently cited of the internationalisation process theories is Johanson and Vahlne's (1977) "Model of Knowledge Development and Increasing Foreign Market Commitments". Also assuming that lack of knowledge is an important obstacle in international development, and based on the same case material, this model suggests that the necessary knowledge can be acquired mainly through involvement in operations abroad,. From this assumption, the authors suggest that there are one or two distinguishable directions for internationalisation:

1. Increasing involvement of the firm in the individual foreign country.
2. Successive establishment of operations in new countries.

The evolutionary process from no exporting, to agency exporting, to the establishment of sales subsidiary and thereafter foreign production, is explained as a process of incremental adjustments to changing conditions of the firm and its environment. The

successive establishment of operations in new countries and the time order of such movements as seen by the authors as being related to the psychic distance between the home and import/host countries (Johanson and Vahlne, 1977, p33). Having little predictive ability, the model attempts to explain internationalisation as being dependent on two mechanisms - state and change aspects.

Box 4.1 The Basic Mechanism of Internationalisation: State and Change Aspects



Source: Johanson and Vahlne (1977, 1990)

The dynamic model suggests that a firm's present knowledge about a foreign market and its level of resource commitment to that market (state aspects) will affect decisions to commit resources and the performance of current business activities (change aspects). These in turn will change knowledge and commitment. Emphasis in this study was placed on export organisation at different levels of involvement.

A further development of process approaches which incorporates alternative foreign market entry modes and value chain activities, of internationalisation is that put forward by Luostarinen (1979). This author explains the internationalisation process of Finnish industrial firms around three constructs or strategies: product, operation and market (POM). The 1979 research reported that Finnish firms followed a step-stage pattern of internationalisation. The product strategy found firms moving from goods to services, to systems and finally to know-how. The operation strategy was found to follow a progression from non-direct investment marketing operations (i.e. traditional exporting) to direct investment marketing operations (company representative or sales branch exporting); and from there to non-direct investment production operations such as licensing and franchising; and then to direct investment production operations such as assembly and manufacturing subsidiaries. Firms' market strategy suggested evolution from countries with a short business distance from the home market to a greater business distance as knowledge develops (where business distance is a combination of physical, cultural and economic distance). More recently Luostarinen et al., (1994) reported findings in recent literature, which indicate that SMEs in dynamic sectors of

the Finnish economy tended to omit stages in the basic pattern, undergoing a very short domestic stage or even moving into a foreign stage simultaneously or without a domestic stage.

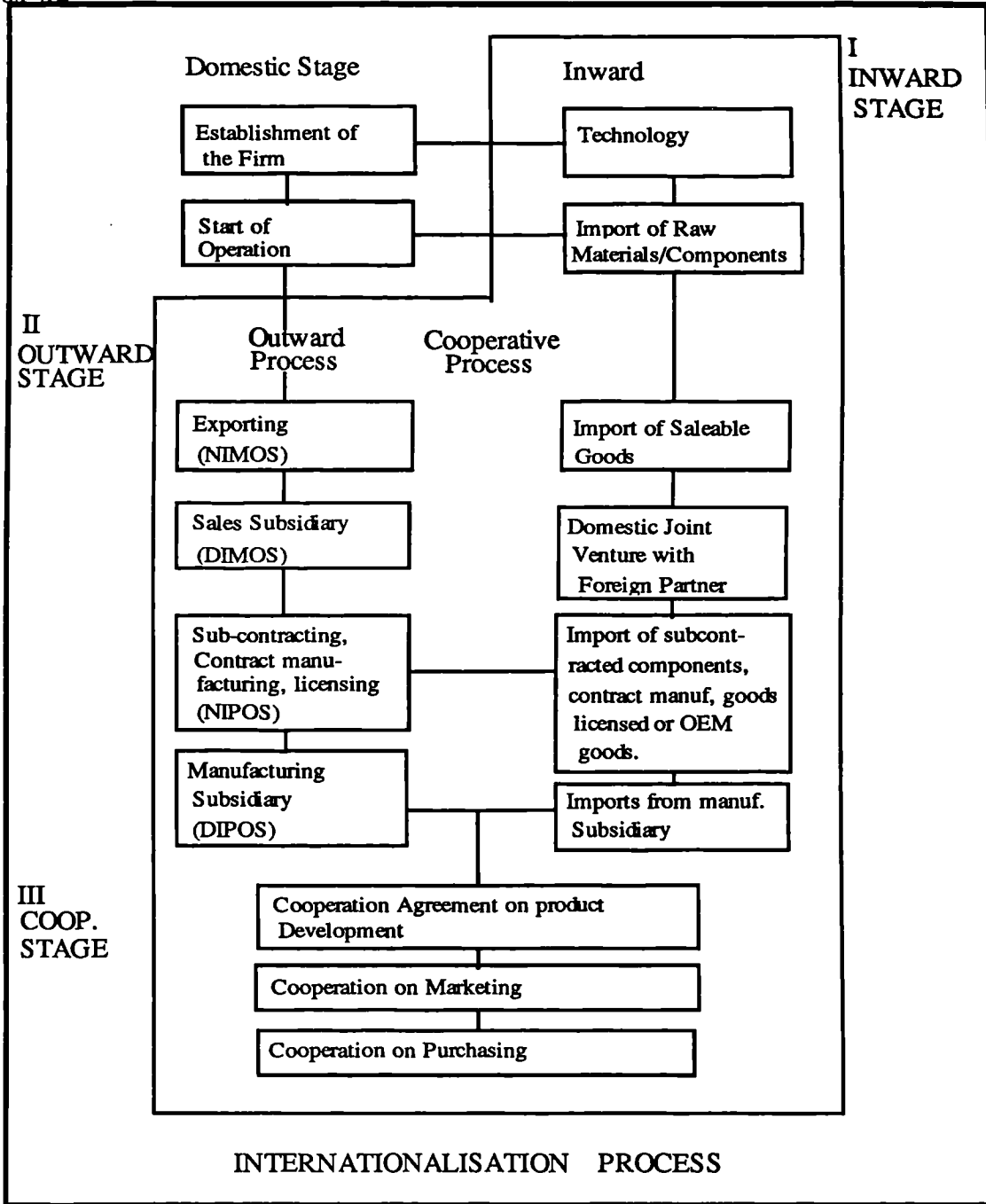
The same authors (1994, p212) suggest that the POM model can be divided into four stages, starting stage, development stage, growth stage and mature stage on the basis of changes in product, operation and market strategy patterns. Typically, a firm in the starting stage of internationalisation will introduce products, already sold domestically, to markets which are close in terms of business distance through non-investment marketing operations. A change in the firm's product, operation or market posture is required to move it from one stage to the next. Using this basic stage model as a benchmark, the report indicates that SMEs in Finland have progressed further in the internationalisation process than indicated in earlier Finnish studies with 60 per cent of SMEs at the starting stage, 23 per cent at the development stage, 16 per cent at the growth stage and 3 per cent in the mature stage. The average length of time spent in the domestic stage had decreased and an increased rate of internationalisation was especially marked amongst newly established SMEs.

Firms' international operation activities have been found by Luostarinen typically to progress from less advanced to more advanced modes through indirect exporting - direct exporting - licensing - direct investment. Of interest from the 1994 report is evidence that SMEs are using more advanced operation modes than previously. Inward internationalisation influences have also been examined, and amongst these importing of raw materials and components was the most common inward operation for SMEs in 1990. Amongst outward modes, direct exporting through foreign intermediaries and exporting direct to the final customer were most common. Contract manufacturing was found to be uncommon generally, but there were some examples of usage by Finnish industrial SMEs. Co-operation, categorised as commercial, industrial or managerial, was found to be utilised later in the internationalisation process with 18.7 per cent of SMEs reporting sales and marketing alliances with foreign firms.

In response to reported changing modes of international activity by SMEs, the concept of a more holistic pattern of internationalisation including both inward and co-operative modes has been introduced. The stages identified are thus: domestic stage, inward stage, outward stage and co-operative stage. The inclusion of the inward stage is seen as being important in the development of small firms since inward technology licensing, for example, may eventually result in outward technology sales, formalised cross-licensing arrangements etc.. Although Luostarinen acknowledges that the inward-outward connections are not clear in the early stages, it attempts to classify inward-

outward connections along the dimensions of direct and indirect relationships. Direct relationships are typified by overt dependence between inward and outward movements such as in countertrade, co-operation deals and cross-licensing while in indirect relationships inward and outward movements are relatively independent. This perspective and the findings of the reported studies on internationalising SMEs suggests that this is a research area which is in need of further exploration and theoretical development.

Box 4.2



Source: Luostarinen and Hellman (1994).

Comments on and Criticisms of Process Theories

Empirical Evidence

A number of studies have provided evidence to suggest that firms do in fact go through an incremental process of increasing involvement and commitment in their international expansion. Buckley, Newbould and Thurwell (1979) in a study of UK and European firms beginning internationalisation found that only 15% omitted the export stage in the process. A similar pattern was reported by Luostarinen (1979) and Larimo (1985) in separate studies of the outward movements of Finnish firms.

The internationalisation process model, although widely accepted due to its readily understandable logic and intuitive appeal, has been empirically tested elsewhere and has failed to produce the same incremental progression as suggested by any of the theorists discussed above. For instance, a study by Hood and Young (1983) of 140 US and European subsidiaries in the UK found that 44% had no involvement in the market prior to direct investment. A study of outward direct investment from Australia found that 39% of their 228 instances of foreign direct investment had no prior involvement in the host country (BIE, 1984).

Turnbull and Valla (1986) and Buckley, Newbould and Thurwell (1979), contrary to Johanson and Vahlne's suggestion, showed that firms in general do not follow a consistent organisational approach in either foreign market entry or export expansion. Another study of 29 high-technology SMEs in Canada in 1970, and followed up in 1980 and 1989 found that nine out of the ten surviving firms, and five out of ten firms which had been acquired progressed through three stages of internationalisation: direct export of goods and services from Canada, the sale of goods from foreign-based sales subsidiaries, and the assembly and manufacture of products by one or more foreign subsidiaries. These phases however were found to be neither mutually exclusive nor sequential (Litvak, 1990, p11).

Turnbull (1987) challenged Johanson and Wiedersheim-Paul's thesis in an empirical survey of firms in 3 UK industries: marine diesel engines, vehicle components and telecommunications, which were known to have European export markets. Using the latter authors' proposition that export organisation changes as firms increase commitment to, and knowledge of international markets, the study found little evidence of a sequential or stepwise development of organisational structure in any of the industries examined, and moreover some evidence was found which was at variance with the step-wise progression model. The study of 24 UK based companies revealed 72 export structures which were identified by company type, country and firm

characteristics such as size, and gross and export sales turnover. In the marine diesel engine sample reliance was on agents with direct selling through company representatives also being used in most cases. The study found no significant relationship between total company sales turnover and sales organisation used, which would tend to refute any claims to a sequential development (Turnbull, 1987, p178).

The sampled firms from the vehicle components industry tended to favour local representation in the market but exhibited different combinations of structures across markets and between firms. The telecommunications industry, renowned for rapid and dramatic change in the technological and economic and political fronts, also tended to have an international outlook (Turnbull, 1987, p180) which was felt by Turnbull to have interesting implications for the study of internationalisation:

"Consequently, the market entry and development strategies and the structure of the international organisational forms adopted by these expansionist companies are of particular relevance to understanding the internationalisation process".

Particularly interesting here is Turnbull's finding that in the sample of telecommunications firms, the same organisational structure tended to be adopted by firms across their various country markets regardless of existing sales volume in the country concerned. Explanation offered was that organisational philosophy and strategy of the firm may determine the consistency in the type of organisational structure used in internationalisation. Another challenge to the step-stage model was evidence that some firms adopted two or more forms of marketing organisation in an individual country, which is inconsistent with Johanson and Vahlne's proposition of sequential organisational evolution. Nor did the study find much evidence to suggest that organisational form was affected by company size as measured by total sales, or by volume of sales in the overseas market. The frequency with which various organisational structures occurred compared to the degree of international orientation (proportion of sales turnover accounted for by exports) revealed no relationship between the two variables, but surprisingly, distributors and agents were used relatively frequently by highly internationalised firms, while nearly 50% of firms with low international development had established sales subsidiaries in Western Europe.

In summary, Turnbull's research indicated that a stages theory of internationalisation was inaccurate in describing the international expansion of British companies in Europe. Evidence from the study in fact suggested that a firm's "stage" of internationalisation "is largely determined by the operating environment, industry

structure, and its own marketing strategy" (Turnbull 1987, p183). Turnbull's study has some particular relevance for this study of technology intensive firms where the traditional export expansion route and internationalisation stages may be ruled out from the outset due to the particular demands of new and emerging technologies. As with Turnbull's sample, it is expected that a survey of technology intensive firms will display significant variations between and within firms in not only the handling of exports but of international expansion forms which may arise from firm and market specific factors (Reid, 1983, p62; Turnbull 1987, p183).

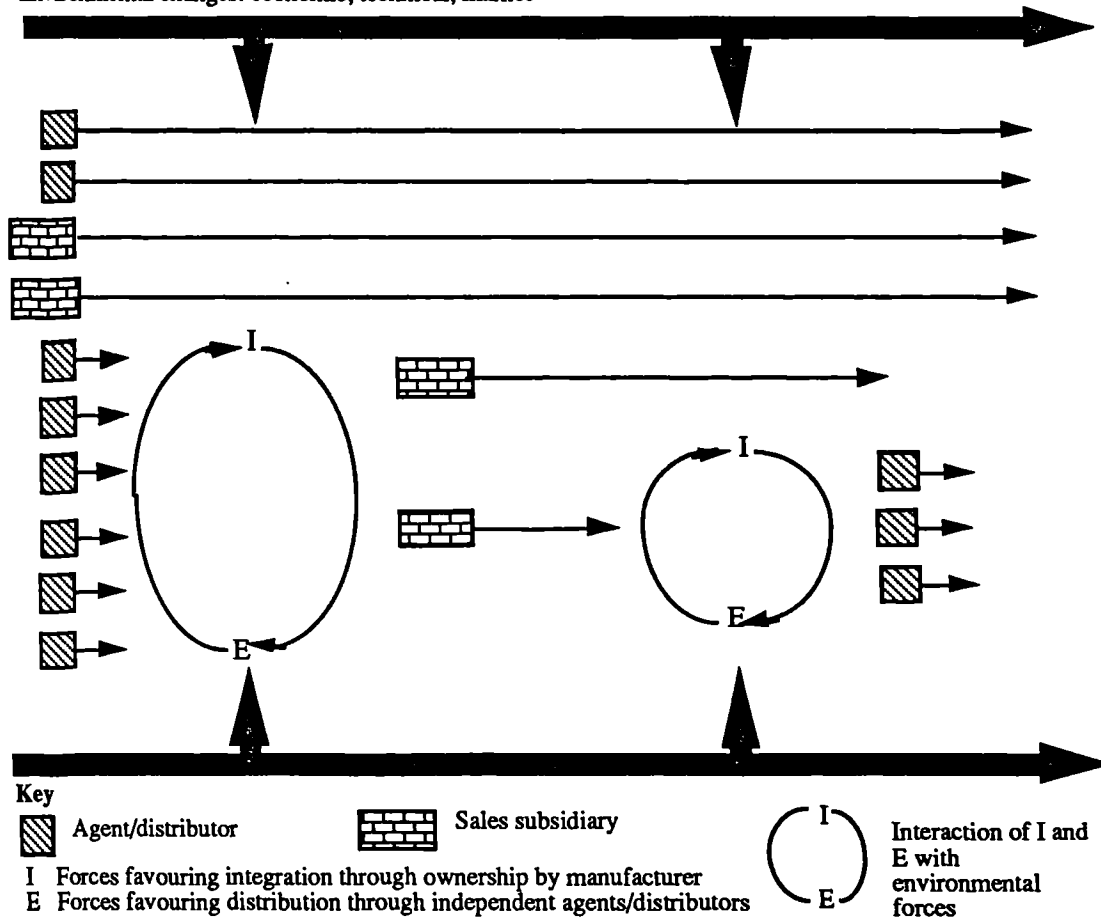
The above studies indicate that the firm may begin internationalisation through different entry modes, or at different stages in the international development process. There is almost an implicit understanding that firms move through modes determined by their level of commitment, risk, investment and level of control. Recent evidence however suggests that there may be reversal in this process due to re-evaluations of the situation or changes in the circumstances the firm finds itself in (Turnbull, 1987; Wheeler et al., 1996). Clark and Mallory (1993) found that although the stepwise development from export through to FDI is the most common route for firms, it was only one of a number of identified routes undertaken by their sample. Their study consisted of 23 UK based firms, operating in 687 foreign markets and generating 203 market servicing mode shifts. This cross-sectoral study of a sample drawn from a list of the 1000 largest manufacturing firms in the UK found that reversals were not uncommon. Clark and Mallory suggest that entry mode choice should be considered in a global rather than a country by country basis. They suggest that initial market entry is not confined to exporting, as any of the entry modes could be used. A move to FDI may confirm the firm's commitment to its overseas markets but is not seen by the those authors as a culmination of an internationalisation process. They also recognised a retrenchment stage where firms reduce their resource commitment to a particular country market and "shifts within modes" whereby the firm shifts its form of representation within one of the generic forms of entry i.e. exporting, licensing or FDI.

More recently evidence has been found of reversal from sales subsidiary representation back to independent agent amongst importers of machine tools into the UK market (Wheeler et al. 1996). Here the triggers included changes in the economy which rendered the costs of running a sales subsidiary higher than had previously been the case, and intensification of competition due to standardisation of technology. Overall this triggered changes in market structure which resulted in the market knowledge and contacts of the agent becoming more important as competition increased and the firms' technological lead diminished. That particular study, while presenting a challenge to stages theories, indicated the potential of internalisation and transaction cost approaches

to dynamic explanations of MNE activity where changes in the environment over time are taken into account.

Box 4.3

Patterns In Market Entry Modes And Channels Of Distribution In The Machine Tool Industry
 Environmental changes: economic, technical, market



Note: International distribution takes place in a turbulent environment. Changes in distribution from sales subsidiary to independent agent/distributor and vice versa are influenced by the interaction of environmental factors with internationalization forces (I) and externalization forces (E). Channel integration through ownership, therefore, rather than being an incremental step in the internationalization process, is a competitive response to environmental pressures and I and E forces.

Source: Wheeler, Jones and Young (1996).

Conceptualisation

Notwithstanding their intuitive appeal, internationalisation process theories have been criticised on points of conceptualisation. Sullivan and Bauerschmidt (1990) challenged Johanson and Vahlne's underlying premise that internationalisation is best understood in terms of the psychic distance in the minds of managers between home and host nations. The former authors tested the contention that "--the cumulative knowledge held by managers acts decisively on the process of internationalisation" in an empirical

survey of European forest products firms. The measure used as an indication of internationalisation scope was geographical spread which resulted in the sample being divided into six groups of firms falling into the categories below:

Table 4.1 Geographical Proximity of International Sales or Production Unit.

- Adjacent market only
- Adjacent market and continental Europe
- Adjacent market, continental Europe and one overseas
- Adjacent market continental Europe and several overseas
- Principally overseas markets
- Intermediate due to consortium membership

Independent variables were, respondents attitude towards an extensive list of barriers and incentives to export. The results collectively showed that managers' objective and experiential knowledge drives internationalisation. The proposition that firms with a different scope of

internationalisation would judge barriers and incentives to internationalisation differently was not supported and no significant differences were found between groups of firms.

Despite the results however Sullivan and Bauerschmidt were unwilling to reject Johanson and Vahlne's thesis but rather challenged the proposition that the "--notion of psychic distance and its underlying logic of 'reasoning by analogy' are representative of the decision dynamic of internationalisation".

The suggestion being made here is that such studies "based on reasoning by analogy" may in fact create a simplistic rather than simplified view of decision situations. Sullivan and Bauerschmidt contend that where Johanson and Vahlne's thesis is overtly logical and therefore intuitively appealing, its ready acceptance may hinder rather than help the development of other explanations of internationalisation.

From the point of view of this thesis, internationalisation process theories are inherently limited by their almost universal focus on the development of export markets. The implicit assumption of all of these theories is that, in the first instance, firms begin internationalisation either reactively or proactively, in pursuit of export markets (Dunning, 1993). Internalisation models on the other hand suggest a number of reasons for international development including reasons connected to production efficiency, resource requirements, and international strategy. Studies have shown that there are a number of objectives underlying the internationalisation process which would be inadequately satisfied through the export expansion route.

Methodology

Process theories have also been criticised on methodological grounds, for example, Johanson and Wiedersheim-Paul's model was developed from a study of only 4 Swedish firms, which raises questions as to the generalisability of the thesis. Apart from the small size of the sample, no account was taken in the study of the peculiar qualities of Swedish firms in the sense that the small size of the Swedish market may be a significant factor triggering their international expansion process.

Bilkey and Tesar (1977) and Cavusgil (1984), although providing empirical evidence based on sample survey, categorised firms according to the extent of export commitment and did not take into consideration modes of international involvement other than export.

Strandskov (1986) in a discussion of some of the methodological issues involved in internationalisation studies suggests that a stage approach which attempts to generalise development into stages relies on causal relationships between sets of variables external and internal to the firm. To establish stages, causalities would be put forward as hypotheses and tested to determine whether reality corresponds to the hypothesised relationships (Strandskov, 1986, p210). This scientific desire to explain and predict he feels, has to some extent been inadequate in its treatment of business phenomena which are often complex, involve human behaviour and include qualitative dimensions.

Another limitation is that internationalisation process research tends to be approached retrospectively in that firms are viewed at a particular point of time. Analysis therefore relies on interpreting and evaluating manager's as compared to the researcher's understanding of the sequence of events leading up to the firm's current stage of development (Strandskov, 1986, p211). Much work still needs to be done in the area of longitudinal studies of internationalisation.

A number of researchers (e.g. Strandskov, 1986; Turnbull, 1987) have argued against the conceptualisation of internationalisation as a uniform, linear and mechanistic process that all firms go through but agree that there are underlying factors connecting aspects of the process,

"--there seems to be some empirical evidence of the existence of continuous links between sets of variables, consisting of the dimensions of strategy-making, environment, organisational structure ---"

(Strandskov, 1986, p212).

Andersen (1993) evaluated the export development models (I or internationalisation models) and the Johanson and Vahlne (U or Uppsala models) in relation to their adequacy as theoretical explanations or models of the internationalisation process. Essentially, Andersen attempted to determine the extent to which the approaches: state their boundary assumptions, are falsifiable (Popper, 1983), and can be empirically verified. In respect of the Uppsala model, he found that there was no explanation of why or how the process starts, the sequence of states or conditions was not discussed, nor were factors which might influence the process. He levelled a similar criticism at the I models. In stating boundary assumptions, Andersen found that those models were delimited by firm size but the Uppsala model listed no delimiting factors and therefore had wider applicability as a theory. Overall, Andersen (1993) found both models to be rather inadequate in their inclusion of causal factors and proper definitions on which to specify the necessary and sufficient conditions for the process to take place and movement between stages be explained.

Summary

While criticism of internationalisation process models has been somewhat severe, the extent to which the models have been cited in the literature suggests that they have widespread intuitive appeal. Much of the literature citing the models however has been concerned with either validating or refuting the approaches, or have simply used the stages as a means of categorising exporters. As a stimulus for research into the international expansion process of small firms, such models have been very influential.

Somewhat surprising is that considerably less attention has been paid to the work of Luostarinen (1979, 1994; Luostarinen and Hellman, 1994; Luostarinen et al. 1994; Luostarinen and Welch, 1990; Welch and Luostarinen, 1988, 1993), despite the wider, deeper and more interpretative of the original thesis (1979), which was based on a substantial empirical sample and drew on MNE theory for its constructs and interpretation. Luostarinen's treatment of internationalisation as a holistic growth process has been less obviously influential in subsequent studies of internationalisation than have the more descriptive but less explanatory U and I models discussed above. His classification of foreign operations along the dimensions of location and investment, and evaluation of the same along the dimensions of commitment, control and financial and political risk is robust and has become common parlance in many studies of foreign market entry. Threads of Luostarinen's conceptualisation are apparent in the Uppsala studies which have emphasised the knowledge development of firms in the internationalisation process and the importance of psychic/business distance. The cost and efficiency variables included in Luostarinen's work have largely been ignored by the Uppsala school in favour of a more behavioural explanation.

Finally while internationalisation is undoubtedly a "process", the number of variables involved in internationalisation decisions, the variety of motives, and the heterogeneity of firm characteristics would suggest that internationalisation processes may be unique to individual firms. It would therefore seem inappropriate to prescribe incremental steps or decisions to expanding firms. Rather a set of decision criteria and analytical frameworks would be more appropriate. The usefulness of step/stage models is that they provide a framework by which firms may be grouped according to their stage of internationalisation - a particularly useful tool for the targeting of government assistance. The models also provide a useful framework for learning (either students or firms) - from the less to the more complex issues. As a benchmark for firm development their use is in the sensible, if cautious recommendation of international expansion through "toe in the water" non-committed methods through gradual immersion to fully committed methods of greater involvement. Of more interest to this author, is Luostarinen's approach to internationalisation which has the potential to pay considerably more attention to small firm heterogeneity and contingency factors than other studies reviewed here.

Network Approaches to Internationalisation

A relatively recent approach to the study of business and economics is the "network approach" which recognises that the behaviour of firms and individuals takes place within, and is affected by other firms and individuals linked together in networks. Evolving in areas which are geographically dispersed and within a range of disciplines the "network approach" to the analysis of industrial networks and international linkages has become relatively well developed among researchers connected with the IMP group (Industrial Purchasing and Marketing) and especially within the Swedish research community. Recently a number of these researchers have turned their attention to internationalisation as a network process. While some authors trace the roots of the approach to Johanson and Vahlne (1977), others have placed emphasis on resource-based approaches, internalisation and social network research as the underlying disciplinary sources of the approach's development.

The Industrial Network Approach

The industrial network approach is an approach to the study of organisations and systems, which takes the relationship as its central unit of analysis. The industrial network approach, since it focuses on relationships between individuals and firms may be described as a behavioural model except in that it recognises the economic transaction or exchange as being fundamental to the existence of an industrial as opposed to a social or other network (Hakansson, 1989).

In the industrial network approach, markets, firms and other forms of organisation are seen as networks of relationships which are interdependent and interlinked in a variety of ways. There are three dimensions to the approach: actors, activities and resources. Relationships are formed amongst actors by activities which evolve around the need to access or control resources. Competition in its traditional sense is, in this approach, replaced by a "rivalry" for control of resources which is recognised as taking place within the network rather than either inside or outside the boundaries of specific firms or institutions. In the economic approaches discussed above firms tend to be externally competitors with cooperation taking place only where activities are internalised, whereas in the network approach it is recognised that firms interact in ways which are not always competitive and that they may be interdependent whilst remaining autonomous.

Network approaches are in their infancy and a universal model or theory has yet to be developed but there are pockets of convergent ideas. Johanson and Mattsson (1988) present a network representation of internationalisation based on the views and empirical findings of a number of researchers whose main interests are in distribution systems, internationalisation processes of industrial firms and interactive approaches to industrial marketing and purchasing (Johanson and Mattsson, 1988, p305).

Very briefly, the network approach suggests that buyers and sellers develop relationships in the course of their activities through which exchange takes place and bonds in various guises (technical, planning, knowledge, social and economic and legal) are forged between firms (Hammarkvist, 1983). The firm is in this way linked to a network of firms within which it occupies a position which it may seek to change or defend (Mattsson, 1985). To enter a new market, a firm must build relationships which are new to itself and members of its own network (Johanson and Mattsson, 1988, p306). This initiative may be taken by either a buyer or seller and the development of relationships is seen as a two-way and cumulative process of development. Particularly interesting for this research is the basic assumption in the network approach that individual firms are dependent on resources controlled by other firms.

Applying the network approach to internationalisation, this is done through attempts by the firm to establish and develop positions in relation to firms in foreign networks. The same authors (1988, p309) suggest that this may be done in the following way:

1. *International Extension* by establishing positions in relation to counterparts in national nets that are new to the firm,

2. *Penetration*

by developing the positions and increasing resource commitments in those nets abroad where the firm already has positions,

3. *International Integration*

by increasing coordination between positions in different national nets.

The extent of internationalisation is interpreted according to its position in national nets and the importance and extent of integration of the positions. Another measure of internationalisation alluded to here is the number and strength of relationships linking firms between different national sections of the net. Distinction is made between firms at four levels of internationalisation as shown in Box 4.4.

Box 4.4	Degree of Internationalisation of the Market (the production net)		
		Low	High
Degree of Internationalisation of the Firm	Low	The Early Starter	The Late Starter
	High	The Lonely International	The International Amongst Others

(Johanson and Mattsson, 1988, p310)

What this particular model adds to existing theory is the recognition and acknowledgement of increasing internationalisation of the environment within which the

firm operates, which may, according to its proponents affect the internationalisation mode of firms. As such it is consistent with Turnbull's suggestion that the firm's "operating environment" may affect its stage of internationalisation (Turnbull, 1987, p183) and Strandskov's (1986) call for a model which takes the environment into account as a set of variables. Johanson and Mattsson's model attempts to explain the entry mode decision at each prescribed stage of internationalisation. For example, the early starter which enters a market which is not internationalised to any great extent, they predict, will follow the route of agents previously used, by investing in relationships already established, or will take over another firm in order to achieve a position in the network which will provide market knowledge. The late starter, i.e. a newly internationalising firm in a highly internationalised market, according to the model will probably be highly specialised, in the case of small firms, and its strategy will evolve around the building of bonds with customers and the coordination of production activities. On the other hand they suggest that a larger, less specialised firm is more likely to become established in foreign production through acquisition or joint venture.

Johanson and Mattsson's explanation of internationalisation using a network model clearly has strategic dimensions concerned with the attainment of network positions in

order to utilise network resources and develop knowledge. Albeit that the emphasis is on relationships, the approach is strategic in that relationships which are important to the firm are sought and cultivated.

Comments on and Criticisms of Network Approaches

There are however some contradictions in treatments of the above approach, and conceptualisation of network approaches to internationalisation in general, at their current state of development. For example, Johanson and Vahlne (1992) in a study of foreign market entry by two Swedish MNEs, Losec and Korrugal, suggested that Korrugal's Italian entry was "by no means a planned strategy" but a gradual process advanced by interaction between members of Korrugal and members of the trade office and Italian construction industry. The authors suggested that there was nothing predetermined in the process and that market opportunity was created through interactive processes. While the authors place emphasis on market entry and internationalisation through the development of relationships and the pursuance of interaction, they explicitly reject the possibility of a market entry strategy:

"--- the setting of market entry is unclear, complex, continuously changing and changing in unpredictable ways. This makes it difficult to plan or formulate a strategy and then implement it. In fact, the strategy cannot even be decided upon by the focal firm. The strategy, i.e. way of entering the foreign market, emerges out of interplay between actors in the foreign market and focal firm". (Johanson and Vahlne, 1992, pp23-24).

This is clearly diverging from the earlier, Johanson and Mattsson (1988), which overtly proposed that internationalisation is a process of investments in relationships, utilisation of network resources and the changing and defending of network positions none of which suggests an entirely unplanned or organic expansion. Blankenburg (1992) drawing on Weick's (1979, p77) argument that the firm in any network is but one variable in a sequence of causal loops over time, suggests that the foreign market entry process is a result of interaction between network actors in the ever changing conditions of the network. Blankenburg sees foreign market entry as being driven by two forces, external and internal. External forces may include conflicting interests by external network actors which may be in the form of protectionism where conflict is high, or the provision of resources, especially network knowledge, where conflict is low. Internal

forces such as the ambitions, ideas and interests of firms may drive foreign market entry, but these are conditioned by network structure and conditions.

Where it is difficult to see any real differences between Blankenburg's internal and external forces and Dunning's ownership and location specific variables, there is significant difference in the conceptualisation of the internalisation approach compared to the network approach. Where the former is concerned with economic efficiency, the latter is very much concerned with the human element of business. In the former, human behaviour if considered at all, is built into the structure and strategy of business enterprise, whereas in the latter, the business is developed around interpersonal and interfirm relationships. In general economic and network approaches deal with the same constructs, which are however dealt with from entirely different perspectives, (Johanson and Mattsson, 1987).

In addition to apparent disagreement between network researchers as to whether network processes are, or should be strategic in nature, there is also disparity in acceptance of the concepts used to describe and explain network phenomena. There are however, attempts amongst theorists to reduce and specifically define concepts used in network approaches (Axelsson, 1992, p245).

Another criticism of the network approach is the difficulty with which such concepts as efficiency and effectiveness are measured, if at all. It could be argued that efficiency itself is an economic concept and not the concern of relationship researchers, however, convergence with economic theories on this point, which to some extent is reflected in the work of Dunning and Cantwell, would represent a welcome advance in the understanding of complex forms of organisation. Where network studies in general have focused on the inputs to networks, i.e. resources, actors and activities, little if any emphasis has been placed on the output of networks, or firms within networks from the proponents of this approach. Andersson (1979) stated that knowledge of the real effects of cooperation is low. Hovi (1994) suggests that the outcomes of cooperation are the benefits and losses which accrue as a result of the partnership. In a review of the pertinent literature (1994, p674) she found that most studies of the outcomes of cooperation list criteria which are largely qualitative in nature for example efficiencies through economies of scale, complementarity of resources, ability to concentrate on the firm's distinct competencies, learning from partners, risk sharing, reduction of barriers and easier access to markets. The lack of suitable measures as indicators of network efficiency, performance and competitiveness, from the business point of view, would tend to render such studies academic with limited value for practical application. Further development of a strategic approach to network activity (as begun by Mattsson,

1985), would be a welcome added dimension to current thought in this developing research area.

Since a network "theory" has not yet emerged from any of the diverse pockets of researchers interested in the phenomena, criticism of the approach tends to be confined to specific aspects of its conceptualisation, its current limitations and the extent to which it has added, or failed to add to understanding.³

Recent Integrations of Theory and New Perspectives

Recently, attempts have been made to integrate theoretical approaches by a number of researchers. For example Luostarinen (1994) in a longitudinal study of Finnish firms has developed and extended his original process model of firm internationalisation. This model has been discussed above in the section on process approaches to internationalisation, and is examined in relation to the findings of this study in Chapter 8.

Developments have also been made in economic approaches to international firm expansion. Buckley (1990) suggests that the established theory of international business is problematic in that the key relationships between internalisation and market structure on the one hand, and internalisation and competitive advantage on the other, need to be more clearly specified. He outlines established theory as being based on a synthesis of internalisation theory, the theory of location and competitive dynamics. Links between the internalisation approach (Buckley and Casson, 1976, 1985) with the market power approach (Hymer, 1976) have been advocated by Cantwell (1988) and specific attempts at integration suggested by Hymer (1968) and Casson (1989). This integration, as presented by Buckley (1990, p658) suggests that there are two sets of processes at work. The first, internalisation, within a fixed industry size, determines the number of firms in the industry. The second, market structure, determines the opportunities for horizontal expansion. From this he suggests that highly concentrated industries encourage diversification while the imperfections of other market structures may induce price distortions and forward and backward integrations.

Buckley also identifies links between the internalisation approach and Porter's (1980, 1985, 1986) models of competitive advantage. While the internalisation approach in Buckley's view is concerned with the growth of the firm as determined by the benefits of internal control relative to the cost of using external markets, Porter views growth as

³ While a network theory is still some way off, there is currently a plethora of research interest in network phenomena from researchers in a number of disciplines. Relevant empirical evidence from such studies will be discussed throughout this thesis where it adds to general understanding of the research question.

being the result of competitive advantage, i.e. the advantage of one firm vis-à-vis another. Competitive advantage in this sense Buckley indicates as being directly analogous to Dunning's ownership or firm specific advantages (Dunning, 1981).

Theories of international business have been criticised for neglecting firm specific attributes and in particular, for their failure to take into account "evaluative judgements" in strategic decision-making. In particular, firms' willingness to take a decision is overlooked (Dunning, 1988; Carlisle, 1993). The latter author suggests that more cognisance needs to be taken of corporate heterogeneity. This echoes a widespread call for stronger links between economic approaches and other disciplines. In Buckley's view, an integration of economic approaches with approaches from other disciplines such as political science, sociology, geography, entrepreneurship and resource dependence, is important but more difficult to achieve. Such integrations he suggests:

"---will perforce proceed piecemeal. It is therefore essential to examine the theory for linking points with such concepts in the hope of building bridges that will bear the weight that they must carry".

Internalisation, Marketing and Distribution

Buckley, Pass and Prescott (1990) presented a synthesis of marketing approaches to internationalisation which concentrate predominantly on export and distribution, with economic and business approaches which are more concerned with production activities and largely ignore marketing functions. What Buckley et al. suggest is that international market servicing involves the entire channel or value chain of activities and that various functions and activities within the channel will be alternatively externalised or internalised. Four propositions are made:

- Proposition 1* The whole channel must be considered in making market servicing decisions ----'closeness to customer' entails the optimum mix of location and internalisation decisions.
- Proposition 2* Once a part of a channel is externalised, downstream activities (towards the customer) will not be internalised.
- Proposition 3* Once a part of the channel is located abroad, there will be a tendency for downstream activities also to be located abroad.
- Proposition 4* Control and monitoring of information is vital to the success of international channel management. The control and direction of information will be a major reason for internalisation of key functions.
-

What this attempted integration suggests is that internalisation decisions affect the efficiency and costs of a firms operations at functional level. The interdependencies of functions are therefore important in the externalisation/internalisation and market servicing mode decision.

Important here is the acknowledgement that internalisation may occur, not only of intermediate production but also of associate functions such as marketing and distribution. The authors point out that the relative efficiency of internalisation/externalisation of functions is therefore important. Interesting for this thesis is the value chain approach adopted here which emphasises the externalisation of functional activities. Small firms are often specialists in relatively narrow ranges of activity within the production value chain, what is important here therefore is external links with other firms and the potential for small firm internalisation (inward or outward).

Internalisation and Systems Theory

Another relevant integration is Casson's (1992) integration of systems theory with the internalisation approach. Casson develops the idea that the internalisation of markets may be partial (1992, p6) as some links, e.g. between intermediate production units may be internalised whilst others e.g. between a production unit and the downstream activities of another firm are not. The efficiency of the system becomes the sum of the economies stemming from all linkages. Of some interest here is Casson's identification of ownership strategies for innovative firms (Box 4.5).

Box 4.5

Alternative Ownership Strategies for a System of Production Marketing and Research and Development Facilities			
Strategy	Isolated Activity	External Linkages	Internal Linkages
Full integration	-	-	R-M,M-P, R-P
Licensing	R	R-M, R-P,	M-P
Subcontracting	P	M-P,R-P	R-M
Sales Agency	M	M-P,R-M	R-P
Complete disintegration	R, P, M	R-M, M-P, R-P	-
Source: Casson, M (1992) p9.			

In Casson's integration, transaction costs are seen as arising not so much from the specificity of assets (Williamson, 1975), as from defective property rights, quality uncertainty and the difficulty of enforcing collusion. In Casson's view the limitations of the patent system coupled with the need for secrecy provide

strong incentives for complete integration of the system. International expansion as

opposed to purely domestic expansion is explained by Casson through differentiating between technical know-how which he sees as universal in its geographical coverage, and marketing know-how which is not, (Casson, 1992, p12-13). The argument put forward is that the owner of technical know-how has domestic market knowledge but does not have foreign market knowledge. Lack of knowledge, of the foreign market, generates costs in doing business in foreign markets (Kindleberger, 1970). Such assumptions, Casson suggests, stimulate the argument that domestic R&D and domestic marketing may be internalised at negligible cost, since knowledge of both is held by the integrating firm. Internalisation of R&D with foreign marketing operations is more costly because the relevant know-how belongs to different people. From this Casson hypothesises that licensing and agency selling will be more common in international business than in domestic business and that domestic licensing and sales agency will never occur when the firm has wholly-owned marketing subsidiaries abroad.

Following this line of argument, as the firm develops trust with its foreign agent, but while it is still unsure of its foreign marketing know-how, it may be prepared to share control with the agent through a joint venture agreement in which R&D and domestic marketing are partially internalised with foreign marketing. Eventually the overseas partner may be bought out and internalisation is complete (incremental ownership).

In Casson's approach transaction costs are vested in know-how and international expansion is seen as a process of incremental ownership beginning with agency or licensing agreements between domestic R&D and foreign marketing, and progressing to joint venture and full ownership of the foreign operations.

This approach comes some way towards an explanation of the transition from export entry modes to direct investment overseas using discrepancies in technical and foreign market know-how as the link pin. This approach also sees cross-border cooperation between firms as an important, if transitional, step in the internationalisation process. There are interesting implications here for the a possible explanation of the early internationalisation of NTBFs since such firms, which are inherently innovative, have ownership advantages in their technological know-how but may lack resources necessary to fund patent protection, and, in the beginning at least, may lack know-how of both domestic and foreign markets and indeed marketing processes. The implications of Casson's approach are that licensing or agency sales will be the first step in internationalisation with joint venture agreements and complete internalisation coming later. Limitations of this explanation are that it does not explain cooperative

R&D, since it implicitly assumes that internationalisation takes place for the purposes of marketing and not for the development of technology.

Internalisation and Entrepreneurship

Some recent research has suggested that far from going through a gradual process of internationalisation, some firms are in fact international from the outset (new international ventures - NIVs), a proposition which sits uneasily alongside traditional multi-national theory. Oviatt and McDougall (1994) propose that four necessary and sufficient elements are necessary to establish whether or not a firm is a NIV:

- organisational formation through internalisation of some transactions,
- strong reliance on alternative governance structures to access resources,
- establishment of foreign location advantages,
- control over unique resources.

The size and experience of the firm is clearly not important here but other competencies and factors come into play. The same authors identified 4 categories of NIV distinguished by the number of value chain activities that are coordinated and the number of countries entered. The first category is *New International Market-Makers*. These effectively are import/export start-ups. The most important value chain activities to these firms, and which are most likely to be internalised are systems and knowledge of logistics. The success of these NIVs has been identified as the ability to spot and act on new opportunities before competitors, knowledge of markets and suppliers, and the ability to attract and maintain a network of business associates. The second category, *Multinational Traders*, is similar to import/export start-ups, but these firms tend to serve more countries. The third group, *Geographically focused Start-Ups*, are those which serve the needs of a particular region of the world through the use of foreign resources. Their competitive advantage lies in their ability to coordinate multiple value chain activities such as technical development, human resources and production. The fourth category *Global Start-ups*, exhibit extensive coordination among multiple organisational activities in unlimited geographic locations.

This approach, based on transaction cost rationalisation, offers an explanation which acknowledges entrepreneurial differences between small firms and takes on board the value chain position and involvement of the firm and its level of development in its industry. Important in this study of small firm internationalisation in technology intensive industries is the idea that firms do not need to progress through an established chain of activity, but have 'random access' to countries/markets based on their resource/capability configurations and the considered decision of the entrepreneur.

Internalisation and Technological Accumulation

Recent developments in MNE theory have emerged from changes in the international competitive environment. Increasing internationalisation of manufacturing production is to some extent connected with technological competition between MNEs (Cantwell, 1989). Of particular interest in this respect is Pavitt's (1987) suggestion that MNE growth can be linked to a process of technological accumulation within the firm and from this, innovation and the growth of international production are seen as mutually supportive.

The technological accumulation approach takes the view that the development of technology within a firm is a gradual process during which knowledge, and thus technology itself develops over a period of time and accumulates as experience is gained and further adjustments and refinements made. Although firms within an industry or technology may be undergoing similar processes of technological development, within each firm this process will be different. The basic assumption of the approach is that firms in oligopolistic industries must develop or acquire new technology in order to be competitive. Where technology is acquired it needs to be integrated into the current production system within the firm.

As technological accumulation, within the firm, and the path such development takes (technological trajectory) is a gradual process depending on the development of knowledge and experience, it tends to be very firm specific, and favours internalisation (Dunning, 1993, p87). Firm specific technology however, needs to be disseminated, and in order to remain technologically competitive, firms need to buy-in or access external technology. Where technological accumulation has become very specialised within a firm it is less costly to extend its production network overseas by internalising other production and R&D units of similar or complementary technologies than to buy-in technology from competitors and abandon its trajectory (Cantwell, 1989, 1991). Thus Cantwell sees internalisation in technology based firms as being a process of technological accumulation and network development.

Dunning (1993) treating technological competence as a firm specific asset, suggests that the creation and sustenance of such an asset may be dependent on the innovatory characteristics of the countries in which the firm locates its production (Dunning, 1993, p87). The dependence of technological development on specific factor endowments of particular locations suggests that there may be industry or national patterns of technological accumulation. Pavitt (1988) has suggested just that. In an exploration of international patterns of technological accumulation, it was hypothesised that

international patterns of technological advantage may result from, attempts to substitute for high-priced factor inputs, availability of raw materials and government support, but more importantly here, from firm-specific entrepreneurial activities.

"These entrepreneurial activities both reflect and determine the technology accumulated in firms through R&D, design, investment, production engineering and production activities. They are also a function of firms' methods of organisation and evaluation of innovative activity, and of their competence in forming expectations about future technological developments and their commercial implications" (Pavitt, 1988, p151).

There are two important implications here for this thesis. The first is that if patterns of technological activity can be predicted amongst sectors and amongst countries as suggested by Pavitt (1988), it may also be possible to predict the direction and location of internationalisation by small technology intensive firms based on knowledge of patterns of technological accumulation in countries or regions. Whilst such predictions are beyond the scope of this research, patterns in the location of TIFs trade, investment or country of origin of their cooperative partners may emerge from the findings. Examination of international linkage activity at firm level could add to existing knowledge on technological accumulation in firm, network, region and country.

The second is the suggestion quoted above from Pavitt (1988) but also frequently iterated by Cantwell and Dunning, that firms' "method of organisation" may become its competitive advantage. Again there are interesting implications for this research in that interest is in new forms of international agreement which involve long-term commitments by firms to work together. Interest also is in how early growth through external linkages may lead to the development of a new international venture. Important linkages may exist between the processes of technological accumulation and organisational arrangements for internationalisation. In addition, the multinational process of technological accumulation is likely to have spill-over and spin-off effects which could positively influence the expansion and internationalisation process of small firms.

Knowledge and Resource Based Approaches

Knowledge has become an important issue in current interpretations and applications of the internalisation approach to the international expansion of the firm. Several such interpretations have been discussed above (Teece, 1977; Casson, 1992; Kogut and Zander, 1992, 93; Wheeler et al., 1996). While no specific knowledge-based approach

appears to have emerged from studies of firm international expansion, the frequency with which *knowledge* has been mentioned in internalisation, export development and network approaches suggests that it is a fundamental issue to most explanations of international expansion. Certainly the recent integrations and new perspectives discussed above have tended to home in on *knowledge* as a key issue in the development of theory.

Resources on the other hand appear to have been mentioned only in the context of market imperfections and firm specific advantages and it is the firms' privileged access to or ownership of resources which has been examined. Resources have been mentioned in relation to resource seeking motivations for MNE investment and in connection with strategic alliance formation. In studies of small firm internationalisation, very little attention has been paid to the access to or management of resources by small firms and their role in cross-border activity. There is a wide spread implicit acceptance that small firms are inhibited in international growth because of a restricted resource base. Consequently, this assumption has limited studies of small firm international expansion and the development of a fully explanatory theoretical approach.

In the view of this author explanations of small firm international expansion are most likely to emerge from resource and knowledge based perspectives and may incorporate aspects of internalisation and entrepreneurial behaviour. This argument is further developed in the next main section of the chapter which discusses small firms in relation to foreign market entry.

Summary

Three main sources of explanation of the international expansion of firms have been explored. These were, economic approaches to multinational development, process or export development approaches, and network approaches. While each of these three main schools of thought have made major contributions to the understanding of the international expansion of firms, none is comprehensive in its treatment. While a comprehensive explanation is probably neither possible or desirable, there is a need for greater cross-fertilisation of ideas between the main approaches. Recent integrations of theory, some of which have been discussed above have tended to converge on transaction costs as the main supporting frameworks and have expanded interpretation of its components to accommodate behavioural and dynamic processes within its inherently rational and cost-based foundation.

In general, the theories reviewed are limited in their explanation of the international expansion of very small, very young firms and this gap is particularly pronounced in the early, transitional stages of the firms international expansion. A convergence towards internalisation approaches has been noted and of particular interest are explanations which emphasise knowledge and resources since these are issues of particular importance to small firms with growth potential. Step/stage approaches to international expansion are not thought to be of particular relevance but the work of Luostarinen is of particular interest to the researcher, as is very recent work on new international ventures which recognise the role of the entrepreneur in the internationalisation process. The next section is focused more specifically on the treatment of small firms in the internationalisation literature.

Small Firm Internationalisation and Foreign Country/Market Entry Modes

Outside the export behaviour, development and performance literatures, studies of small firm internationalisation have not tended to view internationalisation as a holistic process but rather, have concentrated on specific types of cross-border activity. Cross-border activity in the guise of foreign market entry/servicing mode has been seen as a frontier issue in international business research since the late 1980s. Emphasis on specific modes has resulted in a fragmented literature, especially where Small Firms is concerned. In general, the literature on foreign market entry modes as competitive strategy has reached some degree of maturity. Foreign market entry modes as part of a holistic growth process of small firms has received much less attention and as such is perhaps a frontier issue for research in the Millenium.

Much of the research on foreign market entry modes has tended to emphasise the modes as alternatives necessitating some kind of strategic choice in their selection and implementation (Young et al., 1989; Root, 1987, 1994). To this extent, links between research into specific entry modes and their treatment in internationalisation process approaches are anything but straightforward. Modes of entering foreign markets represent important decisions for firms in the process of internationalisation but, in the literature, links between entry modes and the actual process of going international are frequently implicit rather than explicit and tend to rest on a few assumptions, as discussed in relation to step/stage models of export development above.

The fact that foreign market entry modes are actually different forms of business activity suitable for different types of firms in different circumstances, conditions and with different areas of competence has largely been overlooked by the process theorists who

have tended to adopt a "learning theory" approach to internationalisation. Economic approaches have emphasised cost and risk in linking entry modes with international expansion and have tended to advocate a gradual move from low cost / low risk strategies such as exporting to higher cost/higher risk strategies such as wholly owned production subsidiaries.

The importance of ownership and control in such approaches has tended to marginalise entry modes where firm independence is not complete and where the major source of income is service rather than product related. Subsequently, studies on internationalisation, i.e. looking at the cross-border expansion of a firm's business activities, are relatively few in comparison to the vast accumulation of literature on specific entry modes such as exporting or overseas production subsidiaries. As this study is concerned with the early international expansion of small firms, it must encompass a number of alternative entry modes, especially as the intrinsic nature of small firms' business may change fundamentally in the early stages of its development, for example, a firm specialising in R&D may develop a production line but may decide to concentrate on its research and profit from its intellectual output. Similarly, a manufacturing firm may find that its competencies lie in technical or management service and international expansion may involve these activities to a greater extent than exporting.

Table 4.2 Definitions of Foreign Market Entry Modes

Exporting	Transfer of goods and/or services across national boundaries via indirect (export house, confirming house, trading company, piggybacking etc.) or direct (agents, distributors, company export salespersons, sales subsidiaries) methods.
Licensing	Contracts in which the licensor provides licensees abroad with access to one, or a set of technologies or know-how, in return for financial compensation.
Franchising	Contracts in which a franchiser provides a franchisee abroad with a 'package' including not only trademarks and know-how, but also exclusivity and management and financial assistance and joint advertising.
Management Contracts	An arrangement under which operational control of an enterprise, which would otherwise be exercised by a board of directors or managers elected and appointed by its owners, is vested by contract in a separate enterprise which performs the necessary management functions in return for a fee.
Turnkey Contracts	Contracts in which a contractor has responsibility for establishing a complete production unit or infrastructure project in a host country.
Contract Manufacture/ International Subcontracting	A contractual arrangement in which a company (the principal) in one country places an order, with specifications as to conditions of sale and products required, with a firm in another country.
Industrial Co-operation Agreements	Hybrid arrangements conventionally applied to arrangements between Western companies and government agencies or enterprises in the Eastern Bloc.
Contractual Joint Ventures	Contracts formed for a particular project of limited duration or for a longer term cooperative effort with the contractual relationship commonly terminating once the project is complete. May relate to co-production, co-R&D, co-development, co-marketing plus co-publishing, consortium ventures by banks to finance large loans etc.
Equity Joint Ventures	Arrangements which involve the sharing of assets, risks and profits and participation in the ownership, (i.e. equity) of a particular enterprise or investment project by more than one firm.
Wholly-Owned Subsidiaries	Operations which are one hundred percent owned abroad. May be manufacturing or sales/service ventures. May be formed through acquisitions or greenfield operations.

Summarised and Tabulated from: Young et al. (1989) pp1-2.

In recent years many different methods of expanding into international markets have been added to the classic three alternatives of exporting, licensing and foreign direct investment. Definitions of some of these modes have been listed by Young et al. (1989) and are reproduced in Table 4.2.

Although each entry mode involves different processes, it is possible to categorise the modes along the dimensions of risk, control, managerial commitment and investment and according to the location of production. Luostarinen (1980) provides a useful categorisation of foreign market entry modes in which the alternatives are classified in the first instance by whether the production activity takes place at home or overseas. In the former category he includes forms of indirect and direct exporting which are conveniently sub-divided into forms in which there is no direct investment in marketing operations overseas, and those in which there is. The second main category of entry methods, where production takes place in the foreign location, is sub-divided into non-direct investment production operations including, licensing, franchising, contract manufacturing, international subcontracting and turnkey operations, and direct investment production operations which may involve assembly and manufacture and include a range of levels of ownership control including minority holdings, joint ventures and wholly owned operations.

The usefulness of this categorisation lies in the distinction it makes between home and overseas production and its arrangement from left to right of modes by increasing levels of risk, commitment, investment and control. The main limitation of the categorisation is that it does not include inward internationalisation processes as it stems from Luostarinen's early conceptualisation of internationalisation as "the outward movement of a firm's activities" and therefore does not include inward internationalisation processes resulting from foreign firms' involvement in the domestic market and their influence on domestic firms' international orientation and activities. Observation of this type of organisation of entry modes through increasing risk, investment and commitment from indirect exporting through to wholly owned foreign production operations (Simyar and Aigheyd, 1987) has contributed to the generally held assumption that small firms begin internationalisation through least risk, lowest investment methods, e.g. indirect export, moving to higher risk, higher investment modes as the firm develops and gains experiential knowledge of foreign markets. This widespread but implicit assumption has been explicitly hypothesised by process theorists (Johanson and Vahlne, 1977; Bilkey and Tesar, 1977; Cavusgil, 1984, see discussion above). This appealingly logical and progressional approach is in part supported by analysis of the costs involved in exporting compared to foreign direct investment. Buckley and Casson (1985) using a marginal cost approach to the cost/volume equation demonstrated that costs of servicing markets through exporting would increase with volume to the point where it would be more economical to switch to production abroad. In order to become involved in FDI therefore, a firm would need to increase its volume sales either domestically or in export markets to a point where direct foreign investment is more cost efficient. Again this supports the idea that small

firms begin internationalisation through export. Although there is adequate evidence in the literature to suggest that small firms may begin internationalisation through other foreign market entry modes, the cost/volume, investment/risk arguments have tended to set the stage for the evolution of the literature on the small firm internationalisation process. The vast bulk of the literature on this topic therefore, with a few notable exceptions (e.g. Oviatt and McDougall, 1994; Welch, 1993; Litvak, 1990; Welch, 1981; Luostarinen, 1979; Buckley, 1979; Newbould et al., 1978) is focused on exporting. Literature on international joint ventures, strategic alliances and wholly owned overseas production, on the other hand, is dominated by studies of large multinational firms. In general, studies of internationalisation as a growth process have tended to focus on the later value chain stages of international growth (i.e. production, marketing and distribution) and have largely ignored small firm involvement in research design and development which more recently has been seen to internationalise through MNE networks and government technology programmes. Another area which has been inadequately explored is the transitional phase in which the small firm becomes a large firm, and the wholly domestic firm becomes an international firm. Literature specifically on small firm internationalisation is at this stage fragmented, tends to focus on individual entry modes and seldom discusses the range of alternatives available to very small firms.

Limited resources and management abilities, together with the expense and commitment involved in going international and a plethora of studies providing empirical evidence that most firms go international in the first instance through exporting, have led to an implicit association in the literature between exporting (one mode of international activity) and the international expansion process of small firms. There are a number of problems with this association and approach to small firm internationalisation:

Firstly, choice of market entry mode is not purely a cost/volume, investment/risk evaluation of alternatives. Root (1987), Turnbull (1987) and Wheeler et al. (1996) have suggested that both external and internal factors influence the market entry mode decision.

External factors include both foreign country factors (including sales potential, competitive structure, production costs, trade and investment policies, geographic distance, exchange controls and cultural and political risk), and home country factors (including market size, competitive structure, production costs and trade and investment policies). Internal factors are concerned with the type of product and its level of adaptation, the level of firm resources and its willingness and ability for commitment.

While Root (1987) expands the entry mode decision criteria beyond the basic rational, cost-based factors, behavioural issues are not included. Some writers (Young et al., 1989) have suggested that firms undertake a strategic decision-making approach to market entry mode choice, weighing up the advantages and disadvantages of entry modes against country factors and firm factors including the firm's objectives. This competitive strategy perspective includes an entrepreneurial/behavioural dimension which Root's checklist, of internal and external factors in the entry mode decision, omits. His checklist recommends that firms with limited resources opt for either exporting or licensing and does not advocate direct investment.

The emphasis in the checklist is implicitly on independent expansion. The possibility for small firms of accessing additional resources through external connections, would, intuitively increase the choice of entry modes by increasing firms' "accessible" resource base (Forsgren and Johansson, 1992). Another problem lies in the tendency for internationalisation to be seen as isolated one-off decisions relating to market entry rather than a series of strategic choices related to continuing expansion and in association with the firm's existing or potential external links.

Secondly, exporting involves the sale abroad of a "product" or "service" which, one way or another, needs to be transported or transferred across national borders.

Returning to the concept of "internationalisation" as being the "outward expansion of a firm's activities", the concept tends to be linked with the marketing stage of the production chain and hence "market entry" rather than the wider range of cross-border economic activity involving flows of not only goods and services but of knowledge, rights, technology, personnel, ideas and business systems. This approach to studies of small firm internationalisation is inadequate for very small, very young firms for a number of reasons. Some products, and especially services need to be produced in the customer's market, e.g. perishable products or those which are highly integrated with another production process as is the case in some technology intensive products. In these instances direct investment in foreign production may be the best choice for the small firm.

Another point is that although in the export literature lip service has been paid to the export of services, attention has for the most part been on manufactured products, and little attention has been paid to the position of specialised small firms in the value chain. This overlooks services performed in the domestic market for overseas based customers and clients. It does not consider soft-start firms which may be involved in international business activities such as R&D, service or consultancy, and implicitly presupposes

that all internationalising firms are manufacturers of "products". Chapter 3 of this thesis discussed the international dimensions of technology and in particular the role of national and international technology policy. In recent years this has placed considerable emphasis on the role of small firms in R&D and has actively encouraged cross-border collaboration through project funding.

Thirdly, although the role of unsolicited orders from overseas has been explored in the context of export stimulation, the influence of foreign contacts /partners on small firm internationalisation has been inadequately explained.

Until recently (Luostarinen et al., 1994) little account has been taken of the effects of inward internationalisation on the cross-border expansion of local small firms. Despite the fact that a considerable number of export studies have identified the receipt of unsolicited orders as an important stimulus for exporting (e.g. da Rocha et al., 1990; Karafakioglu, 1986; Beamish and Munro, 1986; Bilkey, 1978; Wiedersheim-Paul et al., 1978), the importing process is almost entirely neglected in studies of internationalisation. In an aggregate analysis of the literature on export stimulation, Leonidou (1995) found that the receipt of unsolicited orders from foreign customers was the most frequent and most influential factor stimulating export initiation. He concluded from this that firms engage in exporting in a very "passive and opportunistic manner (1995, p19). The actual effect, and especially the behavioural dimensions of importing on the outward internationalisation process of small firms has rarely been discussed (Liang, 1995, p37). The implicit assumption is that unsolicited orders are accepted in an ad hoc and reactive fashion by potential exporters. Liang (1995) reported that while literature on organisational buyer behaviour prescribes systematic vendor selection and appraisal, a number of studies of international purchasing have found that the process is more often non-systematic and ad-hoc (Gomez-Mejia and McCann, 1989; Papadopoulos and Denis, 1988). The former author hypothesises that firms which initiate unsolicited export orders are themselves inexperienced and at early stages of internationalisation.

Fourthly, many small firms exist as importers for or sub-contractors to larger firms and involvement in foreign markets and the internationalisation process in general may be strongly influenced by linkages between small domestic firms and large foreign firms or organisations.

Recent studies of MNE networks and studies on the impact of MNE activity on host economies suggest that where there is a concentration of MNE activity in host economies, there are likely to be significant spin-off and spill-over effects which will

affect local firms. There is a huge literature on this topic which is thoroughly summarised in Dunning (1993). Of particular interest here are linkages and spill-over effects which may influence the development of local small firms. A number of researchers have examined the sourcing strategies of MNEs (Lall, 1980; UNCTC, 1981) and found that the local content of the sales of two British MNEs located in India was extremely high. This pattern is not consistent however, and in a similar study (Landi, 1986) in a study of the automobile industry in Nigeria found that foreign affiliates were more likely to import intermediate products than their local counterparts. Similar results were found by McAleese and McDonald (1978) in a study of foreign affiliates in Ireland and South Korea. Amongst reasons for these differences was the level of development of supplier capabilities in different countries. MNE subsidiaries have also been found to engage in sub-contracting in the local economy (Halbach, 1989) and again the level of activity tends to be positively correlated with the level of sophistication of the local industrial infrastructure (Dunning, 1993, p451). While sub-contract and supplier links may, to a large extent be triggered by host government local content requirements, some MNEs, reputedly the Japanese, utilise their network of suppliers to gain and integrate new knowledge from suppliers into their own products and production processes (Okada, 1991).

MNEs also forge linkages with local firms in the primary product sector, the service sector and with local customers. Such links are not only likely to increase the output of local firms and the numbers of supplying firms in the local industry, but also the nature and quality of the output. Synthesising the pertinent literature (Lall, 1980; UNCTC, 1981; Halbach, 1989), Dunning identifies nine different types of links between the purchasing arms of MNEs and local suppliers. These links facilitate or provide for: information exchange, technical assistance, financial assistance, procurement assistance, location advice and notification, managerial and organisational assistance (Table 4.3).

Similar linkage activity exists between MNE subsidiaries and downstream members of the value chain such as customers and forward linkages in processing activities. While macro-economic literature is full of reports from studies on the impact of MNE activity on local economies, there is a dearth of information at small firm level on the effects of such linkages on their growth and development, and in particular in recognition of the role of such links in small firm internationalisation. In the MNE literature, such external or transactional links tend to be dismissed as a necessary evil where internalisation of intermediate product markets is impossible or limited.

"In a perfectly functioning intermediate product market, there would be no need for firms to establish any of these linkages. In the real world of market failure, however, enterprises are faced with various kinds of transaction costs which they perceive they can best circumvent by concluding a variety of formal or informal arrangements with their suppliers". (Dunning, 1993, p456).

Such links are not only likely to stimulate the start-up of small supplier firms in the MNE host economy, but provide a source of information, technical expertise, managerial and financial support (see table 4.3 below) and as well as stimulating the growth of individual firms, may provide a bridge for their international expansion through the MNEs overseas links and networks (Johanson and Mattsson, 1987). In developed and highly internationalised economies such as the UK, evidence of such widespread MNE activity raises questions concerning the wisdom of the widespread assumption that small firm internationalisation begins, or is characterised by exporting. At any rate, there is definitely a need for more empirically based research on the effects of MNE linkages on small firm growth and international expansion focused at small firm level.

1. Information Linkages	These include exchanges of information on market characteristics and trends, on future investment intentions, on host government regulations, and on foreign suppliers of machinery, parts material and components. Information might also be provided to the suppliers, by the parent company of the MNE, about local firms with whom joint ventures or non-equity collaborative agreements might be concluded.
2. Technical Assistance	This includes help given or received on such matters as innovation and product design, proprietary product specifications, development processes, factory layout, tooling, quality control, labour training, inventory management, machine maintenance, inspection and testing procedures, and so on. It might also include the provision of used machinery.
3. Financial Assistance	This may embrace repayable loans or concessionable contributions to the sub-contractors' risk capital, terms, grants, prefinancing of machinery and tools, and special price agreements and financial help to local suppliers in visiting their opposite numbers in the home country of the parent company.
4. Procurement Assistance	This covers help, other than noted in (1), to suppliers in obtaining capital equipment, raw materials and other intermediate products at competitive prices. In some cases, the affiliates suppliers might receive direct assistance from the suppliers of their parent company.
5. Location	This includes advice given to potential suppliers (particularly those of foreign origin) on the siting of a new plant or an existing establishment.
6. Managerial & Organisational Assistance	This includes help on a range of financial, accounting, and general managerial control procedures.
7. Pricing Assistance	This covers technical advice about the costing of products, and of contractual and bargaining procedures in order to determine prices.
8. Other Assistance.	This includes helping suppliers to obtain sales to third parties in the open market; assistance in exporting to markets which are familiar to the MNE; advice on diversification strategies, dealing with foreign suppliers etc.
Adapted and Tabulated from: Dunning, 1993, pp455-6.	

Fifthly, the cost structures of exporting and FDI in high technology industries have been changing.

In a telephone conversation with the researcher (1993), Rothwell suggested that FDI (internalisation) for small firms in very new and emerging technologies may be cheaper than the transaction costs involved in a search for customers or licensing partners. In under-developed markets, or areas where technology has very specialised applications, the transaction costs involved in trying to enter markets through trade or contractual arrangements could be prohibitive. New technologies tend to use much smaller and more specialised production processes than previously and may have a high intellectual rather than physical content. FDI for such firms may involve the establishment of a laboratory or office, and the transfer of key personnel rather than the transfer of a hugely expensive production plant or process. This has been the experience of two companies known to the researcher, Cruachem (biochemical products with medical applications) and Midland Valley (software for geological diagnostics). Both of these

small Scottish firms established wholly owned subsidiaries in the USA while still very small (under 50 employees) and in the first few years of their existence. As in these examples, internalisation for some small firms may be viable in terms of cost and may be the only way of protecting intellectual property where it is inappropriate to take out legal protection for IPRs (see discussion of Casson, 1992, above).

Summary and Conclusion

The literature on the internationalisation of small firms was found to be vast but over concentrated in the area of export development, performance and behaviour and in general the literature was found to pay scant attention to either the heterogeneity of the small firm sector or the various and often specialised roles played by small firms in the value chain. This chapter has not attempted to provide a comprehensive review of the literature on small firm internationalisation which is so concentrated in the area of export, a literature which has been well summarised and discussed elsewhere. Rather, an attempt has been made to review recent and current explanations of international expansion and identify gaps and issues, which are particularly salient to a study of the internationalisation of small technology intensive firms.

The above discussion and ensuing arguments suggest that *types of business activity* rather than *modes of foreign market entry* are important in the international expansion of small firms. Studies of small firm internationalisation which concentrate on export behaviour are limited in that they tend to ignore the heterogeneity of the small firm sector and are concerned almost exclusively with the development of the marketing and distribution function or the development of export markets. Although some studies have concentrated on specific entry modes in relation to the expansion of small firms (e.g. licensing or FDI), these do not purport to give a general explanation of international growth or expansion.

The literature on the internationalisation of small firms is at present underdeveloped and fragmentary. Specific aspects of small firm internationalisation have been dealt with in depth and there is a plethora of literature on export development, the characteristics of exporters and export performance and behaviour. Literature on the development of multinational firms, their impact and strategy and studies on strategic alliances, joint ventures and multinational networks have provided some evidence that small firms in local economies may become drawn into international markets through their involvement with MNE affiliates and subsidiaries.

Outside the export field however, the internationalisation of small entrepreneurial firms has largely been neglected. Specific gaps exist in knowledge on the relationship

between market entry modes and the internationalisation process, and although entrepreneurial and other behavioural aspects of internationalisation have been paid lip-service in the multinational literature, little research has been undertaken which explicitly addresses the internationalisation of the small firm and more particularly, the development and utilisation of external linkages in small firm internationalisation.

Network approaches, while providing a realistic description of the process of international expansion of small firms through the development of interfirm relationships, at this stage in their development provide neither a set of decision criteria for management nor any clear means of establishing the output or performance of networks. It is clear however that all approaches have something to offer and in the case of very small firms a hybrid approach may be necessary to interpret and explain international expansion. In the view of the research this is likely to be rooted in internalisation and resource/knowledge based approaches with explanation of firm behaviour coming from entrepreneurial factors.

The purpose of this chapter has been to bring together strands of thought relevant to the current position of small firms vis-à-vis international expansion. In summary, the chapter has suggested that theoretical approaches to the international expansion of firms need to be opened out to accommodate both economic and behavioural dimensions of growth and provide a dynamic rather than a static or incremental explanation of the process. Review of the literature on small firm internationalisation revealed a heavy concentration of studies of export development. The ensuing argument suggested that studies of small firm internationalisation need to accommodate all market entry modes which rather, should be seen as ways of doing business across borders. In addition, more attention needs to be paid to the heterogeneous and often specialised nature of the small firm sector.

A common theme identified throughout the international literature is that small firms are often inhibited or limited in their international expansion due to a limited resource base and managerial capabilities. While export policy has traditionally provided support for export expansion, evidence has been emerging that small firms are sometimes able to increase their resource base through accessing and utilising external links and contacts. Literature on the cross-border linkage activity of small firms is at this stage fragmentary and underdeveloped, but represents a rich and important perspective for this and future studies of small firm internationalisation.

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Chapter 5

Conceptualisation and Problem Statement

Chapter Objectives

- *To make a clear statement of the aims and objectives of the thesis together with a statement of the assumptions made.*
- *To discuss the conceptual approach taken, contextualised within the four main theoretical approaches discussed in the literature chapters, these approaches are:*

Network/Behavioural

Internalisation/Transaction cost

Internationalisation/Export development

Resource-Based.

- *To explain the research constructs, external links and the dimensions on which they are constructed:*

Internal/External

Inward/Outward/Cooperative

R&D, Production, Marketing/Distribution

- *To develop specific research questions based on the more broadly defined aims and objectives of the study.*

Introduction

The purpose of this chapter is to state the aims and objectives of the research, make a clear statement of its conceptual stance and assumptions made, and develop the main research questions to be addressed through the proposed fieldwork, the latter being discussed in Chapter 6. The chapter begins by setting the context for the research and by making statements of the research aims and objectives which are concerned with international aspects of firm development over time. The background to and support for the aims and objectives are developed in a brief discussion of converging themes and issues from the preceding literature chapters.

The conceptual framework and approach of the research are fundamentally important to the research design, and to the usefulness and applicability of the research results. This chapter therefore draws together themes and ideas from the preceding three literature review chapters and, examining relevant empirical studies concerned with the technological and/or international growth of small firms, develops the conceptual framework and research questions.

Underlying the conceptualisation of the research is a single belief or idea which is stated in the chapter as the *central tenet* of the research. The tenet, *that small firm growth and expansion can be tracked through the examination of external links made over time*, is explored through a discussion of the role external links have played in the growth and development of small firms, in various studies, from currently fragmented sources. From these studies specific links are identified which are of particular significance to the objectives of this study.

The research was conceptualised from the perspective of firm development and growth, and takes the view that international expansion is part of a holistic growth process. This is made clear in a series of statements outlining the conceptual framework and the assumptions made in the development of the research questions and overall research design.

The research is exploratory in nature and for this reason the research design is formulated as a series of broad research questions rather than hypotheses, which identify and explore issues pertinent to the international growth and expansion of the small firm. Finally, the chapter ends with a statement and discussion of the research questions which form the basis of the fieldwork and the analysis.

Development of the Conceptual Approach

Aims and Objectives of the Research

The whole purpose and motivation for the research is grounded in the researcher's interest in the early stage development of small firms' international activity. Fundamentally, the researcher's interest is in how exactly internationalisation begins for small firms, and how their international expansion process develops over time and in conjunction with the development of the firm per se. Specifically, interest is in the small technology based firm which, in addition to the usual problems pertaining to small firm survival and growth, is faced with rapidly changing technological processes, markets, industries and products. In addition, technology markets and industries are themselves rapidly internationalising and products and technologies may have specialised but global applications. Such small firms may need to operate and succeed at international level almost from inception. As indicated in the literature review on international expansion however, research in small firm internationalisation is heavily concentrated in export studies and studies specific to entry modes. Internationalisation as part of the growth process of the firm has received much less attention.

The aim of this research is to examine the *international expansion process* of small technology based firms. Stated explicitly, the overall aim of the research (box 5.1 below) takes a holistic and exploratory approach to internationalisation, which has been termed *international expansion* to distinguish it from the establishment chain, and export development approaches which have been discussed and critiqued in chapter 4.

Box 5.1

Research Aims

The aims of the research are:

To describe and analyse the international expansion processes of small, technology based firms through examination of early cross-border links and business activities. (The view is taken that internationalisation is part of, and inseparable from the overall growth and development of small firms. This holistic process may involve any or all of the main value chain activities, R&D, production and marketing/distribution).

The aim is to examine the international expansion process through firms' cross-border linkage activity. It is worth pointing out here that this is not a network study although that strand of thinking has had a strong influence of the development of the research. It should also be noted that this is not specifically a study of foreign market entry although

“entry modes” are significant in the research design as outward external links. Rather the aim is to take a *holistic* view of the international expansion process incorporating links between the firms’ core functions, and individuals and bodies based in overseas countries. The rationale for this approach is discussed throughout the rest of this chapter.

Essentially, it is assumed that tracking specific types of links formed over time will allow a picture to be built up depicting the nature of the firm’s development in terms of its business activities, and the nature of its international expansion process. This is stated explicitly in Box 5.2. The firm’s links with overseas individuals and organisations are identified in relation to the specific value chain activities R&D, production and marketing and distribution. The types of links therefore are seen as evidence of the type of functional activity taking place within the firm, bearing in mind that neither activities nor links are generally mutually exclusive.

Box 5.2

Central Tenet

That the direction and nature of firm growth and expansion may be tracked through the identification and examination of the links formed with the external environment over time. International expansion may be tracked through the establishment of cross-border links over time.

The objectives of the research, stated explicitly in box 5.3, are concerned with the identification of very specific types of cross-border links made by the sample firms over the period between the foundation of the firm and the time of the survey.

The first objective (Box 5.3) is concerned with the extent of external cross-border linkage activity established by the firms in the study and the nature of that activity in terms of the types of links established. Interest is in how extensive cross-border activity is amongst the sample small firms and which types of links are established most commonly. Following this description, the second objective is to ascertain the importance of cross-border linkage activity in terms of firm development and growth. This objective is restricted to what can be determined from the *incidence* of links rather than the *value* of links. More depth and qualitative insights are planned for a follow-up study to this thesis. Here the objective is concerned with the establishment of the extent of linkage activity across the sample and to determine whether particular types of link, and frequency of contact with links are associated with firm growth and development and in particular, with *international* growth and development.

Research Objectives

The objectives of the research are:

1. To determine the extent of international activity (with potential economic gain) undertaken by small firms (≤ 200 employees), which are technology based, in four new technology sectors: pharmaceuticals, plastics and composites, advanced medical equipment, and electronic instruments.
2. To ascertain the importance of cross-border linkages in the development and growth of small, UK based technology firms.
3. To determine the extent to which small technology based firms utilise informal cross-border linkages and more formal cross-border cooperative arrangements in three core functional areas of activity:
 1. research and development
 2. production and technological development
 3. marketing and distribution
4. To identify factors which, in conjunction with cross-border linkages, influence the pattern of growth and development of small technology based firms and in particular, their international development.
5. To comment on models or theoretical frameworks predicting the pattern of international growth and development of firms with specific reference to small technology based firms.

Conventional wisdom, discussed in chapter 4, suggests implicitly and sometimes explicitly that international expansion for small firms is likely to begin through export sales, followed by other low risk contractual activities, culminating eventually in direct investment in sales or production facilities or processes overseas. In contrast, studies of small firm growth and development outside the international literature (chapters 2 and 3) have suggested that development and growth, especially in the early stages, do not necessarily emphasise hard output (manufactured products) and sales of the same.

Small firms have been found to develop through many and diverse activities including service activities, consultancy, R&D and other activities based on knowledge and capability rather as well as, or instead of, prior to sales of hard-core manufactures.

Other studies (see chapter 3) have suggested that technology based small firms especially, may specialise in particular value chain activities depending on their role in a network or within an industry structure for their survival and growth. For these reasons, the third objective is concerned with the types of cross-border links which are formed in relation to the three core function or value chain activities, research and development, production and technological development and marketing and distribution.

Identification of link types alone would provide only a description or outline of the international development and expansion of the sample firms without any causal explanation. The fourth objective therefore is to identify aspects of the firms themselves, their management, and product, industry and, market factors which might influence the types of cross-border links formed. In addition, the aim here is to identify *patterns* of international development, stages, periods of extensive generalised or specialised activity, or sequences of events, to ascertain whether patterns of growth are generalisable to all firms in the study, or are in some ways diverse.

The final objective is to discuss the findings of the study in relation to major theoretical contributions to knowledge on the international growth and development of the firm.

Constructs of the Research

There are three main constructs in the research. These are: the firm, consisting of its core activities, the external cross-border links established by the firm, and the firm's development and growth.

1. The Firm. The firm in this study is small, and as such, it is assumed that the main functional or value chain activities, R&D, production and marketing and distribution, are interlinked and managed and coordinated by an entrepreneurial owner/manager or small management team. Management is likely to be knowledgeable about all activities in the firm which may be not only coordinated but inseparable at least at early stages in the firms growth and development. In the early stages firms may concentrate on one or more of their core functional activities or specialise in a specific value chain activity. Concentration or specialisation would tend to be reflected in the types of links formed, the links themselves being evidence of the firm's activities in a functional area, and/or competence in , or resource needs for that particular activity.

The small firm in this study is examined in relation to its size and its age, characteristics which are regarded as key factors in internationalisation studies. In addition, the firm is examined in relation to the way in which it was founded, and its level of independence. While definitions of small firms invariably stipulate independence as a criterion for inclusion in small firm studies (see Chapter 2), minority equity links and corporate links relating to formation through spin-off, are seen here as factors which may influence cross-border linkage formation and international expansion.

Other firm characteristics which are considered important in this study are its concentration or specialisation in specific value chain activities. The study therefore characterises firms by their R&D intensity measured by the percentage of turnover investment, and by employment in R&D. Further evidence on specialisation or concentration is sought through determination of the percentage of employees engaged in each value chain activity.

2. External Cross-Border Links. The second construct is the *external links* established by the firm *over time*. External links are constructed on three dimensions:

- value chain links (R&D based, production based and marketing and distribution based,
- directional links, inward and outward, and
- consolidation of links, internal (integrated) and external (transactional).

The first dimension reflects the main functional or value chain activities of the firm and it is expected, as discussed above, that the types of links formed will reflect the specialisation or concentration of activity in the firm. Growth of the firm, especially at early stages may have a functional rather than a purely commercial focus.

The second dimension, the direction of the link, is determined in this study by the location of the value adding activity vis-à-vis the focal firm's interest. Thus conventional foreign market entry modes (Luostarinen, 1979; Root, 1984; Young et al., 1989) are considered here to be outward external links. Importing activity and R&D, production and marketing/distribution contract-in work and services performed in the UK for an overseas partner, are considered to be inward links. It is acknowledged that the direction of links could be established by alternative means such as the direction of financial, knowledge or product flows, but such analysis is beyond the scope of this study and will be considered in follow-up investigations.

The third dimension of external cross-border links has been developed from internalisation approaches to international expansion. In this study, internalised (investment) links are not assumed to be a viable option for small firms except in exceptional circumstances, due to the limits of the resource base. Internal cross-border links rather are seen here as being most likely an intensification or consolidation of contractual linkage activity. These types of link are treated as being on a continuum of involvement from very informal links (not discussed in this study, but see for example network approaches to firm growth), through various types of transactional external links to internalised links (integrated or consolidated external links).

3. Firm Development and Growth. The third construct of the research is the development and growth of the firm itself. One of the main underlying assumptions made in this study is that international expansion is part of the firm growth and development process per se. The main purpose of the research however is to characterise and explain different types of growth process as evidenced by the types of links formed by the firms. As the firms in the study are expected to be at different stages in development, it is not appropriate to compare their performance or profitability. The effect of the chosen modes of expansion is important here and the study examines the growth of domestic and international turnover in relation to the type of links formed. Reflecting the Scott and Bruce (1987) model of firm growth (discussed in Chapter 2) the structural development of the firm from 'entrepreneurial' to 'managed' is examined in relation to the establishment of formal R&D and export departments. Measuring the growth and development of small firms is not without problems however and this issue is discussed in relation to the research questions to be addressed in this study, later in this chapter.

Conceptual Framework and Assumptions

The research is set within a specific context and is based on a set of assumptions which have been developed from the literature and are stated explicitly in Box 5.4. The context of the research is that of small high technology based firms based in Scotland and England. The empirical data was gathered in 1994 and referred to the experience of the study firms during the period prior to that date. The assumptions made are that international expansion is a holistic process, which may be tempered by the resource base of the firm. The assumption is also made that international expansion for small firms is not confined to outward activities as in the export development models. It is assumed that cross-border links in an inward direction, e.g. work done in the UK for overseas-based firms, and importing are important, and part of the internationalisation process. Finally, as small firms are unlikely to undertake a comprehensive and objective screening and evaluation of all potential countries before establishing cross-

border links, it is assumed that foreign country factors play a minor or benign role in the early stages of international development. Another consideration here is that for high technology firms, the industry or market within which they operate is likely to be global or highly internationalised. Emphasis of this study is therefore placed on firm, product and domestic market/industry factors.

Box 5.4

Conceptual Framework and Assumptions

1. That internationalisation (here termed international expansion) for small high technology firms is a growth and development process which, at least in the early stages, is commensurate with and inseparable from the holistic growth and development process of the firm itself.
2. That the international expansion process of small high technology firms is tempered but not dictated by the resource base of the firm.
3. That the international expansion process of small high technology firms will be influenced by inward as well as outward cross-border business activities, the extent of involvement being determined by firm factors on the one hand and technology and market/industry factors on the other.
4. That cross-border activities/links undertaken by small high technology firms will reflect the nature of their business, specialisation or current concentration of activity in the firm and as such will be commensurate with the growth and development process described in assumption 1 above.
5. That for small high technology firms international expansion, at least in the early stages may have more to do with firm factors and domestic market/industry conditions and structure than with foreign country factors or conditions. Foreign country factors are assumed to be benign factors in early stages.

Theoretical Basis of the Research.

The approach taken in this research is necessarily eclectic. Review of theory on the growth and development of firms across the small firms, technology and

internationalisation literatures suggested that there was no comprehensive explanation of the international expansion of small firms. Approaches tended to emphasise specific aspects of small firm growth and development e.g.

- functional focus
- locational focus
- processual development
- behavioural focus
- strategic and resource-based alternatives.

Fragments of explanation were apparent in a number of approaches but, because the small firm is less a collection of parts than an integrated, holistic entity, the approach taken in this study needs to be similarly holistic, or at least eclectic in its focus.

Drawing together some strands of thought from the three literature chapters, in relation to small firms, and especially start-up firms, three issues were identified as fundamental to their growth and development. These are:

- resource considerations
- knowledge accumulation and transfer, and
- competence and capability considerations.

Much of the theory specific to internationalising small firms has tended to be descriptive rather than explanatory. The entrepreneur is frequently seen as the main explanatory factor and the approach behavioural, while strategic growth alternatives based on rational cost and risk factors have to a larger extent tended to form the basis of MNE rather than SME explanations. Here internalisation/transaction cost based explanations would seem to offer potential except that the emphasis of these approaches has tended to be on internalisation rather than external transactions as the main vehicle for growth. It is suggested here that future explanations of the international expansion of small firms are most likely to emerge from integrations of internalisation approaches with resource-based considerations, the latter including knowledge and entrepreneurial capability as resource factors, with network and internationalisation approaches describing the process. These are the approaches which have influenced the conceptualisation of this study and have determined the questions, variables and measures upon which the research is constructed.

The main dependent variable of the study is the external link of the expanding firm. The chapter continues by explaining why external links are the central focus of the

research, and examines their importance in a selection of relevant studies of small firm growth and international expansion.

Why External Links?

Going back to the central tenet of the research (box 5.2), it was suggested that the international expansion process of the small firm can be examined through tracking and examining the cross-border external links formed by the firms over time.

It has been stated quite clearly, earlier in this chapter, that although the emphasis is on external links, this *is not* a network study. It *is* an examination of how firms expand internationally using the types of links they form as *evidence* of their business activity at particular points in time. The study is not concerned with relationships, bonds or networks, but with the external linkage activity of individual firms examined in relation to a survey sample. The rationale for this approach is clarified in a discussion of terms in Box 5.5.

Conceptualisation - Why External Links?

Why 'links' rather than networks, relationships, cooperation or exchange?

Networks - implies established groups of firms working together. Here concern is with earlier stages of the networking process, i.e. the establishment of links whether isolated or connected.

Relationships - a relationship 'implies' a bond or bonds between the partners which develop over time. Interest here is in any, including short-term and tentative, links which may not, at the time of the study, have developed into relationships.

Cooperation - this term requires definition to be explicitly understood and frequently is associated with 'reciprocity'. It also tends to imply collusion or agreement between firms which may not have been made explicitly.

Exchange - again tends to imply reciprocity and agreement between the parties and is often associated with trade.

Links - the term 'link' is relatively innocuous and carries with it no implications of time-scale, obligation or exchange. A link is the 'least common denominator' of the other terms, i.e. networks, relationships, cooperation and exchange. It is the foundation upon which all other arrangements are built. It is therefore most suitable here as a means of identifying the building blocks or bridge between firms and their external environment.

The Importance of External Links For this Study

No firm is an island! From a basic systems perspective, a firm without links to the external environment will very quickly collapse in on itself and die. External links are therefore fundamental to survival. It is the nature of the links and the way in which they are established, managed and combined which determines the state of the firm and its expansion vis-à-vis internationalisation.

Drawing on the literature, several issues which have already been discussed, can be restated in terms of cross-border linkage activity:

- Early internationalisation is most likely to take place through external links (market transactions) as small firms in general lack the resources to internalise their markets or integrate production chain activities. In support of this statement, it is suggested that transaction costs are likely to be cheaper than internalisation costs at early stages, especially where the small firm serves a monopsonist or where the government provides assistance in the information search.
- External links are an important component of small firm growth because they may expand the resource base by providing access to externally held technology, knowledge and financial resources. In addition, links provide routes to specific markets, provide a mechanism for transfer or exchange between firms, and may provide the opportunity to develop experiential knowledge.
- Subsequent internalisation (integration) for small firms is likely to depend on the effectiveness with which external links have been managed (i.e. accumulation of wealth, resources and experience will result from the effective management of external links).

The emphasis of this study is firmly rooted in the development of cross-border linkage formation of small technology based firms. It is proposed to do this through the use of a sample survey, a decision which is discussed further in the next chapter. Part of the rationale for that choice of data collection method is that the researcher wanted to examine the linkage formation of a number of small firms independently rather than within specific small firm networks. It was felt that evidence taken from a study of

networks would be bounded and formulated by the focal networks and hence less applicable to a wider population of small firms.

The opportunities presented by the proposed conceptual approach are seen as:

- An opportunity to build a picture of how small firms establish themselves in, and move through their external environment, in an international context. Examination of internationalisation and pre-internationalisation of small young firms has seldom been examined empirically in the literature.
- An opportunity to build an empirical foundation, which may be used to measure the effectiveness of cross-border external links on small firm growth and international expansion.
- An opportunity to ultimately 'measure' the effects of linkage activity to form a basis for policy recommendations. This has not been achieved by network studies, which are too particular and specific and have in general not examined the outcome of networks.
- The establishment of a starting point for a determination of the extent to which a firm's own links or linkage activity could be used in a policy context to supply the needs for:
 - early internationalisation
 - subsequent expansion and possible internalisation.

Following a brief discussion of important issues and themes which emerged from the preceding literature chapters, this first part of the chapter has established the aims and objectives of the research. Particular attention was paid to the underlying assumptions which had been made and these were developed into a series of statements which established the conceptual framework of the study. The fundamental construct of the study is the external link. The reason for this focus was clarified in a glossary comparing the term *link* with other similar terms (Box 5.6). It is implicit in the ensuing points that the theoretical basis of the study is eclectic, deriving firstly from internalisation and resource-based arguments, which are seen as most likely to explain the nature of linkages, and network and internationalisation considerations which describe the process of development.

The ideas on which the conceptualisation are based are derived largely from literature on the theory of firm growth, technology and international expansion. Good empirical studies of small firm international expansion as a holistic process are scarce (the most notable exception being Luostarinen, 1979). There was therefore little opportunity of replication of previous work in this area unless export development studies were used as a benchmark but, because of the arguments voiced at the end of Chapter 4 this approach was rejected. As an alternative, it was decided to draw on studies of small firm growth and competitiveness which had identified external links as an important component of survival and growth. The next section of the chapter examines the need for external links in relation to small firm growth and development.

Developing the Constructs: Identifying Link Types and Roles

The constructs discussed above have been developed from an eclectic literature on small firms, which shares an emphasis on small firm development and growth, and which presents empirical evidence relating to the role of external links in the growth process. The following review is presented in support of the conceptual approach taken in this study which differs from the approaches to small firm growth and international development discussed in the literature reviews in Chapters 2, 3 and 4. This section of this chapter therefore serves three purposes:

- It presents evidence from studies of small firm growth and expansion which examine, or discuss the role of the firms' external links in relation to their growth and development.
- It identifies the types of links which firms are likely to make, discusses the imperatives for their formation and in some instances, their impact on firm development and growth.
- It develops the argument for growth through the establishment and management of external links in the specific context of the small internationalising firm and draws on evidence and debate relevant to this conceptualisation.

Role of External Links in the Growth of Firm

The inhibiting effects of a limited resource base on small firm development and growth has clearly been overcome by firms which have developed and grown to considerable

size (see the Intel example, Chapter 3). The ways in which firms increase their resource base through the identification, access, management and sometimes absorption of external resources has received explicit, but more often implicit attention in a variety of research studies.

It has been thought that small firm growth is dependent on entrepreneurial attributes and expertise and because the entrepreneurs' expertise is bounded, growth may be limited (McGuire, 1976). Firms which achieve growth to considerable size were thought to do so through the 'amplification' of entrepreneurial expertise through education, external advice or the employment of specified personnel (Williamson, 1970). External experts may include consultants and companies and individuals with financial interest in the firm including franchise operators. McGuire (1976) suggested this although consultation with such external experts may amplify managerial expertise, its success lies largely with the entrepreneur's ability to evaluate the source and information provided. McGuire's discussion was concerned largely with consultancy type external advice for which the firm would have to pay. The alternative to external advice was the employment of internal experts which was seen as providing the entrepreneur with more control over the knowledge and expertise. Growth of the entrepreneurial enterprise, in economic terms, must end when the marginal costs of employing or paying for expertise exceeds the marginal revenues produced by that expertise (Chandler, 1966). Growth of the centralised, single profit centre firm would therefore be restricted when:

"... the operations became too complex and the problems of coordination, appraisal, and policy formulation too intricate for a small number of top officers to handle both long-run entrepreneurial, and short-run, operational administrators activities" (Chandler 1966 p369).

Three main issues which emerge from this discussion are that if small firms are to grow

- entrepreneurial expertise needs to be supplemented through recourse to either internal or external sources,
- the cost of that expertise will reach an optimal point beyond which there are diminishing returns, and
- growth is bounded by entrepreneurial ability to effectively control or manage sources of expertise.

Ultimately this suggests that if growth is to continue, the cost of expertise must be kept down and the organisational structure of the firm needs to evolve to cope with the expanding administrative or managerial burden.

From a transaction cost perspective and building on McGuire's discussion, 'expertise' may be 'bought' in the external market, internalised through the employment of experts or education of in-house personnel. Recently, emphasis has been placed on a third alternative-external links which are not necessarily traded in the external market or internalised by the firm but which are 'accessed' by a number of firms. Implications for management therefore become the ability to identify, evaluate, access and utilise external links and services. The small firms literature acknowledges the role of external links in small firms growth but at present says little, except prescriptively about managerial or policy implications. There is evidence from a number of empirical studies in diverse fields which suggest that external links are increasingly important in business but at present, this literature is fragmented.

Further support for Johanson's (1990) conceptualisation, of small firm growth through cooperation (reviewed in Chapter 2), is evident in the results of a study of small Italian firms. In the Emilia Romagna region of Italy artisan firms have been found to remain restricted in size due in part to financial incentives to remain small. Growth there was often found to take place through the development of new small firms in which original owner-managers play the role of partner in the new small firms. Such firms are apparently technologically dynamic and are active exporters. In this case too, growth is external rather than internal and consists of a growing network of ownership and interest. (report by Mark Lazerson as discussed by Bosworth and Jacobs (1989))

The network perspective suggests that "growth" may be achieved through identifying, accessing and utilising external resources in a network context. In this way the firm may retain its autonomy, entrepreneurial flexibility, innovative capability etc., while increasing its output efficiency. While transaction costs theorists may argue against this approach on the grounds of increased costs of transacting in a network compared to an internalised market, in the realm of small firms, and in particular innovative small firms, effective identification, access to and management of external resources could offer a real alternative to scale economies and cost efficiency. The network approach may be especially useful in explaining the co-existence of large and small firms in industries and sectors.

Recent research (Rothwell and Zegveld, 1992) has suggested that especially in innovation, neither large or small firms are disadvantaged in innovation but rather have

abilities which are mutually complementary. Where earlier approaches have tended to attempt to explain why some firms grow and others do not, interest is currently turning to the roles large and small firms play in relation to each other. In the realm of large global companies, the trend towards restructuring, concentration on core technologies and the increased emphasis on contracting out activities to a number of small buyers suppliers and functional specialists has concentrated the mind on the importance of the network in 1990s business.

In support of this proposed paradigm shift in small firm studies, evidence has been found to suggest that rapid growth may be experienced by firms more extensively using external resources (Jarillo-Mossi, 1986). This phenomenon has been observed specifically in relation to high-tech firms (Docter et al., 1989) and NTBFs (Rothwell, 1991). In the UK, researchers of entrepreneurial firms have observed a trend for such firms to open additional businesses dealing with separate products, and/or activities, as yet this trend is largely unresearched. Although evidence links high growth or rapid growth with external networking, research has not as yet established the extent to which this process influences growth. Some evidence has been found however to link types of external linkages with stages of innovation (Chesnais 1988, Forrest, 1991, reviewed in Chapter 3).

Technology, Innovation and External Links

Rothwell and Zegveld (1985) suggested that innovative SMEs may be disadvantaged in respect of innovation and hence growth because:

- SMEs often lack the time or resources to identify and use important external sources of scientific expertise and advice, and
- SMEs often lack suitably qualified technical specialists. They are unable to support a formal R&D effort on an appreciable scale".

Part of the solution to these problems is evidently to identify, access and effectively utilise external resources, and in particular external technology. Results of work on innovatory firms done by the Science Policy Research Unit (SPRU, Sussex) concluded that since 1970, small UK firms have been increasingly successful in accessing external technology and in increasing their contribution to national manufacturing innovations. A SPRU survey on the external linkages of small innovative firms suggested that there were high levels of external technological usage by innovative firms.

Rothwell and Beesley (1989) found no evidence to suggest that lack of access to external technology and know-how is a significant barrier to growth in SMEs with growth potential. This finding echoes earlier results by SQW (the Cambridge Phenomenon), which found that access to external technological know-how and advice is definitely not a barrier to growth in either traditional or technology-based SMEs, but this is linked to the employment of qualified scientists and/or engineers who play an essential role in facilitating external contacts and assimilating new technology. The main problem therefore seems to be associated with a lack of ability to effectively incorporate and utilise external technology within the firm. This points, like a number of small firm studies already discussed, to problems related to management inability to coordinate resources effectively whether they are internal to the firm or external. This inability would appear to be due either to a genuine lack of appropriate skill in management, or the fact that managerial resources are stretched to their limit, inhibiting further growth or development. These assumptions are implicitly reflected in a study of traditional firms in Suffolk, which revealed the following barriers to growth (Beesley and Rothwell 1986; Rothwell and Beesley, 1989):

- Lack of skilled labour and middle-management to "support expansion",
- Firms too comfortable in their own particular niche,
- Perceived problems in defending intellectual property rights with products having high market potential that might be of interest to a large corporation,
- Lack of qualified staff to cope with the transition to a higher-technology level,
- Fear of losing qualified staff due to insufficient volume of interesting high-technology work,
- Managing the conflict between introducing new products and maintaining existing ones,
- Lack of professional management and technical infrastructure.

Lack of time, resources and management ability were also reflected in the findings of BASE International (1986) which reported that the most important barriers to growth and innovation are:

- Lack of management time to consider any business development activity,

- Lack of vision and flair in the management team to consider the development of any new business areas beyond the existing experience,
- Lack of resources, both financial and people, to implement any innovation strategy even if they had one."

The IRDAC Committee reported similar problems concerning the growth of NTBFs, with additional problems specific to new technology firms, as discussed in Chapter 3.

As already discussed, a number of studies have suggested that external technical linkages play a role in the growth and development of small firms (Rothwell and Dodgson, 1987; Rothwell and Beesley, 1989; Rothwell and Dodgson, 1992; Oviatt and McDougall, 1994). Others have stressed the importance of a more general linking of SMEs to external resources, or to other organisations in a supporting network (Rothwell, 1991; Rothwell and Dodgson, 1992; Birley et al., 1991; Curran and Blackburn, 1991).

In particular, the importance of information gathering through an informal network of family and friends and members of local neighbourhoods, has been emphasised in the early stage of enterprise development (Birley and Cromie, 1988). Later on, small firms come more to rely on networks of professional bankers, accountants, lawyers, suppliers, government agencies etc. as a source of business information (Birley, Cromie and Myers, 1991, p59). Such personal and professional networks may become supplemented by local small firm networks. Birley et al. found in a small firm survey of networks in Northern Ireland that although owner/managers rely heavily on personal contacts for information, this information does not come easily and much money and skill is expended in acquiring it.

In the same study, differences were found between networks in different countries. Direct networks of Irish entrepreneurs for example were found to be smaller than other countries. Less time had been spent in courting contacts than for example in the Swedish sample. The Irish did however spend more time in maintaining existing contacts. What is important here is that the development and maintenance of external links requires considerable management time, effort and interpersonal skills.

Hakansson (1990) in an extensive longitudinal study of Swedish industrial companies found that collaborative relationships are of strategic importance to companies. In Hakansson's study it was found that on average about half of resources invested in

technological development went into projects where external parties were involved. As with Birley et al. (1991), Hakansson found that links with external partners were investment-intensive involving considerable time and effort to develop. Paradoxically, because of the intensity of investment in external linkages it would seem that partners may become "locked-in" to each other's operations hence reducing each individual firms flexibility and freedom of movement. However the relationship between firms effectively increases the resource base of each. Hakansson found however that development through cooperative relationships was for the most part organic.

Rothwell (1991, p96) cited evidence from the literature to suggest that efficient external communication is a significant factor contributing to successful technological innovation (and hence growth). He suggests that:

"Successfully innovative firms generally are well 'plugged-in' to the market-place and to external sources of technological expertise and advice".

He also cites Beije (1987) in pointing out that accessing external technical knowledge is not a costless process and may involve considerable opportunity costs.

What is important to note here is that evidence from Rothwell's research (1991) found that the external needs of SMEs vary considerably between industry sectors, but also within sectors depending on the nature of innovations being developed by the firms.

Evidence from broad-based empirical surveys of SMEs would suggest that external linking or networking is widespread. External links may be loose, informal arrangements such as in buyer-seller relationships, to more formal cooperation contracts, joint-ventures and alliances, to outright mergers and acquisitions. It is useful here to provide a back-cloth to the external links and activities of UK SMEs by summarising some of the findings from the recent SBRC (1992) survey report, the Cosh and Hughes (1996) ESRC survey report on small firms, and other relevant empirical studies.

SMEs Access to Technological Innovation and Information.

Table 5.1 External Sources of Technical Information Used by SMEs			
External Source	Local %	National %	Inter- national %
University/Higher Education	13	12	3
Private Research Institutions or Consultants	9	22	6
Government Research Establishments	2	12	3
Suppliers or Customers	22	54	23
Other Firms	11	24	10
Trade or Professional Journals	12	59	24
Total Responses (no.)	1172	1172	1172
Source: The SBRC Report,(1992) p64.			

External sources of technological innovation include: universities, public laboratories, contract research companies, federative industrial research organisations, suppliers (especially of equipment), customers and their clients. Although such sources are available to small firms, the OECD (1993) report on small firms and competitiveness suggests that the

effectiveness of the transfer of information from sources such as the above to SMEs depends on a number of factors and conditions:

- "the quality, density and complementarity of these various sources and channels;
- the availability of the information;
- the effectiveness of the links between these sources and channels and SMEs;
- how relevant and appropriate the scientific and technological information supplied is to the needs of the SMEs;
- favourable micro and macro-economic conditions;
- SMEs own dynamism, the effectiveness of their technology watch and their ability to transfer information into action." (OECD, 1993, p8)

Amongst success factors identified from the study of successful collaboration between universities and SMEs was the importance of personal contacts with the duration of contacts appearing as another important success factor.

External Technical Information and Support.

The SBRC (1992) report found that over 60% of the SMEs in their sample of over 2000 small firms made use of external technical information in the development of new products or production processes, a trend which was more pronounced in

manufacturing than in service firms. Bearing in mind that that report was a cross-sectional, cross-sectoral survey of UK SMEs, the importance placed on various sources of information reported by firms which claimed to use external sources is extremely interesting. Table 5.1 shows results by the source of information: local, national or international. Most interesting is that 10% of SMEs had established international links. The report found little evidence to suggest that particular types of external information may be linked to growth performance. Interesting however is that fast-growth firms were found to make slightly greater use of technical information from universities and government research establishments than did stable or medium-growth firms. Newer firms also tended to use universities, private and government research institutions at an international level more extensively than more mature firms.

Table 5.2 Interactions Between SMEs and Higher Education Establishments.	
Nature of Interaction	% of SMEs (employment <500)
Product development	37
Use of test equipment	22
Placement of students	28
Attendance at conference/seminars	22
Attendance on courses	22
Technical problem solving	28
Technical information	40
Source: Lowe and Rothwell (1987)	

Lowe and Rothwell (1987) in a survey of firms' interactions with higher education establishments in Sussex found that small firms (<50 employees) frequently had external links with academic institutions. Over 42% of firms in the sample with under 50 employees had links with universities, just over 26% had links with polytechnics and just over 20% with technical colleges.

The most frequently occurring interactions between SMEs (<500 employees) and higher education establishments involved activities as listed in the table 5.2

External Links and Manufacturing

Manufacturing under sub-contract was found to be common amongst SMEs in the SBRC report (1992). In general the survey found that the smaller the firm, the more likely it was to engage in sub-contracting, and where they did so, were more dependent on sub-contract work (as a proportion of the whole business) than larger firms. Smaller and newer firms were more dependent on this type of work than were older and larger firms (p17). The survey also found evidence to suggest that sub-contracting in the SME sector in general had been increasing and between 1987 and 1990, subcontracting in services increased at approximately double the rate of that in manufacturing (p17).

Rothwell (1991) stated, without explicit reference to evidence, that many SMEs are sub-contractors for other companies producing components and sub-assemblies to customer specifications. As such, these firms are unlikely to perform R&D but depend on technology derived from customers. For firms which do act largely in the capacity of sub-contractors therefore, external linkages with large firms are likely to be

extremely important in terms of innovation, growth and internationalisation where the large firms are foreign.

Reason	% Firms
	91 (95)
Expand range of expertise	63 (66)
Assist in development of specialist services	54 (56)
Provide access to new UK markets	48 (46)
Provide access to new overseas markets	46 (42)
Improve financial and market credibility	35 (33)
Share research and development	35 (29)
Help to keep current customers	29 (38)
Gain access to and spread cost of new equip.	19 (16)
Assist in management and staff development	17 (14)

Source: Adapted from the ESRC Report (1996) p28.

External Links and Organisation Membership

The SBRC (1992) survey also found that SMEs, contrary to expectations, did not exhibit a propensity to form external linkages, a tendency which was measured by membership of business and professional

organisations. Less than one third of all firms claimed to be members of such bodies (SBRC, 1992, p23).

External Links and Collaboration

Evidence of collaboration and partnerships proved to be more interesting than organisation membership. Around one third of all firms in the survey had entered formal or informal collaborative arrangements with other organisations in the preceding three years. Faster growing firms were found to be more likely to enter into partnerships than other firms and service firms more likely than manufacturing firms. The SBRC (1992) report suggests that "--such arrangements may improve performance and growth". It also suggests that there is an association between fast-growth firms or sectors and collaborative activity, but there is no evidence (in this report) that collaboration is the reason for fast growth. This does however add weight to studies mentioned above which have linked external linkages with growth.

The nature of collaborative partners in the SBRC (1992) survey sample is also of some interest. Of the 32% of firms entering collaborative arrangements the partners were found to be: customers, 39%; suppliers, 38%, competitors, 17%; firms with complementary interests, 17%; higher education institutions, 13% and others, 9%.

External relationships between customers/suppliers are however important in technical development. In Hakansson's (1989) study of technological collaboration, relationships involving either customers or suppliers made up almost 75% of the cooperation partners in his sample. Relationships between focal firms and customers/suppliers were also of longer duration than relationships with horizontal partners lasting on average 13 years in the former case and 8 years in the latter. In general then, it is appealing to suggest that supplier/customer relationships are important to small firms, have been associated with collaborative technical development and are likely to represent external links which bear some relationship with innovation and hence growth.

The SBRC (1992) and the Cosh and Hughes (1996) reports shed no light on the collaborative practices of specific industries or sectors, nor does it address the question as to whether partners are local or foreign. It does however identify the reasons given by firms for seeking collaborative agreements.

In addition to collaborative arrangements the SBRC (1992) report suggests that the use of external advice helps firms to overcome growth constraints and found evidence that external advice is most frequently used by firms which, in recent years, have experienced moderate or substantial growth. Fast growth firms were found to make more use of external advice on marketing, personnel and recruitment, and on taxation and financial management. Most firms were found to seek external finance with the most popular source being banks, followed by hire purchase or leasing agreements. Only around 7% of the whole sample used venture capital as a source of finance and this was concentrated amongst medium-sized firms.

Ultimate External Linkages: Mergers and Acquisitions

More formal linkages than discussed above are moves towards acquisitions or mergers between firms, which once effected would more normally be referred to as internalisation.

The Bolton Committee (1971) found that merger and acquisition activity tended to increase industry concentration with the result that the small firm sector was diminished and hence also its ability to act as a "seed-bed" for innovation and entrepreneurship (Hughes, 1989, p128).

At micro level, acquisition or merger could have both negative and positive effects on the growth of the small firm. Hughes (1989) maintains that while a horizontal merger may increase the joint market of the two firms, the adverse effect may be to increase the desire and ability of the larger unit to indulge in anti-competitive behaviour towards

smaller firms. Alternatively, the competitive process may be enhanced by the avoidance of duplicated R&D (Ordoover and Willig, 1985), and through the reduction of managerial services required to run the enlarged organisation (Penrose, 1959). Other advantages of merger include scale and scope economies and the more effective use of managerial resources, which, in the view of Penrose (1959) will have the effect of pushing outwards the limits to growth.

It is clear also that merger or

"---cooperative or non-competitive activity may offer opportunities for small firms. Thus agreements to avoid duplicated efforts, mount jointly financed research and development projects, or introduce standardisation or specialisation of products (giving cost efficiency through longer production runs) may revitalise their competitive prospects and hence the force of innovative mechanism" (Hughes, 1989, p133).

From this it would seem that merger or cooperation can provide the ability to pool resources, standardise procedures and gain from transaction, management, production and research economies. Outright acquisition by larger firms, however, effectively ends "--the growth prospects of small firms as independent units" and may also end the life of the innovative capacity of the unit as it is absorbed into a "large-firm ethos". Acquisition may simply see the end of the "small" firm which instantaneously joins the category of large firm and obliquely, small firms tend to grow faster than large firms (quotes from Hannah and Kay, 1977).

Hughes (1989, p135) suggests that within an industry there may be complementarities between firms of different sizes, interacting and playing different roles in the innovation process from R&D through invention and innovation to the diffusion of new products and processes.

Rothwell and Dodgson (1992), Hughes (1989), Buckley and Casson (1979), Utterback and Abernathy (1978), and Williamson (1975), amongst others have suggested that the early stages of innovation may be best achieved in a small, flexible, informally structured organisation while later stages, requiring the setting up and standardisation of production systems may be better undertaken by larger organisations with more resources, especially finance and marketing skills. At later stages in the development of innovation, technology may be transferred by contract to the larger firm or alternatively acquisition or merger may take place combining the complementary skills, capabilities and resources of the two units. An important point made here by Hughes (1989, p136)

is that success will depend on the ability of the large firm to effect the merger or acquisition without adversely affecting innovative creativity in the acquired enterprise. Looser ties between the firms, he suggests, with a view to subsequent ownership ties, may stimulate venture capital provision by the large firm.

Despite widespread fears in the literature that merger or acquisition of small firms might dampen innovative ability, in a comprehensive review of the literature on small firm merger activity, Hughes (1989) found little evidence to suggest that takeover by large firms inhibit either growth or the innovatory prospects of small firms.

Little is known of acquisition activity amongst smaller firms but what evidence there is suggests that such activity may be relatively high. Of the two thousand firms in the SBRC sample, (SBRC, 1992), one in five were found to have acquired at least one other firm in the previous five years. This acquisition activity was found to become more intensive with increasing firm size. The survey addressed the question as to whether acquisition is an important source of growth for small firms and tried to determine the extent to which acquisition intensity is higher amongst fast-growth firms. Fast-growth firms were found to have a higher acquisition intensity than firms which were stable or declining in size. Whilst fast-growth firms did not have a higher acquisition intensity than medium-growth firms, fast-growth firms on average acquired more firms than medium-growth acquirers (p42). The report points out however that 80% of fast-growth firms had made no acquisitions and had achieved their high growth rates organically. While it is intuitively appealing to conclude that in general fast-growth firms are younger and smaller and therefore less likely to have been involved in acquisition activity, the report found no differences in the acquisition activity of older compared to newer firms. Nor were there any significant differences between service and manufacturing firms.

Acquisition activity in the small firm sector in general has been increasing as can be seen in the table below comparing acquisition intensity found by the Bolton Committee in 1969 with the 1990 SBRC results. Amongst motives for acquisitions the most

Table 5.4 Acquisition Intensity: SBRC and Bolton Manufacturing Samples Compared		
	% of firms which have taken over or merged with other firms in the last five years	
	1990 SBRC Sample	1969 Bolton Sample
Manufacturing	20	9
Less than 100 employees	15	7
100-199 employees	28	18
Slow growth	15	5
Fast Growth	21	16
SBRC (1992) p43.		

important was identified as "capturing market share" followed by "diversification into new products and new areas" and "attempts to achieve economies of scale". Interestingly and significantly, vertical integration was not found to be an important motivator for acquisitions by SMEs. Other motives

listed included: to acquire management skills or expertise, to reduce competition by acquiring a competitor, to gain new premises and a very few firms acquired to gain access to new technology (p44). It should be noted here however that the SBRC results are not broken down by industry. Motivations for acquisition and indeed for other external linkages may be significantly different in high-technology industries.

Whether, or the extent to which acquired firms were previously partners in some cooperative agreement is not addressed in the SBRC report. Anecdotal evidence from the researcher's discussions with bureaucrats involved in EU technology programmes requiring SMEs to become involved in collaboration suggests that firms are often inhibited in becoming involved in collaboration because they fear take-over by larger partners. Certainly SMEs, from the evidence above and especially those with innovative capability are likely to be attractive targets for takeover activity.

In fact, one in five of the SBRC sample firms had received a takeover bid or merger proposal from a larger firm in the last five years with the vast majority of such bids coming from other UK firms. The proportion of firms which had received a bid was found to rise steadily from the smallest to the largest firm size groups. Older firms were found to be more likely to receive bids than newer firms, and fast and medium growth firms more likely than stable/declining firms. In a study of UK based agents and distributors of machine tools in the UK by the researcher and others, a number of firms interviewed had been approached by overseas firms suggesting merger or takeover in the five years prior to the study, (unpublished results).

SME Attitudes to Acquisition

The SBRC report found that in general firms were not in favour of being acquired, although newer firms were less opposed to acquisition than older firms. Fast-growth firms had a more positive attitude to being acquired than medium-growth or stable/declining firms. In general, fast growing small and medium-sized firms (50-199 employees) had a more positive attitude to being acquired than other firms. Perceptions of advantages being acquired were in order of importance: "the prospect of capital gains and increased market share" followed by "the solution of management succession problems" and "realisation of economies of scale". The benefits of closer links to buyers and suppliers were not seen as important, which emphasises the finding of a low incidence of vertical integration in the small firm sector. Firms perceived disadvantages in being acquired such as "loss of control" and also loss of motivation, dislike of large company ethos, loss of flexibility, loss of focus, loss of identity and job prospects.

Developing the Constructs: Small Firm Internationalisation and External Links

The Limited Resource Base and Internationalisation

At the end of Chapter 4, five points were presented which suggest that studies which characterise small firm internationalisation as an export process are inadequate in their explanation except in very general terms, and are concentrated on one functional area viz. marketing and distribution. What emerges strongly from the literature however is an acknowledgement that small firms are inhibited in the scope and extent of international expansion due to their limited resource base. The general effects on firm growth do not need to be repeated here as they have been discussed in depth in chapter 2 in relation to small firms in general and in chapter 3 in relation to technology and innovation in the small firm. In the international literature, this has been summarised succinctly by Buckley (1979) in his discussion of foreign direct investment success for smaller firms as:

- shortages of capital and management time
- shortages of skilled management
- limited managerial capacity
- difficulties in transition from a family to a management controlled firm
- political naiveté (summarised from Buckley, 1989).

Fundamentally the problems fall into two main areas, managerial capability and capital resources. In much of the literature on small firm internationalisation these issues have been synthesised into two variables - firm age, and firm size

The Limitation Effects of Firm Age/Experience

The age of the firm has seldom been explicitly examined in the internationalisation literature. There is a general but implicit assumption that firms reach a fairly advanced stage of development in domestic markets before they go international. In a review of the literature on exporting, Bell (1994) found conflicting results. While Kirpalani and Macintosh (1980) and Ursic and Czinkota (1989) found younger and smaller firms to be more likely to become involved in exporting, Wiedersheim-Paul (1980) found the converse - that older firms are more likely to export. Oviatt and McDougall (1994) in a review of the literature on small firm internationalisation found that the age of small firm exporters has frequently been viewed as unimportant as a demographic characteristic, or incidental to other characteristics (Malekzadeh and Nahavandi, 1985; Cooper and Kleinschmidt, 1985). Welch and Luostarinen (1988) found that firms which were international from inception tended to be the exception rather than the rule.

More recently, Oviatt and McDougall (1994, p47) have provided evidence from a number of reports compiled since 1989, mostly from studies of entrepreneurship, of a growing incidence of NIVs.¹ Some of these studies indicate that the formation of such ventures arises from the ability of internationally experienced entrepreneurs to link resources from multiple countries to serve inherently international markets (Coviello and Munro, 1992; Hoy, Pivoda and Mackrle, 1992; McDougall and Oviatt, 1991; Oviatt et al., 1994; Ray, 1989). Case study research has shown that the success of NIVs depends largely on the firm having an international orientation from inception, an innovative product or service marketed through a strong network and a tightly managed organisation intent on international sales growth (Ganitsky, 1989; Jolly et al., 1992; McDougall et al., 1994).

Evidence testifying to the emergence of the NIV includes a study by Brush (1992), which found that amongst her nationwide random sample of small, internationalised US manufacturers, 13% had internationalised during their first year of operation. Burrill and Almassy (1993) found that in the American electronics industry, firms tended to

¹NIVs are defined by Oviatt and McDougall (1994) as " - - - a business organisation that, from inception, seeks to derive significant competitive advantage from the use of resources and the sale of outputs in multiple countries."

internationalise very rapidly. These studies suggest that firm age alone is not a barrier to internationalisation. Indications from the above studies are that the nature of the product, industry and the orientation and experience of entrepreneurs influence the speed and nature of internationalisation. The recency of such studies might suggest that NIVs are a phenomenon of this time.

The Effect of Firm Size on International Expansion

Some early studies of export success have suggested that the characteristics of the decision-maker are important in internationalisation (Wiedersheim-Paul et al., 1978) while the same authors and others have indicated that international orientation is a significant factor (Dichtl et al., 1990; Cavusgil, 1984; Reid, 1983; Johanson and Vahlne, 1977; Langston and Teas, 1976; Stopford, 1974). International orientation involves the extent to which the individual has been abroad or works abroad, language ability, travel, and positive perceptions of foreign and international events. In the view of the researcher, international orientation is likely to increase in significance as a factor in the international expansion of small firms as international travel and communications become cheaper and ever more widely accessible.

Research which has examined the size of the firm in relation to its international activities has also produced mixed results which again suggests that entrepreneurial or other factors together with firm size may be more important than size alone. In a synthesis of the small firm export literature Bell (1995) found a widespread but often implicit belief that small firms and young firms may experience difficulties preventing them from beginning exporting. Tookey (1964), Reid (1982) and Naor (1983) found a positive relationship between firm size measured by number of employees and export activity.

Similar studies by Bilkey and Tesar (1977) and Kirpalani and MacIntosh (1980) however revealed no significant relationship between these measures. Bell (1995) reported a very similar pattern in the literature on the relationship between firm size measured by sales and export turnover. Piercy (1985), Kaynak (1985), and Ito and Pucik (1993) found positive relationships between these measures while Reid (1982), Ali and Swiercz (1991) and Liouville (1992) found no such association.

Comparison of results has been complicated by different size categories being placed on firms by different researchers (Miesenbock, 1988). Withey (1980) however found that when the size of firms reaches 20 employees a greater number of firms begin exporting than do firms with less than 20 employees. Other studies summarised by Miesenbock (1988) suggest that very small firms do not export and that exporting begins when a critical size is reached. There is little in the export literature however which explains the

international activities or connections firms may be developing before exporting begins (exceptions include Dichtl et al. (1990) and Wiedersheim-Paul et al. (1978) as discussed above).

Evidence that small firm size and lack of experience inhibit internationalisation is in general inconclusive and emerges from export studies rather than broader studies of the international expansion of small firms. Size and age however are indicative of limits in the firm's resource base which is discussed in the next section.

External Linkages and Internationalisation: Empirical Evidence

As discussed above, the limited resource base of small firms is widely acknowledged as being an impediment to their growth. In the case of small firms in new and emerging technologies, the need to develop and grow is more pressing due to the rapid pace of change and high levels of competition in these industries. While governments tend to stimulate international expansion through policies aimed at aiding or subsidising exporters, the current ideology is that such support should be reduced and firms encouraged to be more independent (see discussion of policy imperatives Chapters 2 and 3).

For small firms this means that they may have to become more interdependent and learn to access, utilise and manage resources held by other firms and organisations. While it is clear that small firms can be adept at network management in the domestic market, cross-border links may be more difficult to establish and manage, and yet may be crucial where industries are international and rapidly changing.

The first two chapters of this thesis have highlighted a growing appreciation that small firms are very much linked to the external environment, may be highly dependent on external resources, abilities and know-how and often have strong connections with other firms, academic and research institutions, government bodies and professional associations, or may be very dependent on infrastructural networks.

Little is known at this stage of the extent to which small firms establish such cross-border links, the extent to which cross-border links exist in the small firm sector, or how such links influence the international expansion process of small firms. Network studies of internationalisation have emphasised the role of networks in internationalisation processes, but tend to be dominated by case studies of large firms or focal nets.

Very few studies focused specifically on the role of external links in the internationalisation process of small firms exist at this time. Evidence is emerging from a variety of sources however that such links are important in the international expansion and development of small firms. Some of this evidence is referred to in the following summary list of extant studies.

Table 5.5

Evidence on Role of External Links in Small Firm Internationalisation

Study	Findings	Approach/Sample
Bell (1995)	Contact with foreign suppliers initiated exports and speeded up the internationalisation process of small software firms.	98 small software firms, <200 employees. (Norway, Scotland, Finland)
Coviello and Munro (1995)	Major network partners triggered foreign market selection and entry mode. Rapid internationalisation and rapid growth resulted.	4 case studies, firms <150 employees, between 10-15 years old. (New Zealand)
Coviello and Munro (1995)	Sixty four percent of the sample indicated that initial foreign market selection and entry modes were triggered by opportunities presented by contacts. Rank importance of contacts to internationalisation were: general business contacts, customers in foreign markets, own sales force and existing partners. Although network relationships shape internationalisation, such links may limit scope and nature of market opportunity.	25 exporting software firms. Average size=19 employees; average age=7.5years. (New Zealand)
Liang (1995)	Unsolicited orders are an important trigger in the internationalisation process. "Boundary spanners" may be important.	Literature Review. Generally surveys of exporting firms.
Tymri (1994)	External links are important as a source of information for foreign market selection and market information.	87 Finnish MNEs. All firms highly internationalised.
Welch and Luostarinen (1993)	Internationalisation may be triggered or stimulated by inward-outward links such as; those forced by governments in countertrade; strategic alliances; importing from foreign suppliers; franchise and licensing links.	Literature review.

Lindqvist (1991)	Cooperative sales agreements and sub-contracting arrangements with domestic MNEs helped small firms to quickly establish foreign representation in important markets.	144 technology based firms. <200 employees. (Sweden).
Terpstra and Yu (1990)	Piggybacking may facilitate and speed up the internationalisation of small firms by reducing the transaction costs involved in direct exporting and by compensating for their limited resource base.	Conceptual. US case examples.
Luostarinen and Welch (1990)	Recipients of foreign franchises gained their first experience and knowledge of internationalisation through these links.	18 franchisees. (Australia)
Hakansson, (1989, 82); Hakansson and Johanson(1988); Johanson and Mattsson (1988)	Foreign supplier networks are used as a resource for subsequent internationalisation.	Case studies and longitudinal survey, largest - Hakansson; 120 Swedish firms over 10 years.
Carstairs and Welch (1982)	Licensing-in preceded and ultimately contributed to licensing-out in 4 firms.	43 Australian Companies involved in outward licensing.
Newbould et al. (1978)	Overseas production established after approach by external contact in 7 firms	43 firms under £10m annual turnover with overseas subsidiaries.

Boundary Spanners and Unsolicited Orders

Liang (1995) suggests that "boundary spanners" are important in establishing such cross-border links, boundary spanners being people who have studied, lived, worked or emigrated abroad. Implications here are that unsolicited orders, or more generally, importing plays an important role in the initiation of exports and outward internationalisation of small firms and that this role has been inadequately explored in empirical studies.

Cross-Border Business Structures and Arrangements

Strong links, both internal and transactional have been found between firms or units engaged in importing and distribution in the machine tool industry (Wheeler et al., 1996). Luostarinen et al. (1994) suggested that import/export arrangements may constitute 'direct' relationships between firms of different countries while writers on strategic alliances have identified huge multinational networks of suppliers and buyers.

Such networks (e.g. in the software industry), where flexible operating systems and standardisation has freed up assembly, and where competitive advantage has moved downstream to marketing and distribution activities, has tended to find small firms specialised in vertical niches which may span national boundaries (McNaughton, 1995; Dunn et al., 1991; Jones et al., 1992). Such structures are likely to draw small firms into certain paths of international expansion and development, dependent on or associated with MNE networks.

Contracts and Relationships

In a study of the internationalisation of small computer software firms in the small and peripheral economies of Scotland, Ireland and Norway, Bell (1995) found evidence that contact with foreign suppliers to obtain hardware, local software distribution rights and production licences led to the initiation of exports. The same author expressed doubt that exporting would have begun without such relationships and felt that their existence speeded up the internationalisation process (Bell, 1995, p70).

In a study of small firms with overseas production facilities (Newbould et al., 1978), 7 out of 43 firms established overseas production following an approach by a person external to the firm. Success of these subsidiaries was found to be lower than those established in response to other stimuli.

International Market Information

Tyyri (1994) found that existing networks were important in the process of collecting information about international markets and in the market selection process where managers were found to focus their attention on countries where the firm already operates. The survey of 87 Finnish MNEs with over 50% equity ownership in production facilities overseas found that the three most important sources of information for international selection were: "own foreign travel", 'foreign customers' and 'subordinates' followed by MNE's foreign units and foreign middlemen. Less important were various secondary sources of information and industry associations (p663). The most important sources for identifying and analysing international markets were: in-house market research, potential foreign customers and statistics (p664), while agents, commissioned market research and foreign subsidiaries were less important.

The survey found that in general personal sources of information were preferred over impersonal ones and concluded that existing networks of business relations do play an important role in international market selection. Similar results were found in another study by the researcher and others (Hart, Webb and Jones, 1994). It should be noted here however that the firms selected were highly internationalised and would have

already established significant networks of contacts - this situation is likely to be very different in newly internationalising firms particularly where the industry itself is still developing.

International Contracts and Facilitators

In discussing the international licensing arrangements of Australian firms Welch (1981) found that licensing was often preceded, most often by exporting but also by foreign direct investment. Some evidence was found which suggested that licensing arrangements tended to develop out of existing export arrangements. These extended the relationship with the export agent to licensing deals. Other firms which had already established joint ventures or wholly owned production facilities abroad extended their relationship with the foreign market by the use of licensing. Although Welch does not explicitly mention connections or links in his discussion, his use of the phrase 'relationship with the foreign market' suggests the existence of interfirm or interpersonal links of some importance to the firm's market servicing activities. Four firms in his study specifically mentioned the contribution of inward licensing to the later step of outward licensing. Inward licensing was found to generate an awareness of licensing and served as a benchmark for future outward licensing arrangements. Although Welch expressed the view that licensing offers limited potential for developing knowledge about foreign markets, the potential exists, through licensing for a two-way flow of technology, information on the partners and their respective country markets.

Problems Associated with Cross-Border External Links

Buckley (1979) suggests that small firms may be vulnerable in their dealings with external contacts. In particular he points out that they may lack public relations skills, lobbying power and economic muscle, in relation to foreign direct investment. FDI is often instigated by an approach from an external source such as a foreign agent/distributor, company or government.

"One of the great dangers for smaller firms is that an 'external approach' by a powerful customer, supplier or foreign official will induce them to make an investment without sufficient consideration of alternative modes of operation - such as licensing a local firm. The approach of an interested outsider, even if this is an agent or foreign partner of the firm, must be viewed with mistrust until properly evaluated" (Buckley, 1979, p14).

The assumption of naiveté explicit in this quotation and implicit in references to reactive export initiation through the satisfaction of unsolicited export orders is a matter for concern. If small firms are vulnerable to approaches from more proactive, more experienced and potentially aggressive or threatening external approaches, then clearly more needs to be known about the types of links firms form in the early stages of internationalisation and how the most promising links may be encouraged, cultivated and managed.

Buckley (1979) believed that small firms have a low threshold for tolerance of joint decision-making (p15) Buckley found that foreign agents (who often initiated moves towards investment) often make bad partners (p15).

Although a number of export studies have explored issues of government support to potential exporters (Crick, 1996; Bell, 1996), the usefulness of other external links in developing the resource base of small firms has received less attention. Tyrri (1994) found that small firms tended to prefer personal contacts as sources of information about foreign markets. In a study of the information needs and information collection processes of exporters by the researcher and others (Crick et al., 1994; Hart et al., 1994), formal sources of information were not rated as important to respondents, informal sources were not however explored in that study.

Summary: Key Issues

Underlying much of the literature reviewed above is acknowledgement of the very restricted resource base of small firms, accompanied in some instances with limitations in the capabilities and competencies of the entrepreneur or owner/manager. Recourse to external sources of expertise, advice, technical and market knowledge, finance, markets and sources of supply would seem to be essential for the survival and growth of the small firm.

Sources of knowledge would seem to be especially important for technology based firms where the emphasis is on science, technology and innovation processes, and for the internationalising firm where the emphasis is on knowledge of markets and business processes. What is apparent is that there are great many different types of links and few are specific to a particular need or type of activity. For example, agents, distributors and customers may supply information or contribute to innovation and technological development. R&D contracts or venues may provide, directly or indirectly, commercial contracts. Different types of organisations such as banks, government departments, and export intermediaries to name a few, provide networking sources. Clearly links may be specific or multi-purpose.

Links were found to vary in intensity from very informal links to the ultimate, mergers, acquisitions, new venture investments and various types of formal cooperative arrangement. While links are made between individual firms, they often occur in networks, the structure and composition of which varies between countries and the types of activities associated with identifying, forging and managing links vary accordingly. The strength of the firm in relationships has been found to depend on its size and relative contribution to the relationship and far from being cost free, links with other firms may carry an opportunity cost based on other alternative arrangements.

In terms of international expansion, this process has been found to be triggered in some instances from links formed by overseas firms with local firms. While Buckley warns of the vulnerability of small firms in such situations, Liang et al. (1995) found that unsolicited orders often came from equally small and vulnerable firms.

Essentially, the issue is not so much *whether* small firms establish cross-border links, as what type of links do they establish and what role do they play in the international growth and development of the firm. The aims and objectives of the research can therefore be achieved through the development of several research questions relating to the linkage activity of the sample firms. The literature summarised in Table 5.5 supports the contention that external contacts, suppliers, buyers, intermediaries of various types and existing business partners may provide the trigger for international expansion, or prompt a move from one mode of activity to another. Contacts not only provide the business links for international activity, but often serve as a resource for further expansion, especially in terms of information provision. Contacts may play an important role in expanding the internationalising firm's horizons by introducing new contacts and expanding the network, or scope of activity.

Although this study has avoided taking a specific network approach, the literature in this chapter emphasises the role of individuals and networks whether or not a *network* has been the focus of the study. It is apparent, from the discussion in this chapter and in Chapter 4 on internationalisation, that the international expansion of small firms is most likely to take place through external/transactional means at least in the early stages. An important point was made in that respect by Terpstra and Yu (1990) who suggested that piggybacking may speed up the internationalisation process by reducing transaction costs and compensating for a limited resource base. This exceptionally important point could of course be true of a number of collaborative and network type arrangements which essentially facilitate a partial internalisation of firm advantage within a network rather than a firm may provide access to externally held network resources.

These points suggest, as indicated earlier in the chapter, that there are potential points of convergence between behavioural/network and internalisation/transaction cost explanations of small firm growth. While large firms (resource endowed) can expand through internalisation, small firms (resource restricted) have to compensate and protect themselves from the market by exploiting their firm specific assets within manageable and controllable boundaries, i.e. the network, or in less structured/stringent terms, within the scope of their cross-border contacts. The challenge for the small firm becomes one of the identification and utilisation of its external contacts or links effectively and efficiently, thus benefiting from an increased resource base whilst reducing the transaction costs associated with external markets. Returning to Chandler's (1966) point, growth may be limited by the extent to which *external links* can be controlled and managed by the firm (see 'Role of External Links in the Growth of the Firm').

Understanding the international expansion process of the small firm therefore may emerge from studies of the patterns of linkage activity between small firms and other individuals and organisations in the international environment. The scope for research is tremendous and this study, by integrating some of the key issues from the major theoretical areas represents a step in that direction.

Developing the Research Questions

The specific studies discussed in the section above have influenced the formulation of specific research questions which are listed in Box 5.6. This last section of the chapter discusses the questions and where appropriate, the type of response answers which might be expected. As the research is exploratory, based on a conceptual approach developed from eclectic theoretical contributions, hypotheses have not been presented. The questions asked here outline the key issues; the results are intended to chart out the territory for future research.

Box 5.6

Research Questions

How does international expansion begin and progress?

- What types of cross-border links have been established by the sample firms?
- Where do formal/investment links come in the process of international expansion?

Why does international expansion begin?

- What are the characteristics of the sample firms?
- What characteristics and conditions are associated with individual types of cross-border links?

How important are cross-border linkage activities to firm development and growth?

- What is the effect of product/technology and market/industry factors on firm development and growth?
- What is the effect of frequency of contact with overseas links on firm development and growth?

How does international expansion begin and progress?

Through what modes of business or other cross-border linkages do firms initially become involved in internationalisation, and what patterns, if any, can be identified in their international expansion?

There are two issues here. First, the type of cross-border link established by each firm, and second, the date on which each link type was first established. The question therefore attempts to track the establishment of cross-border activity chronologically as specific events over a period of time. The foundation date of each firm, together with dates on which each link type was established allows three constructs to be developed:

1. The length of *time* before each link is established,
2. Specific *events*, i.e. periods of time in when links were established,
3. *Gaps*, i.e. periods of time between events.

Event analysis should therefore indicate definitively whether there are sequences or patterns of events in the internationalisation process.

What types of cross-border links have been established by the sample firms? ²

This question rejects the export development models of internationalisation which suggest that firms go international in the first instance through indirect export. The main proposition here is that internationalisation is constructed around external linkages which extend across national borders. Identifying cross-border external linkages therefore should identify pre-internationalisation activity and early international activity.

The list of link types included in the survey questions were constructed from several sources. Firstly, studies of technology based small firms which emphasise the role of external links in the growth and development process. These links reflect the three main stages of the innovation chain: R&D, production and commercial links (marketing and distribution). Essentially resource-based, the links include collaborative research projects, independent research projects and contract research, contract production and related consultancy and technical service, and marketing activities.

The range of links is intended to accommodate soft-start firms and those specialised in specific value chain activities, as well as those which concentrate on manufacture. The links types include conventional foreign market entry modes (indirect and direct exporting modes, licensing and foreign direct investment). Link types therefore include both inward and outward cross-border links (see earlier explanation) and reflect resource and market based imperatives to internationalise, and technology push and market pull influences on the innovation process.

Where do formal/investment links come in the life of the firm and its stage of international expansion?

To what extent have formal cross-border arrangements, i.e. cross-border cooperation³
⁴, independent exporting⁵ or foreign direct investment and licensing, been preceded by

² External linkages were intuitively expected by Rothwell and Dodgeson (1992, p8) to be an important factor affecting small firm growth potential. External linkages may be technological, commercial or production links. (Rothwell, R. and Dodgeson, M. (1992) "Growth and Renewal in Technology-Based SMEs: The Role of External Technology", Paper prepared for the International Conference on Birth and Start-Up of Small Firms, University of Bocconi, Milan, June 18-19, p8.). External Linkages which are "cross-border" will be presumed to be technological, commercial or production links which stretch across national borders. Equity links and owner manager links in terms of international education and working experience and language capabilities have also been included.

³Cooperative arrangements" for the purpose of this research are as defined by Ricotta and Mariotti (1986) and used by Chesnais (1988) for his study of cross-border technical cooperation agreements between firms, "----

less formal cross-border linkages or conditions (such as R&D links, equity links and owner/manager links).

In addition to the sequence in which informal and formal arrangements are made, interest is in when integrated or internalised modes of operation (i.e. integrated export channels or ownership/investment in overseas production) take place. It is anticipated that, at least in respect of the latter, very few firms will show evidence of internalisation. Where foreign direct investment does occur, it is expected to take place at later stages in firm development.

Why does international expansion begin?⁶

This question is not concerned with the motives for internationalisation but with firm characteristics, attributes such as the nationality and source of education of owner/managers, firm language capability, link management and early equity and R&D links which may influence internationalisation.

What are the characteristics of the sample firms?

The characteristics of the sample firms which are of interest are size, age/experience, level of independence, foundation method, R&D intensity, industry, proprietary technology, and retention of founder members. In addition, firm specific factors such as concentration of employment in value chain activities, product attributes and market industry factors were included to differentiate between firms by specialisation and the competitiveness of their markets.

inter-company cooperation agreements, which are formal, and informal, agreements between two or more companies providing for a certain degree of collaboration between them (and) involving equity participation, or the creation of new companies (as well as) non-equity agreements" (Chesnais, 1988, p56). Outright acquisitions and mergers are excluded from this definition and included under "independent modes" of development. "International cooperative agreements" for the purposes of this research are those in which at least one partner is based in a country other than the UK.

⁴Using Chesnais' (1988) classification, using the R&D to Marketing chain, previously advanced by Hacklisch (1986), cooperative arrangements include technology sharing agreements where large firms may cooperate with smaller ones for strategic benefit, R&D cooperation where firms may be involved with government, university an/or industry research projects, comprehensive consortia which usually involve a large number of firms for pre-determined technological and economic objectives, and distribution agreements where partners' reliance on each other is formalised in long term agreements. (see Chesnais, 1988, pp59-62)

⁵Independent modes of development and internationalisation are those in which the firm contracts with another over a short time period as in exporting (arms-length trade), or where there are majority equity links involved as in merger, acquisition or greenfield investment. Links may be inward or outward.

⁶ The term "international expansion" here refers to the **outward activities** of the focal firm across national borders and/or the **inward activities** with foreign firms or organisations which may significantly affect the development and growth of the focal firm, or alter its state.

Aspects of international orientation and management commitment are also included as forms of overseas contact. The extent to which entrepreneurial or managerial competence and experience could be included in the research design is severely restricted due to the need to keep the length of the questionnaire manageable (see discussion in Chapter 6). Three issues were included, prior education and nationality, foreign language capability and frequency of contact with overseas bodies, organisations, firms and individuals.

What characteristics and conditions are associated with individual types of cross-border links?

Other than firm age/experience, which has frequently been associated with export mode, it is not anticipated that individual firm characteristics will be associated with individual types of cross-border links except in the case of very specialised links. There may for example, be R&D links made by firms with high levels of R&D intensity. As R&D intensity has been associated in the literature with export activity, it is likely that such association will be reflected in the findings. Generally, it is accepted that small firm growth/competitiveness is associated with specific bundles of resources, competencies and capabilities. This suggests that combinations of characteristics and contingency factors rather than individual characteristics may be associated with either link types or international expansion patterns.

How important are cross-border linkage activities to firm development and growth?⁷

This question is not so much concerned with the effect/profitability of individual linkages or modes but with patterns of linkage activity and growth indicators such as growth rate, stages of development, and performance indicators such as turnover and export turnover.

Measures of firm performance tend to reflect the perspective of the researcher or purpose of the study. For example business or marketing studies would use such measures as sales or profit growth rates, market shares, sales/cost ratios, loan/working

⁷Development and growth are separate but inter-related concepts. Growth here refers to the size of the firm, increase in the number of employees and increase in annual turnover and also growth in production output. Development in the case of some firms may refer to increased intensity of firm activities and/or progression of the firm along the value chain. Both concepts are important as technology transfer will take place at different points in the value chain, or at different points in the firm's development. Some firms may be "soft-start" firms developing their activities from R&D to production and so on while others may remain in their initially defined businesses.

capital ratios etc. Economic studies, in addition to the usual accounting conventions may measure firm growth by percentage growth rates. Studies of innovation may focus on return on investment, number of product innovations per time period or time to market. International studies deal with export ratios, number of markets served and commitment to or level of involvement in foreign markets. This study of small innovative firms in new technologies is concerned with all of the aforementioned issues, i.e. firm development and growth, innovation and international involvement. In small firms these processes are not only interrelated but concentrated, and ultimate firm success will depend on performance in a number of activities and will involve a number of measures or indicators of development and/or growth.

There are problems in measuring the performance of small firms, including the unwillingness of executives to divulge details of sales or profits, and attempts at tax avoidance which result in inaccurate records even where these are divulged (Oakey, Rothwell & Cooper, 1988, p71). In very small, new firms comparability may be difficult due to high start-up costs and long-lead times involved in profiting from technological development. In new technologies where industries and markets are undeveloped, services may be measurable purely through speculation. Buckley et al. (1988) suggested that profit objectives in particular are firm specific and difficulties arise in the comparison of firms based on measures of profitability. These include, problems where firms are of different size, where they have forgone short-term profits for longer term objectives and where there is a portfolio of products of variable performance. In terms of international performance at firm level, Buckley et al. (1988) suggest the following measures:

- export market share
- export dependency (ratio of exports to domestic sales)
- export growth
- profitability

Two of the above measures are not suitable for this study i.e. export market share and profitability due in the first case to the size of the firms concerned in relation to the size of international markets, and in the second due to differences in the expectations of profit across the range of ages of firms included in this study.

Export growth over a short period, e.g. 3 to 5 years and the ratio of overseas to domestic turnover are measures which are more suitable to this study, and more easily compared between firms of different sizes and ages. Growth in small firms has been

measured by a percentage change in a chosen factor (e.g. turnover or employment) over a three to five year period (Siegel et al., 1990), or a ten year period (Leigh et al., 1990). Where the concern is with start-up firms and early growth, there are problems related to the length of time the firm has been in existence and the proportionality which, when measured in percentage terms tends to decrease as the size of the firm increases.

Comparability is also a problem when comparing firms of different sizes measured in turnover. For example, a five percent increase in turnover for a £500k per year firm is vastly different in value to a 5 percent increase in a £5m per year firm. Also, it has been recognised that very new firms grow initially much more rapidly than they do later. These issues are of some concern in this study, as firms at various stages of development are being compared. It was decided to measure growth as an average percentage change in turnover, and in export growth over the three years prior to the study.

It is acknowledged that growth over a three year period is limited as a measure of the continuing performance of firms, but information covering a longer time period could not be collected from the sample due to the issues discussed above. The aim here however was not to classify firms according to their growth rate, but to determine whether cross-border activity is associated with growth factors.

What is the effect of product/technology and market/industry factors on firm performance and growth?

The performance of the firm in domestic market and domestic market/industry conditions have been discussed in many studies on the motivations or triggers of international firms (see for example Root (1994) and Young et al. (1989) for a summary of the literature and discussion). Essentially, the important factors would seem to be revolve around three issues, the nature of the product, the competitiveness of the market/industry and the firms' response or strategy in relation to the market/industry.

In respect of the product, the level of technology, its relative complexity, software content and level of standardisation are considered in this study. It might be expected that products which are high technology, include high levels of software and which are complex may have more and earlier international exposure than more standardised, simpler products. This assumption being based on technical uniqueness of the product and the level of services required to support its sale or transfer.

The competitiveness of the industry/market is examined through measures of industry applications and availability of alternatives the former indicating market potential in the domestic market, and the latter, the extent of competition. The firms' response or strategy was gauged by their extent of technological innovation and the extent to which products are tailored to customer specifications.

The three main issues discussed clearly overlap and measures are based on attitudinal responses of the responding firms. However, it was considered that simple scales on key issues would permit a comparison of firms to be made on product/industry factors and an identification of factors associated with international expansion processes. Interpretation of results needs to be made with caution and it is recommended that future studies explore these issues qualitatively .

What is the effect of frequency of contact with overseas links on firm performance and growth?

An important influence on small firms' internationalisation may be their initial external links or contacts. Because of small firms' lack of resources and time to consult sources of information - or to conduct international market research, there is likely to be a greater tendency to rely on the 'expert' opinion of their existing links than to actively search for new information. The pattern of internationalisation may therefore be one of following links into foreign markets. This differs from the network approach which seems to take the view that firms operate within their existing nets and expand into new ones. Here firms may use links to move through networks without necessarily becoming embedded in any one of them.

In addition to network process perspectives, the frequency of contact with overseas bodies is likely to be indicative of firms' attitude to international markets and the effort put into establishing and maintaining contact with specific cross-border links. It is anticipated that while frequency of contact could be expected to increase as the firm develops internationally, there will be differences between firms based on effort and attitude.

Conclusion

This chapter has discussed in some detail the conceptualisation of the research approach. The stance taken is that international expansion of small firms is a growth and development process largely inseparable from the growth and development process of the firm itself. A holistic approach such as this needs to consider a wide range of

factors in order to determine what exactly happens in the growth and development process and why. Much of the chapter was devoted to the development of research constructs which would serve to group the huge array of contingent issues into unifying frameworks. The main constructs were:

- **the small firm** and its main value chain activities: *R&D, production and marketing/distribution,*
- **the external links** of the firm, reflecting the above value chain activities but considered on the dimensions of:
 - internal* (ownership or integrated) links and *external* (transactional) links, and
 - inward* (value-adding activity occurring in UK) and *outward* (value adding activity occurring overseas),
- **the growth and development** of the firm considered on *performance and structural* dimensions:
 - turnover and export growth,
 - international ratio,
 - number of export countries,
 - formalisation of internal functions, R&D and export.

The theoretical approach taken in the study is eclectic drawing on internationalisation, internalisation, network/behavioural and resource-based approaches and it is anticipated that explanation of the international expansion process of small/young firms may evolve from an integration of the above approaches with emphasis on internalisation and resource-based considerations. The type of links included in the study were constructed from extant empirical studies which identified and discussed the role of external links, contacts and external/transaction based modes of business activity in the growth and development process of the firm. This chapter has devoted itself to the development of the conceptual framework and research questions. The practical aspects of research design, methodology, data collection and analysis are discussed in Chapter 6.

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Chapter 6

Research Design and Methodology

Chapter Objectives

- *To outline the procedure followed in constructing the research design.*
- *To identify major decision stages and discuss and evaluate alternative decision choices.*
- *To establish criteria for the construction of the research instrument, inclusion/exclusion of respondents, and construct measures.*
- *To evaluate the survey response.*

Research Design and Methodology

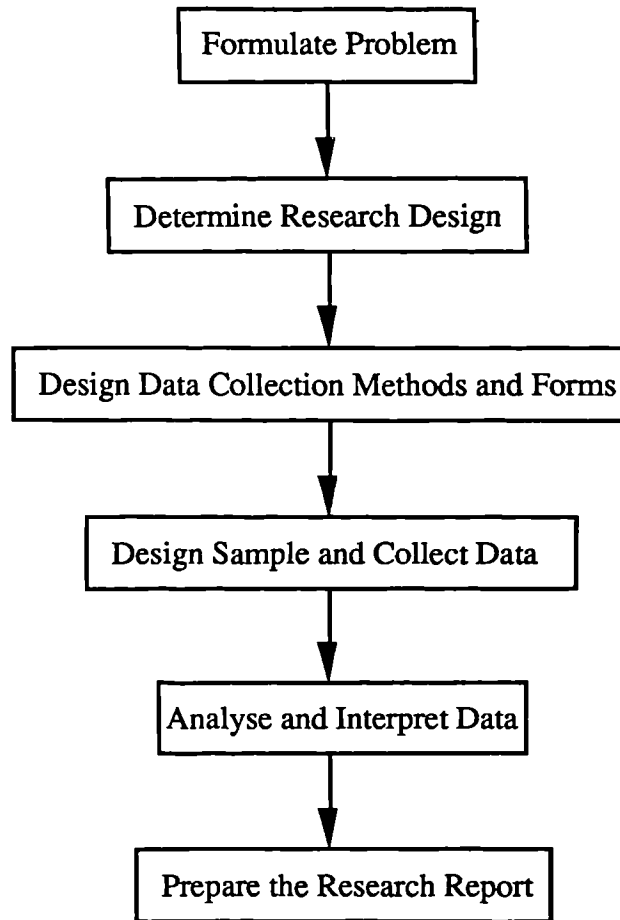
Introduction

This chapter describes and explains the research process undertaken to construct and achieve the objectives and questions detailed in chapter 5. Research is invariably conducted within a set time scale and with a finite budget and resources, and the research design necessarily needs to be both efficient and parsimonious. The limitations to the research are discussed in this chapter and the procedure followed to achieve an efficient research design and accurate results within budgetary and resource constraints is outlined. This chapter is not intended to be a comprehensive review of research methods, but rather, a considered discussion of the research design constructed for this study. The view taken here is that the research process is a learning process and proceeds in a series of evaluative loops. The process is illustrated in a model of the research process which serves as the structural framework for this chapter.

The Research Process

Traditionally, the research process is depicted as a number of sequential steps or stages beginning with the formulation of the problem and ending with the presentation of the results (Rummel and Ballaine, 1963; Seltiz et al., 1976; Howard and Sharp, 1983; Boyd et al., 1985; Churchill, 1987 and Gill, Johnson, 1991). Stages in the process are represented sequentially as typified by Churchill (1987) in Box 6.1.

Box 6.1



Source: Churchill (1987).

In practice there is considerable iteration at each stage followed by an evaluation of the process and results at each stage, reappraisal of the research design and modification of research objectives and propositions. Harvey-Jones (1989) advises that managers setting tasks should distinguish between the content of the task (what is being done) and the process (how the task is being done), which would seem reasonable advice for research which is also concerned with setting objectives (the content) and designing and carrying out a methodology (process). Where the nature of the research is exploratory, each stage in the research process represents a learning opportunity and in the course of this research it proved useful to take stock of what had been learned periodically throughout the process.

At each stage in the research process cognisance was taken of its implications before progression to the next stage. While Gill and Johnson (1991) amongst others advise that the research process needs to be carefully planned in advance to ensure clarity and avoid losing time by unnecessarily returning to earlier stages in the process, it was felt

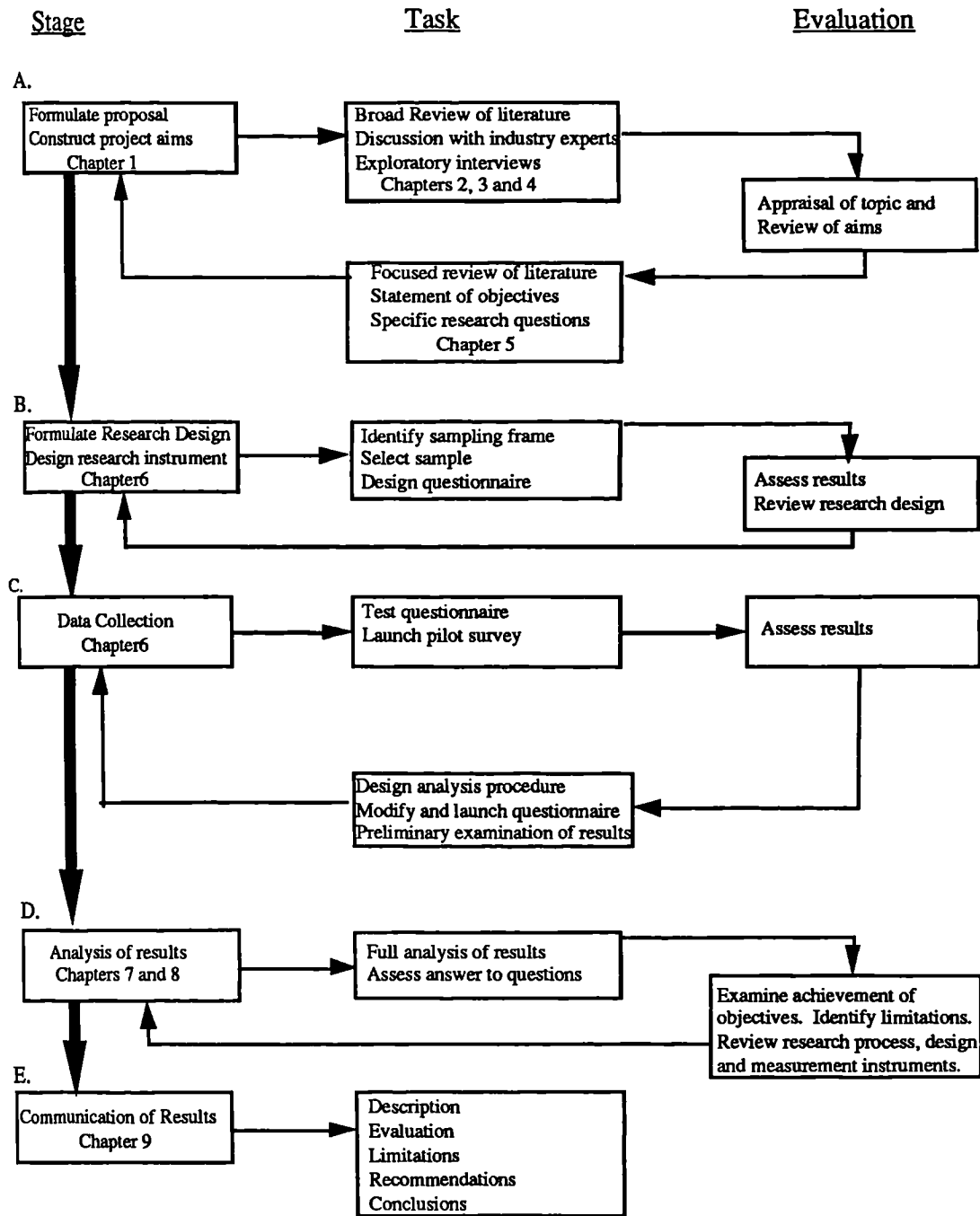
that there should be enough flexibility in the plan to allow for review and evaluation of *process* as well as *content* (results). The process followed for this research project (Box 6.2) is divided into five main process/decision stages: A. the formulation of the research proposal and construction of research aims, B. formulation of the research design and data collection instruments, C. the process of data collection, D. analysis of results and E. the communication of the results.

At each of the main stages a series of tasks was carried out and then reviewed and evaluated before progression to the next stage. Churchill (1987, p26) suggests that the process of problem definition involves specifying the objectives of the specific research project

"Each project should have one or more objectives, and the next stage in the process should not be taken until these can be explicitly stated".

The research therefore progressed in a series of cyclical stages or loops which facilitated evaluation of the process as well as the results of each stage. The research questions and objectives became more finely tuned as the research progressed as a result of the learning taking place.

The Research Process Followed in this Study



Source: Author

Stage A: Formulation of Proposal and Project Aims

Initial formulation of the research proposal, on the international growth and expansion of technology intensive small firms, and the research aims, was followed by a literature search and a series of very informal interviews with subject and industry experts and with companies.

Industry experts consisted of senior members of Scottish Enterprise, Glasgow Development Authority and the Glasgow section of the DTI (Department of Trade and Industry), including the technology section. Informal discussions were also held with The Licensing Centre, Scottish Innovation and a number of consultants and technology firm owner/managers at seminars arranged by Scottish Enterprise on the subject of innovation. Similar informal discussions at an Export Forum on small firm export research in London, and at the Small Firms High Technology Conferences in Manchester proved useful in alerting the researcher to the real issues and experiences of those working in, or with small technology based firms.

Several firms were interviewed specifically in connection with the preliminary research for this study. These were: TAG (Technology Applications Group), Albanet, Cruachem, and Carntyne Electronics Ltd.. The first three were originally university spin-offs established specifically to exploit a scientific innovation in robotics/prosthetics, information technology and biotechnology (manufacture of DNA) respectively. The fourth was a small manufacturer of electronic components heavily dependent on contract manufacture for Siemens, the German MNE. In addition, the researcher has had the opportunity, during the course of the study, to interview a number of small internationalising firms in other industries as part of the supervision process on the MSc in International Marketing research projects at the University of Strathclyde.

The information gathered was incorporated into the literature review and conceptualisation chapters as part of the overall discussion. The resulting broad literature review formed the basis of the research proposal which emphasised specific aspects of growth in technology intensive firms viz. innovation/technical development and international expansion. In particular, the role of external links and linkage activity was identified as central to the research question. The literature also identified pertinent theory and analytical frameworks around which the research constructs would be formed and later analysed.

Appraisal of the topic and review of aims at that stage led to a more focused and critical review of the literature and development of specific research propositions. The purpose of the literature review is to develop an awareness of what has been written on the research topic and the current state of knowledge on the subject. The review should demonstrate "---a critical awareness of background studies and matters relating to the thesis" (Gill and Johnson , 1991, p21).

The literature review is an ongoing process throughout the course of the research and while a thorough knowledge of extant literature on the topic is important, the latter authors advise against "---becoming over-concerned with other people's work at the expense of creativity" (Gill and Johnson, 1991, p21). They point out that the literature review together with preliminary discussion and interviews should identify gaps in existing knowledge and lead to clarification of how the intended research will contribute to filling them. The results of the literature research and review are presented here as chapters 2, 3 and 4, and the conceptualisation of the research (Chapter 5) which draws on both the literature and preliminary fieldwork in developing the approach to, and constructs of, the research (see Chapter 5 for specific details).

Decision Box 1. Approach and Constructs

Focus: The international expansion of small high technology firms
Theoretical Approach: Eclectic
Constructs: The small firm, cross-border external links, growth and development.

(The approach taken and the constructs of the research are discussed fully in Chapter 5).

Stage B: Formulation of Research Design and Instruments.

Research Design and Reasoning

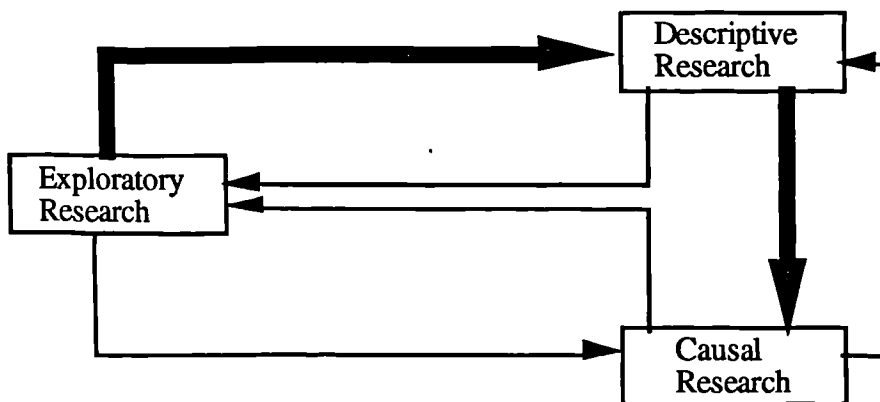
The research design is a framework or plan for the study which is used as a guide in collecting and analysing data (Churchill, 1987, p71), Churchill points out that the research design should ensure that the study will be appropriate and relevant to the problem and will be economical. The ultimate research design will be the one most effective for the research problem but will be constructed within the limitations imposed by the resources available for the research. Simon (1969, p4) made the point that there are many ways of carrying out research, but there is never a single, standard, correct method.

Selltiz et al. (1976) however effectively classified the many research designs possible according to the objective of the research and identified three main types of research design:

- exploratory
- descriptive
- causal

The latter authors describe the purpose of exploratory research as the discovery of ideas and insights, while descriptive research is concerned with the frequency of an event occurring or the relationship between two variables, while causal research is concerned with cause and effect and typically but not always involves experimentation.

The three objectives of research, exploration, description and causality are not necessarily alternatives and Churchill (1987, p73) makes the important point that the three basic designs may be seen as stages in a continuous process with exploration as the initial step providing tentative explanations or hypotheses from which the descriptive and causal stages may be built.. This is illustrated in the figure below:



Source: Churchill (1987, p73).

Underlying research method and design is the type of reasoning employed in its execution and analysis. Generally two forms of reasoning have been utilised in social science research methods, these are deduction and induction. Gill and Johnson (1991) describe a deductive research method as one which "--- entails the development of a conceptual and theoretical structure prior to its testing through empirical observation" (p28). In the process of deduction, the researcher establishes rules or concepts against which empirical observations are compared for similarity or difference. Concepts are presented as hypotheses, which are then tested against the empirical evidence to determine association or causality. Induction is explained by the same authors as being

the opposite of deduction and involves the construction of explanations and theories about the empirical observations. Both approaches involve the systematic and rigorous collection of empirical data, but where in the former case a fairly rigid theoretical or conceptual framework is constructed prior to the fieldwork, in the latter, the conceptual or theoretical framework is the outcome of the research.

A useful explanation from a research colleague distinguishes the two approaches in the following way. Following a deductive approach Christopher Columbus' hypotheses might be that if one sails west from Britain, one will come to India. Landing in America would result in the hypotheses being rejected. Following an inductive approach, landing in America would result in the formation of a theory - that on route to India, there is a large, previously unknown land mass.

There has been much debate amongst social scientists as to which approach is most appropriate for social science. The traditional positivist view, based on research method in the pure sciences, emphasises accurate measurement, and is concerned with the replicability of studies. Deduction which is concerned with testing phenomena against known structures or theories is advocated. Support for positivism tends to emphasise the need for rigour, objectivity and replicability and advocates rationality. Supporters of inductivist methods (for example, Glaser and Strauss, 1967; Laing, 1967; Giddens, 1976; Hammersley and Atkinson, 1983), emphasise behavioural issues and suggest that human activity is different from physical activity since the former involves subjects which "think", while the latter involves passive, stimulus-response interaction.

Gill and Johnson suggest that research methods can be placed on a continuum according to the type of reasoning they employ between nomothetic methods at one end and ideographic methods at the other. Table 6.1, replicated below from Gill and Johnson (1991), draws a comparison between the two approaches.

Table 6.1 Comparison of Nomothetic and Ideographic Methods	
Nomothetic Methods Emphasise:	Ideographic Methods Emphasise
1. Deduction	vs Induction
2. Explanation via analysis of causal relationships and explanation by covering-laws (etic).	vs Explanation of subjective meaning systems and explanation by understanding (emic).
3. Generation and use of quantitative data.	vs Generation and use of qualitative data.
4. Use of various controls, physical or statistical, so as to allow the testing of hypotheses.	vs Commitment to research in everyday settings, to allow access to, and minimise reactivity among the subjects of research.
5. Highly structured research methodology to ensure replicability of 1,2,3,4.	vs Minimum structure to ensure 2, 3 and 4. (and as a result of 1)
Laboratory Experiments, Quasi Experiments, Surveys, Action Research, Ethnography.	
Source: Gill and Johnson (1991) p36	

The choice of research strategy, design and method is subject to a number of influences, philosophical, social, political and practical (Gill and Johnson, p142). While decisions on the research strategy may be made rationally based on the nature of the topic, subject and surrounding circumstances, the latter authors stress that the researcher's attitudes and beliefs and prior exposure to intellectual and social traditions, mores, norms and values are especially important in devising a workable strategy. Here the natural inclination of the researcher is towards the creative aspect of research and interest derives from the unknown or unexplored areas of the topic. This tendency however is tempered by training, which has emphasised positivism and deduction, and by the literature review process which has explored the contributions and limitations of both social/behavioural and economic/rational approaches to small firm expansion and internationalisation.

Decision Box 2. Design and Reasoning	
<i>Design:</i>	<i>Positivistic, structured research design.</i>
<i>Data type:</i>	<i>Quantitative.</i>
<i>Interpretation:</i>	<i>Inductive, theory based analysis and reasoning.</i>
(The approach taken and the constructs of the research are discussed fully in Chapter 5).	

This research topic by nature is descriptive and exploratory in that it is concerned with links between behaviour and rationality in the formation of cross-border linkages.

Returning to the conceptual approach developed in Chapter 5, the approach employed is both deductive and inductive since there are testable assumptions or statements concerned with association between firm characteristics, linkage activity and firm performance and these assumptions and statements are based on a strong conceptual structure and theoretical foundations. The research also employs inductive reasoning in that patterns of linkage activity, freed from conventional conceptual structures by emphasis on value chain type and chronological data rather than pre-determined stages of development, are examined. Attempts are then made to explain patterns from existing knowledge and theories.

There is support in the literature for this type of methodological plurality (Trow, 1957; Smith, 1975; Burrell and Morgan, 1979, all as cited in Gill and Johnson, 1991). In general, support for the use of multi-methods or reasoning tends to emphasise triangulation as a way of reinforcing or verifying research results (Denzin, 1970; Campbell and Fiske, 1959; Jick, 1979; Miller and Friesen, 1982). Before moving on to research methods, it is worthwhile summarising the main research designs or approaches in relation to the objectives of this thesis.

Experimental Research Design.

In an experimental research design, subjects are divided into either an experimental group or a control group at random. Stimuli, usually one at a time, are applied to the experimental group but not the control group. Changes in both groups are measured and compared to assess the effect of the experiment. Typically used in medical and psycho-social research, the best known use of this technique in business management research is the Hawthorne studies. The main difficulty with this approach is in its assumption that nothing happens to the control group during the course of the experiment and it may be difficult to separate the effects of the experiment from environmental stimuli (Easterby-Smith et al., 1991, p38).

Quasi-Experiments and Action Research

True experiments take place in a laboratory setting where conditions can be strictly controlled and true random processes used in assigning subjects to experimental and control groups. Quasi-experiments follow the same principles in a real-life setting and control and experimental groups are identified in the field by whether or not they have experienced the experimental stimuli. Advantages of this approach have been identified by Gill and Johnson (1991, p55) as the potential to avoid an artificial laboratory setting, the potential to carry out the research in the setting where the findings will be extrapolated, and the fact that it can be used where it is not realistically possible to manipulate independent variables or systematically assign subjects to control or

experimental groups. This method is often used to determine the effects of policy instruments or test markets. As with true experimental design however, the approach is intrusive. Action research is similar to quasi experimentation but the involvement of the researcher is much more interventionist since he/she contributes to, and interacts with the phenomena being studied, as for example in some consultancy studies.

Survey Research Design

Survey research is a flexible type of research design which may incorporate both inductive and deductive reasoning depending on the type and structure of data collection procedures and instruments. Where deductive reasoning is to be applied, the emphasis is on reliability and the statistical control of variables and procedures such as sample selection and size, and methods of analysis and measurement. Open ended questions and inductive reasoning may be used in surveys where the aim is exploration or description or as preliminary processes in more complex or multi-method research designs. Survey research in general is concerned with the generalisability of research findings to a wider population rather than applicability to a particular case.

Ethnographic Research Design

Ethnographic research design has its roots in anthropology, is inductivist, and in practice utilises participant observation as its main data collection technique. This type of design has been used extensively in the study of ethnic groups, for example, Whyte (1984), and of organisational behaviour, e.g. Dalton (1959), Sayles (1964). It is particularly important in studies of human behaviour, especially where an understanding of cultures and sub-cultures in particular settings is important, and where beliefs, values and other social systems are important in influencing behaviour. A major problem in ethnographic research is in gaining access to the organisation or social setting. In the case of this research the time scale over which the organisational activity of establishing external links is both too variable and too long to make this method worthwhile, although it is intended to launch a follow-up study utilising self-completion diaries in the future.

The Research Design Decision

The rationale adopted here was to choose a research design, after evaluating the alternatives, which would achieve the research objectives both effectively and efficiently. While the design needed to utilise a methodology and data collection instrument which would prove to be both valid and reliable, it was recognised that compromise would have to be made between the "best" method and the most practical method. Limitations on the research design included the time scale, financial and

human resources available, and other barriers or limitations beyond the control of the researcher such as lack of access to firms or data.

The most important factor in selecting the research design was thought to be the overall purpose or aim of the research. In summary, this was to examine the effects of external links on the growth and international expansion of small technology intensive firms. The nature of the research question was therefore both exploratory and descriptive and intended to seek tentative explanations, if not causal factors. The conceptualisation was seen as having deductive, "positivist" elements in that it drew extensively on extant knowledge in the development of research propositions. The aim of the research, however, went beyond this descriptive phase in that it proposed to inductively explore patterns of linkage activity and international expansion. Another key factor in selecting a research design is the nature of the subjects and the activities to be examined. Here the subjects are small firms and the activity, international expansion. The subjects are renowned for their heterogeneity and the activities may take place over a variable and often extensive time-scale. ✓

Appreciation of these issues allows three of the main research designs to be eliminated as possibilities. Experimentation, quasi experiments and action research may be eliminated as the research is not seeking the effect of pre-determined stimuli on the subjects but is concerned with how firms develop linkages over time in a turbulent environment. The stimuli are likely to be unknown to the researcher and may be unanticipated by the firm. It would also be impossible to control the subjects or their exposure to environmental elements. Ethnographic methods and action research which involve the participation of the researcher in the subjects' activities would only be useful if a small number of case studies were to be conducted, but even here, the time-scale would render this method impractical. As the latter methods are particular, intensive and may be intrusive, they are more appropriate for in-depth studies of human activity in particular settings.

In order to examine the international expansion process of small firms, which is one of the objectives of the research, the research needs to examine a relatively large number of firms in order to identify general patterns of behaviour. Survey research offers a more suitable research design since it reaches a much wider proportion of the population and allows more general conclusions to be made. The survey is also relatively cheap as a data collection method in that a large number of subjects can be approached with a concise, standard questionnaire. As questions may be prepared in advance, and can be highly structured, there is considerable control over the reliability of the research instrument. (It can be used again in another survey, or by a different researcher and

results verified. In general survey research using structured questionnaires is readily replicable).

Surveys, however, are susceptible to weaknesses in internal validity since they are liable to be subject to conflicting hypotheses in their construction, and in external validity i.e. the extent to which results may be extended to the wider population. In analytical surveys it may be difficult to establish cause and effect since it is not possible to apply stimuli and measure response. Multivariate statistics however make it possible to establish correlation, i.e. whether there is any association between groups of variables, which was considered appropriate for the exploratory part of this study. In researching the growth of firms, the interest is on firm activity over time, which may be influenced by a variety of stimuli, including managerial behaviour and environmental influences. Here, the intention was to identify association between firm linkage activity and performance and growth, to explore and chart the international expansion process of small, technology intensive firms, and to provide a solid empirical base on which future studies on the management of external links could be built. For these reasons, survey research has been selected as the main research design for this project.

Decision Box 3. Main Data Collection Technique

<i>Technique:</i>	<i>Survey</i>
<i>Research Instrument:</i>	<i>Structured questionnaire</i>
<i>Delivery System:</i>	<i>Mail</i>

(The approach taken and the constructs of the research are discussed fully in Chapter 5).

There are problems and limitations associated with survey research design. *Firstly*, as discussed above, is the problem of validity. This tends to be exacerbated by the extensive use of very structured, closed questions in which the respondent is forced to indicate one of a number of alternatives which may not be a particularly good representation of the true situation. Also, questions may be misunderstood. Structured questions on the other hand reduce the likelihood of interviewer bias, especially where a mail rather than a telephone or personal interview survey is used. Structured questions are also easier to interpret since there is a definite response with an unequivocal meaning. *Secondly*, the use of very structured questions in a survey, relies for its success on constructs and frameworks developed from extant knowledge, which may severely limit the possibility of inductive interpretation. *Thirdly*, the validity of surveys may be threatened by problems relating to the population definition, sampling procedures, and the problem of non-response. Efforts have been made here to reduce

the negative effects associated with these processes and procedures and are discussed throughout the rest of this chapter.

Qualitative versus Quantitative Techniques in Respect of this Study

Closely connected with the type of reasoning underlying the research design is the decision to use qualitative or quantitative techniques. Qualitative techniques tend to be associated with inductive reasoning (Gill and Johnson, 1991), are often used for theory building (Luck and Rubin, 1987) and attempt diagnostically to uncover deeper meanings behind and the cause of the phenomenon being studied (Green et al. 1988; Chisnall, 1986; Strauss and Corbin, 1990). Qualitative approaches utilise a number of techniques to describe, decode, and explain naturally occurring social phenomenon (Van Maanen, 1983). Qualitative research is more concerned with the reasons behind the phenomena rather than the frequencies with which they occur or the strength of association between variables, although it is important to recognise that qualitative data can be interpreted quantitatively.

The advantages of qualitative approaches are found in the richness of the data provided (Hart, 1987) and its ability to lead to serendipitous findings (Miles and Huberman, 1984). There are also weaknesses associated with qualitative approaches. Qualitative analysis tends to be weak in external validity since it is self-generated and controlled (Hart, 1987), as such methods of analysis may not be well formulated (Miles and Huberman, 1984). Some researchers argue that the soft data generated by a qualitative approach cannot be quantified or subjected to statistical procedures (Gordon and Langmaid, 1988; Strauss and Corbin, 1990), although descriptive statistics have often been applied to qualitative data. A considerable disadvantage of qualitative approaches is the cost of the methods employed, which often involve one or a number of researchers tied up for long periods conducting interviews, focus groups or various observational techniques. In addition the data may be difficult and time consuming to analyse and may produce 'soft data' which lacks reliability and validity.

Quantitative research approaches tend to be associated with empiricist, positivist methods employing deductive reasoning and the testing of hypotheses (Gill and Johnson, 1991). Quantitative methods tend to be associated with survey research and large samples and as discussed above in connection with deductive reasoning, are concerned with replicability of the research and generalisability to a wider population. Hart (1987) sums up the advantages of quantitative approaches as ease of comparison as data is reduced to numerical format and the standardised data are amenable to the tests of classical survey statistics. In addition, she points out that quantitative data are associated with clear analytical procedures with clear conventions which the researcher

can use and the internal validity of the research findings can be more easily assessed. The weaknesses of quantitative approaches are that they tend to rely on a pre-designed research instrument, offer little opportunity to probe and tend to rely on the expressed perceptions and feelings of respondents rather than actual events (Van Maanen, 1979; McDaniel and Gates, 1993; Hart, 1987). Quantitative techniques, however, tend to be cheaper than qualitative approaches and are able to access a much larger sample or population.

As conventional wisdom clearly associates quantitative approaches with deductive, hypotheses testing research and qualitative approaches with inductive, theory building research, it is important to explain why this research has adopted a quantitative survey as its main data collection method. In addition to the arguments given above, it was felt that this research topic is one which will be pursued by the researcher in future beyond the bounds of this thesis. One of the purposes of this research is to build a strong foundation for a future research career investigating the international expansion of small firms. This thesis therefore represents a stage in a much larger research picture which will ultimately include qualitative investigation of small firm expansion processes. As stressed frequently throughout the thesis, the small firm sector is heterogeneous.

Existing research on the international expansion of small high technology firms has tended to focus very narrowly on one or more entry modes, or on case studies of a few firms. The purpose of this survey is to take a broader, and deeper picture of the situation, test the research propositions deductively and then explore the data statistically to identify patterns and trends which may be analysed inductively. This advocates a more creative and exploratory use of statistical techniques than has hitherto been advocated by convention, but which has been made possible by advances in computer technology and the development of multivariate analysis and structured equation modelling.

Population Definition and Sampling Frame Selection

Success of sampling depends, in the first instance, on the effectiveness of the population definition and the choice of sampling frame (Chisnall, 1986). Williams (1978) stated that the use of samples is an effective technique which may be used to obtain relatively precise information about a population. Surprisingly however, studies seldom define or adequately describe their target population. Yu and Cooper (1983, p370) in a quantitative study of research design effects on survey questionnaire response found that the target population had been specified so infrequently in reports to prevent this variable from being subjected to qualitative analysis. *The population* of any research study is "--the definition of all those people or elements of interest to the

information seekers and from among whom the sample will be selected" (Alreck and Settle, 1995, p451). In this case, the population of interest is small technology intensive firms which are to some extent involved in both innovation and internationalisation.

The sampling frame is a list of all those who are in the population. Where the sampling frame provides an accurate list of the population, the procedure simply involves drawing a sample from the list using an appropriate method, e.g. systematic, random or convenience sampling. In practice, lists of firms may not fully or accurately represent the population identified for the study and the sample has to be drawn from a wider population and a multi-stage sifting or filtering process may be necessary to find the firms meeting the selection criteria. Two alternatives were considered here. *The first* was to use general firm directories and conduct a large survey of small firms across selected industry sectors with a basic questionnaire on firm characteristics. From the response, firms meeting the selection criteria (population definition) could then be targeted with a second, more in-depth questionnaire. As the number of firms in the general population with innovative and international activity was not known, an extremely large and expensive mailing would have to be undertaken in order to ensure capture of target firms. *The second* alternative was to seek a list or database of firms which more accurately represented the population or which allowed a customised search for specific firms within its listings. This second approach was thought to be the more efficient and cost effective approach and it was therefore considered to be worthwhile to examine a number of databases and lists which might provide useful sampling frames for research on small firm internationalisation in technology sectors.

Decision Box 4 . *Population and Sampling Frame*

Decision: *To search for a database, directory or list which would represent the population of firms and facilitate a search using specific criteria.*

(The approach taken and the constructs of the research are discussed fully in Chapter 5).

As a particular interest in the research was in a specific category of technology intensive firms, i.e. NTBFs, any list of firms would have to include this category. No comprehensive list or database of NTBFs were found to be available for this research. Existing studies of NTBFs in general tend to be derived from larger studies of innovative or high tech firms. Studies specifically concerned with NTBFs have based their estimates of the number of NTBFs operating in a given area on data derived from a variety of sources. The FSI/SQW (1988) study for example was based on the following sets of data:

- Department of Trade and Industry records concerning new-start companies and companies in high-technology sectors.
- Information from venture capital firms.
- Data from other financial organisations - principally major clearing banks.
- Data derived from regional and other public development agencies.
- Research on certain sectors and studies on high-technology industry in different areas. (1988, p8).

Keeble's study of locational factors in NTBF development was based largely on data purchased from Dunn and Bradstreet, which was assembled from such sources as the registrar of companies and VAT registration data. Both Dr Keeble and Roger Quince of Segal Quince and Wicksteed were approached concerning access to their data sources. The latter reported that the firm had never assembled a data base of NTBF firms but were willing to give access to their company files on individual NTBFs with whom they had dealt. They were not able however to estimate the number of company names they could supply nor give any indication of the number of firms with international connections. Keeble's database was confidential. He suggested using VAT registration or company registration data. This approach, was explored but in addition to the time involved in assembling data in this way, a number of other problems were identified:

- Company registration data exclude partnerships and owner-managed businesses.
- VAT registration excludes very small or start-up companies which are exempt from VAT.¹
- Such records give no indication of international involvement.
- If, as one study suggests, as little as 5% of innovative firm external linkages at the R&D stage are international (Rothwell 1993), and as Chesnais (1988) suggests, cooperative partners tend to be fewer in number at the commercialisation stages, at least 2000 firms would need to be approached in order to identify 100 firms with international linkages. This figure being further reduced by the willingness of firms to respond.

¹ Access to such data has not been explored, nor has the depth of information included in VAT registrations been explored. Anecdotal evidence from researchers in the field suggests that this source of data suffers from the high incidence of firm failure.

Large-scale data sources, which are published regularly and often have electronic access, clearly have potential as sampling frames and a number of possibilities were explored. Export directories were not considered appropriate here, as firms which do not export but are involved in other forms of international involvement would be excluded and it is precisely this group of firms, in addition to exporters, which is the focus of the study. Additionally, extensive directories such as Kompass take at least 3 years to be compiled and published, new firms or those embarking on internationalisation during this period would not be included.

Another consideration is that the population from which a sample needs to be drawn consists of SMEs which are in high-technology sectors (of which some will be NTBFs) and which have international linkages.² No comprehensive database exists which satisfies all of these criteria and there may in fact be very few NTBFs of small and medium size involved in international cooperation. There are however two major sources of information from which suitable lists of firms may be constructed. These are 1. directories, data bases and lists of innovations and of high - tech firms, 2. lists and databases of international linkages or potential international partners.

1. Innovation and High -Tech Data Bases

The following lists and databases were examined:

1. The Science Park Data Base. This lists all firms located in the UK Science Parks - high-tech SMEs may be selected from this.
2. The Scottish Office - Technology Unit Database which contains some 2500 Scottish technology firms - access to this was considered possible through negotiation.
3. The SPRU Innovation Data bases which contains a chronological record of British innovations over a number of years.
4. The Scottish Bio-technology directory contains mostly very small firms (≤ 10 employees) and does not indicate international connections. Less than ten firms could be selected from this.

² Since few sources of data on firms give either the date of founding or the reason for founding, NTBFs can only be identified from a wider population during the course of the research. However, NTBFs are a subset of the high-technology firm sector and are also by definition "innovative". Lists of high technology firms and or innovative firms may therefore be useful for sampling purposes.

5. The Scottish Electronics Firms directory. May be useful, but again the final list will be small, as the directory contains a number of agents distributors and sundry suppliers which are not relevant here.

Limitations of Innovation and High -Tech Data Bases

None of the above listings give any indication of international involvement and few differentiate amongst firms by size. An interesting possibility would be to use such data to determine the extent of international linkages by innovative and high-tech firms in general. The usefulness of this approach is however questionable as the objective is to examine cross-border interaction with a responding sample large enough to facilitate comparisons between groups of firms. There is some doubt as to whether the above data sources are comprehensive enough to achieve this end and in any case such a survey would add another tier to the research.

2. Databases of International Linkages and Potential Partnerships

1. Cordis Partner Search - An EC wide, on-line data-base containing all firms which are seeking international partners including a large number which have already participated in an EC technology programme. A Boolean search of the database for UK firms of less than 500 employees in the business of manufacturing, technology transfer or consultancy (mainly R&D) who are seeking partners worldwide, provided a list of 566 firms. A number of firms however had made multiple applications and on elimination of these the list was reduced to 287 firms. This list still includes some public bodies and university departments which need to be eliminated. More importantly, there was no way of differentiating between firms, by size, in the under 500 employees category.
2. BC-Net - a data base of firms involved with international partners - this however is strictly confidential and to date access has not been achieved.
3. Europartinarariat - a list of innovative firms meeting at a symposium in Glasgow in 1993 for the purpose of meeting up with pre-selected potential partners. A complete listing of Scottish participants has been attained. Around 20 firms fall into the high - tech sector.
4. Euromatch - A database of Glasgow firms looking for international linkages. This list has not been updated since 1989 and is reputedly

not a good source of data on internationalising firms. Many of the firms, according to anecdotal evidence, had no international connections and used Euromatch simply as a means of getting listed in an international directory.

Limitations of the Above Sources of Data

With the exception of Cordis, all of the above sources of data provide a very small number of reasonably suitable firms. Of the above sources Cordis, the Europartinariat catalogue and the BC-Net, for the most part represent lists of potential partners rather than actual partners which suggests that a proportion of the firms may be using this route as a first attempt to internationalise.

Cordis is a rich database with fairly extensive information on participating firms. It is however predominantly concerned with R&D links, although a cursory examination of the types of partners required, revealed a number of instances in which manufacturing, marketing and distribution links had been requested.

Other Sources

It was known that Local Enterprise Companies, had been involved heavily in the last few years in matching SMEs, which are often innovative or high-tech based, with international partners. Such local enterprise companies do have lists of firms cooperating with international partners. Approaches to a few such bodies proved fruitless, as the information was considered by its holders to be confidential, a source of competitive advantage, and the Data Protection Act was frequently quoted as being the major barrier to its dissemination.

A major effort in the early stages of this research was made in an attempt to access SMEs which had participated in the EC SPRINT initiative. The major stumbling block proved to be the structure of the programme under which the intermediary task of matching partners was contracted out and further subcontracted several times. A list of operators (firms and other bodies to which the intermediary function was subcontracted), was attained and approaches made to a few of the operators. None were able to supply the names of more than half a dozen firms and all approached insisted on first contacting the firms before handing over any information. As all operators were expected to return a quarterly report to DG XIII, it was assumed that this information would be stored in some kind of data retrieval system. Enquiries to the directorate suggested that where access to the data in Brussels "may" be possible, there could be no guarantee that it would be suitable or usable. Anecdotal evidence from other researchers in the field doing work on the efficiency of the programme at the

bureaucratic level suggested that such information was not, at that time, organised collated or filed and would not be easily converted into a useful form.

Further enquiries into other efforts to "match" firms with international partners suggested that the decentralised structure and use of private consultants and other intermediaries was fairly typical, which means that data access would only be possible where centralised records are kept and these made accessible to the researcher.

Another possibility considered was that firms performing the intermediary functions would be willing to pass on questionnaires to their client firms without divulging the identity of such firms to the researcher. The obvious drawbacks are: dependence on the goodwill of the consultants and other intermediaries, lack of control over the sample and administration of the questionnaire, and lack of control over the time period within which the research is conducted. This could provide a way to effectively target SMEs which are actually involved in international cooperation, but would produce a small and possibly biased sample.

An obviously suitable database for this research would have been the SPRU database of British Innovations. On enquiry however, it transpired that this database had not been systematically maintained since 1982 and since many NTBFs may have been established since that date, this possibility was rejected. Another alternative considered was the list of firms compiled at SPRU from the World Patent Index. This list comprised firms which had made applications for patents in the US over the last 20 years. While this would seem to be a useful approach as patent applications indicate some kind of technological, scientific or product development and applications to the US, in addition, indicate an interest in, if not a specific intention to enter a foreign market. Examination of the list however, found that a large proportion of these firms were very large and in most cases, multinational companies. In addition, addresses of these companies could only be attained by the lengthy and time-consuming process of looking up the patent registration numbers in the patent's register.

Courses of Action

Amongst the possibilities three alternative courses of action were considered:

1. Undertake a large scale survey from some or all above sources to identify firms which do have international linkages. Follow this up with a more focused survey of firms responding positively. The success of this approach depends on the extent of the first survey, the response rate, and the proportion of firms reporting international connections.

2. Survey only those sources which are specifically concerned with international linkages and accept the limitations of small sample size and bias towards R&D connections. As NTBFs are R&D intensive and not particularly prolific, databases such as Cordis may be a fairly good representation of the international activities of NTBFs.

3. Establish search criteria which would pick up firms most likely to be small, technology intensive and have cross-border links and utilise the Boolean search facility of large on-line or CD-ROM data-bases and survey these, relying on the questionnaire to distinguish between suitable and non-suitable firms through respondent self selection.

The third strategy was pursued as on-line databases were perceived to be more comprehensive than many printed directories and more likely to be regularly up-dated and therefore contain very young firms. Most importantly, the Boolean search facility allows the population to be identified through the application of pre-determined search criteria and the 'hits' are achieved through a process approximating random sampling. A few on-line data-bases were explored in order to determine the extent to which very small firms were incorporated, and whether the way in which data was recorded and stored would allow the research selection criteria to be used as search terms.

Result of On-Line Searches

The focus of the research is on firm growth, innovation and internationalisation processes in small technology intensive firms and in particular, new technology based firms. NTBFs are found in emerging technologies including biotechnology, advanced materials technologies, information technologies and energy technologies. Several on-line data-bases were accessed in order to identify and locate firms which satisfy as many of the above criteria as possible. Basically, what was sought was a sample of firms of less than or equal to 100 employees; less than 10 years of age (hopefully so that corporate memory of developments will be intact), which are actively involved in the conversion of science to technology and which have or are about to have economically gainful international links. On-line data bases which came close to satisfying most of the criteria listed were selected and searched. The results are discussed in the following paragraphs.

The Cordis Database

The Cordis database is an EC wide on-line database which includes firms which are seeking international partners for a number of purposes including: marketing,

distribution, production and R&D, although the latter category is predominant. Search facilities within this database allowed a search for UK companies with 500 employees or less, in the business of manufacturing, technology transfer, or consultancy, seeking partners world-wide, to be carried out. The result was a list of 566 firms which reduced to 287 firms after duplicate applications had been eliminated. These 287 would have to be reduced further after manual elimination of public institutions and firms in SIC categories other than those stipulated above as new or emerging technologies.

The search facilities provided only for searches of greater than 500 employees, between 50 and 500 employees and less than 50 employees. This database provided suitable information to the extent that it is R&D intensive, reflecting the character of the firms sought, and have had, or are attempting to form linkages with foreign partners. The limitations of the database are that a large (but unknown) number of firms are included in the database because of their involvement in EC R&D or technology programmes such as BRITE, ESPRIT etc.. Payments for participation are made by the EC and international collaboration is frequently a requisite for participation. The form of international expansion by participant firms is therefore likely to be influenced strongly by the policy instruments. While it is important to include firms internationalising by such means in the sample, over-emphasis would unduly influence interpretation of the results and therefore it was decided to explore other databases.

Dunn and Bradstreet (Market Identifiers)

This is a very large credit-rating database from which it was found possible to perform a finely tuned search. This database has been extensively used in studies of SMEs and hi-tech and NTBF firms. Its use is therefore justified here. Due to the cost involved in on-line searches, the exploratory search was limited to the following categories: computers (in Scotland only), software houses, diagnostics, composites, scientific instruments, satellites and pharmaceuticals. The firms were based in the UK and had less than or equal to 200 employees. In most cases the firms were founded in 1994 or more recently except where the search revealed very few firms and this was extended. Obviously unsuitable firms (e.g. foreign owned, or retailers, wholesalers or others whose role in the conversion of science to technology would be non-existent or limited) were eliminated manually, in other words, likely firms were hand-picked from the list produced by the automated search. This database allows firms to be identified by SIC category, size, and age. It does not give any indication of international involvement - this can only be established by contacting the firms themselves. Examination of the search result found that the data-base included very new and very small firms and sole-traders and partnerships as well as companies and public institutions.

The World Patent Index

This database again is very large and the search had to be limited according to time and cost criteria. A search was carried out for British originated patent applications in 1993 in the appropriate SIC categories. Only those applications which had sought 10 or more patents (by country) were included. This, it was thought, would give some indication of the extent of internationalisation, or intended internationalisation. The WPI allowed large firms to be distinguished from smaller firms in the printout although a search for firms by size category was not facilitated. No indication of "large" or "small" was given in absolute terms. This search identifies patent application numbers which still have to be manually searched for through patent application registration forms, held in Mitchell Library, in order to get details of the applicant firms.

Advantages of this database are that it allows actively innovative firms of "small" size with actual or anticipated international links to be identified. The potential of WPI searches are immense, but very expensive, which is why the search was confined to applications made in 1993.

Data Search Decision and Summary

The use of on-line data-bases is potentially very useful in survey research where a large sample, or sample from a large population is required. In this case, the population of technology intense and specifically, NTBFs is unknown and identification of any "representative" sample difficult. The search facilities, however, provide a useful first step in data reduction in allowing the obviously unsuitable to be eliminated and firms within the research population to be identified.

Disadvantages of on-line searches include the cost of the process which increases with the time spent on-line, the complexity of the search or number of search criteria, and the number of hits. Sampling decisions would tend therefore to be dominated by cost considerations rather than the requirements of sampling design. In using on-line databases, the researcher has little idea of the scope of the data nor how it was collected. The implications are that the researcher has little if any information on the population, control over the sampling procedure is diluted and there is no control over bias in the representativeness of the sample drawn. These issues receive little, if any, attention in the literature cited in this thesis which is surprising considering the importance of sampling in survey research. The lack of attention may reflect the rapid change in information technology, the growth of information as an industry and attempts by government to protect data, all of which have resulted in a proliferation of information but much more restricted access than previously. Some of the most suitable sources of

data for this research were inaccessible to the researcher or too costly within the financial bounds of the project. The decision was made to extract a sample of small technology intensive firms from the on-line database "Dunn and Bradstreet Market Identifiers" to a value of £480.

Sample Selection

As discussed in the section on on-line searches, there is no perfect sampling frame for this survey since any directory of firms is secondary data and constructed for purposes other than this research. The sampling frame for this survey was therefore constructed from three sources:

Decision Box 5. *The Sampling Frame*

"Dunn and Bradstreet Market Identifiers" on-line search.
"Scottish Biotechnology Firms".
"Scottish Electronics Firms".

(The approach taken and the constructs of the research are discussed fully in Chapter 5).

Ideally, the sampling frame should be all inclusive, i.e. including all members of the population to be surveyed. This is not the case here as the parameters of the population are unknown.

One of the difficulties in small firms research is dealing with the considerable amount of heterogeneity in small firms. In this research interest is in very small firms in new and emerging technologies and particularly in those which may be categorised as NTBFs. The firms should be small enough that data on their early expansion efforts through organic as well as through acquisition activity may be captured. In addition, they should be relatively young to ensure that there is corporate memory of expansion activity and in particular international expansion. Alreck and Settle (1995) suggest that the specification of a sampling design should begin with the identification of the population being examined and recommend the following steps:

- "1. Be sure the population consists of those people who actually possess the information sought by the survey.
2. Identify all the major factors that would otherwise qualify respondents and make their responses meaningful to the sponsor.

3. List the criteria for inclusion and exclusion of respondents, together with the decision rules to be used." (Alreck and Settle, 1995, p55).

The procedure adopted is discussed in the following section on sampling method.

Sampling Method

The type of sampling used here is judgement or purposive sampling (William, 1980). In this type of sampling the elements are hand-picked according to criteria established by the researcher. Purposive sampling tends to be used in exploratory research designs where the researcher is interested in sampling those who can offer insight into the research question rather than a cross-section of opinion from a more general population (Churchill, 1987, p437). The type of sampling method employed is important in the choice of statistical methods and the generalisability of results to the target population. The strongest statistical techniques rely on probability samples in their application. The use of the non-probability sample can be supported if the researcher using the sample:

"... defends the validity of this work by citing the adequacy of the controls employed and the manner in which the controls, as originally planned, survived the execution of the study", (Gentry and Hailey, 1981, p184).

Those authors go on to suggest that despite the limitations of the non-probability sample, where it is well designed and executed, it may be superior to a probability sample which has been poorly designed or executed, and suggest that frequently researchers assume there is a probability sample where one does not in fact exist, and ignore potential problems arising from the sample design and execution. Discussion of potential sampling frames for this research, and their limitations above, indicates that a probability sample is not possible or appropriate here. Even if random selection could be applied to one of the larger databases, the researcher has no indication of how well that database represents the population (unless it claims to be a census) or how that database was assembled. A random sample here would be a fanciful notion.

Gentry and Hailey (1981) suggest that in non-probability sampling, demographic factors may comprise the "controls" used in designing the sample. The quality of these controls becomes a major factor in evaluating the validity of the sample. They suggest that if the researcher feels strongly that the comparison of demographics (characteristics) indicates that the responding group "retains the quality of probability present in the sample as originally designed", then statistical techniques appropriate to

probability samples may be used. However, the premise and controls should be communicated to the users of the research results. It is sufficient here to indicate that the stance taken in this research is that the controls and procedures discussed here in the context of sample design and selection, are sufficiently rigorous to merit the use of statistical tests and techniques reliant on probability samples. Further discussion of analytical procedures is contained in Appendix 1 " Statistical Procedures".

This decision to use the Dunn and Bradstreet Market Identifiers database was made because a test run, searching for Scottish and English firms in given SIC sectors (all SIC codes related to manufacturing firms), with 50 or less employees was found to include very new firms which had been established within the last three years. The search facility also permitted firms to be identified by number of employees and by industry sector identified by American SIC codes (see Appendix 2). Further refinement of the search would have been possible but more expensive and beyond the budget available for this project. In order to avoid the necessity of doing a very large survey, it was decided to concentrate on a few narrowly defined sectors and search for firms registered as having 50 or less employees (taking account of firm growth after compilation of the directory, the actual cut-off for acceptance of responses was firms of 200 employees).

Industry sectors selected were those which were thought to be most likely to contain young technology intensive firms. As a starting point, Butchart's (1987) definition of high technology firms was used as a guide. It was found that UK SIC codes had been changed in the early 1990s when a few new sectors were added and a number of existing ones were merged. For guidance, Rothwell's list of emerging technologies (1991), which were listed without SIC codes, was consulted. The main sectors in this list were Biotechnology, Energy Technologies, Advanced Materials and Information Technologies. Energy Technologies was eliminated from the study as investigation showed that this sector was dominated by very large firms. The other three sectors were very broad and it was decided to focus on specific sub-sectors of manufacturing firms in each of the three groups. US SIC codes for the selected sub-sectors had to be found in order to construct the search commands. Specific new technology sectors selected were as detailed in Decision Box 6.

Decision Box 6 <i>Sample Selection Criteria</i>		
	<i>US SIC</i>	<i>Sector</i>
1	2821 2824	<i>Plastics and Composites.</i>
2	2831 2833 2834	<i>Biological Products/ Medicinal and pharmaceutical compounds.</i>
3	3841 3842	<i>Advanced surgical instruments and appliances.</i>
4	-	<i>Advanced electronic instruments. (from "Scottish Electronics Firms").</i>
<i>Firm Size Less than or equal to 50 employees when registered in database.</i>		
<i>(The approach taken and the constructs of the research are discussed fully in Chapter 5).</i>		

Search of the database produced the following breakdown.

	Sector	England	Scotland
1	Plastics and Composites.	153	7
2	Biological Products/ Medicinal and pharmaceutical compounds.	200	17
3	Advanced surgical instruments and appliances.	400	26

The database was found to contain no Scottish firms in the biotechnology sector. As it was known that there were small biotechnology firms in Scotland, it was decided to add those listed in the Scottish Biotechnology Firms directory to the list. To keep the cost of the survey down, a directory of Scottish Electronic Firms was used to identify firms in the sector dealing specifically with advanced electronic instruments for industry (see Decision Box 6). No equivalent directory was found for English based firms and therefore a further search of Dunn and Bradstreet was carried out. The list of firms produced was scanned for obvious misfits, e.g. manufacturers of petfood containers and utensils, which may not be appropriately included in high-technology sectors. Such firms were contacted by telephone and eliminated if they were found to have no involvement in technological innovation or the manufacture of high technology products. The resulting sample consisted of 1051 firms. Fifty of these were randomly selected for the pilot survey and the remaining 1001 was the sample used in the full survey.

It is important to note here that the intention was not to make cross-sectoral comparisons. Several industries were included in the sample however, to ensure that the firm activity measured was not subject to specific industry influence. No specific effort was made to select sub-samples representative of the industry categories mentioned above.

Design and Construction of Questionnaire

The questionnaire was constructed in seven sections. Section A and Section G were concerned with firm characteristics and performance indicators respectively. Performance indicators were positioned at the end of the questionnaire so as not to discourage firms which might feel sensitive about financial information. Section B was concerned with the firms' research development and technical innovation. Sections C, D, E and F were concerned with external linkages with other firms and institutions. The sections were sequenced from very informal links through to more formal links, i.e. from external contractual arrangements to internalised links such as overseas production and other equity investments to formal cooperation such as cooperative research and development projects. The sequence of sections was intended to reflect growth patterns suggested by the small firm growth literature (Chapter 2) and the internationalisation literature (Chapter 4), from early tentative links to more formal, riskier and more committed links later in the life of the firm.

To ease both response and analysis, all questions were structured. Dichotomous questions were used extensively to determine whether or not all firms fell into a particular category or not. To supplement this categorical data, firms were asked to state the country in which they first established a particular link and the date on which that event took place (ordinal and ratio data). A number of multiple choice questions were included where respondents were expected to select one or more alternatives from given lists (categorical data). At this stage it was intended that the survey collect data on firms' motivations for forming external links and the effect on growth which respondents perceived to be attributable to external linkages. To this end, 5-point Likert scale questions were included (interval data). The questionnaire was put through several stages of review and reconstruction before it reached a stage where it was considered ready for pre-test procedures.

Stage C: Data Collection

Testing and Piloting the Questionnaire

The questionnaire was tested rigorously with reference to existing literature in the appropriate areas (see Decision Box 7). In addition it was subjected to *expert opinion* by a number of researchers in the fields of *innovation, small firms, technology transfer and internationalisation*. These were Professor Michael Baker, (innovation and new product development), Dr Maureen Berry (small firms and technology strategy), Professor Susan Shaw (small firms and supply chain), Dr Jim Taggart (R&D management and technology transfer), Professor Stephen Young and Professor Neil Hood (internationalisation, small firms and venture capital and the economics of the multinational), Professor Peter Buckley (small firms and foreign direct investment), and Dr David Crick and Dr Jim Bell (small firms and support for exporters). It was also scrutinised by *experts in research design and questionnaire construction*. These were Professor Susan Shaw, Dr John Webb and Dr Stephen Tagg.

Decision Box 7. *Testing the Research Instrument*

- *reference to existing literature,*
- *review by expert opinion, academic and practitioner*

(The approach taken and the constructs of the research are discussed fully in Chapter 5).

It was also felt necessary to subject the questionnaire to scrutiny by people working in the *targeted industry sectors* who were in a position to offer advice, and to conduct a pilot survey. Verbal feedback was received from The Licensing Centre, the Venture Capital section of Scottish Enterprise and the Technology section of DTI. Opinion of firms themselves was sought through a pilot survey with follow-up telephone interviews.

The literature on the pretesting of questionnaires was found by Reynolds et al. (1993, p74) to be largely normative in nature and suffering from a lack of empirical evidence. The purpose of the pretest is to refine the questionnaire and identify errors which would only emerge during a test run of the survey. Reynolds et al. cited a number of authors' descriptions of pretesting, e.g. Green, Tull and Albaum (1988) felt that the activity was related to the development of the questionnaire or measurement instrument while Hunt, Sparkman and Wilcox (1982) saw the process as a dry run of the entire research process.

The pretest is important in that it represents an opportunity to identify and correct fundamental problems which could not be corrected at the main survey stage (Lehmann, 1989). Perdue and Summers (1986) suggested that pretesting should, if effective, suggest changes to be made in the manipulation of the questionnaire.

The importance of pretesting for novel research projects or those concerned with complex or specialised issues was emphasised by Peterson (1988). In general the literature offers the general consensus that pretesting is essential, except where the pretest might in itself influence the outcome of the final study, e.g. where the target population is very small (Reynolds et al., 1993, p172)

The latter authors divided the pretesting of a questionnaire into two main areas:

- a) pretesting individual questions
- b) checking the overall design

The same authors listed the main items which should be included in the two areas of the pre-test.

- double questions
- ambiguous questions
- ambiguous word meanings
- loaded or leading questions or phrase
- level of question difficulty
- lop-sided response categories
- missing response categories
- missing questions
- necessity and relevance of individual questions
- discriminatory questions
- non-response rates
- effect of ordinal position of multiple responses
- perception of pictures
- degree of attention

Various methods are available from pretesting. Boyd, Westfall and Stasch (1989) suggest that pretests be conducted through personal interviews; a process which allows respondents' behaviour to be observed and gives the researcher the opportunity to ask questions. The final pretest however, should use the medium to be used in the main study (Kinnear and Taylor, 1987; Boyd, Westfall and Stasch, 1989). Reynolds et al.

(p175) suggest that according to general opinion in the literature, the pretest sample should be as similar in nature to the final sample. Although the agreement in the literature is that the pretest sample is small, actual size of the test sample will vary according to the heterogeneity of the sample (Green, Tull and Albaum, 1988), the variety of respondents and complexity/uniqueness of the questionnaire (Tull and Hawkins, 1987).

Procedure Followed

As the firms in the sample were heterogeneous in terms of their stage of growth, involvement in innovation and level of internationalisation, a relatively large group of firms would need to be observed or interviewed in order to pretest in the manner suggested by Boyd et al. (1989), Peterson (1988) and Kinnear and Taylor (1987). It was therefore decided to rely on expert opinion and a dry-run of the whole survey. The pretest procedure therefore consisted of two stages:

1. Discussion of questionnaire with experts.
2. Dry-run of the whole survey.

Discussion of Questionnaire with Experts

The questionnaire was scrutinised by investment consultants in Scottish Enterprise who do considerable work with new technology based small firms. In addition, the questionnaire was circulated to academic experts in the various fields of expertise as discussed above. To focus their evaluation, they were also provided with a concise summary of the research conceptualisation and a detailed outline of the project objectives, main research questions and propositions. Useful advice was given, by the experts, on the structure and format of individual questions, wording and overall sequencing and structure. Some of the advice represented conflicting opinion, but most was useful and was taken into account in modifying and tightening up the questions. Subject and industry experts were for the most part satisfied with the content, level of detail and measures used. Concern was expressed about how respondents might interpret the term 'cooperation' which was used extensively throughout the questionnaire, and although a definition was provided, it was still generally felt that the concept was perhaps too wide to be easily interpreted in the results. The researcher's concern over the length of the questionnaire and the general applicability of certain sections within was echoed by the experts. Discussion with the experts however revealed that they themselves would be unwilling to drop any particular questions or areas, in addition, although a few tentative suggestions for change were made, none of the subject experts were able to suggest how to deal with the issue and suggested going ahead with the questionnaire at that stage.

Decision Box 8. *Testing the Research Design*

It was decided to conduct a dry-run of the entire survey based on a small sample of 50 firms and analyse the results.

(The approach taken and the constructs of the research are discussed fully in Chapter 5).

The researcher's concern over low response or fragmentary response across the questionnaire sections led to the decision to launch a test-run of the survey in order to examine the results and then, based on assessment of the response pattern and ease of analysis, decide whether to reduce the length of the questionnaire and in which dimension.

Dry-Run of the Whole Survey

The dry run was conducted by selecting 50 firms from the data list. These fifty firms were pre-notified, then two weeks later were mailed the questionnaire, an introductory letter, and information sheet and a reply-paid envelope. A reminder was sent three weeks later. (see Appendix 3). Two firms were found not to exist and therefore the actual sample size was 48 firms.

Interpreting Response to the Dry-Run

Response to the dry-run was tabulated on a spreadsheet and examined (Appendix 4). Of the 48 targeted firms, 7 (14.5%) had "gone away", bringing the actual sample size down to 41. Nine questionnaires were returned (22%), two of which however were not completed, bringing the actual response rate down to 17%. Examination of the returned completed questionnaires found that, as expected, not all the sections³ were relevant to every firm. Only two firms were in a position to answer all sections and a further two answered six of the seven sections. In all, five questionnaires (12%) were usable. One of the partially completed questionnaires was from a firm in an industry sector irrelevant to the survey and would have to be eliminated. One respondent filled in the first three sections and then gave up due to time constraints. A further firm refused to participate stating that "hundreds of questionnaires" were received each week. Examination of the names of firms in the data list revealed a garment manufacturer and a packaging firm. Classification of either of these firms as "high -technology" was considered dubious and again suggests that sampling frames in industrial surveys may not be as accurate and reliable as tends to be implicitly assumed in most research

³ Sections of the questionnaire roughly corresponded to stages in the firm's growth, and therefore, firms at early stages of the growth process would only be able to complete the early sections of the questionnaire and

reports. Due to the low response rate and patchy response across the questionnaire sections, it was decided that some changes must be made. Two main alternatives were considered:

- 1 to ruthlessly prune the questionnaire,
- 2 to reconsider the research objectives and the purpose of the survey.

Having already weighed up the first alternative during the earlier consultation with experts stage, it was decided to pursue the latter option. The original objectives for the survey were to identify the types of cross-border external links formed by firms and to determine the role played by these linkages in their individual development and growth. The pre-test indicated that this was in fact too ambitious for a general survey and that the later objective be dropped and picked-up in a future study through telephone or personal interviews. The decision to concentrate on the identification of external links allowed the questionnaire to be simplified by dropping the sections separating each part of the questionnaire and removing the scaled questions on perceptions of the contribution of links to development and growth. More attention was then paid to performance measures and the dates on which links were established, thus providing ratio and interval data to broaden the scope of statistical analysis.

Decision Box 9. Modification of the Research Design.

It was decided to relax some of the original objectives which, for the sake of clarity, have not been included in the discussion in Chapter 5.

This involved concentration on the identification of external links and international development and growth.

(The approach taken and the constructs of the research are discussed fully in Chapter 5).

The modified questionnaire was again subjected to expert opinion but no pre-test was run for fear of diminishing the sample and because of time constraints.

Retrospectively, it seems obvious that the objectives for the survey were too ambitious. Expert review however did not anticipate the practical problems associated with low response combined with partial response across the questionnaire sections. Although concern was expressed at the length of the questionnaire, advice given was simply that some questions should be omitted. In practice, once the pattern of responses had been identified through the pre-test, it was obvious that comparisons between firms would be

the final section on firm performance.

difficult, would have to rely on statistical tests for small samples and would not be generalisable to the whole population. The pattern of response indicated that the research instrument included sections and questions relevant to small sub-samples and most of it would be irrelevant to large groups of firms. It was realised from this that in small firms research there is a trade-off between the desire to apply homogeneous structures and theories in the questioning (e.g. growth stage, size, age, sector etc.) and the need to reflect a wide range of heterogeneous factors relevant to small firm operation and strategy. It would seem that a great deal of care needs to be taken in the design of the questionnaire, which could be too general to provide any really useful and discriminatory information, or on the other hand, too specific to be relevant to the target population in general. Experience here also emphasises the need to define the target population, select an appropriate sampling frame and employ a search strategy which will as far as possible, select appropriate firms, or eliminate irrelevant ones.

An obvious question arising from the pre-test evaluation is whether survey research is indeed appropriate for this particular study. Adding experiential knowledge to the reasoning applied in the earlier section on research design, it is suggested that, as a filter for identifying the target population from a more general data list, and as a descriptive study, the survey is probably the most appropriate first step in identifying the firms themselves, the types of cross-border links they have established.

Deductive reasoning and the use of hypotheses here would seem to be limited as the use of theory and pre-determined analytical structures tended to render the research instrument too restricting when applied to the heterogeneous small firms sector, even within more narrowly defined inclusion criteria. The pre-test suggested that releasing the data from pre-defined structures might be more revealing when interpreted inductively. In other words, for the exploratory purposes intended, the first questionnaire was eventually considered to be too tightly structured and reflected conventional step/stage approaches to firm growth too strongly.

Modification of Questionnaire and Plan for Analysis Procedure

Response to the questionnaire was not expected to be high due to its being used as a filter to sift out firms involved in innovation and internationalisation from the wider population of small firms in technology sectors. It was therefore considered important to increase the potential response rate by paying a great deal of attention to detail in the design and construction of the questionnaire, the presentation of the documentation and the mailing procedures. Modification to the content of the questionnaire after the pilot survey resulted in the removal of a number of questions which allowed the sequencing and structure to be simplified and streamlined. All attitudinal questions were dropped

from the questionnaire and questions on external links were simplified and reorganised into two main sections, inward links and outward links, (see Appendix 5). General presentation of the package and mailing procedures however were the same across the pilot and final run.

The pre-test and pilot run were found to be useful in assessing the nature of analysis procedures to be applied to the questionnaire response. To plan for data analysis the researcher needs to differentiate between the four different types of data: nominal, ordinal, interval and ratio, to decide on which are the dependent and independent variables and to determine the purpose and type of analysis. During the course of modifying the questionnaire, questions were coded for analysis and variables were labelled according to their data type. The full list is reproduced in Appendix 6.

Enhancing Response to the Questionnaire

A number of authors have discussed the issue of response rates in mail surveys (Janssens and Pessemier, 1980; Gentry and Hailey, 1981; Yu and Cooper, 1983; Jobber, 1986; Jobber and Saunders, 1986; Walker et al., 1987; Pressley, 1980; Harvey, 1987; Jobber, 1985; Deshpande and Zaltman, 1984). The main issues arising from that literature have been brought together in a discussion by Diamantopoulos et al. (1991). These authors identify two basic strategies for dealing with the non-response problem in mail surveys:

1. estimate non-response bias for a sample of non-respondents (Gentry and Hailey, 1981) and
2. minimise non-response by carefully executing and designing the survey.

The latter approach they suggest, quoting Yu and Cooper (1983, p36), is the better approach since "it is an attempt to eliminate non-response bias entirely and thus avoid the untestable assumptions in other solutions" (see decision Box 10 for procedure followed). The second approach was also considered appropriate for this research design and execution and the following issues were considered.

The credibility of the researcher was thought to be particularly important to the population since high technology firms are more likely to be owned/managed by people with first and advanced degrees than the general population, and would expect a high level of competence in research. To communicate credibility and professionalism, the research was referred to as a project being conducted in the International Business Unit

by a researcher rather than by a doctoral student. The questionnaire was produced on good quality white paper bound in an A4 booklet.

As research indicates that the auspices of the researcher/research sponsor may increase response rates (Gray, 1957; Scott, 1961; Cooper and Brown, 1967; Vocino, 1977; Lebreque, 1978; Harvey, 1987), the cover page included the university crest. The title of the project, general instructions and a statement of confidentiality were also on the front page. Academic jargon was avoided and a plain and clear typographic style and layout adopted. White paper was used to promote a serious and professional image and to distinguish the questionnaire from the ubiquitous and more colourful direct mail promotional material received by everyone these days. To add to the professional image, the cover letter also bore the university crest as did a one page information sheet which was produced on white paper with navy blue type to break up the monotony of black print, but without losing the simple uncluttered appearance of the package.

Decision Box 10. *Enhancing Response Rate*

- *closed, structured questions,*
- *professional appearance, quality stationery,*
- *researcher/institutional credibility,*
- *altruistic appeal, and benefits stressed,*
- *background information provided,*
- *stamped addressed envelope, reminders and some telephone enquiries,*
- *confidentiality assured.*

(The approach taken and the constructs of the research are discussed fully in Chapter 5).

These efforts were made in an attempt to increase the chances of the questionnaire getting to the desk of the intended recipient and getting into that person's mind-set. The transmission of the message, i.e. questionnaire, to the receiver may be inhibited or stopped entirely by aspects of the receiver's environment such as work-loads, a stream of questionnaires from various sources and the screening process of gatekeepers in the organisation. Once the questionnaire has finally reached the attention of the receiver, there is still some likelihood that it will be filed and forgotten or simply binned (Diamantopoulos et al., 1991, p330). De Lozier (1976, p6) suggests that the respondent is more likely to pay attention to the questionnaire if there is an overlap in the perceptual fields of the researcher and respondent. In other words, the greater the common ground between the two, the greater the chance that the respondent will notice and act favourably towards the questionnaire.

It was thought that as intended respondents had probably been through the higher education process, they would be more likely to identify with the researcher and the institution, hence the use of the university crest. As small business owner/managers they would also be concerned with the performance and growth of their firms and therefore these aspects of the research were emphasised in the covering letter and information sheet.

Altruistic appeal has been found to increase response rates (Kevin and Harvey, 1976; Childers et al., 1980). The competence of new technology based firms in developing external linkages in response to growth barriers was stressed in the cover letter and information sheet. The firms were thus being approached as "experts" in the field from whom advice was being sought. The aim of the research - to determine the effect of external linking on firm performance was stressed as an area of common interest between researcher and respondent. Sudman (1985) indicated that interest in the topic is especially important when professionals are surveyed. Having stimulated the interest of respondents in the potential benefits of the research for their firms, a copy of the research results was promised to them in the event that they returned a completed questionnaire. It was pointed out that this would allow them to compare their own performance with that of other firms. The potential benefit of gaining a new perspective of the business through the process of filling in the questionnaire was emphasised in the cover letter.

The questionnaire was quite long and although open to further investigation, some research has shown that response rates are lower in the case of long questionnaires (Goyder, 1982; Baumgartner and Heberlein, 1984), although Brook (1975) suggested that "long" depends on the subject of enquiry and target population. Low response rate is of concern to the researcher because the implications are that low response indicates bias in those who did respond. Herzog and Bachman (1981) found that stereo-typical responding was more likely to occur in long questionnaires. Sudman and Bradburn (1984) suggested that long questionnaires with low response rates would tend to be returned to a greater extent by opinionated individuals. Other studies have found that an increase in response rate does not automatically result in a reduction in bias (Hutchieson et al., 1987). More recently, Roszkowski et al. (1990) found that lower response need not necessarily lead to biased measures.

Concern in the literature seems to highlight a potential trade-off between quality versus quantity in response to mailed questionnaires. While the debate is as yet unresolved, it is sensible to make the questionnaire no longer than necessary, and both interesting and

uncomplicated in its content and style. All questions which were not entirely necessary were eliminated and difficulty was experienced not so much in what to put in, but what to leave out. This elimination process was however useful in determining the precise cut-off points for this research and formulating a proposal for a follow-up study which will be conducted in the year following completion of this thesis.

The questionnaire consisted of closed, highly structured questions for ease of entry and analysis. Because of the length of the questionnaire, potential respondents were informed in both the letter and the covering page of the questionnaire that not all sections of the questionnaire, or indeed individual questions, would be relevant to their firm and that these questions should be skipped. Considerable use was made of routing in the questionnaire to help cut down on answering time.

While the above efforts were made to maximise response rates, care was taken to avoid "forcing" response and hence reducing the quality of the information in the response. The view taken echoes that of Roszkowski et al. which is supported by their empirical evidence and analysis of the literature:

"---many of the methods meant to increase response rate, even when successful, do not necessarily improve the quality of the information that one obtains through a mail survey". (Roszkowski et al., 1990, p508)

Mailing Procedures

Advance warning letters were sent to inform potential respondents of the research and its purpose and to evoke attention to the questionnaire which was sent out a few days later. Personal salutations were used wherever possible (861 out of 869 cases). The questionnaire was followed up by a reminder letter and a fresh copy of the questionnaire two weeks later. Respondents were asked to return the questionnaire even if they did not intend or were not able to complete it and were asked to provide their name and address so that they could be removed from the mailing list.

Firms which had been approached for the pilot run were not included in the main run of the survey. Letters of thanks were sent to all firms which responded positively and these were recorded in order to mail reports of the research results in due course. Firms were asked if they would be willing to participate in future research on the topic. Over one hundred firms expressed willingness and their names were recorded in a database for future reference. This was thought to be important as it would allow the

development and growth of these firms to be tracked in a series of longitudinal surveys later in the career of the researcher.

Stage D: Analysis of Results

Response to the Questionnaire

Mail Survey Response			
	1st Mailing	Reminder	Total
Questionnaires sent	<u>1001</u>	<u>779</u>	
Received			
Addressee gone away	58	21	
Wrong sector/business	12	17	
Large firm	9	7	
Addressee illness/absence	4	3	
Firm taken over	1	3	
Ceased trading	—	<u>6</u>	
Less	84	57	
Useful Sent			<u>860</u>
Refused, no reason	23	80	
Too busy/abroad	6	7	
Company policy	4	4	
Too small	<u>2</u>	<u>3</u>	
Total refusals	35	94	129
Returned Complete	141	107	
Not usable	<u>24</u>	<u>11</u>	
Total Usable	117	96	213
Not returned			<u>518</u>
			<u>860</u>
Response Rate			24.7%

Of the 1001 questionnaires mailed, 141 were eliminated when the response revealed that the firms had either ceased to exist, changed status or otherwise failed to meet the survey criteria for inclusion. This reduced the actual, useful sample size to 860 firms. Fifteen per cent (129) declined to answer the questionnaire for reasons listed in the table above. Four per cent (35) of the returned, completed questionnaires were spoiled or incomplete and had to be eliminated. The total usable response was therefore just under 25%.

Selection Criteria and Problems with the Sample

There were a number of problems with the sample which became apparent from the survey response. It should be noted however, that it was not possible to apply all of the criteria for identification of population members to the on-line search. The survey itself therefore to some extent acted as a filter as respondents were often self-selecting and respondents which did not fulfil the criteria for selection were screened out by the researcher.

Criteria applied to the on-line search were that the firm should have 50 or less employees and should belong to one of the designated high technology sectors.

Some firms which had been included in the category of firms of <50 employees in the data base were actually much larger. In most cases the potential respondents returned blank questionnaires with a note to that effect. In cases where completed questionnaires were returned, the questionnaires were included if the firm had grown to large size within 10 years or less, otherwise the questionnaire was rejected. Some firms were service firms, retailers or distributors. Where no manufacturing whatsoever was done, or the firm was well established as a service firm, these were also rejected. There is however a fine line here as new soft-start firms may not yet have expanded into manufacturing but may ultimately do so. The decision as to whether to include non-manufacturing firms was based on whether or not they performed any R&D and the age of the firm. A firm of 5 years or less with R&D but no manufacturing would be included, whereas a firm of more than 5 years with no R&D and no manufacturing could not be classified as a soft-start and hence would not be included.

Decision Box 11. The Criteria for Inclusion of Responses

- *a member of the designated sectors*
- *a firm with 200 or less employees*
- *a manufacturer or new start (under five years old)*
- *one with high technology products or processes or some involvement in either innovation or R&D.*

(The approach taken and the constructs of the research are discussed fully in Chapter 5).

The criteria for inclusion of the respondents in the survey were that the firm is a member of the designated sectors, a firm with 200 or less employees, a manufacturer or

new start (under five years old), one with high technology products or processes or some involvement in either innovation or R&D.⁴

The above reflects the difficulty in small firms research in dealing with heterogeneity. Statistical analysis requires that the sample of firms is homogeneous in respect of the criteria set for identification of the population. The final sample therefore was selected by determining whether the responding firms satisfied the set criteria, and the considered judgement of the researcher. Statistical tests were also applied to determine consistency across the two mailings.

Stage E: Communication of Results

The results of the research are presented in Chapter 7 of this thesis and analysed and discussed in Chapters 8 & 9. The results will also be communicated to the wider academic community through journal articles and conference papers. Respondents to the survey were promised copies of the research results. In addition to the encouragement of response, it was intended that a report, tailored for the business community, would be prepared and distributed to respondents, enterprise and industry councils. The purpose being to publicise the research results and the work of Strathclyde International Business Unit, and to attract funding for future work.

Future work relating to this topic has been planned and includes a series of depth qualitative follow-up interviews with some of the respondents to the survey. This will be a large-scale survey of small high technology firms in the UK based on further development of the conceptual approach applied in this study. The possibility of cross-national comparison surveys has been discussed with colleagues in the USA and is a long-term possibility. Immediate plans are to publish the results of the study in a series of articles and conference papers

Summary

This chapter has outlined the research design and methodology utilised in this research project and is supplemented by tables detailing the main administrative procedures in appendices 1.1 to 1.6. The research design consists of a literature review and informal preliminary interviews followed by a formal structured questionnaire to a sample of 1001 small firms in high technology sectors. Statistical analysis followed deductive

⁴Firms with no international links were not excluded from the study since one of its aims was to ascertain

reasoning and examines assumptions based on strong theoretical frameworks which emerged from the literature (see Chapter 7). The second part of the analysis was much more exploratory and utilises inductive reasoning to explore statistical relationships and patterns in the data, using statistical model building techniques, for which explanations were later sought by recourse to extant knowledge and theory from the literature (see Chapter 8). Interpretation of the results relies on the theory and evidence from studies reviewed in Chapters 2-5 inclusive.

Finally, in survey research it is important to determine whether the research instrument is both reliable and valid. Validity is the extent to which the instrument measures what it is supposed to measure (Gill and Johnson, 1991, p88). The latter authors suggest that the only way to assess the validity of a measuring instrument is to evaluate the results against other measures or criteria which have already demonstrated its validity. Smith, 1975; Cronbach and Meehl, 1979) suggest that a thorough knowledge of previous research literature will provide possible criteria against which validity can be checked.

Churchill (1987, pp382-384) identifies 4 types of validity: pragmatic validity, concurrent validity, content validity and construct validity. Pragmatic validity is determined by how well the measure predicts the criterion, e.g. the GMAT test (Graduate Management Admissions Test) is commonly used by major business schools to predict performance on MBA examinations. The fact that this test is used so extensively attests its pragmatic validity (Churchill, 1987, p383). Pragmatic validity is determined by correlation between the two measures, if it is high the measure is said to have pragmatic validity. (In this study several measures of performance have been used; turnover, international turnover ratio, growth in turnover, and growth in exports). All of these measures have been used extensively in studies of export and firm internationalisation with the exception of *international ratio*, which in this study is the ratio of all earnings from overseas as a proportion of total turnover. The pragmatic validity of the conceptual approach of this study can only be tested in future by comparison with other studies emerging in this field of international entrepreneurship. Essentially, it is a new approach, drawing on existing studies but developed specifically to deal with international expansion as apart of a holistic growth process of the small firm.

Content validity is concerned with the adequacy with which the domain of the characteristic is captured by the measure. If the domain included in the measure is

association between international activity and the firms' growth and performance.

decidedly different from the domain of the variable conceived, it will lack content validity. (This is an issue which presented challenges in this survey. While the main interest of the research was technology intensive firms, the sample, although narrowed within criteria most likely to capture such firms, inevitably would include firms which were not involved in research and development and therefore not technology intensive. The questionnaire therefore could not be said to have content validity for firms which were not NTBFs, since the questions were constructed around issues and concepts pertinent to these firms. Widening the domain to include issues relevant to other firms would be unrealistic in scope and depth. The questionnaire was however scrutinised by experts in the areas of small technology firms and small firm internationalisation and declared to have content validity for the appropriate sub-sample).

Construct validity is concerned with what the research instrument is actually measuring (Churchill, 1987, p384). According to Churchill, construct validity is the most difficult type of validity to establish. There needs to be internal consistency amongst the items of the domain - the higher the correlations the better the items are at measuring the same underlying construct. Churchill points out that the construct validity of a measure is assessed by whether the measure confirms or denies the hypotheses predicted from the theory base on the constructs, however its failure may be due to incorrect theory rather than a poor construct (p386).

In addition to being valid, a measure should also be reliable.

"Validity refers to the measurement process while the reliability of measurement refers to its consistency; that is, the extent to which a measuring device will produce the same results when applied more than once to the same person under the same conditions" (Gill and Johnson, 1991, p88).

Reliability can be tested by repeating the process under the same conditions and correlating the second set of results with the first, or by asking the same questions in different ways at different points in the questionnaire (see also Kalton, 1971, pp353-7, and Summers, 1970). The questionnaire responses were tested by alpha tests of reliability in respect of scaled questions and comparisons of means tests. Results have been presented selectively where it was considered essential to convey such results.

Finally, it can be said that there is no perfect research design or method for any particular topic, and there are seldom black or white, right or wrong answers to the many questions relating to the construction of a research study. The main limiting

factors in this case were time, money and accessibility to firms. These factors set the absolute parameters for the research scope, design and process.

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Chapter 7

Results: Firm Characteristics and Cross-Border Activity

Chapter Objectives

- *To answer the preliminary research questions developed in Chapter 5 which are:*
 1. *What are the characteristics of the sample firms?*
 2. *What types of cross-border links have been established by sample firms?*
 3. *What characteristics and conditions are associated with individual types of cross-border link?*
 4. *What is the effect of product and market/industry factors on firm performance and growth?*
 5. *What is the effect of frequency of contact with overseas links on firm performance and growth?*

- *To present the results of bivariate cross-tabulations and statistical tests constructed in answer to the research questions.*

- *To interpret the results and discuss their implications and adequacy.*

Introduction

The results of the study are reported in Chapters 7 and 8. The report is organised from the simple, descriptive to the more complex, analytical. The presentation of the results does not follow the order of the questions developed in Chapter 5 (Box 5.6), but that of statistical procedure. The structure adopted therefore addresses questions which require description (univariate statistics), followed by analysis (bivariate analysis) in this chapter, and finally assimilation and interpretation (multivariate model-building) in Chapter 8. The main headings used in this chapter indicate the research questions to which the results relate.

The characteristics of the sample firms, i.e. the key characteristics of the firm, its industry and business activities which are the main independent variables for the analysis are reported in tables as firm profiles. The profiles are: a firm and industry profile, a technology profile, a founder/personnel profile, a product/market profile, a profile of overseas contacts and a growth and performance profile. The profiles are followed by an examination and discussion of the relationships between domestic and international development and growth. Finally, association between firm characteristics and growth and development is identified. *Types of cross-border links which have been established by the sample firms* since their inception, is established in the next section of this chapter. The frequency of link types across the sample is established and a series of cross tabulations presented illustrating association between firm characteristics and link types. This is followed by cross-tabulations of growth indicators with link types. The main purpose of the cross-tabulations is to demonstrate the structure of link type distributions, and identify the effect of any association between variables, rather than to establish causal links between firm characteristics and performance with specific modes of cross-border activity. *Association between cross border link types and firm characteristics* is determined through the examination of significant results for Pearson's chi-square tests drawn from the above mentioned cross-tabulations.

The likely effect of product factors and domestic market/industry factors on the international development and growth of the sample firms is presented as a series of cross-tabulations utilising Pearson's correlation for ordinal data. The final research question dealt with in this chapter examines the *frequency of cross-border contact with a range of individuals and organisations in relation to the firms' international growth and expansion*, a question which is addressed through factor analysis of the variables and Kruskal-Wallis tests of association.

What Are The Characteristics Of The Sample Firms?

Firm and Industry Profile

	f	%
Age of Firm n = 212		
less than 5	42	19.8
6 - 10	53	25.0
11 - 15	37	17.5
16 - 25	43	20.3
26 - 35	16	7.5
36 - 65	17	8.0
66 and above	4	1.9
Size of Firm (employees) n = 213		
1 - 5	21	9.9
6 - 10	35	16.4
11 - 20	52	24.4
21 - 30	38	17.8
31 - 40	23	10.8
41 - 50	17	8.0
51 - 100	21	9.9
101 - 200	6	2.8
Size of Firm (turnover) n = 210		
Less than £0.25m	33	15.7
£0.25m - £0.49m	26	12.4
£0.5m - £0.9m	55	26.2
£1m - £4.9m	90	42.9
£5m - £10m	6	2.9
State of Independence n = 213		
Wholly independent	164	77.0
Independent but supervised	1	0.5
Up to 20% owned by other firm	3	1.4
More than 20% held by other firm	13	6.1
Subsidiary (prev. independent)	28	13.1
Other	4	1.9
Mode of Foundation n = 212		
New start up	135	63.7
Firm spin-off	50	23.6
University spin-off	5	2.4
Merger/takeover	6	2.8
Management/worker buy-out	10	4.7
Other	6	2.8
Industry Sector n = 212		
Plastics and Composites	22	10.4
Biotechnology/Pharmaceuticals	34	16.0
Adv. medical insts/appliances	48	22.6
Electronic equip/insts for industry	54	25.5
Other	54	25.5

Age

The survey proved successful in capturing young firms and almost 50% of the sample turned out to be less than 10 years old (Table 7.1). No cut-off date was applied in terms of age and the oldest firm in the sample was in fact 196 years old. To reduce the distortion effect of extreme outliers, the four firms which were established before the turn of the twentieth century were recorded as having been established in the year 1900. Only around a third of firms were established more than 35 years ago and most of those were clustered at the lower end of the 35 to 65 age group. The skewed nature of the distribution is quite likely reflective of two events, the failure rate of small firms which would account for higher numbers in the younger categories, and the growth of small firms over time which would move them into a larger size category and thus exclude them from the sample, and mergers and takeovers which would have the same effect.

Size

Responding firms with more than 200 employees were excluded from the sample. The size of firms as measured by the number of employees ranged from firms with one employee to firms of 200 employees (Table 7.1). In general however, the firms were very small with more than 80% having less than 50 employees. Just over a quarter of

the 213 responding firms reported having less than 10 employees and just over one half of the sample had 20 employees or less. Firm size as measured by total annual turnover also indicated that in general the sample featured small firms and more than half of the 210 firms responding indicated that they had a total turnover of less than £1m in 1993. Just under 43% reported a turnover of between £1m and £4.9m and less than 3% reported a turnover of between £5m and £10m. No firms in the sample reported a turnover of more than £10m.

Mode of Firm Foundation

Respondents were asked whether their firm was a completely new start-up or whether it evolved from another organisation. Almost 64% of the sample firm's 213 firms began life as new start-ups, i.e. as completely new enterprises. On the other hand, 36% had evolved or emerged from an existing organisation or its networks. Fifty firms (24%) claimed to be spin-offs from other firms. Only 5 firms (3%) indicated that they were spin-off firms from universities. A further 16 (8%) firms had been established after either a merger / takeover or management / worker buy-out. What is important here is that just over a quarter of sample firms had emerged from other organisations and whereas new-starts may have to generate external links with other organisations from scratch, evolved firms may benefit from links with an existing network. Where a firm has emerged from a foreign based organisation, important overseas links may exist. Sixty seven firms of the 77 which claimed to have emerged from other organisations were able to identify the country of origin of the original organisation. Most, over 80% were British and 12% were American. This suggests that very few firms will be subject to influence from foreign parents.

Four firms reported that they had emerged from other organisations based in more than one country. Overall, only 13 firms had evolved from overseas organisations. Evidence of cross-border business activity emerging from such links can therefore be assumed to be of little influence in this study.

Independence

Small firm studies often define small firms as being 'independent', but in practice it has proved difficult to establish independence. Here, a classification (Aydalot, 1988) was adapted in an attempt to distinguish between independent and non-independent small firms and to establish whether degrees of independence are associated with the firms' linkage activities. The vast majority of firms in the sample claimed to be wholly independent (164 (76%)), (Table 7.1). The remaining 23% reported some degree of ownership link with another firm. Just over 1% claimed that up to a fifth of the equity

was held by another firm, a further 6% claimed that over a fifth of equity was held by another firm and over 13% were subsidiaries which were previously independent.

The firms which indicated that they were subsidiaries but previously independent have been considered here to be representative of small firms which have evolved to a new status rather than as subsidiaries of large firms which had no previous independent status. It should be noted that firms which classed themselves as subsidiaries, and had not previously been independent firms, tended to screen themselves out of the survey, others were removed by the researcher. Non-independent firms included in this study therefore are those which have equity links with other organisations but were previously independent. In total, only 11% of the 213 firms had such links to overseas based organisation (see Appendix 7).

Twelve of the 24 firms with overseas equity links cited the US as the location of the parent/partner firm. Australia, Japan and EU/EFTA nations accounted for the others.

Industry Sector

Responses received from the two categories, plastics and composites, and pharmaceutical/biotechnology were low in comparison to the other two industry sectors surveyed. This reflects the lower number of hits achieved in the data-base search (Table 7.1). These two sectors tend to be dominated by large firms which would account for the lower target and response. Examination of the database before mailing indicated that the plastics and composites sector tended to consist of very high technology firms involved in the development of technology on the one hand, and very low technology manufacturers of moulded plastics on the other. It is worth reiterating here that no attempt was made in the construction of the study database to reflect industries proportionately. Interpretation of the results in Chapter 8 takes this problem into account.

Technology Profile

Innovation	f	%
At foundation n = 213	79	37
Subsequent n = 213	95	45
Cooperative n = 213	68	32
R&D Intensity		
<u>% of 1993 Turnover invested in R&D n = 181</u>		
Zero	20	11
1% to 5%	84	47
6% to 20%	49	27
21% to 100%	28	16
<u>1993 Staff in R&D (% of establishment) n = 182</u>		
Zero	51	28
1% to 10%	119	65
11% to 20%	7	4
21% to 100%	5	3
<u>Specific R&D Department n = 213</u>		
Yes	87	41
No	126	59
Application for IPRs		
<u>Initial innovation n = 78</u>		
In UK only	12	15
Overseas only	1	1
Both UK and Overseas	36	47
Neither UK nor Overseas	29	37
<u>Subsequent innovation n = 213</u>		
Either UK or Overseas	95	45
From Cooperation	68	32
Cooperative R&D		
<u>Total n = 213</u>		
<u>By Location n = 66</u>		
UK Based	4	6
USA Based	31	47
Total Overseas Based (including USA)	62	94

Innovation

Innovative capability featured very strongly in the sample and almost 40% of the sample firms reported that they were established specifically to develop a scientific/technical innovation and therefore these firms are clearly identifiable as new technology based firms (NTBFs) (Table 7.2). Just under half of the 213 sample firms claimed to have made a scientific or technical innovation since foundation for which protection for intellectual property rights (IPRs) had been applied for or granted. A third of firms had been involved in cooperative innovation with other firms. Overall, almost a half of the 213 firms are, or have been actively involved in technical or scientific innovation.

R&D Intensity

R&D intensity was measured in two different ways, as a percentage of turnover invested in R&D and as a percentage of full-time employment in R&D, neither of which is totally satisfactory for small firms. Problems may arise where personnel employed in R&D are part-time or "wear" a number of "hats" within the organisation, where R&D is conducted on an ad hoc project basis, where records have not been kept of expenditure on R&D activities and where the R&D function is not easily

separated from other functional activities within the firm. Both measures have been used however because while R&D measured as employment considers only in-house R&D, whereas investment as a proportion of turnover includes external cooperative or contract R&D. The two measures have a relatively strong positive correlation .59, but as 40% of the variance is not shared, the measures are clearly not substitutes for each

other. Results therefore are discussed in terms of either R&D investment or R&D employment where appropriate.

Almost three quarters of the responding firms were found to have spent up to a fifth of their total turnover in 1993 on R&D. Just over 10% had spent nothing at all on R&D. However, 16% spent more than a fifth of their turnover on R&D. The distribution is highly skewed with most sample firms clustered at the low end of the scale with very low levels of R&D expenditure. This result supports earlier work by Smith and Creamer (1967) which found a similar pattern in their sample of small firms. Investment of up to 20% of turnover is common in this sample with fewer firms making heavier or nil investments. Overall, it can be taken that the sample is representative of technology based firms rather than small firms in general. This point is important in that not all firms categorised as belonging to high technology industry sectors are actually involved in technological development or innovation. Although the sample is considered representative of technology based firms, it is acknowledged that there will be differences in levels of innovative activity and in the nature of the technology common to each firm. Respondents perceptions of their technology and involvement in innovation have been taken into account and this point is discussed further in the product and production profile further on in this chapter.

Investment in R&D was found to have a weak negative association with firm age and with firm size when measured by turnover suggesting that smaller and younger firms invest a larger proportion of turnover in R&D than do larger firms. This finding is partly attributable here to a fairly large proportion of small specialised firms in the sample. There was no correlation between investment in R&D and firm size measured by number of employees. Weak but significant positive correlations were found between investment in R&D and export growth and international turnover suggesting that R&D intensive firms are more likely to have commercially viable cross-border links than those with lower levels of investment.

Turning to "employees engaged in R&D", over a quarter of the 182 firms responding to this question employed no full time or equivalent personnel in R&D in 1993. Around three quarters of firms employed at least 1 full-time employee in R&D during that time period. Research staff are often employed on a contract basis and there are likely to be significant changes in the number of R&D personnel employed from year to year depending, amongst other things, on the availability of project funding. *R&D intensity measured by employment was also found to have a weak negative association with firm turnover and firm age, supporting the suggestion that smaller younger firms are more R&D intensive.* This finding supports those of previous studies, e.g. McConnell and

Peterson (1968) who found a negative relationship between firm size and R&D employment. Zerbe (1976), examining studies of large firms, found cases where there was no relationship between firm size and also cases where R&D intensity increased to a point and then diminished. Generally, R&D intensity may be influenced by government support for R&D and whether this is aimed at small/large firms or specific industry sectors. A significant positive correlation was found between R&D intensity (employment) and international ratio, but not, in this case, with export growth. This finding is discussed in relation to Research Question 3 further on in this chapter.

Just over 40% of the firms were found to have departments dedicated to R&D, which is somewhat surprising in firms so small. This is not necessarily an indication of a move to a formal functional corporate structure however, as the firms in this sample are more R&D intensive than the general population and some may have evolved from research laboratories or incubator organisations. The proportion however is larger than the 36% claiming to have evolved from other institutions, suggesting the subsequent establishment of a dedicated research department. In firms as small as those in this sample however, questions arise as to exactly what respondents mean by an "R&D" department, which could, in some instances consist of "one person working in a cupboard", or of the entire organisation operating from a laboratory.

Proprietary Rights: Initial Innovation

Of the 79 firms which were established to exploit a scientific/technological innovation, just over a half (48 firms) claimed to have applied for or to have been granted IPRs in the UK. Thirty seven firms, almost a half, had applied for / been granted IPRs overseas. While 36 firms had made applications in both the UK and overseas, 12 had applied in the UK only and one had applied overseas but not in the UK. Application for IPRs may be taken to indicate an intention to exploit proprietary technology and where application is made overseas, there is clearly an intention to transfer the technology abroad. Small firms are notorious for their reluctance to register IPRs or to maintain their rights once granted (Macdonald and Lefang, 1997) and certainly here only half of the firms with initial innovations were found to have made applications.

Proprietary Rights: Subsequent Innovations

Just under half of the 213 sample firms claimed to have made a scientific/technical innovation since foundation for which IPRs had been applied/granted. This may be taken to be roughly indicative of whether firms are innovative or not. While firms may develop technical/scientific innovations but not follow up by applying for IPRs, application demonstrates a proactive and concerted effort to firstly protect what has been

identified by the firm as a unique advantage and secondly, as an indication that the firm intends to progress this innovation to market.

Firms were asked if they had ever been involved in the development of a scientific/technical innovation for which *another* firm had applied for/been granted IPRs. Research has found that suppliers and or customers are often involved in the development of innovations and/or other technical developments (Håkansson, 1989) and that cooperative R&D sometimes results in problems in deciding which of the partners has the legal rights to the outcome (anecdotal evidence - preliminary interviews). Just under one third of the 213 sample firms reported that they had been involved in the development of a scientific/technical innovation for which IPRs had been applied for by another firm. Of the 68 firms involved in the scientific/technical innovation for which another firm had applied for/been granted IPRs, two thirds of partner firms were based in the UK and a third overseas. Three firms had been involved in innovation with both UK-based and foreign-based firms. *In total therefore, 28 firms responding to this question had been involved in the development of a scientific/technical innovation with overseas-based firms, at least at an informal level.*

Cooperative R&D

Respondents were asked whether their firm had ever been involved in a cooperative R&D project where one or all partners were from overseas based organisations. While it should be noted that the response to this question may overlap with the previous one on co-development of a scientific/technical innovation, the results are nevertheless interesting. *Seventy two (34%) firms, of 212 responding, claimed to have been involved in a cooperative R&D project in which some/all of the partners were from overseas-based organisations.* The earliest case of a cooperative R&D project reported here was in 1970. Just over two thirds of projects occurred very recently, i.e. between 1990 and 1995 (the date of the survey). The country most frequently cited as the country base of the cooperative R&D project was the USA. Less than 10% stated that the cooperative R&D project was based in the UK. Firms were asked how their first involvement in such projects was funded. Categories were not mutually exclusive as more than one source could be used to fund any one project. *Typically, cooperative R&D projects were found to have been funded by the associated firms.* British government/enterprise funding was found to have been utilised by 16% of the firms. Approximately 10% of firms responding to this question reported that they had utilised EU funding. The question did not mention venture capital specifically and no firms mentioned this option under the "other" category. It is likely however that "funding by associated firms" includes venture capital. Only one firm claimed to have received funding from a trade or industry association.

Founder and Personnel Profile

<u>Respondent Status</u>	f	%
<u>Position</u> n = 209		
Managing Director	179	86
Other director	20	10
Manager	6	3
Other	4	2
<u>Founder</u> n = 213	140	66
<u>Small Firm Status</u>		
<u>Number of founders</u> n = 208		
Zero	1	1
Six or less	200	97
More than six (highest reported = 17)	7	3
<u>Remaining founders</u> n = 211		
None	33	15
One to six	174	83
More than six (highest reported = 10)	4	2

Respondent Status

Just over 85% (n=209) of the respondents said they were the managing director of the firm (Table 7.3). Over 95% purported to be one of the directors. The credibility of the respondents would therefore seem to be high. Less than five percent of the respondents held positions other than director.

Just under two thirds 140 (66%) of the respondents indicated that they were one of the founders of the firm (Table 7.3). This is important in this survey firstly as it is one of the criteria by which new

technology based firms are characterised, and secondly because as the research is concerned with the chronology of firm development and growth, it is important that there is sufficient corporate memory. The existence of one of the original founders together with the prior selection of firms which are relatively young should enable the research instrument to pick up chronological details of the firms' development. It is clear from the response to these questions that the sample is one of 'entrepreneurial firms'.

Small Firm Status

In summary approximately 97% of the sample reported having six or less founders and less than 4% had more than 6 founders. One of the criteria for identifying new technology based firms is that there is usually an identifiable group of up to five or six founders. In this survey sample it is clearly the norm to have a small group of founders, yet not all firms satisfy the other criteria identifying them as NTBFs such as having been established to exploit a scientific/technical innovation or to be highly R&D intensive.

Overall 178 (84%) of the sample claimed to have at least one founding member still with the firm. As suggested above, existence of one or more of the original founders in the firm indicates that there may be some continuity of the corporate culture. However, the presence of original founders may indicate the retention of a small, rather than large firm ethos, organisational structure, decision-making style and attitude to growth all of which have been found to influence small firm performance and growth. In particular, aspects of management in small entrepreneurial firms, in particular paternalistic style have been found to hinder export development (Young et al., 1989).

Product and Production Profile

Concentration of Employment

Table 7.4 Concentration of Employment

% Total Employment	R&D		Production		Marketing/ Distribution		Other	
	f	%	f	%	f	%	f	%
zero	71	36	19	9	29	15	53	26
1 - 5	18	9	1	1	20	10	5	2
6 - 10	29	15	1	1	28	15	13	6
11 - 20	33	17	16	7	49	25	51	25
21 - 100	48	24	171	82	68	35	84	41
n	199	101*	208	100	194	100	206	100

* total does not add up to 100 because of rounding

An indication of areas of specialisation or concentration of activity is given by the proportion of total employment of a firm which is dedicated to a specific task. At early

stages of growth employees are more likely to perform a number of different tasks with functional specialisation occurring later in the firm's development. A quarter of firms employed 20% or more of their staff in R&D while over 80% employed the same proportion in marketing/distribution (Table 7.4). The ratios indicate the intensity of a firm's involvement in each value chain activity rather than a proportional split between functions.

Product Attributes and Market/Industry Conditions

The range of product types across the sample was expected to be diverse and in addition the technical nature and specifications of products across four high technology industries was expected to, and indeed did defy categorisation by the researcher. In order to find a more useful categorisation of the firms' products and related production activities, respondents were asked to rate their major products on a five point scale from 1 (low) to 5 (high), across a number of dimensions relating to the level of technology of the product, the extent of innovative input by the firm, the amount of software in the product, and its complexity (Table 7.5).

Several of the product attributes reflect the nature of competition in the market or industry, for example, the level of standardisation of the product or production process

which gives an indication of the stage of the product/technology life cycle of the product and the firm's position in the industry. The level of customisation to customer specifications which, if high, may be indicative of a product with very specific applications or an intensely competitive market calling for product adaptations. Other similar measures included the number of industry applications which distinguishes amongst generic products or technologies and specialised products or technologies and finally, the number of alternative products in the UK market, which differentiates between firms facing extensive competition from those with less intense competition or more clearly defined markets. The set of attributes was adapted from a similar set used by Lindqvist (1991).

Table 7.5 Product Attributes & Market/Industry Conditions

	x	sd
Technology (n=200)	3.57	1.15
Extent of Technological Innovation (n=199)	3.47	1.32
Level of software content (n=196)	2.22	1.40
Level of product complexity (n=196)	3.14	1.07
Level of standardisation (product/production) (n=201)	3.26	1.14
Customisation to customer specs (n=200)	3.75	1.32
Number of industry applications (n=197)	2.87	1.56
Availability of alternatives in UK (n=200)	2.64	1.33

All attributes measured on a five point scale from 1 (low) to 5 (high).

The results for the sample indicated that firms tended to perceive their products as high technology products, the mean response being 3.57 on a five point scale. There was some indication that although the SIC sectors selected for the sample were high technology sectors, not all firms necessarily had

high technology products. The firm's own perception of the level of their technology was sought here and 55% of firms felt their products to be at the higher end of the scale. The distribution shows a good spread which allows the effects of technology on international linkages to be determined (Chapter 8).

Across the sample other factors which scored highly were the level of technological innovation by sample firms, customisation of products to customer specifications, the level of product/production standardisation and the level of product complexity. The overall impression is one of firms adapting or developing relatively sophisticated products for a specialised market using standardised technology. In addition, the number of industry applications was felt to be relatively low as was the availability of alternative products in the UK. *Mean values suggest that there is a tendency in the sample for firms to produce specialised products for niche markets with few competitors.* The distributions however, show good dispersions, suggesting variability between firms on the product/market attributes (Table 7.5). The above factors are incorporated in an analysis of the nature and direction of international links (logistic

regression modelling, Chapter 8). Here each attribute was correlated with all others to identify areas of association and/or redundancy and the following results were attained.

Considering only results significant at the 1% level, several pairs of variables were found to have correlations higher than that expected by chance if the two variables were related in the population (see Appendix 7). Level of innovation undertaken by the firm was found to be positively correlated with the level of technology suggesting that *innovation is more likely to be undertaken by high technology producers*. A positive but weak correlation was found between the level of technology and level of software, which may be interpreted in this case as the intellectual content of the technology. Product complexity was associated with levels of technology, innovation and software content.

A weak positive correlation was found between the number of industry applications in the UK and the level of customisation to customer specifications which could suggest *while products have widespread applicability, the nature of product use is diverse and requires specific product adaptations*. The relationship again however is weak ($r=.28$, see Appendix 7). A negative association ($r=-.11$), was found between the number of industry applications and the extent to which products/production processes are standardised. This suggests that the level of standardisation is inversely but very weakly related to the number of industry applications. Taking these two factors together, *an increase in industry applications rather than leading to standardisation as might be expected, actually results in an increase in customisation. It appears that product/technology application in this sample has a tendency to be specific to customer needs*. This is an important point which is incorporated in the interpretation of the logistic regression models in chapter 8.

The strongest association was found between levels of technology and levels of innovation, but as less than 60% of the variance was shared between the two measures, they were not considered to be substitutes for each other.

Profile of Overseas Contacts

A series of questions, the purpose of which was to determine the firm's international predisposition to international expansion, was concerned with the firm founders' experience or sense of connection with overseas countries, their language capability and general language capability in the firm. Frequency of contact with overseas individuals and bodies was determined as an indicator of the firm's effort in terms of the management of overseas links. Results are presented in Table 7.6.

<u>International Predisposition</u>		
<u>Founders' Overseas Links</u>	f	%
Foreign nationals as founders n = 206	24	12
Founders fluent in frgn lge n = 206	54	26
Founders overseas education n = 203	43	21
Founders o/seas work exp. n = 209	108	52
<u>Useful Frgn Languages in Firm (n= 213)</u>	f	%
None/declined to answer	102	48
One language	111	52
Two languages	62	30
Three languages	27	13
Four languages	10	5
Five languages	6	3
Six or more languages	3	1
<u>Overseas Contacts</u>	f	%
Chambers of Commerce (n = 202)	57	28
Trade/employers associations (n = 202)	66	33
Professional associations (n = 201)	80	40
Alumni associations (n = 201)	14	7
University research depts (n = 202)	83	41
Public research institutions (n = 201)	50	25
Co/ind based research units (n = 202)	81	40
Trade Fairs n = (208)	162	78
Academic confs/seminars (n = 202)	109	54
Research colloquia (n = 198)	54	27
Customers (n = 209)	176	84
Suppliers (n = 204)	152	75
Distributors/agents (n = 206)	151	74
Other (n = 2)	2	1

International Predisposition

A very small proportion of the sample (12%) had founders who were foreign nationals and a fifth had benefited from some overseas education. A quarter of founders claimed to be fluent in at least one foreign language and just over a half had had overseas work experience prior to the establishment of their current firm. At least half of the sample firms therefore could be expected to be predisposed to international business activity through orientation or previous experience. In addition, these firms may already have contacts in overseas markets or specific knowledge of foreign markets and/or business procedures.

Almost a half of firms (48%) declined to answer the question

relating to foreign language capability in the firm. Just over a half reported at least one foreign language in the firm useful to their business activities, and a third were able to list two or more useful foreign languages. The most important language was French followed by German.

Contacts with Organisations and Events Overseas.¹

Respondents were asked the frequency with which any of their members make contact with or attend overseas organisations and events (Table 7.6). This question in addition to giving an indication of firm effort in managing overseas links, was intended to pick up contact made by firms which had not necessarily resulted in a formal exchange in commercial or technological terms. Measured on a 7 point scale the question also indicated the amount of effort made by management in managing cross-border contacts. The information relates only to overseas based contacts and therefore excludes local intermediaries and partners. There was considerable variation in the frequency of contact with various organisations and individuals which is discussed further later in this chapter. At this point it is useful to note the incidence of overseas contacts amongst the sample firms.

Examining Table 7.6, it appears that a very large proportion of the sample firms (over 74%) reported contact with customers, suppliers and distributors and agents. A similarly large proportion (78%) reported attendance at overseas trade fairs. Links with commercially-based contacts overseas is therefore common-place amongst the small high technology firms which make up this sample. There is evidence also of strong links with higher education and over 50% of responding firms reported attendance at overseas academic conferences. Over a third (40%) reported contact with university research laboratories overseas, and industry-based research units (40%). Fewer (<30%) reported contact with overseas government research facilities or attendance at research colloquia.

Membership of formally organised associations was not particularly high and only a third or less of firms reported contact with trade associations and chambers of commerce. A higher proportion (40%) were in contact with professional associations.

Overall, contact with overseas bodies and individuals reported by the sample is high with almost 80% reporting at least one type of contact, however infrequently made. The frequency of contact by individual firms is important in the establishment of successful and long term business links and is incorporated in the analysis in Chapter 8.

¹ At the time this survey was conducted the internet was not a significant means of contact for small firms and its use tended to be confined to government and academic institutions. Since 1995 the growth of the internet as a means of international communication has been explosive. Future studies in this area would need to address the implications of the net for communications and business arrangements in general.

Growth and Performance Profile

Structural Development		
Remaining Founders n = 211	f	%
Yes	178	85
No	33	15
Application for IPRs (any) n = 213		
Yes	134	63
No	79	37
Specific R&D Department n = 213		
Yes	87	41
No	126	59
Specific Export Department n = 200		
Yes	33	17
No	167	83
Firm Performance		
Av Turnover Growth (91 - 93) n=180	f	%
Negative	19	11
Zero	11	6
1 - 10%	51	28
11 - 30%	73	41
31 - 100%	19	11
Over 100%	7	4
Av Export Growth (91 - 93) n = 146		
Negative	6	4
Zero	35	24
1 - 10%	34	23
11 - 30%	47	33
31 - 100%	14	10
Over 100%	10	7
Extent of Internationalisation		
Value of Exports 1993 (£000s) n=141	f	%
Less than 10	6	4
11 - 50	22	16
51 - 100	18	13
101 - 500	45	32
501 - 1000	22	16
Over 1000	28	20
Intl/Domestic Turnover (%) n = 206		
Zero	41	20
1 - 10	36	17
11 - 30	51	25
31 - 50	29	14
51 - 80	35	17
81 - 100	14	7
Number of Export Markets n = 178		
Zero	30	17
1 - 5	51	29
6 - 10	35	20
11 - 20	27	15
21 and over (highest reported = 100)	35	20

Structural Development

There is some emphasis in the small firm literature on changes in organisational structure and management style throughout the growth process. Paternalistic management, typical of very small owner-managed firms has been found to hinder growth as owners struggle to cope with the increasing complexity and size of a growing organisation. Entrepreneurial management, in the technology literature is often associated with innovation and development rather than firm growth per se. There was little scope in this survey for detailed questions relating to management style and organisational structure, but four key indicators were used to describe the structural development of sample firms. These are, the continued presence of founders in the firm, application for protection of intellectual property rights, the presence of an R&D department, and the existence of a specific export department.

Firm founders are assumed to have a strong influence on managerial decision-making and organisational structure. Firms with remaining founders therefore may be more likely to retain a "small firm ethos"

than where the founders have all left. Results indicate that a very large proportion (85%) of the sample firms have remaining founders.

Application for protection for IPRs may indicate that, in the first instance, firms have been active in innovation, and secondly, that they have adopted a proactive attitude to existing or new markets. In total, almost two thirds of the sample firms have at some time made application for protection for IPRs. Again, there was no scope for detailed questions on granting or maintenance of the rights. The result suggests however that a large proportion of the firms consider themselves to have commercially viable intellectual property. The literature suggests that few small firms bother to register their intellectual property and by inference, it is likely that more than the 63% noted here are innovative and have produced commercially viable technology.

Over a third of the sample (41%) claimed to have a department dedicated to R&D. While for larger firms the existence of an R&D department may be indicative of structural development, in this sample that assumption could be misleading. A number of the firms are specialist R&D firms and most likely operate from an R&D unit or laboratory. Soft-start R&D intensive firms may develop through the addition of production facilities to an existing R&D facility rather than the other way round. The existence of an R&D department however can be taken to be indicative of the existence of R&D facilities and capability.

The establishment of an export department is generally considered to be an indicator of export experience as the adoption of a formal structure is eventually necessary to handle continued export growth Young et al. (1989). Less than 20% of the firms in the sample were found to have export departments.

Firm Performance

Measurement of growth was restricted to the three full financial years prior to the survey due to the inclusion of new starts in the survey, and difficulties associated with record keeping in small firms. This particular period in the UK was one of recession and large-scale failure amongst small firms. Less than 20% of the sample experienced zero or negative growth during this period and nearly 60% experienced an average annual growth of 30% or more. Turnover has already been discussed above in relation to firm size.

A smaller proportion of firms reported export growth since not all sample firms are exporters. Almost 30% of those with export earnings reported zero or negative growth

during this period. A good proportion however (50%) reported average annual growth rates of 30% or more of export earnings.

Extent of Internationalisation

Export earnings of sample firms are relatively modest. Only 20% of those involved in international activity earn over a £1m a year from exports. However, nearly 70% earned at least £100 000 from overseas in 1993. The international turnover ratio² is more revealing and more interesting as it includes all income generated from overseas activities. A much larger number of firms (206) reported earnings from overseas than did export earnings (141). A fifth of the former group earned nothing from abroad while over 60% earned at least a tenth of their 1993 income from overseas activities. More than a fifth of the sample firms are very dependent on income from overseas and reported an international/domestic turnover ratio of over 80%. Concentration versus spread of export activities was also reported. While again, nearly a fifth of respondents reported having no export markets, another fifth claimed to be exporting to over twenty country markets with the highest number reported being 100 countries. Almost a half however claimed to be exporting to less than ten country markets in 1993.

Indicators of the extent of internationalisation of firms have been associated with the size of firms (Tookey, 1964; Reid, 1982; Naor, 1983; Piercy, 1985; Kaynak, 1985; Ito and Pucik, 1993) and with the age/experience of firms (Kirpalani and Macintosh, 1980; Ursic and Czincota, 1989; Wiedersheim-Paul, 1980). The next section examines the relationship between the firm characteristics, age and size and domestic performance with measures of international growth and development.

Association of Performance with Firm Characteristics

Relationship Between Domestic and International Growth and Development

A Pearson correlation of the key growth and development indicators indicated patterns of growth in the sample, and determined whether there might be any association between international performance, overall performance and factors underlying growth such as the age of the firm, its size and investment in R&D (Table 7.8).

² The international turnover ratio, or international ratio is the proportion of all income from overseas to total turnover in a year. International ratio was used throughout this study in preference to export sales ratios because the former includes other income such as royalties, management fees and contract payments. Sample firms were found to be able to distinguish between income from overseas and income from domestic markets, but in most cases could not break their annual turnover down by business activity.

International turnover ratio was found to be positively correlated with the level of investment in R&D which supports points made earlier in the chapter and adds to work done elsewhere which has found positive relationships between investment in R&D and exporting (Kessing, 1967). *A positive but weak correlation was found between international ratio and export growth, and between international ratio and turnover growth which suggests a link between firm growth and the proportion of international to domestic activity undertaken by the firms (Table 7.8).*

Firm Age (years)	r=.144						
R&D Int. (% turn.)	r=-.224**	r=-.219**					
Export Turnover	r=.438***	r=-.011	r=.066				
Export Growth	r=.020	r=-.130	r=.253**	r=.087			
Turnover Growth	r=-.040	r=-.158	r=.119	r=.059	r=.714***		
Number of Exp Mkts	r=.297***	r=.094	r=.040	r=.548***	r=-.022	r=-.031	
International Ratio.	r=.114	r=-.102	r=.311***	r=.477***	r=.255**	r=.155*	r=.423***
.05 = *	Firm Size (turnover)	Firm Age (years)	R&D Intensity (% turnov)	Export Turnover	Export Growth	Turnover Growth	Number Export Markets
.01 = **							
.001 = ***							

Stronger, was the relationship found between the international ratio and the value of export turnover and with the number of export markets (Table 7.8). This quite strongly positive and significant relationship indicates that *increasing value and spread of export activity is associated with an increasing proportion of international to domestic turnover*. Put another way, firms with higher levels of export turnover are more concentrated on international activity than those with lower export turnover. Importantly here, no relationship was found between international ratio and firms' age or size (measured by turnover). *Implications are that a firm's level of involvement in international markets is not directly connected to either its size or age.*

Performance and growth in domestic markets and performance and growth in overseas markets do seem to be linked and there are strong and significant positive correlations between total turnover and domestic turnover and between turnover growth and export growth. This result could be expected where firm competencies and capabilities are transferable between markets and where industry performance is subject to international rather than local economic trends.

Of some interest is the finding that investment in R&D was negatively correlated with firm age and with firm size (Table 7.8). The relationship is weak but it appears that younger and smaller firms invest a greater proportion of their turnover in R&D than do larger and older firms. *Implications are that as the firm grows in terms of production and output proportionately less is spent on R&D.*

Relationship between Key Firm Characteristics and Performance

1. Association between Firm Characteristics and Turnover Growth and International Ratio.

Further insight into the relationship between firm characteristics and, in this case turnover growth and international ratio was achieved by cross-tabulation of the distributions. The results of this analysis are presented in Table 7.9.

For the purpose of this part of the analysis, average turnover growth over the three years prior to the survey was grouped into three categories: firms which had experienced zero or negative growth, firms with up to 10% growth and firms with more than 10% growth. This permitted a distinction to be drawn between firms which were failing during this period, those which were experiencing some growth and those experiencing rapid growth. Two considerations taken into account here were that this period was one of international recession, although technology industries were less affected than others and that growth measured as a percentage change in turnover is more pronounced in smaller than larger firms.

Examination of the distributions across the three growth categories (Table 7.9, first column) suggests that for all independent variables (firm characteristics) firms may fall into any of the three growth categories. Pearson chi-square tests of independence confirmed that point and all firm characteristics measured, with the exception of firm age were found to be independent of the level of turnover growth. Examination of residuals from the chi-square distribution indicated that *young firms were more likely to experience high turnover growth than either new firms or older firms*. Mature firms were more likely to experience negative or zero growth and less likely to experience high growth than all younger firms. This finding confirms those of other studies notably the Cambridge report (SBRC, 1992) which found *small firms to experience a period of rapid growth early in their lives*.

Turning to the international ratio (second column in Table 7.9), the firms' international ratio was found to be associated with the level of its turnover, investment in R&D and employment in R&D (see also correlation between performance indicators in the

previous section in this chapter). Examination of the chi-square residuals suggested that firms in the largest size category were less likely to have a zero international ratio than those in the smaller size categories. Returning to the results of the performance indicators correlations in the previous section, it would seem that *in this sample higher levels of turnover are associated with international activity*. The relationship is not clear cut however as firms in the middle turnover category were found to be slightly more likely to have a zero international ratio than either smaller or larger firms.

The association of R&D intensity measured by both investment and by the concentration of employment in R&D was strongly significant with the international ratio. In the case of investment in R&D it was found that firms with over 20% of their turnover invested in R&D were more likely to have a very high ratio of international to domestic turnover. R&D by employment showed the same pattern, but additionally, firms with no employees working in R&D were more likely to have no turnover from overseas.

A highly significant association was found between international ratio and whether or not firms were established to exploit a scientific or technological innovation (NTBFs). Those with initial innovations were found to be less likely to have a zero international ratio and more likely to have international to domestic ratios of over 50%. Those without initial innovations were more likely to have zero international ratios. *Implications here are quite clear, firms which begin life with a scientific or technological innovation have an advantage, or at least the opportunity to exploit that advantage overseas.*

Table 7.9 Performance Assessed by Firm Characteristics

(Distribution Cross-tabulation)	% Turnover Growth (% firms)			% International Ratio (% firms)			
	0 or -	≤10%	>10%	zero	1- 10	11- 50	51+
Size of Firm (employees)							
Less than 10	37	16	27	34	28	25	18
11 to 20	20	29	24	29	25	24	22
21 to 50	30	43	36	37	33	40	33
51 to 200	13	12	13	0	14	11	27
No. of Firms	30	51	102	41	36	80	49
Size of Firm (turnover)							
Less than £0.5m	33	18	28	37	25	27	22
£0.5m to £0.9m	37	23	23	41	19	23	25
More than £0.9m	30	59	49	22	56	50	53
No. of Firms	30	51	101	41	36	79	49
Age of Firm (years)							
New (5 or less)	20	12	18	20	20	14	27
Young (6 to 10)	17	18	33	30	25	24	27
Adolescent (11 to 25)	30	43	37	30	33	46	32
Mature (26 +)	33	27	12	20	22	16	14
No. of Firms	30	51	102	40	36	80	49
Independence							
Wholly Independent	73	67	83	78	83	81	63
Not wholly independent	27	33	17	22	17	19	37
No. of Firms	30	51	102	41	36	80	49
Foundation							
New start up	67	59	66	70	56	69	53
Evolution	33	41	34	30	44	31	47
No. of Firms	30	51	101	40	36	80	49
R & D Intensity (turnover)							
Zero	12	14	9	15	23	6	6
1% to 5%	56	48	46	62	43	55	28
6% to 20%	20	29	28	17	10	33	35
21% to 100%	12	9	17	6	24	6	31
No. of Firms	25	44	88	34	30	67	46
R & D Intensity (employees)							
Zero	35	29	23	51	45	18	13
1% to 10%	35	35	36	29	14	50	28
11% to 20%	9	18	22	11	17	20	20
21% to 100%	21	18	19	9	24	12	39
No. of Firms	23	45	88	35	29	66	46
NTBF							
Yes	73	67	62	88	78	56	45
No	27	33	38	12	22	44	55
No. of Firms	30	51	102	41	36	80	49
Industry Sector							
Plastics/Comp.	17	14	8	24	6	10	4
Biotech/Pharm.	7	12	18	12	14	14	26
Adv. Medical.	24	22	25	15	22	24	30
Electronics	24	29	22	22	28	25	20
Other	28	23	27	27	30	27	20
No. of Firms	29	51	102	41	36	79	49

Pearson χ^2



not significant



significant at ≤ .05

2. Association between Firm Characteristics and Export Growth and Number of Export Countries.

The same process as discussed in the previous section was applied to firm characteristics and export growth and number of export countries (Table 7.10). Taking export growth first (first column of Table 7.10), application of the chi-square test indicated that there was no association between any of the firm characteristics listed and export growth. While there is some concern about the way in which export growth was measured (see discussion in Chapter 6), it is interesting that *neither the age nor the size of the firm was found to have any association with export growth*, these being the characteristics most often applied to differentiate firms in studies of export development. Export growth could be explained here as a factor of management effort and of the growth of export markets themselves. From that perspective, an association between R&D intensity (management effort) and industry sector (specific markets) with export growth, could be expected. No evidence of such association was found here.

Of some interest here in light of the export market concentration/spreading debate is the association found between the number of export countries and the size of the firm measured both by the number of employees and by turnover. In the former case, firms with less than 10 employees were found to be less likely to have more than 10 export markets and those with over 50 employees are more likely to do so. The pattern is the same in the latter case with the lowest level of turnover showing less inclination to export to markets in excess of 10, and the highest turnover level firms, more so. *Evidence here suggests that there is a difference in the spread of export activities between the smallest and largest of firms within the 200 employee size category.*

R&D intensity (turnover) was found to be associated with the number of export markets which might be expected, in light of the association found between this variable and the international ratio. The result of the chi-square test here however is not particularly strong (≤ 0.04) and as 30% of the cells in the cross-tabulation had less than 5 responses, interpretation here cannot be made with certainty. *All other firm characteristics: firm age, independence, foundation method, employment in R&D, NTBF and industry sector were found to be independent of the number of export markets.* The absence of a relationship between firm age and the number of export markets is to some extent surprising as intuitively it could be expected that the number of markets would gradually increase as the firm grows. Although there is no evidence here to support this contention, it is possible that there is a manageable number of export markets that can be handled by small firms and firms either expand their export markets to the level with which they can cope, or drop less attractive markets as they add new ones to their portfolio.

Table 7.10 Performance Assessed by Firm Characteristics

(Distribution Cross-tabulation)	% Export Growth (% firms)			Number of Export Countries (% firms)			
	0 or -	≤10%	>10%	Zero	1 - 5	6 - 10	10+
Size of Firm (employees)							
Less than 10	27	21	25	33	41	23	8
11 to 20	24	32	18	33	20	31	24
21 to 50	34	35	41	27	33	34	44
51 to 200	15	12	16	7	6	12	24
No. of Firms	41	34	73	30	51	35	62
Size of Firm (turnover)							
Less than £0.5m	29	24	19	37	35	34	7
£0.5m to £0.9m	32	24	23	37	28	20	23
More than £0.9m	32	52	58	26	37	46	20
No. of Firms	41	34	73	30	51	35	61
Age of Firm (years)							
New (5 or less)	17	0	17	17	16	20	14
Young (6 to 10)	22	27	30	33	27	37	16
Adolescent (11 to 25)	34	50	38	33	41	37	42
Mature (26 +)	27	23	15	17	16	6	28
No. of Firms	41	34	73	30	51	35	62
Independence							
Wholly Independent.	80	76	78	73	84	71	74
Not wholly independent	20	24	22	27	16	29	26
No. of Firms	41	34	73	30	51	35	62
Foundation							
New start up	68	71	60	63	71	57	64
Evolution	32	29	40	37	29	43	36
No. of Firms	41	34	72	30	51	35	61
R & D Intensity (turnover)							
Zero	18	4	7	16	14	10	2
1% to 5%	45	55	50	52	49	37	54
6% to 20%	21	31	29	12	21	30	38
21% to 100%	16	10	14	20	16	23	6
No. of Firms	38	29	62	25	43	30	35
R & D Intensity (employees)							
Zero	30	20	21	40	38	19	14
1% to 10%	35	44	37	24	27	36	53
11% to 20%	13	13	25	16	15	19	21
21% to 100%	22	23	17	20	20	26	12
No. of Firms	37	30	63	25	40	31	57
NTBF							
Yes	68	53	64	73	71	57	52
No	32	47	36	27	29	43	48
No. of Firms	41	34	73	30	51	35	62
Industry Sector							
Plastics/Comp.	7	12	10	14	14	12	6
Biotech/Pharm.	15	18	16	20	12	17	17
Adv. Medical.	29	23	26	20	24	11	32
Electronics	29	29	19	23	24	23	27
Other	20	18	29	23	26	37	18
No. of Firms	41	34	73	30	50	35	62

Pearson χ^2



not significant



significant at $\leq .05$

What Types Of Cross-Border Links Have Been Established By Sample Firms?

Profile of Cross-Border Links

This section is concerned with the types of cross-border links which have been established by firms and the extent to which they are common to the sample. Results are presented in Table 7.11 below.

	f	%
Ownshp/Equity links with Os Partners/Parents (n = 21)	24	12
<u>Technology Links</u>	f	%
Coop innovation with os based firms n = 213	28	13
Coop R&D project n = 212	72	34
<u>Inward Links</u> n = 210	f	%
Imports from overseas based supplier	154	73
Distribution of imports in the UK	81	39
Contract R&D for overseas firm	52	25
Technical serv/cons in UK for os firm	54	26
Mgmt/mkg serv/cons in UK for overseas firm	23	11
Contract mft in UK for overseas firm	93	44
Licensing-in technology from overseas firm	18	9
Other inward involvement	17	8
<u>Outward Links</u> n = 209	f	%
Export through UK based intermediary	92	44
Export through foreign based ag/distributor	124	59
Export through co reps/branches based os	61	29
License out technology to os based firm	21	10
Contract-out mft performed by os based firm	26	13
Contract-out R&D performed by os based firm	18	9
Mgmt/mkg serv/consultancy performed os	21	10
Technical serv/consultancy performed os	45	22
Production in os subsidiary (<=50% equity)	3	2
Production in os subsidiary (>50% equity)	5	3
Other outward links	7	3
<u>Formal Cross-Border Cooperation Agreements</u> n = 209	f	%
Technology sharing agreements	15	7
Non-equity joint production agreements	9	4
Comp R&D, mfg and mkng consortia	9	4
Dist agreements with suppliers of compl prods	39	19

Cross-Border

Ownership/Equity Links

Only 12% of the 213 sample firms reported a portion of their equity being held by overseas partners. Inward direct investment of this type by foreign firms is of interest here as it may provide support for the local firm but may also open foreign distribution channels and markets through existing networks of contacts. Outward direct investment by sample firms is dealt with below (outward links).

Cross-Border Technology

Links

Of 68 firms which indicated that they had been involved in innovation with another firm where the partner had applied for / been granted protection for IPRs, 28 were with overseas-based partners. This question was asked as a tentative search for instances of informal cross-border innovation activities which do not necessarily result in the development of proprietary technology for the focal firm. Overseas contact here was

experienced by just over 10% of the sample. One third (34%) of the 212 responding

firms indicated that they had been involved in cooperative R&D with overseas-based partners, but involvement was not necessarily formal.

Inward Links

Firms were asked to indicate whether they had been involved in any of a given list of activities with overseas based firms. The term "inward links" was used here to indicate links between British firms and overseas based firms where the value-adding activity takes place in the UK. *The most frequently reported inward link was found to be imports from an overseas based supplier*, with 154 (73%) of the 210 responding firms reporting that they had been involved in this activity. The second most important inward link was *contract manufacturing performed in the UK for an overseas based firm*, with 93 (44%) of respondents claiming to have been involved. Eighty one firms (39%) had been involved in distribution in the UK for overseas based suppliers. Contract R&D was only performed by 52 (25%) of firms and fewer firms (18 (9%)) reported having licensed-in technology.

The results in the first instance indicate that three quarters of the sample are involved in importing, if only for their own use, and much smaller proportions of the sample have reported involvement in the other listed activities. What is important here, and merits further investigation, is that while imports involve an outflow of funds from the British firm to the overseas based firm, all other listed inward activities, with the exception of the licensing in of technology, involve flows of payments in the opposite direction. Traditionally, theories of internationalisation have either implicitly or explicitly emphasised outward internationalisation focusing on the location of production or value adding activities and assuming payment flows in the direction of the home country or firm. In this thesis, the emphasis is on the role of external links in the expansion process of small technology firms and important here, in addition to product, production and payment flows are flows of technology, knowledge, personnel and services which could stimulate the growth of firms by adding to the resource base.

Outward Links

Firms were asked to state whether they had been involved in a given list of cross-border activities. These activities have been termed "outward links" because the value adding activity takes place in the foreign country. This definition is not entirely clear-cut however as exporting (effectively a sales function) relies on production in the home market for success and production traditionally tends to be viewed as the main value-adding activity in the value chain. Here the view is taken that export is an activity in the foreign market in which the firm has a commercial interest and is part of an outward

expansion process. Exporting from this perspective is an outward link (see also discussion in Chapter 5).

Contracted out R&D and manufacturing have been placed in the list of outward links because the value adding activities take place in the foreign locations. The case is complicated however by the fact that these activities are performed by firms other than the focal firm and payment flows are outward rather than inward. Again it is emphasised that the focus of this study is the role of external links in the expansion process of the firm rather than the direction of expansion and therefore, as with inward links, flows of knowledge, technology and personnel are as important as flows of products, production and payments.

The results at this stage indicate that 124 (59%) of firms have been involved in direct exporting through a foreign based agent or distributor, and 61 (29%) have exported through company representatives or sales branches. Based on export development models this would suggest that a sizeable proportion of the sample are experienced exporters. Ninety two firms (44%) claimed to have been involved in exporting through UK base intermediaries. As the sample consists predominantly of firms involved in R&D and/or innovation, it was expected that a relatively high number of firms would have been involved in the licensing-out of technology to overseas partners. The results indicate that only 21 firms (10%) have been involved in the licensing-out of technology to overseas based partners. There was however more involvement in technical services or consultancy performed overseas with 45 firms (22%) claiming to have been involved in such activities.

Production in overseas subsidiaries was expected to be confined to a few firms because the firms in the sample are small and because of the scale of investment and resource commitment required. Only 8 firms (5%) claimed to have invested in overseas production.

Formal Cross-Border Cooperation Agreements

Formal cross-border cooperation agreements as distinct from informal cooperation was defined for respondents as "--- interfirm cooperation, that spans national boundaries, in product development, manufacture or marketing, which is based on one-off sales and includes substantial contributions by partners of capital, technology or other assets". The most frequently reported cooperation agreement type was *distribution agreements with suppliers of complementary products*, with 39 firms (19%) reporting involvement. Technology sharing agreements were listed by 15 firms (7%) and non-equity joint

production agreements and comprehensive consortia accounted for 9 firms or (4%) each.

Summary

Identification of cross-border links suggests that there is a considerable amount of activity taking place which is essentially international in nature. *The types of link most common to the sample firms are trade links with importing and agent/distributor exporting mentioned by well over 60% of the sample.* "Contractual arrangements", of varying types other than export, were found to be common with contract-in manufacture being the most frequently mentioned of these. Licensing of technology whether inward or outward was not common and only 10% and less of firms reported involvement in these activities. This is commensurate with previous studies e.g. Tesar (1977), Luostarinen (1979) and Welch (1981) which found licensing to be a secondary form of international business activity. Comprehensive statistics on the extent of international licensing are scarce. Fragmented reports suggest that licensing is not common amongst SMEs for example, O'Doherty and McDevitt (1994) report 22 instances of SME licensing out compared to almost 3000 instances of export and a UK study (SBRT, 1993) estimated the percentage of SME exporters, of 50 or more employees, with licensing activities to be around 12%. In the mid 1990s, and for a sample consisting of innovative high technology firms, a higher incidence of licensing might have been expected in relation to this sample and to the SME population in general.

Internalised or integrated activities are interesting in that almost 30% of firms reported involvement in integrated exporting, but only 5% had made any investment in overseas production. A proposition emerging from this is that, for small firms, integrated export and FDI are a result of the intensification of international business activity rather than independent steps or stages into foreign markets. This proposition is pursued in chapter eight in which the sequence of linkage formation is examined.

It is important to reiterate here that the external links listed as separate forms of business activity are, in reality, often difficult to distinguish one from another. Inward and outward links may have an element of reciprocity and value chain activities, e.g. production and technical support may be mutually supportive. For small firms especially, functional activities may be very blurred, but the overall activity of the firm quite specialised or specific to a market or industry. Early cross-border links will clearly have some impact on the subsequent international expansion and growth of the firms. *It is suggested here that early links will reflect the nature of the firms' activities and resource needs, and that these activities and resources are the starting point of*

internationalisation, and export sales or agent/distributor relationships may be an effect and not the cause of an internationalisation process.

A final point here is to emphasise that the cross-border links listed record the firms' first experience with each type of activity and do not attempt to measure on-going or repeated activity or the intensity of any activity. The next chapter examines the rate of linkage formation, the sequence of events in terms of cross-border activity and cause and effect factors associated with link formation.

What Characteristics and Conditions are Associated with Individual Types of Cross-Border Link?

To answer this question, explanation is sought through the identification of explanatory variables such as firm characteristics, the nature of technology, type of business being undertaken by the firm etc., which may influence the type of cross-border links made. To determine which characteristics and conditions are associated with individual types of cross-border link, the independent variables as used in the previous section were cross-tabulated with a dichotomous variable indicating whether firms have established the link type or not. The firm characteristics are the independent variables which are listed in the left hand column of Tables 7.12 to 7.14. The figures in the columns of these tables are the percentages of firms which reported having each specific link type, broken down as they are distributed across the categories determined by the independent variable distributions.

The volume of the data represented in Tables 7.12 to 7.14 is such that the results of the chi-square tests of independence have been indicated on the tables for illustrative purposes. The shaded areas represent areas of association between link types and firm characteristics and conditions. The results have been presented in this way to illustrate and determine whether there are any patterns in the types of characteristics associated with particular forms of international business activity. Significant results, which indicate an association between the firm characteristics and the link type are discussed separately in the next main section of the chapter.

Cross-Tabulation of Inward Links with Firm Characteristics

Examining Table 7.12 link by link and looking down the columns, it can be seen that the only characteristic which has a clear association with import activities is the size of the firm in terms of both the number of employees and the value of turnover. *There is a difference between the size categories of firms and whether or not they import.* Firms' propensity to import, from the results does not appear to be affected by the firm' age, industry, foundation method, independence, R&D intensity or whether or not the firm is an NTBF.

Table 7.12 Inward Links by Firm Characteristics

(Distribution Cross-Tabulation)	% Firms with Link Type						
	a	b	c	d	e	f	g
Size of Firm (employees)							
Less than 10	20	17	19	19	26	19	22
11 to 20	27	31	21	24	39	23	11
21 to 50	38	42	43	42	30	41	39
51 to 200	15	10	17	15	4	17	28
No. of Firms	154	81	52	54	23	93	18
Size of Firm (turnover)							
Less than £0.5m	21	17	21	19	22	23	11
£0.5m to £0.9m	24	29	25	24	30	20	22
More than £0.9m	55	54	54	57	48	57	67
No. of Firms	152	80	80	54	23	93	18
Age of Firm (years)							
New (5 or less)	19	17	17	20	26	17	22
Young (6 to 10)	23	17	38	26	26	27	28
Adolescent (11 to 25)	39	47	33	43	35	40	28
Mature (26 +)	19	19	12	11	13	16	22
No. of Firms	154	81	52	54	23	93	18
Independence							
Wholly Independent	75	69	69	70	78	71	67
Not wholly independent	25	31	31	30	22	29	33
No. of Firms	154	81	52	54	23	93	18
Foundation							
New Start-Up	62	55	64	57	73	53	71
Evolution	38	45	36	43	27	47	29
No. of Firms	154	80	52	53	22	93	17
R & D Intensity (turnover)							
Zero	9	9	7	10	9	9	12
1% to 5%	51	56	40	43	52	52	44
6% to 20%	26	25	24	22	26	29	25
21% to 100%	14	10	29	25	13	10	19
No. of Firms	131	71	45	49	23	81	16
R & D Intensity (employees)							
Zero	25	25	11	16	32	23	19
1% to 10%	40	46	36	41	45	40	37
11% to 20%	17	14	17	18	14	22	19
21% to 100%	18	15	36	25	9	15	25
No. of Firms	132	67	47	49	22	82	16
NTBF							
Yes	37	38	44	43	22	34	50
No	63	62	56	57	78	66	50
No. of Firms	154	81	52	54	23	93	18
Industry Sector							
Plastics/Comp.	11	7	12	6	17	9	0
Biotech/Pharm.	16	14	29	22	9	26	17
Adv. Medical.	25	32	19	18	22	17	33
Electronics	24	17	19	28	13	23	28
Other	24	30	21	26	39	25	22
No. of Firms	154	81	52	54	23	93	18
Pearson χ^2	not significant		significant at $\leq .05$				
a. import	b. imp. with dist. in UK			c. contract-in R&D			
d. tech. serv/cons. in the UK for os clients	e. mgt /mkg serv/cons in the UK for os clients			f. contract-in manufacture for overseas based firms			
				g. licensing-in tech. from os.			

The situation changes for firms which import and also distribute those products in the UK for overseas based firms (column b). *In this case the firms' level of independence and the method by which it was founded influence whether or not it establishes this type of import link.* Chances are that links established through parent firms or through organisations from which firms evolved are of some importance here. Other factors associated with this type of cross-border link are the concentration of employment in R&D and the firms' industry sector. The latter two factors may be indicative of specific types of research work which require products or materials unavailable locally or industry sectors with similar activities or established sourcing arrangements.

Turning to column c, (Table 7.12), *contract-in R&D is associated with the firms' R&D intensity as measured both by investment and by employment.* Size and age of the firms do not appear to be determining factors here, nor do firms' independence or foundation method, their industry sector and whether or not they have been established to exploit a technological or scientific innovation.

Whether or not a firm offers technical service and/or consultancy to overseas clients (column d) seems to be independent of any of the characteristics listed here and the same is true of management and marketing services and consultancy activities performed in the UK for overseas firms (column e). It might be expected that such activities would be associated with the number of employees firms have since the activities are essentially labour intensive. This however does not appear to be an influential factor here. Similarly, the concentration of employment in R&D might be expected to influence technical service/consultancy due to the specialised knowledge required, again however, there is no evidence of any connection. Essentially, services are a human resource and the influential factors are most likely to be found in the capabilities, competencies and goals of management and staff, issues which are beyond the scope of this work.

Contract-in manufacture (column f) was found to be associated with turnover, which makes sense since manufacturing output is directly connected to the firms' turnover. Another influence at play here is the firms' foundation method which again suggests links with other firms, or alternatively, the absence of needed links or resources, points which are explored further in Chapter 8. Industry sector is also a factor which could have been expected to influence the contracting-in of manufacturing work and may be linked to the nature of the activity in the industry, its stage of development and level of specialisation.

Table 7.13 Outward Links by Firm Characteristics

(Distribution Cross-Tabulation)	h	i	j	k	l	m	n	o	p	q
Size of Firm (employees)										
Less than 10	27	21	18	24	31	17	24	20	0	0
11 to 20	25	24	26	14	27	22	19	20	0	0
21 to 50	36	40	44	52	15	28	29	44	100	40
51 to 200	12	15	12	10	27	33	28	16	0	60
No. of Firms	92	124	61	21	26	18	21	45	3	5
Size of Firm (turnover)										
Less than £0.5m	24	22	20	24	31	28	30	18	0	0
£0.5m to £0.9m	29	24	22	14	15	28	20	21	0	20
More than £0.9m	47	54	58	62	54	44	50	61	100	80
No. of Firms	91	123	59	21	26	18	20	44	3	5
Age of Firm (years)										
New (5 or less)	13	18	23	14	23	22	14	13	0	20
Young (6 to 10)	26	24	23	34	27	11	38	24	33	20
Adolescent (11 to 25)	46	41	33	38	35	39	34	47	33	60
Mature (26 +)	15	17	21	14	15	28	14	16	33	0
No. of Firms	92	124	61	21	26	18	21	45	3	5
Independence										
Wholly Independent	80	77	72	67	69	67	76	67	67	100
Not Wholly Independent	20	23	28	33	31	33	24	33	33	0
No. of Firms	92	124	61	21	26	18	21	45	3	5
Foundation										
New Start-Up	61	62	55	62	64	71	67	67	67	100
Evolution	39	38	45	38	36	29	33	33	33	0
No. of Firms	92	124	60	21	25	17	21	45	3	5
R & D Intensity (turnover)										
Zero	10	6	8	5	5	0	5	10	0	20
1% to 5%	49	46	43	20	45	29	30	41	0	20
6% to 20%	25	35	40	50	30	21	45	32	100	40
21% to 100%	16	13	9	25	20	50	20	17	0	20
No. of Firms	80	111	53	20	20	14	20	41	2	5
R&D Intensity (empls)										
Zero	25	17	25	14	18	12	16	24	0	20
1% to 10%	41	41	45	29	41	19	26	31	100	40
11% to 20%	15	22	15	33	14	19	32	25	0	20
21% to 100%	19	20	15	24	27	50	26	20	0	20
No. of Firms	80	118	55	21	22	16	19	45	3	5
NTBF										
Yes	41	48	46	71	50	50	52	53	100	60
No	59	52	54	29	50	50	48	47	0	40
No. of Firms	92	124	61	21	26	18	21	45	3	5
Industry Sector										
Plastics/Comp.	11	6	11	14	4	0	0	9	33	0
Biotech/Pharm.	19	18	12	24	27	39	19	18	0	20
Adv. Medical.	28	27	23	24	19	22	19	11	0	20
Electronics	19	26	31	19	35	11	33	40	33	60
Other	23	23	23	19	15	28	29	22	33	0
No. of Firms	91	124	61	21	26	18	21	45	3	5
Pearson χ^2	not significant		significant at $\leq .05$							
h. export (UK intermediary.)					m. contract-out R&D to overseas based firm					
i. export (overseas ag/dist.)					n. mgt/mkg serv/cons. overseas					
j. export (overseas based rep/branch)					o. tech serv/cons. overseas					
k. license-out tech to overseas firm					p. minority investment in overseas production.					
l. contract-out mft to overseas firm					q. majority investment in overseas production.					

Cross-Tabulation of Outward Links with Firm Characteristics

Turning to outward links (Table 7.13) *exporting through UK based intermediaries was not found to be associated with any of the firm characteristics and conditions listed (column h)*. This result could be expected since this type of exporting can be done with little expense, expertise or management commitment (Luostarinen, 1979; Young et al., 1989). There are few if any barriers to this type of international activity and it can be done without any proactive involvement by the exporting firm.

The results are quite different for export through overseas-based intermediaries (column i). Here the size of the firm in terms of turnover is important and several characteristics relating to the firms' technological involvement influence whether or not the firm will establish export links with overseas intermediaries. These are, investment in R&D, concentration of employment in R&D and whether or not the firm was established to exploit a scientific or technological innovation. This confirms the long-standing association of R&D intensity with exporting. Somewhat surprisingly, exporting through overseas branches or representatives was found not to be associated with any of the firm characteristics or conditions listed. *As this mode of export bears considerably more risk and requires more investment and commitment than the previous two forms of exporting (Luostarinen, 1979), it could be expected that firm size and age would be important associated factors, but there is no evidence of any association in the findings of this analysis.*

In relation to the licensing-out of technology to an overseas firm (column k), investment in R&D is an important factor, as is the firms' status as NTBF. For technology based firms these factors underpin the development of innovations and this result could be anticipated. Age of the firm and its size seem to have no effect here, nor does industry which might have been expected to influence licensing activity where there are a concentration of firms working in the development stages of technology.

Contract-out manufacture (column l) is not associated with any of the firm characteristics listed except firm size measured by number of employees. For small firms, as is the case of all firms in this sample, the reason here is likely to be associated with lack of production capability rather than efficiency based sourcing which is a driver of this type of arrangement in larger firms. *Contract-out R&D (column m) is associated here with both investment and employment levels in R&D and also with industry sector.* This type of cross-border arrangement clearly seems to be linked to the specialised nature of the firms' activities, although this does not explain the association between R&D intensity and both export and import activities discussed above.

Table 7.14 Formal Cooperation Links by Firm Characteristics

(Distribution Cross-Tabulation)	% Firms with Link Type			
	r	s	t	u
Size of Firm (employees)				
Less than 10	27	22	34	28
11 to 20	27	11	22	21
21 to 50	26	56	22	46
51 to 200	<u>20</u>	<u>11</u>	<u>22</u>	<u>5</u>
No. of Firms	15	9	9	39
Size of Firm (turnover)				
Less than £0.5m	20	22	11	18
£0.5m to £0.9m	40	22	33	33
More than £0.9m	<u>40</u>	<u>56</u>	<u>56</u>	<u>49</u>
No. of Firms	15	9	9	39
Age of Firm (years)				
New (5 or less)	40	44	22	23
Young (6 to 10)	20	33	33	28
Adolescent (11 to 25)	33	23	33	44
Mature (26 +)	7	0	12	5
No. of Firms	15	9	9	39
Independence				
Wholly Independent	60	67	56	72
Not Wholly Independent	<u>40</u>	<u>33</u>	<u>44</u>	<u>28</u>
No. of Firms	15	9	9	39
Foundation				
New Start-Up	60	56	33	51
Evolution	<u>40</u>	<u>44</u>	<u>67</u>	<u>49</u>
No. of Firms	15	9	9	39
R & D Intensity (turnover)				
Zero	25	12	14	14
1% to 5%	33	38	29	40
6% to 20%	33	38	0	35
21% to 100%	2	<u>12</u>	<u>27</u>	<u>11</u>
No. of Firms	12	8	7	35
R & D Intensity (employees)				
Zero	20	22	12	22
1% to 10%	27	44	25	38
11% to 20%	40	22	13	30
21% to 100%	<u>13</u>	<u>12</u>	<u>5</u>	<u>10</u>
No. of Firms	15	9	8	37
NTBF				
Yes	47	33	67	49
No	<u>53</u>	<u>67</u>	<u>33</u>	<u>51</u>
No. of Firms	15	9	9	39
Industry Sector				
Plastics/Comp.	7	7	11	13
Biotech/Pharm.	27	34	33	15
Adv. Medical.	40	22	33	31
Electronics	20	11	11	31
Other	<u>6</u>	<u>22</u>	<u>11</u>	<u>10</u>
No. of Firms	15	9	9	39
Pearson χ^2		not significant	significant at $\leq .05$	
r. technology sharing agreements		t. comp. R&D manufacturing and mkg consortia		
s. non-equity joint prdn. agreements		u. dist. agrts. with suppliers of compl. prods.		

Overseas-based management or marketing service or consultancy was performed by at least 20 firms in the sample, but this activity was found to have no association with any of the firm characteristics and conditions listed (column n). As discussed previously, this type of activity is probably related to the human resource of the firm, examination of which is beyond the scope of this study.

Overseas technical service or consultancy was found to be associated with the size of the firm in terms of turnover and whether or not the firm was established to exploit a scientific or technological innovation (column o). The latter of these two associations could be anticipated if it is considered that the service and consultancy offered is likely to be associated with the innovation or the expertise connected with it. Other R&D variables were not found to be associated with outward technical service or consultancy.

Overseas investment (columns p and q) were associated with the firms' status as NTBF and its size. So few firms were involved in this type of activity however that the chi-square results could not be interpreted with certainty. However, examination of the cross-tabulated distributions (columns p and q, Table 7.13) revealed that all minority investments had over 20 employees and turned over at least half a million pounds per annum at the time of the survey. In the case of minority investment, all firms involved claimed to have been established to exploit an innovation while 6 of majority investors fell into that category. In general, there were too few investors in overseas production to provide an interpretable cross-tabulation.

Cross-Tabulation of Formal Cooperation by Firm Characteristics

Looking at Table 7.14 holistically, the absence of any association between cooperation links and firm characteristics suggests that the firm characteristics and conditions listed have no effect on whether or not the firm becomes involved in formal alliances. *There is evidence that investment in R&D is associated with comprehensive R&D agreements*, but otherwise chi-square tests of the cross-tabulations revealed no dependence between cooperative link types and firm characteristics.

There are a number of points to note here. The numbers of firms participating in specific agreement types is small, rendering the number of firms per cell in the cross-tabulations too small to produce a valid chi-square result. In addition, the Table and the question to which it relates are concerned with whether firms become involved in formal cross-border cooperation agreements or not. As cooperation arrangements are alternative ways of achieving what could also be achieved independently, the question

only asks whether firms are involved in formal cooperation and not whether they are *only* involved in formal cooperation rather than informal cooperation or independent modes of operation.

From a resource dependency perspective, firms which have limited resources or capabilities would be those most likely to enter cooperation agreements. There is no evidence to that effect here in relation to firms' size, age, industry sector or R&D intensity. However, aggregation of modes of formal cooperation produced more solid results and this is discussed in Chapter 8.

Association Of Firm Characteristics With Specific Cross-Border Link Types

Bivariate analysis in which key firm characteristics (explanatory factors) were cross-tabulated with individual cross-border links and Pearson Chi-square statistics were used to identify individual factors which may be associated with the establishment of each cross-border link (see Appendix 1 for a discussion of the use of Chi-squared statistics). The overall results from the chi-squared tests are indicated in the distribution Tables 7.12 to 7.14 as shaded boxes. This section discusses the significant chi-squared results only and assesses the adequacy of the indicated results and their interpretation.

Independent variables firm size, firm age, industry, R&D intensity, foundation method and level of independence were cross-tabulated with each type of cross-border link established, to determine the extent of association between the key independent variables listed and the types of cross-border links established by the sample firms. Each of the above links was also cross-tabulated with the key firm characteristics and the Chi-square statistic calculated to identify association between any of the two sets of variables. Examination of residuals determined where deviation from the expected results lay e.g. which category of firms (new, young, adolescent or mature) is most likely to export.

By Dependent Variable	% cells<5	df.	Pearson χ^2	Sig.
Import from os supplier	-	3	11.76	.008**
Dist for os firm in UK	-	3	8.27	.041*
Other Inward Activity	37.5	3	8.88	.031*
Contract-out Mft to Os firm	12.5	3	8.24	.041*
Majority owned subsidiary	50.0	3	11.44	.009**
.05 = *, .01 = **, .001 = ***				

Firm Size Effects

Firm size, measured by number of employees, was found to be significantly associated with the five types of cross-border activity listed in Table 7.15.

The latter three however suffer from low cell counts and need to be interpreted with caution. *Indications are that small firms with 10 employees or less are less likely to import than larger firms.* The same group is less involved in importing and UK distribution than larger firms. As this group contains very young firms and firms specialised in R&D, this result could be expected. It is the middle size group of firms which is less likely to contract out manufacturing than either smaller or larger firms. While very small firms may lack production capability and be forced to contract-out manufacture, the reason why they should contract-out to overseas-based organisations cannot be determined here. *Firms in the larger size category of 21-200 employees are more likely to become involved in contract-out manufacture* than the middle group, most likely due to growing business. Predictably, the largest group of firms (21-200) are the ones with investment in majority owned production subsidiaries overseas. No firms of less than 20 employees had made such an investment.

By Dependent Variable	% cells<5	df.	Pearson χ^2	Sig.
Import from os supplier	-	2	20.04	.000***
Dist for os firm in UK	-	2	7.26	.026*
Contract in Mft from os firm	-	2	8.38	.015*
Os agent/dist export	-	2	9.39	.009**
Technical serv/cons done os	-	2	6.10	.047*

≤.05 = *, ≤.01 = **, ≤.001 = ***

The size of firms in terms of their turnover was found to have a significant association with three types of inward link and two outward links. The

smallest firms (those with an annual turnover of <£0.5m) were less likely to import, while those in the largest category (>£0.9m) were more likely to import. Differences were not pronounced however, suggesting that for the *firms in this sample, size is not particularly important vis-à-vis import activities.* The same pattern was found for firms involved in importing with distribution in the UK. *Firms with more than £0.9m annual turnover were the most likely to contract-in manufacture.* This group of firms in the largest turnover category was also found to be *more inclined to export through agents and distributors than other groups and also to perform technical service or consultancy activities overseas.*

Firm Age and Experience Effects

Cross-tabulations were carried out between firm age and all forms of external linkage activity. Chi-squared tests revealed no significant interaction whatsoever between this independent variable and the establishment of any form of external link. *This suggests that the age of the firm has no bearing on the internationalisation process of the small high technology firms in this sample.* This is surprising considering the widely

accepted view in the literature on small firm internationalisation and on MNE development is that small firms undergo a period of development in the domestic market before venturing abroad. While little is known at this stage of the effects of inward activities on internationalisation, a strong association between longer established firms and outward marketing and production links could be expected here, but none was found. This result is particularly interesting in light of knowledge development and experience theories of internationalisation.

The Effect of Firm Independence

By Dependent Variable	% cells<5	df.	Pearson χ^2	Sig.
Cross-border R&D coop	-	1	6.55	.011*
Dist in UK for os firm	-	1	4.18	.041*

≤.05 = *, ≤.01 = **, ≤.001 = ***

It was expected that firms which were not wholly independent would benefit from links with their equity partners which could trigger or

support cross-border linkages. The only significant association in that respect was in the case of cross-border R&D cooperation where non-independent firms were found to be more likely to be involved than independent firms. Non-independent firms were also more likely to import and distribute products in the UK for overseas firms than were independent firms.

The Effect of Firm Foundation Method

By Dependent Variable	% cells<5	df.	Pearson χ^2	Sig.
Dist in UK for os firm	-	1	4.18	.041*
Contract in Mft from os firm	-	1	8.68	.003**

≤.05 = *, ≤.01 = **, ≤.001 = ***

Firms which had evolved from other organisations were found to be marginally

more likely to import and distribute products in the UK and to contract-in manufacture from overseas than were firms which were completely new starts. While it could be expected that firms would retain business links with organisations they had formally been associated with, the only cross-border activity associated with such previous connections is inward distribution and contract manufacture. It should be noted however that only 13 firms in the sample reported former overseas connections.

R&D Effects

Table 7.19 R&D Intensity (turnover) by Links

By Dependent Variable	% cells<5	df.	Pearson χ^2	Sig.
Cross-border R&D coop	-	3	8.01	.046*
R&D performed in UK	-	3	8.47	.037*
Agent/Distributor export	-	3	14.41	.002**
License-out of technology	25	3	9.36	.025*
Contract out R&D	37.5	3	14.21	.002**
Comprehensive consortia	50	3	10.47	.015*

$\leq .05 = *$, $\leq .01 = **$, $\leq .001 = ***$

Firms with the highest level of investment in R&D (21-100% turnover invested in R&D) were those most likely to become involved in cross-border R&D cooperation, and

contract-in R&D. The pattern changes however for outward activities and *firms investing in 6-20% of turnover in R&D are more likely to export through agents and distributors than firms making R&D investments of <6% or more than 20%*. A similar pattern emerges for licensing out technology in which case firms making investments of 6% or over are more likely to license-out technology while contract-out R&D is more likely by firms making investments of over 20% of turnover. It is the group of largest investors again which is more likely to invest in comprehensive consortia. The last three chi-square results need to be interpreted with caution due to low cell counts.

Table 7.20 R&D Intensity (% employment) by Links

By Dependent Variable	% cells<5	df.	Pearson χ^2	Sig.
Cross-border R&D coop	-	3	14.12	.003**
Distribution in UK	-	3	7.95	.047*
R&D performed in UK	-	3	14.74	.002**
Agent/Distributor export	-	3	21.52	.000***
Contract out R&D	37.5	3	10.21	.017**

$\leq .05 = *$, $\leq .01 = **$, $\leq .001 = ***$

Firms with more than 10% of their employees in R&D are more likely to be involved in cross-border R&D cooperation while *those between 1 and 10% are most likely to import and distribute products in the UK*. Firms with

20% or more of employees working in R&D are those most likely to contract-in R&D. *It is firms with the smallest proportion of employees in R&D (excluding those with none) which is more likely to export through agents/distributors*. Firms with 21 - 100% employment in R&D are most likely to contract-out R&D, but due to low cell counts, that result needs to be treated with caution. Intuitively, firms with more in-house R&D capacity would have less need to contract-out R&D than other firms.

Industry Effects

By Dependent Variable	% cells<5	df.	Pearson χ^2	Sig.
Distribution in UK	-	4	10.98	.027*
Contract in mf from os firm	-	4	12.45	.014*

$\leq .05 = *$, $\leq .01 = **$, $\leq .001 = ***$

Industry only had a significant effect on two types of links. Distribution in the UK was found to be

marginally more likely to be performed by the advanced medical products sector while contract-in manufacture was more likely by biotechnology firms. *Industry was not found to have a significant effect on any outward or cooperative mode of cross-border activity.*

Summary

Bivariate analysis was used to identify association between individual key characteristics of the sample firms and each type of cross-border activity. Altogether 192 cross-tabulations were calculated, which resulted in 27 significant associations.

Indications are that the size of firms is important for some inward and outward activities as reported above and for formal cooperation. R&D intensity was important for both inward and outward R&D links, but lower levels of investment were more important for export links. Industry was found to have very little effect on any type of cross-border linkage activity except UK distribution and contract-in manufacture. Most importantly, age of the firm appeared to be of no significance to any form of link whatsoever.

Bivariate analysis here presents problems relating to empty cells and low cell counts yet has been limited to firm characteristics on which information is common to almost all sample firms. The key characteristics are those most frequently used in studies of export development and have been associated with firms at different stages of international development. Generally studies of this type have examined small firms (often < 500 employees) in comparison to larger firms and results have suggested that larger firms are associated with more advanced modes of international activity such as integrated exporting licensing-out and investment in overseas manufacture. These results are generally not supported in this study which consists entirely of firms of less than 200 employees.

While small firms have been found to establish all kinds of international link including "advanced modes" of foreign market entry, size and age have not been found to be of importance within this size category of firms. The relatively strong influence of R&D investment suggests that specialisation of firm activity may be important and the

marginal involvement of industry suggests that further investigation is merited here. Equity links and links to former organisations are important, but the extent of cross-border activity cannot be determined from the evidence available.

Adequacy of the Results

The cross-tabulations and chi-square tests of key firm characteristics with each type of cross-border link has provided some useful insights into the initial international expansion of the sample firms. The strongest pattern emerging is the association of R&D intensity with R&D based link types suggesting that *specialisation* in a particular value chain activity may influence the type of link formed. Size or resource based considerations did show up in the results but to a lesser extent than might be expected, and age/experience was noticeably of no significance, which raises serious questions in respect of the export development models of internationalisation.

The results presented in this section are not without problems or limitations. Firstly, a bivariate examination limits the analysis to two specific variables and no account is taken of the multiple effect of several variables working together, and interaction effect is not examined. In that respect, the usefulness of association of individual characteristics with firm behaviour is questionable, especially where entrepreneurial behaviour is concerned. For example, small size may be a barrier to growth for some, and a challenging but surmountable obstacle to others.

In relation to the characteristics of the sample, differences in instances of different types of links resulted in very small sub-samples. This emerged in the cross-tabulations where empty cells rendered some of the results questionable. This problem was partially solved by grouping firms into categories which were meaningful but more evenly distributed. While the compromise between pragmatic and statistical validity is noted, as Carson et al. (1995) and Storey (1994) note, the subjective categorisation of firms into size and age categories is likely to introduce bias into the analysis. Subjective categorisation may also render comparison between studies difficult.

Secondly, problems emerge in this type of study due to the fact that the categories, here link types, are not necessarily mutually exclusive and may even be mutually supportive or interdependent. In reality, firms do not usually form either one link type or another, but may form several relating to one or more business or functional activities. In small firms there may be very indistinct boundaries between the firm's activities, but even larger firms where there is a more distinct functional delineation may, for strategic reasons, form different types of link simultaneously or in conjunction (see discussion

of innovation models Chapter 3, especially Forrest, 1991). Link types themselves may blur together for example the importation of components from a licensor or technical service with export.

What does emerge clearly from the analysis and is of some importance here is *what was not found*, in addition to what *was found*. What was not found was any association between firm age/experience and the establishment of any single type of cross-border link. Nor was there any marked or consistent association of firm size with cross-border links other than that the smallest firms were less likely to import, and the largest more likely to contract-out manufacture. Within the size range of firms in this sample, size itself does not seem to be important in determining link type. Of some interest is the association between R&D intensity and outward R&D links. The chi-square indicates that firms investing between 6 and 20% of their turnover in R&D are more likely to establish outward R&D links. Returning to the correlation analysis (Table 7.8), there is a weak but significant negative association between R&D intensity and firm age and again with firm size. Taken together, these results lend further support to the often attributed link between investment in R&D and outward internationalisation. Also interesting is the association of firms' previous connections (firm independence and firm foundation method) where association was found between these variables and inward activities viz. import with distribution and contract-in manufacture. While these activities represent earnings from overseas, there is no evidence that previous connections have contributed in any way to outward international expansion.

There is no evidence, in the results discussed in this section, of reciprocity between inward and outward links of the same type. While the short-comings of bivariate analysis (see above) are acknowledged, it could be expected that links of the same value chain activity, but in different directions, would be associated with the same firm characteristics. Examination of Tables 7.17 to 7.21 provides no evidence to suggest that firm characteristics associated with import are also associated with export. There is some evidence of directional reciprocity in R&D links associated with the level of R&D investment (Tables 7.19 and 7.20), lending some support to resource-based and functional specialisation views of international expansion.

The findings examined in this section are by no means conclusive and offer tentative indications of factors associated with specific link types. The absence of conclusive evidence may suggest that a basic examination of a few firm characteristics such as firm size and age is inadequate in explanation, or even description of international expansion.

What is the Effect of Product and Market/Industry Factors on Firm Performance and Growth?

Effects on Turnover Growth and International Ratio

Several product and market/industry factors were found to have significant correlations with turnover growth and with the international ratio. For this analysis all variables were treated as ordinal data and the test used in the cross-tabulations was Pearson's R.

Examining turnover growth first (Table 7.22, first column), the level of the firms' technology and the level of technological innovation made by the sample firms are both positively correlated with turnover growth. This indicates that *firms with higher technology tend to experience higher growth rates than those with lower technology*. This finding is most meaningful when interpreted in relation to market/industry conditions rather than the firms' technological products and processes. Growth in high technology sectors and markets tended to be higher and suffer less from the recession than did low technology sectors during the period prior to this survey. Technological innovation has more to do with the firms' individual efforts and capabilities in the creation and development of new technological products and processes. Findings indicate that *firms which are more innovative tend to experience higher growth rates in terms of turnover than those which are less so*.

Other product and market/industry factors, software content, product complexity, standardisation and industry application had positive but non-significant correlations with turnover growth. The number of UK substitutes which firms faced had a negative but non-significant correlation. Overall, only technology level and technological innovation were found to be associated with turnover growth. Several factors exhibited significant correlations with international turnover ratio (Table 7.22, second column). *Firms with high technology products and processes were found to have higher levels of international ratio. Firms' efforts in terms of their technological innovation were also positively associated with increasing proportions of international to domestic turnover.*

Increasing levels of product complexity were found to be positively correlated with international ratio and while complexity might be thought to be associated with specialised or customised products, customisation here was not found to have a significant relationship with international ratio.

(% firms)	% Turnover Growth			% International Ratio			
	0 or -	≤10%	>10%	zero	1- 10	11- 50	51+
Technology							
Very low	15	10	4	13	12	4	4
Low	15	10	5	15	9	9	4
Medium	33	24	29	28	29	29	26
High	30	31	34	23	29	37	28
Very High	7	25	28	21	21	21	38
Number of Firms	27	51	98	39	34	76	47
Technological Innovation							
Very low	19	14	10	31	9	7	10
Low	12	14	7	13	15	12	4
Medium	35	26	13	26	21	15	21
High	11	28	41	18	33	37	29
Very High	23	18	29	12	22	29	36
Number of Firms	26	50	98	39	33	75	48
Software Content							
Very low	42	51	48	57	44	46	49
Low	23	6	14	8	12	19	6
Medium	23	19	16	24	26	13	17
High	4	14	10	6	18	12	4
Very High	8	10	12	5	0	10	24
Number of Firms	26	51	96	37	34	74	47
Product Complexity							
Very low	12	10	5	15	6	5	8
Low	12	10	18	18	13	19	9
Medium	36	46	43	44	53	41	36
High	32	24	21	13	19	24	30
Very High	8	10	13	10	9	11	17
Number of Firms	25	50	96	39	32	74	47
Standardisation							
Very low	11	2	8	5	3	12	10
Low	15	14	14	15	15	13	10
Medium	30	47	38	46	44	36	34
High	33	23	21	21	23	22	23
Very High	11	14	19	13	15	17	23
Number of Firms	27	51	98	39	34	76	48
Customisation							
Very low	11	14	7	8	0	8	19
Low	15	2	12	13	9	12	8
Medium	4	25	14	20	10	14	21
High	26	16	28	21	22	26	23
Very High	44	43	39	38	59	40	29
Number of Firms	27	49	98	39	32	77	48
Industry Applications							
Very low	41	36	26	31	21	33	26
Low	11	8	21	13	22	16	22
Medium	11	14	19	18	15	16	18
High	4	18	12	5	18	11	17
Very High	33	24	22	33	24	24	17
Number of Firms	27	50	95	39	33	75	46
UK Substitutes							
Very low	37	19	27	18	15	22	50
Low	15	10	20	13	21	20	15
Medium	15	43	34	32	34	32	25
High	22	12	9	21	15	14	4
Very High	11	16	10	16	15	12	6
Number of Firms	27	49	98	38	33	77	48
Pearson's R	not significant		significant at ≤.05	P	positive	N	negative

Interesting though, is the finding that the number of substitute products in the UK has a significant negative correlation with international ratio, indicating that as the level of substitutes in the UK market increases, the international to domestic turnover ratio decreases. This is contrary to conventional export studies which suggest that increasing competition at home may push firms into overseas markets. Another way of interpreting the result here bases its reasoning on the nature of rapidly evolving technology markets. Where there are few substitute products in the UK, there may also be few substitute products abroad. *The opportunity for new or specialised technologies therefore is likely to be global rather than local, at least for a period of time, and barriers to international markets for such products may be low.* While such assumptions clearly require further investigation, it is sensible to assume here that the latter argument may be the case for the firms in this sample.

Effects on Export Growth and Number of Export Countries.

Turning to export growth and the number of export countries (Table 7.23), *only levels of technological innovation were found to have a positive and significant relationship with export growth. The number of export countries was positively and significantly associated with product complexity.* Overall the firms' level of technological innovation is associated with growth whether it is domestic or international, and also with the concentration of international activity and the spread of exports.

Two of the factors which have not produced significant results in relation to measures of performance and growth are the level of standardisation of technology and the level of customisation of products/services to customer specifications. While an increase in standardisation may reflect the maturation of an industry and hence a change in competition, and an increase in customisation an indication of response to such changes (Jones et al. 1992; Wheeler et al. 1996), these factors were not found to affect performance or international ratio of the firms in this sample.

Broadly speaking, it would seem that international performance is either not based on production or product strategies or, as is more likely based on the nature of this sample, the industries concerned are still new and competitiveness based on the R&D and development stage of leading edge technologies.

Table 7.23 Cross-Tabulation Market / Industry Factors by Performance

	% Export Growth (% firms)			No. of Export Countries (% firms)			
	0 or -	≤10%	>10%	Zero	1 - 5	6 - 10	10+
Technology	P			P			
Very low	8	13	4	10	11	6	3
Low	8	6	4	10	6	6	5
Medium	28	31	32	35	30	25	32
High	28	25	34	17	23	44	38
Very High	28	25	26	28	30	19	22
Number of Firms	39	32	71	29	47	32	60
Technological Innovation	P			P			
Very low	22	6	8	24	15	6	8
Low	16	6	8	14	6	6	12
Medium	16	28	16	24	22	30	7
High	22	38	37	17	22	37	41
Very High	24	22	31	21	35	21	32
Number of Firms	37	32	71	29	46	33	59
Software Content	P			P			
Very low	54	47	50	62	40	58	44
Low	3	13	14	4	18	10	13
Medium	20	20	13	24	20	29	13
High	15	13	10	7	13	3	12
Very High	8	7	13	3	9	0	18
Number of Firms	39	30	70	29	45	31	60
Product Complexity	P			P			
Very low	13	6	6	21	4	6	5
Low	11	19	16	17	23	12	12
Medium	38	42	43	42	48	49	36
High	24	26	18	10	11	24	35
Very High	14	7	17	10	14	9	17
Number of Firms	37	31	70	29	44	33	58
Standardisation	P			P			
Very low	13	0	10	7	6	15	7
Low	10	15	11	17	11	9	16
Medium	39	44	34	48	40	34	30
High	20	22	23	21	26	24	25
Very High	18	19	22	7	17	18	22
Number of Firms	39	32	71	29	47	33	60
Customisation	P			N			
Very low	8	13	11	14	6	6	12
Low	14	9	7	11	6	3	18
Medium	16	13	10	21	13	9	20
High	19	28	30	18	34	27	20
Very High	43	37	42	36	41	55	30
Number of Firms	37	32	71	28	47	33	60
Industry Applications	P			N			
Very low	32	28	28	29	35	25	31
Low	21	13	21	18	22	13	20
Medium	10	19	16	14	6	22	12
High	8	15	10	7	11	12	20
Very High	29	25	25	32	26	28	17
Number of Firms	38	32	68	28	46	32	59
UK Substitutes	N			N			
Very low	30	19	29	25	26	40	25
Low	16	19	17	11	19	15	17
Medium	24	44	30	32	28	24	33
High	11	9	11	14	12	12	12
Very High	19	9	13	18	15	9	13
Number of Firms	37	32	71	28	47	33	60

Pearson's R P/N positive/negative correlation not sig. significant at ≤ .05

Summary

Technological innovation was found to be associated with all performance measures, turnover growth, international ratio, export growth and number of export countries. Firms' perceptions of the level of technology of their firms suggested that, moving from low to high technology firms, there was an associated increase in turnover growth and international ratio. Increases in product complexity were associated with increases in international ratio and number of export countries. Finally, the number of UK substitute products was found to be negatively associated with the international ratio.

Factors relating to the competitiveness of industry, namely standardisation, customisation, and numbers of industry applications were not found to have any significant relationships with any of the performance indicators, when examined on a one to one basis through bivariate analysis.

Some interesting results have emerged from this analysis. The first is that technology factors are consistently important in relation to turnover growth and international ratio. Technological innovation is positively and significantly associated with all performance indicators, turnover growth, international ratio, export growth and number of export countries. Product complexity is also positively associated with firms' dependence on international activity (international ratio) and geographic spread (number of export countries). *Technology, innovation and the nature of the product are therefore key issues in the international expansion of small high technology firms.*

The second issue is that competitive market/industry factors have not emerged as significantly important. The competitiveness of the market (industry applications) is not a significant factor and surprisingly, increases in substitute products in the UK market has a negative effect on international ratio. Firms' response to competitive pressures, i.e. standardisation and customisation of products or processes, show no significant relationship with any measure of development or growth.

What is the Effect of Frequency of Contact with Overseas Links on Firm Performance and Growth?

Patterns of Contact: Factor Analysis

Based on the network approach to internationalisation this question assumes that effort in contacting overseas associates, organisations, and other contacts is likely to be associated with the nature of internationalisation (discussed in Chapter 8) and the international performance of firms. Here, effect is measured as the frequency of contact with each type of overseas link measured on a 7-point scale from never to very frequently. Different types of links, by their nature, will require more or less frequent contact than others, e.g. firms would tend to contact organisations such as chambers of commerce much less frequently than customers or suppliers. For this reason, a factor analysis of link types was performed to determine which types of links exhibit similar patterns in terms of frequency of contact.

Table 7.24 Factor Matrix: Frequency of Overseas Contact

	Factor 1 (research contact)	Factor 2 (trade contact)	Factor 3 (professional associations)
University research departments	.7785	.1870	.0553
Company/industry R&D units	.7583	.2059	.1179
Research colloquia	.6750	.1225	.2041
Public research institutions	.5760	.2038	-.0153
Academic conferences/seminars	.5619	.2850	.3570
Customers	.3267	.8705	.1565
Distributors/agents	.2645	.7782	.1649
Suppliers	.2629	.5880	.1743
Trade Fairs	.1841	.4885	.3684
Trade/employers associations	.0485	.1898	.7796
Professional associations	.3405	.1383	.7241
Chambers of Commerce	-.0291	.3019	.3311
Factor	Eigenvalue	Pct of Var	Cum Pct
1	4.62	38.5	38.5
2	1.16	9.7	48.2
3	.86	7.1	55.3
Keyser-Meyer-Olkin Measure of Sampling Adequacy = .8298			
Bartlett Test of Sphericity = 1.084.40 Significance = .0000			

In survey research, factor analysis is typically used for data reduction to reduce a large number of statements to a few factors (Alt, 1990, p49). In exploratory research, the

procedure may be used to search for structure among a set of variables (Hair et al., 1995, p367). It may also be used to confirm the extent to which data meet the expected structure of the analyst. In this case it is expected that different types of business activity will necessitate different patterns in contact frequency. To assess the extent to which frequency of contact with overseas contacts affects international performance, overseas contacts which exhibited similar behaviour in terms of contact frequency were grouped by means of a common factor analysis. The results appear in Table 7.24, the factor analysis procedure and notes on its interpretation are discussed in Appendix 1. The three factors which resulted from the factor analysis were named 'research contact', 'trade contact' and 'professional associations'.

It is interesting that the first and most important factor consists almost entirely of research related contacts. This would tend to indicate that, as anticipated, research contacts share similar patterns of behaviour in terms of how frequently they are contacted by the sample firms. The second factor consists of trade related contacts and events which again share similar patterns of contact behaviour. The third factor consists of contact with organisations of which sample firms might be members. The third variable in this group 'chambers of commerce', has a very weak factor loading, indicating that the pattern of contact behaviour is not very similar to the other two variables loading on that factor.

Contact with Overseas Research Units and Events

From the three factor groupings, cumulative scales were produced and tested for reliability (see alpha reliability scores in Tables 7.25, 7.26, and 7.27). Inclusion of 'chambers of commerce' in the professional associations scale reduced the alpha score to unacceptable levels. That variable was therefore dropped from the cumulative scale. The three resulting scales were then entered into a Kruskal-Wallis 1-Way Analysis of Variance test to determine whether there was any difference in firm performance by the frequency of contact with each contact scale.

Results of the Kruskal-Wallis Anova indicate that *there is an association between the frequency of contact with research based overseas links and the number of export markets and international ratio* (Table 7.25). This suggests logically that frequency of overseas research contact is important in terms of both the intensity of international activity and the geographic spread of activity. This is another indication of the importance of R&D activities to the firms' overseas business activities. No relationship was found between frequency of contact with research based overseas links and either export growth or turnover growth suggesting that contact with overseas research based contacts may be independent of the firms' growth rates.

Table 7.25 Frequency of Contact with Overseas Research Units and Events by Firm Performance
(Kruskal-Wallis 1-Way Analysis of Variance)

	n	χ^2	df	Sig.
Number of Export Markets	168	30.02	3	.000*
Export Growth	141	4.46	2	.107
International Ratio	195	29.14	3	.000*
Turnover Growth	172	4.17	2	.125
Scale Reliability alpha = .8314		* = significant at $\leq .05$		
7 point scale from no contact to very frequent contact. Compound scale across variables includes: contact with university research departments, company/industry based research units, research colloquia, public research institutes and academic conferences. Scale constructed from factor groupings.				

While the number of export markets would demand a wider network of contacts and hence more effort on the part of the firm to keep in touch, the question asked about “frequency” of contact and not the ‘extent’ of contact. Taken together with the significant result from

international ratio, indications may be that frequent contact expands the scope of international expansion. It could be argued that frequent contact may lead to firm relationships and the opportunity of developing further leads from the first point of contact. Firm effort appears to be associated with the scope of international activity.

Trade Contacts and Events

Table 7.26 Frequency of Contact with Trade Contacts and Events by Firm Performance
(Kruskal-Wallis 1-Way Analysis of Variance)

	n	χ^2	df	Sig.
Number of Export Markets	175	65.24	3	.000*
Export Growth	145	17.43	2	.000*
International Ratio	202	53.65	3	.000*
Turnover Growth	180	3.79	2	.151
Scale Reliability alpha = .8401		* = significant at $\leq .05$		
7 point scale from no contact to very frequent contact. Compound scale across variables includes: contacts with customers, suppliers, distributors/agents and attendance at trade fairs. Scale constructed from factor groupings.				

The results reported in Table 7.26 indicate that *frequency of contact with trade contracts and events is associated with all performance indicators other than turnover growth*, with highly significant results. Indications here are that the firms’ efforts in making or

keeping contact with overseas trade-based links affect overseas performance and are associated with both the intensity and spread of international activities. Unfortunately, the Kruskal-Wallis test indicates only that there is an association between the two variables and not precisely where the relationship lies.

Contact with Professional Associations

Table 7.27 Frequency of Contact with Professional Associations by Firm Performance
(Kruskal-Wallis 1-Way Analysis of Variance)

	n	χ^2	df	Sig.
Number of Export Markets	168	16.51	3	.001*
Export Growth	140	.29	2	.865
International Ratio	195	11.37	3	.01*
Turnover Growth	173	.20	2	.906

Scale Reliability alpha = .7570 * = significant at $\leq .05$

7 point scale from no contact to very frequent contact.

Compound scale across variables includes: contact with trade and employers associations and professional associations.

Scale constructed from factor groupings.

Frequency of contact with trade and employers associations and professional associations was found to have a significant association with the number of export markets and the international ratio. No relationship was found with either export

growth or with turnover growth. *Again it is the intensity and spread of international activity which is associated with different levels of frequency of contact with overseas professional associations.*

Summary

It could be argued that the results in this section could be anticipated from common sense in that as overseas activity increases, so does the need for frequent contact with overseas organisations and events such as trade fairs. The analysis has revealed more than this logical assumption however.

Firstly, the factor analysis revealed three factors on which the types of contact loaded. The factors (Table 7.24) show very clear groupings of research-based contacts, and professional associations. This suggests that patterns of contact frequency vary by the type of activity involved. The variables loading on each factor are suggestive of a value chain configuration with distinct specialist or functional activities or motives taking place through cross-border contact.

Secondly, the first *Kruskal-Wallis anova* (Table 7.25) *associates differences in levels of cross-border R&D activity with international ratio and number of export markets.* This is an interesting association in that R&D contact is not necessarily income-generating, but international ratio is a measure of income from overseas and the number of export markets is clearly related to export sales. Although the association is strongly significant, the specific nature of the relationship and processes in the firm between R&D and international business is one which would support further investigation.

Thirdly, while frequency of contact with trade-related links could be expected to be associated with international performance indicators, it is worth pointing out that indirect modes of foreign market entry, often implicitly associated with small firms, require little if no contact between the firm and overseas based individuals and organisations. *The nature of the firms in this study suggests here that frequency of contact with trade links is indicative of effort on the part of the firms involved rather than simply a function of increasing international business itself.*

Overview of Chapter Results

This chapter has presented results which have characterised the firms in the sample, identified the types of cross-border links formed and examined their international growth and development. Analysis, which included cross-tabulation, Chi-squared tests of categorical data, correlation, Pearson correlation for ordinal data, factor-analysis and non-parametric tests of association between firm characteristics, link types, international growth and development indicators and product/market factors.

The analysis of results addressed the descriptive, or foundation questions of the research which ask *what is* the situation as regards the firms in the sample, and *what is* the connection, if any between the main sets of factors, i.e. the firm, its external links and its international growth and expansion. The following sections summarise the key issues from the findings.

Description: Firms and Links

The firms in the sample tended to be small and young with almost 90% having less than 50 employees and two thirds were less than 35 years old. Around a third of the sample emerged from other organisations and a similar proportion reported to not being wholly independent. The sample can be described as technology intensive as at least three quarters had investment or employees in R&D and a similar proportion had made applications for IPR protection for scientific or technological innovations.

In terms of respondent credibility, over 95% were directors of the firm, and over 80% had founding members remaining in the firm. Concentration of employment varied considerably across the sample and while all firms reported having employees in R&D, production and marketing and distribution, the proportion in each functional area varied. Interestingly, over a quarter of firms employed more than a fifth of their personnel in R&D.

Product attributes and market/industry factors also varied across the sample, with standard deviations ranging from 1.07 to 1.56, indicating good potential for comparison of firms on these factors.

Few founders were found to be foreign nationals, fluent in foreign languages or educated overseas. Half of the sample respondents however had overseas working experience. Contact with overseas organisations varied from 28% of firms with regards to chambers of commerce, and 85% in relation to overseas customers.

Structural development of the sample firms in terms of the establishment of an export department was low (17%) but development of R&D activities was high. Almost half of the sample indicated having a specific R&D department and over 60% had applied for IPR protection. Entrepreneurial/small firm ethos was thought to be high however, as most firms had remaining founder members.

Firms in the sample in general were performing well and over 80% reported positive growth rates of between 1 and 100% between 1991 and 1993. More than three quarters of exporters reported similar rates of export growth. Extent of internationalisation was assessed by the international turnover ratio and number of export markets. Again there was great variability across the sample with international ratio ranging from zero to 100% and export countries numbering from zero to over one hundred.

The sample firms demonstrated a wide range of cross-border link types which were reported (Table 7.11) on four dimensions: ownership equity links, inward links, outward links and formal cooperation agreements. Each of the latter three categories included R&D, production and marketing and distribution links. The links most common across the sample were trade links, but there was considerable evidence that the small, young firms in the sample were by no means restricted to trade links. Various R&D and production based links were reported by the sample, in both inward and outward directions. Foreign direct investment in overseas production was noticeably uncommon with only 5% of firms indicating that type of involvement.

Analysis: Firm Characteristics and Performance

Young firms were found to experience higher turnover growth than new or older firms and higher levels of turnover were found to be associated with international activity. This suggests that while size and age may not be important for international expansion, overall performance may well be. There was no evidence to suggest that firm size and

age might be associated with export growth although there was some indication that firm size was associated with international ratio and the number of export countries.

Technology is clearly an important factor in international expansion and R&D intensity was associated with the international ratio and number of export countries. Firms established to exploit a technological or scientific innovation exhibited higher levels of international ratio than those which did not.

Analysis: Firm Characteristics and Links

Some important indications emerged from this part of the analysis. Firstly, the size of firms (employees and turnover) seems to be important in determining whether or not firms import. Except for some association between turnover and agent/distributor export, size did not appear to be important for the determination of export links. From the perspective of the step/stage models of export development, more extensive association across the various export and import modes, with firm size variables could have been expected.

Of some importance is the absence of any association between link types of any kind, and firm age. Firm age/experience is a significant factor in the knowledge/commitment model of internationalisation. While there is no evidence here to suggest that age/experience affects market entry mode choice, indications are that firms are not precluded from any form of international activity purely on the basis of age.

Independence and foundation method have some association with import activities and contract-in manufacture, presumably through previous contacts. No other link type appeared to be influenced by these variables.

Firms involvement in technology is clearly an important factor in international expansion and R&D intensity was found to be associated with import activity and contract-in R&D. In the outward direction, R&D intensity was associated with agent/distributor export, licensing-out and contract-out R&D. There were also significant associations between the existence of an initial exploitable innovation and several types of outward internationalisation.

Analysis: Product/Market Factors and Growth/Development

Analysis found that firms reporting higher levels of technology experienced higher growth rates than those with lower levels of technology. Also, firms which were more innovative tend to experience higher growth rates than those which are less so. In terms of international growth and development, firms with high technology products

and processes, and those which were more technologically innovative tended to have higher international ratios. Firms with more complex products were also likely to be more dependent on international markets.

A finding of some importance was that firms facing higher levels of competition in the home market (number of UK substitutes) had lower international ratios than firms in less competitive markets. Far from being forced into export markets, these firms seemed to be concentrating their efforts on the home front.

Technological innovativeness and product complexity were associated with export growth and the number of export countries respectively. Competitive response such as customisation and standardisation were not found to be associated with any of the four measures of growth and development.

Analysis: Patterns of Contact

Factor analysis indicated three types of overseas contacts, research contacts, trade contacts and professional associations. Frequency of contact with research contacts was found to be associated with the number of export markets and the international ratio but not with either growth measure. Frequency of trade contacts was associated with all measures except turnover growth and frequency of contact with professional associations was associated with the number of export markets and international ratio. Discussion of the results suggested that firm effort and proactive management of overseas contacts is likely to be important for the international growth and development of the small technology based firm.

Overall, the results presented in this chapter provide a strong foundation and identify factors and points of discussion on the international expansion of small technology based firms. In order to develop beyond this towards explanation and a coherent pattern of international expansion, the next chapter takes a multivariate approach to the remaining research questions and builds a number of statistical models of the internationalisation process.

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Chapter 8

Results: Analysis of Cross-Border Activity

Chapter Objectives

- *To answer the major research questions developed in Chapter 5 which are:
 1. *Why does international expansion begin?*
 2. *How does international expansion begin and progress?*
 3. *Where do formal investment links come in the life of the firm and its stage of international expansion?*
 4. *How important are these activities to firm development and growth?**

- *To present the results of multivariate statistical models constructed in answer to the research questions.*

- *To discuss and interpret the results in relation to the thesis and conceptual framework developed from synthesis of the literature (Chapters 2-4) and the research conceptualisation (Chapter 5).*

Why Does International Expansion Begin?

Introduction

The previous chapter presented and discussed the descriptive results and analysed the international linkage activity of the sample firms. The results were analysed on a link by link basis by means of bivariate statistical techniques. This chapter develops the analysis further by analysing and interpreting the results on a firm by firm basis. The techniques employed are multivariate and the aim is to identify causal factors for specific types of link, and identify patterns in linkage formation, between firms and over time.

The chapter begins with an explanation of how the constructs for the analysis were developed and reviews the model building procedure. A brief guide to the interpretation of the models is given, followed by the resulting models and related discussion. Explanation of the mode of international expansion is sought through logistic regression models which determine the likelihood of an event occurring, given a set of determining or causal factors. The causal factors include the firm characteristics, product and market/industry factors, technology factors, management factors and growth indicators. The events are the cross-border links.

The cross-border links are merged into three value chain types: R&D, production, and marketing/distribution. Altogether, seven models are built which identify factors which *interactively* influence the probability of the firm establishing a specific link type. This section of the analysis concludes that international expansion is a holistic process for small high technology firms and is not necessarily export led. While value chain activities may be inseparable and equally influential in the formation of cross-border link types, there is also evidence that specialisation, resource-based considerations and entrepreneurial flair are important in the international expansion of firms.

The second part of the analysis in this chapter (How does internationalisation begin and progress?), is concerned with the sequential or chronological development of cross-border links. The techniques used in this section of the analysis include data manipulation utilising spreadsheets and manual and numeric coding. The first part of the analysis examines the average rate for link formation across the sample and provides a rank order of the average length of time taken for firms to establish each type of link. This is followed by a firm by firm analysis of patterns of link formation constructed on the specific dates on which links were first established and the types of link formed categorised by value chain activity, inward/outward direction, and contractual (external) versus integrated (internal) links. This analysis demonstrates the complexity of the

international expansion process whereby firms form simple or complex links and internationalise quickly or over a long period of time. While the results include some evidence to support the incremental export expansion models, this conventional process is confined to a few firms only.

The final part of the analysis in this chapter examines the evidence of internal (integrated) cross-border links and suggests that these might be linked to the growth and development of the firm itself. Evidence is sought from data relating to the structural development of the firm (formalisation), but limitations in the data render this part of the analysis inconclusive and very much a subject for future research.

Predicting Cross-Border Links: Multivariate Analysis

Objective and Technique

Univariate analysis (previous chapter) was used to identify association between individual firm characteristics and conditions, firm performance and specific types of cross-border link. The chapter reports on multivariate analysis which was carried out to determine whether groups of variables, taken together, were associated with cross-border links. There are a number of multivariate techniques which allow the effect of a number of independent variables on one or more dependent variables to be measured or ascertained. The technique selected depends on the type of data and the objective of the analysis (see Appendix 1).

The object here is to establish whether or not cross-border link types can be predicted from the firm, management and industry variables included in the survey, on a firm by firm basis. Logistic regression was selected as the most appropriate multivariate technique for this purpose, primarily because it predicts the probability of an event (cross-border link) occurring or not. In addition, logistic regression is a model building technique which can accommodate a range of data types as independent variables and a dichotomous dependent variable (see Appendix 1, for a full discussion).

Collapsing the Categories

Independent variables, firm characteristics, technology characteristics, product, business and market factors, personnel factors, link management and performance were retained in their original form (i.e. categorical, numeric etc.) in order to make full use of the information provided by the respondents. The dependent variables (types of cross-border links) were too many for effective analysis. It was therefore decided to construct fewer categories based on rational decisions and extant knowledge from previous research..

A number of issues were considered. Analysis of response indicated that few firms in the sample were involved in FDI, and as would be expected, there were a considerable number of firms involved in exporting and there was considerable inward activity. The traditional exporting, licensing and FDI categorisation of activities was not suitable for this analysis as it does not consider inward activity, not does it incorporate R&D activity other than in connection with licensing. Contractual modes of market entry other than export and licensing are seldom considered in the internationalisation debate, but even so, it is recognised that link types may be interdependent or blurred (see previous chapter). Export process models were rejected for the same reasons (see literature review).

It was decided to use a value chain approach to categorise the types of links. The categories were constructed as shown in Table 8.1. This approach is similar to that used by Luostarinen (1980) who grouped variables into marketing or production operations, further sub-divided into direct and non-direct investment (Luostarinen, 1980, pp108-109). Here no distinction is made around the investment/internalisation division, but distinction is made between inward and outward links which is consistent with Luostarinen's et al. (1994) later work on the internationalisation of Finnish firms.

Support for the value chain approach can also be found in Porter (1980, 1985, 1986) and Chesnais' (1988) study of cross-border technological cooperation. *Combining the types of cross-border activity in this way reduces the cross-border links to three categories, R&D, production and Marketing/distribution, in two directions, inward and outward. Formal cooperation which by nature is reciprocal is treated separately.*

Table 8.1 Cross-Border Links: Value Chain Configuration

Inward Links		
R & D	Production	Marketing & Distribution
<ul style="list-style-type: none"> contract-in R&D license-in tech from overseas-based firm 	<ul style="list-style-type: none"> technical service or consultancy performed in the UK for overseas based clients contract-in manufacture for overseas based firms 	<ul style="list-style-type: none"> import from overseas based supplier import with distribution in the UK management or marketing service or consultancy performed in the UK for overseas based clients
Outward Links		
R & D	Production	Marketing & Distribution
<ul style="list-style-type: none"> license-out technology to overseas based firm contract-out R&D to overseas based firm 	<ul style="list-style-type: none"> contract-out manufacture to overseas based firm technical service or consultancy performed overseas minority investment in overseas production majority investment in overseas production 	<ul style="list-style-type: none"> exporting through UK based intermediary exporting through foreign based agent/distributor exporting through overseas based sales representative or branch. management or marketing services or consultancy performed overseas
Formal Cooperation		
R & D	Production	Marketing & Distribution
<ul style="list-style-type: none"> technology sharing agreements 	<ul style="list-style-type: none"> non-equity joint production agreements 	<ul style="list-style-type: none"> distribution agreements with suppliers of complementary products.
<ul style="list-style-type: none"> comprehensive R&D manufacturing and marketing consortia 		

The frequencies of the establishment of each of these links is listed in the Table 8.2. (NB. frequency here refers to the first instance each type of link was established by firms and not the frequency of incidence of links).

	Inward			Outward			Formal Cooperation		
	f	%	n	f	%	n	f	%	n
R&D	64	30	210	35	17	209	15	7	209
Production	110	53	210	67	32	208	9	4	209
Marketing & Distribution	162	77	210	155	74	209	39	19	209
Comprehensive consortia							9	4	209

Exploring the Value Chain Links: t-tests

As a first step in looking for interaction between the independent variables and the value chain dependent variables, a series of t-tests were run. A total of 51 independent variables were available for inclusion in a planned logistic regression modelling procedure (see below). T-tests identified, in a very crude fashion, where there was interaction between any one of the independent variables and the dependent variables, i.e. value chain links. The procedure also indicated where there was no interaction and in such cases the independent variables may be eliminated early in the development of the regression model.

The t-test results were also examined for patterns across the dependent variables in order to determine whether inward links should be treated separately from outward links and whether formal cooperation (in which links are likely to be reciprocal) should be aggregated or merged with the composite inward/outward linkage activity. The rationale for merging inward and outward links by value chain activity was that they are often reciprocal in nature and there may be little difference in the factors (independent variables) associated with links in either direction. The alternative argument is that inward and outward links of the same value chain activity do not necessarily act either interdependently or simultaneously and different factors may influence inward as compared to outward activity. The pattern of t-test results (Appendix 8) appeared to support the latter argument, as the independent variables interacting with the value chain activities frequently gave different t-test results which distinguish quite well between value chain links when inward and outward links are separated (Appendix 8, first two columns). The distinction is blurred when inward and outward value chain links are aggregated (Appendix 8, 3rd main column) and even less distinct when formal cooperation is included with the aggregate in/out figures (not shown). *It was decided that while reducing the external links to the main value chain activities would alleviate the problems of small sub-sample size, and simplify the analysis and interpretation of the results, merging inward and outward links would be of little benefit and would potentially reduce the information available for interpretation.*

Logistic Regression: Building the Models

According to Norusis (1994a, p486) a good model should be parsimonious and easy to interpret. A number of models which fit the data reasonably well may be found and the selected model should satisfy the statistical conditions for good fit, but also substantive reasons or conditions. The more variables that are in the model, the closer to perfect the fit will be, but the more difficult it will become to determine which variables or groups of variables are interacting with the dependent variable such that reliable predictions of event occurrence can be made.

Variables can be automatically added or removed from a logistic regression model by a stepwise procedure based, inter alia, on the significance of the Wald statistic, or the likelihood ratio (LR) test which examines the change in log-likelihood of the model when each variable is added (backward) or deleted (forward). Automatic stepwise procedures have been criticised by Menard (1995) as based on decisions made by "computer algorithms, rather than choices made directly by the researcher", and by Studenmund and Cassidy (1987) who suggest that the use of automatic stepwise selection is "an admission of ignorance about the phenomenon being studied". In its favour, Agresti and Finlay (1986) and Hosmer and Lemeshow (1989) support its use in exploratory research. Wolford, Elliott and Menard (1994) demonstrate the use of stepwise variable selection in a study of domestic violence, justifying the use of the technique due to the lack of development of theory in the area and that their number of cases was small relative to the number of explanatory variables suggested in the literature.

As there is a theoretical grounding to the variables in this study, the procedure used here was based on interpretation of the statistics and substantive sense made of the data from the researcher's knowledge of the literature. Essentially, the explanatory variables were grouped into similar or related types: firm factors, technology, personnel, business, product/industry, link management and performance/growth indicators. These groups were applied to logistic regression using the forced entry method which includes all variables in one step (see Appendix 1, for further discussion). Variables with a very weak relationship with the dependent were eliminated and the rest included in the final models which were built in a series of stages (see Appendix 1 for details). Model building in each case was terminated when adding or deleting variables made no further improvement to the model.

Interpreting the Models

This is discussed fully in the appendix on the statistical procedures used in this thesis (Appendix 1). Logistic regression is a fairly new technique which has only been used since the early 1990s, and its use in internationalisation studies is not widespread. It is similar in its construction to multiple regression and variations of regression techniques but differs in the way it is interpreted. It is therefore useful to include a few points on interpretation here.

- a significant model χ^2 indicates that the variables in the model have good predictive ability,
- variables included in the models are those selected during the model building process as those most influential in predicting the event (cross-border value chain link),
- the probability of the event taking place for any individual firm in the sample can be predicted from the logistic regression equation. The logistic regression coefficients (Column B) multiplied by the values of the independent variables (selected predictors) for an individual firm form the main part of this equation,
- the importance of individual predictor variables in terms of the change in odds if the value of the predictor is increased, is given by the value and sign of the coefficient (B or $\exp(B)$), " - " indicates a decrease in the odds,
- the contribution of any one variable alone on the likelihood of the event occurring is given by the value and sign of its R value (-1 to +1).

Inward Cross-Border R&D Activity

Table 8.3 Logistic Regression: Inward R&D							
Independent Variables	B	S.E.	Wald	df	Sig	R	EXP(B)
R&D Department ^a	-1.0285	.3319	9.6051	1	.0019**	-.1690	.3576
Other firm IPR ^a	-.7592	.3558	4.5529	1	.0329*	-.0979	.4680
Foreign Languages ^a	-.1585	.3656	10.0431	1	.0015**	-.1738	.3140
Turnover	.1658	.1453	1.3012	1	.2540	.0000	1.1803
Concentration R&D	.0290	.0088	10.7859	1	.0010**	.1817	1.0294
Chambers of Commerce ^b	.6331	.2535	6.2383	1	.0125*	.1262	1.8834
n (cases)	192						
Initial -2LL	266.17						
Final -2LL	193.04						
Model χ^2	73.13***						
Goodness of fit	198.24						
Efficiency	77%						
*** Sig at $\leq .001$	^a dummy variable		df = 6				
** Sig. at $\leq .01$	(ref cat = 0).						
* Sig at $\leq .05$	^b frequency of contact						

$$\text{Prob (inward research)} = \frac{1}{1 + e^{-Z}}$$

$$\text{where } Z = [-1.03(\text{R\&D dept}) - .76(\text{other firm IPR}) - .16(\text{foreign languages}) + .16(\text{turnover}) + .03(\text{R\&D employment}) + .63(\text{frequency of contact with chambers of commerce})]$$

The dependent variable *inward R&D* includes contract-in R&D and licensing-in technology from overseas. The best model explaining inward R&D links (Table 8.3) contained only six variables, three of which were research related activities. The first, the presence of an R&D department was found to be negatively associated with the incidence of inward R&D links, which is somewhat counterintuitive as a firm with formal R&D facilities could be expected to be more likely to have inward cross-border R&D links than other firms. Considering the small size and relatively young age of firms in the sample however, this finding is consistent with the view that very young small firms with a limited resource-base will license-in technology to increase their capabilities and contract-in R&D work to earn revenue to support the growth and development of the firm. This interpretation is also consistent with the soft-start model of firm growth which suggests that small technology intensive firms may initially concentrate on a service, consultancy or R&D activity to support firm growth before "hardening" into manufacture.

Turnover, in the logistic regression model is positively associated with inward R&D links and an increase in turnover will result in an increase in the likelihood of the event

occurring. Turnover alone however is not significant and has a zero partial correlation, indicating that an increase in turnover taken in isolation would not trigger an inward R&D link without the other factors. Concentration of the firm's employment in R&D is also positively associated with inward research links which suggests that firms which specialise in R&D establish inward R&D links, as do those which are R&D intensive, but in the latter case these are more likely at early stages in the firm's development.

Involvement in innovation where another firm has applied for or received IPRs decreases the likelihood of inward R&D activity. While this again would seem to be counter-intuitive, the question asked of respondents was not confined to cross-border cooperation but included domestic arrangements. Where firms are involved in cooperative innovation in the domestic market, resource needs could be adequately met locally, precluding the need for cross-border activity.

Frequency of contact with overseas chambers of commerce is positively associated with inward R&D links and very much suggests a proactive search in overseas markets for technology and/or research contacts. Frequent contact with overseas chambers of commerce is also interesting in its association with inward R&D. It is likely these fora provide the opportunity for firms to identify R&D partners and trade links, important for later stages in the firm's development. The foreign language capability of the founder is negatively associated with the dependent variable, which is not readily explained since the implication is that firms with founders who are fluent in foreign languages are less likely to have inward R&D links with overseas based firms than those with no language capability.

The model has good predictive efficiency (77%), suggesting that specific combinations of factors identified in the logistic regression equation can together determine whether or not a firm will establish an inward R&D link with an overseas based firm. Individually, predictor variables in this model have very low partial correlations (R) and alone, are unlikely to influence the occurrence of the event.

Overall, the model supports the soft-start model of growth for technology intensive firms. Specialisation may also be a factor here, forcing firms to look overseas for very specialised technology. This cannot be stated with certainty as product/market factors including "specialisation" have not been included in the model. Questions relating to product/market factors have however been framed very much in the "tangible goods" context and would be less relevant to firms which are predominantly R&D specialists or service units.

Age and size are variables which have been excluded from the model, suggesting that resource needs, capability and specialisation are the major determining factors.

Outward Cross-Border R&D Activity

Independent Variables	B	S.E.	Wald	df	Sig	R	EXP(B)
Industry			5.6326	4	.2283	.0000	.2069
Industry (plastics) ^a	-1.5754	1.2029	1.7152	1	.1903	.0000	.2069
Industry (biotech) ^a	-1.0951	1.0877	1.0136	1	.3140	.0000	.3345
Industry (medinst) ^a	-1.9796	1.1974	2.7333	1	.0983	-.0594	.1381
Industry (electinst) ^a	-2.1290	.9488	5.0350	1	.0248*	-.1208	.1190
Firm size (employees)	.0206	.0114	3.2776	1	.0702	.0784	1.0208
Customisation (L/H)	-1.2275	.3605	11.5940	1	.0007***	-.2148	.2930
Industry Applications (L/H)	.3671	.2517	2.1268	1	.1447	.0247	1.4435
R&D Department ^a	-1.5680	.7825	4.0155	1	.0451*	-.0984	.2085
R&D (% Turnover)	.0376	.0205	3.3844	1	.0658	.0816	1.0383
Other firm IPR ^a	-3.4597	1.0628	10.5963	1	.0011**	-.2033	.0314
NTBF ^a	-1.6976	.8476	4.0114	1	.0452*	-.0984	.1831
Foreign nationals ^a	-1.7093	.9331	3.3558	1	.0670	-.0807	.1810
Overseas work Experience ^a	-1.5955	.8014	3.9633	1	.0465*	-.0972	.2028
Concentration R&D	.0634	.0279	5.1719	1	.0230*	.1235	1.0655
Concentration production	.0720	.0272	7.0101	1	.0081**	.1552	1.0747
Concentration mktg/dist.	.0672	.0296	5.1466	1	.0233*	.1230	1.0696
Other employment	.0565	.0304	3.4502	1	.0632	.0835	1.0582
Trade fairs ^b	-.9102	.5171	3.0979	1	.0784	-.0727	.4024
Customers ^b	1.3631	.6060	5.0586	1	.0245*	.1213	3.9082
Suppliers ^b	-.9555	.4591	4.3307	1	.0374*	-.1059	.3846
n (cases)	150						
Initial -2LL	207.94						
Final -2LL	75.26						
Model χ^2	132.69***						
Goodness of fit	193.86						
Efficiency	93%						
*** Sig at $\leq .001$	^a dummy variable		df = 20				
** Sig. at $\leq .01$	(ref cat = 0).						
* Sig at $\leq .05$	^b frequency of contact						

Outward R&D includes the licensing-out of technology to an overseas based firm and the contracting-out of R&D. Although both of these activities represent the transfer of technological activity to an overseas based firm, in other respects they are diametrically opposed. While licensing-out technology represents an inflow of funds, contract-out R&D represents the opposite. The ownership of proprietary technology in the former represents technological capacity, while the latter may indicate an absence of it or the

lack of resources or facilities to carry it out. Licensing-out technology is often undertaken by small firms which lack production or marketing capability, while firms which contract-out R&D may be large scale producers. The logistic regression model for outward R&D activity has a high predictive efficiency (93%) and contains a number of predictor variables of fairly strong negative or positive influence which to some extent reflects the different conditions under which each of the two discrete types of outward link would be made. Applied to any individual firm in the sample, the logistic regression equation becomes:

$$\text{Prob (outward research)} = \frac{1}{1 - e^{-Z}}$$

where Z = [-1.57(industry) +.02(number of employees) -1.23(level of customisation) +.37(level of industry applications) -1.57(R&D dept) +.04(R&D intensity) -3.46(other firm IPR) -1.7(NTBF) -1.71(foreign nationals) -1.59(overseas work exp) +.06(concentration R&D) +.07(concentration production) +.07(concentration mkg/dist) +.06(other empl) -.91 (frequency of contact with trade fairs) +1.36(frequency of contact with customers) -.95(frequency of contact with suppliers)]

In comparison to inward R&D links, a considerable number of variables were selected for the model for outward R&D links¹ (Table 8.4). Variables which have a positive effect on the likelihood of outward R&D taking place includes firm size in terms of number of employees. *An increase in the number of employees increases the likelihood of outward R&D activity.* Investment in R&D also increases the likelihood, which is contrary to the negative inclusion of "R&D department" in the same model. However, investment in R&D could very well relate to investment in external R&D rather than internal R&D, which would account for the outward R&D linkage activity. Establishment of an R&D department would reduce the need for access to external technology. An increase in concentration of employment in any of the functional areas listed will increase the odds of an outward R&D link taking place. *Intensity of business activities in general therefore would seem to be important rather than an increase in employment in any particular area.* Taken together with firm size, firm growth and development appear here to be proactively associated with outward R&D links. An increase in the level of industry applications increases the chances of outward R&D links taking place; widespread applicability of the firm's technology may therefore be a factor in opening up market opportunities for technology in other industries which the firm could not serve adequately through its own production capabilities. Licensing-out technology would, in the circumstances, provide a useful expansion route. Frequency

¹It should be noted that in building this model the variables "export growth" and "export value" were found to have a distorting effect on the data, which prevented a model from being built. The model was therefore built without these variables and "export department" and "international ratio" were retained as indicators of international performance.

of contact with customers also increases the chances of outward R&D links, but this is more likely to be an effect rather than a cause of the link.

A number of variables in the model have a negative effect on the likelihood of R&D links taking place. Membership of any of the specialised industries, plastics, biotechnology, medical instruments or electronic instruments would reduce the likelihood of outward R&D. Referring back to the previous chapter, a considerable number of firms in the sample claimed to belong to industries other than those listed, or no particular industry. Evidence here suggests that *membership of a specific, tightly defined industry reduces the firm's need for outward R&D links. Any increase in the firm's ability to customise its products/technology decreases the odds as does the presence of an R&D department. Consistently too, new technology based firms (those established to exploit an innovation) are less likely to seek cross-border R&D links.* The firm's predisposition to international activity, here represented by foreign founders and founders with overseas work experience, again reduces the likelihood of outward R&D, as does frequency of contact with overseas suppliers and trade fairs.

The pattern of results here is difficult to explain when viewed from the internationalisation or internalisation literature. While the former implicitly expects outward internationalisation to take place when firms have an international orientation, the opposite seems to be true in respect of outward R&D links going by the findings presented here. The latter approach suggests that increasing specialisation under specific circumstances will lead to international expansion and yet here, outward R&D links are less likely when the firm becomes more specialised in R&D or its industry, and where its marketing and customisation capabilities increase.

The pattern of results is much easier to explain when viewed from a small firms, resource-based approach to growth. Taking the positive selected variables first, outward cross-border R&D links are more likely to take place when firms are larger, have a greater number of applications for their technology, when they increase employment generally and with increasing contact with customers. *Overall this suggests that outward R&D is associated with generalised firms with no specific R&D capabilities, little in the way of overseas experience, but with widespread applicability of technology.* Outward R&D links therefore supply specific R&D capabilities and/or in the case of licensing-out, provide a relatively easy, arms-length means of expansion and of grasping foreign market opportunity.

The selected variables which have a negative effect on the model, taken together, suggest that *as firms increase their R&D capability, they have less need of outward R&D links*. The inclusion of "other firm IPR" as a negative influence corroborates this perspective since firms which have been involved in cooperative innovation in the UK are more likely to find their resource requirements satisfied through that type of relationship than those which have not. Firms with greater knowledge or experience of overseas business, or more contact with overseas suppliers are again less likely to become involved in outward R&D links.

Overall, the picture here suggests fairly strongly that outward R&D links are associated with the firm's capabilities and resource needs and are not a popular means of international expansion except for larger firms which can afford to contract out R&D but which may not have developed the production economies necessary to satisfy widespread international market opportunity, or the knowledge and experience to enter overseas markets more directly.

Amongst factors which have not been included in the model is "Application for IPRs". While pre-competitive R&D would not be associated with application for the protection of intellectual property rights, intuitively, licensing-out technology would. Studies elsewhere have suggested that small firms often do not register for IPRs or subsequently maintain their rights, and it could be expected that those involved in international business might be more inclined to do so. *Implications here are that R&D is largely pre-competitive, licensing-out involves predominantly standardised technology, and/or R&D relationships with overseas partners are close and trust-based.*

This particular model has a very good fit, is 93% efficient and is very significant. All selected variables in the model, with the exception of two industries, have a partial correlation with the dependent suggesting that each is of some individual as well as collective importance in determining the likelihood of outward R&D taking place.

Inward Cross-Border Production Activity

Table 8.5 Logistic Regression: Inward Production							
Independent Variables	B	S.E.	Wald	df	Sig	R	EXP(B)
Industry			10.0442	4	.0397*		
Industry (plastics) ^a	-1.3769	.7347	3.5125	1	.0609	-.0774	.2524
Industry (biotech) ^a	1.0253	.6255	2.6874	1	.1011	.0522	2.7880
Industry (medinst) ^a	-.3972	.5369	.5349	1	.4646	.0000	.6753
Industry (electinst) ^a	.3690	.5376	.4710	1	.4925	.0000	1.4463
Technology (L/H)	.3810	.2132	3.1942	1	.0739	.0688	1.4638
Innovation (L/H)	-.3714	.1769	4.4100	1	.0357*	-.0977	.6898
Software content (L/H)	-.5278	.1571	11.2847	1	.0008***	-.1918	.5899
Customisation (L/H)	.1420	.1234	1.3243	1	.2498	.0000	1.1526
UK Substitutes (L/H)	.3413	.1381	6.1107	1	.0134*	.1276	1.4068
Other firm IPR ^a	-1.7113	.4250	16.2123	1	.0001***	-.2373	.1806
Mode of foundation ^c	-.9562	.3924	5.9366	1	.0148*	-.1249	.3844
International ratio	.0162	.0077	4.4687	1	.0345*	.0989	1.0163
Customers ^b	.6011	.1914	9.8609	1	.0017**	.1765	1.8241
n (cases)	182						
Initial -2LL	252.31						
Final -2LL	183.50						
Model χ^2	68.81***						
Goodness of fit	171.58						
Efficiency	78%						
*** Sig. at $\leq .001$	^a dummy variable					^c dummy variable	
** Sig. at $\leq .01$	(ref cat = 0).					1 = new start	
* Sig. at $\leq .05$	^b frequency of contact					2 = evolved	
df = 13						(ref cat = 1).	

$$\text{Prob (inward production)} = \frac{1}{1 + e^{-Z}}$$

where Z = [-1.38(industry) + .38(level of technology) - .37(level of innovation) - .53(level of software) + .14(level of custom) + .34(level of UK substitutes) - 1.71(other firm IPR) - .96(mode of foundation) + .02(international ratio) + .60(freq. of contact with customers)]

The dependent variable *inward production* includes UK based technical consultancy and contract-in manufacture. Variables included in the logistic regression model for inward production links include industry, product and market factors, mode of foundation and the firm's international turnover ratio (Table 8.5). Taking the positive influences first, firms in the biotechnology and electronic instruments sectors are more likely to form inward production links than those in plastics and composites and advanced medical instruments. *Firms which considered themselves to be high technology and which*

claimed to customise products to customer specifications were also more likely to establish inward production links. An increase in any of the above mentioned variables is likely to result in a substantial increase in the odds of that event taking place. As frequency of contact with overseas customers and international turnover ratio increase, so does the likelihood of inward production though these variables are probably effects of the link rather than direct causes, especially since other variables associated with firm size and performance have not been included in the model.

Variables with a negative influence on the model include firm innovation and product software content, an increase in either of which reduces the likelihood of inward production. *Surprisingly, firms which have evolved from other organisations are less likely to have inward production links than those which are completely new starts.* While links with previous organisations would be expected to be retained, it appears that it is new firms which attract inward production. Firms which have cooperated with another firm, but where the other firm made application for IPRs, are again less likely to form an inward cross-border link related to production than firms which have not had that experience.

Overall, the picture presented here suggests that firms involved in inward production are most likely to be sub-contract manufacturers producing fairly standardised high technology, customised to customer specifications, but with little innovative or intellectual input from the firm itself. This view is supported by the level of UK substitutes, an increase in which represents an increase in the likelihood of inward production links taking place. This suggests a relatively well developed industry with relatively standardised technology and small firms serving well defined niches in a competitive market.

The absence of any variables associated with age, size or growth of the firm suggests relative stability and, at least within the characteristics of this sample (firms between 1 and 200 employees) *there is no evident discrimination between firms based on size, age or development stage in their propensity to form inward production links.* The model in general is strong, with good predictive efficiency (78%), including several variables with particularly strong significance. The partial correlation of the industry and customisation variables (column R) indicate that while those variables are of little individual importance in predicting the dependent, they are important in combination with the other selected variables, rather, it is not the industry itself, but the particular circumstances within the industry which is important in relation to the inward internationalisation of small, high technology firms.

Outward Cross-Border Production Activity

Table 8.6 Logistic Regression: Outward Production							
Independent Variables	B	S.E.	Wald	df	Sig	R	EXP(B)
Export Department ^a	1.5400	.7959	3.7438	1	.0530*	.1079	4.6646
Export value	.0022	.0006	12.3391	1	.0004***	.2628	1.0022
Export Growth	.0224	.0105	4.4953	1	.0340*	.1291	1.0226
Turnover Growth	-.0567	.0224	6.4300	1	.0112*	-.1720	.9448
Industry			11.3632	4	.0228*	.1499	
Industry (plastics) ^a	-2.0251	1.7638	1.3182	1	.2509	.0000	.1320
Industry (biotech) ^a	1.2732	.9348	1.8551	1	.1732	.0000	3.5723
Industry (medinst) ^a	-1.3512	.8186	2.7243	1	.0988	-.0696	.2589
Industry (electinst) ^a	1.0320	.7717	1.7882	1	.1811	.0000	2.8066
R&D (% Turnover)	.0135	.0156	.7466	1	.3876	.0000	1.0136
Other firm IPR ^a	-.8639	.6478	1.7788	1	.1823	.0000	.4215
Year of foundation	-.0204	.0115	3.1736	1	.0748	-.0885	.9798
Foreign Languages ^a	-.6102	.7370	.6856	1	.4077	.0000	.5432
Educated Overseas ^a	.5423	.7937	.4669	1	.4944	.0000	1.7200
Overseas work Experience ^a	-.8961	.6176	2.1049	1	.1468	-.0265	.4082
n (cases)	108						
Initial -2LL	149.72						
Final -2LL	86.71						
Model χ^2	63.01***						
Goodness of fit	85.50						
Efficiency	80%						
*** Sig at $\leq .001$	a dummy variable	df = 14					
** Sig. at $\leq .01$	(ref cat = 0).						
* Sig at $\leq .05$	b frequency of contact						

$$\text{Prob (outward production)} = \frac{1}{1 - e^{-Z}}$$

where Z = [-1.54(export department) + .00(export value) + .02(export growth) - .06(turnover growth) - 2.03(industry) + .01(R&D turnover) - .86(other firm IPR) - .02(year of foundation) - .61(foreign languages) + .54(overseas education) - .9(overseas work experience)]

The dependent variable *outward production* includes investment in overseas production, contract-out manufacture and overseas-based technical service and consultancy. *The most important variables in the outward production model are those related to the firm's export performance, development and growth and R&D intensity (Table 8.6).* All of those variables are positively associated with outward production links and an increase in any or all of those variables will result in an increase in the odds of outward production taking place. The very strong association of export activity with outward production is consistent with studies suggesting that firms progress from exporting

through to overseas production. However, results here tend to refute that linear development (see discussion of event analysis later in the chapter). In this study outward production links were found to be preceded by export links in most cases, and in this study too, outward production is more loosely defined to include production related consultancy and services and contract-out production (essentially a supply activity). Traditionally, outward production is treated more narrowly as "investment" in overseas production with the emphasis on the integration of the value chain rather than the management of external sources and channels. *The strong link between export and production here suggests that these two activities are mutually supportive, if not dependent.* Which is the cause and which the effect however, and which precedes the other is very much a chicken and egg argument and one specific to the needs and circumstances of individual firms.

As export department, export growth and export value are included in the model, it is suggested strongly that firm growth and development are the main underlying issues. Firms in a steady and stable state in their fundamental activities and in their core industry and market are likely to be those which can support cross-border expansion in production activities. There is no real evidence to suggest that such a state is related to either the age of the firm, or its length of time developing in the domestic market. *Firm size, measured either by turnover or number of employees are variables which have not been included in the model and age is non-significant with a small partial effect.* Implications are that older firms are marginally more likely to form outward production links, but the effect of age is not pronounced and as an individual predictor, has little effect on the odds. Building on that argument, turnover growth is negatively associated with outward production. As smaller younger firms tend to have faster growth rates than longer established larger firms, the negative association of the firm's date of foundation is explained, i.e. outward production is more likely to take place as firms become older. *Importantly though, outward production is associated not so much with firm age or size, but with the development and performance of its export activities.* Interesting here is that the number of exporting countries is a variable which has not been included in the model. By induction, the spread or concentration of a firm's export activities has little effect on whether or not it establishes outward production links. The inclusion of country location variables in the model would add depth to the latter argument, but the associated analysis is beyond the scope of this thesis and will be followed up for subsequent publication.

In common with inward R&D links, membership of the biotechnology and electronic instruments industries is more likely to lead to outward production links taking place

than membership of the plastics or medical instruments sectors. Implications are that the former industry sectors are much more internationalised than the others, equally, the industries themselves could be further developed with relatively standardised production and established industry structures.

The last three variables, the presence of founders with foreign language capability, and overseas work experience have a negative effect on the model, which cannot easily be explained. The actual questions asked refer to the founders themselves and are not concerned with overseas experience, education or language capability of other members of the firm. The results indicate that the predisposition of founders to overseas links has no bearing on outward production but, returning to the frequency of response to the individual questions here, the number of cases is very small. A similar picture emerges in the case of overseas education and therefore the results of these three variables cannot be interpreted with certainty. In the case of foreign languages and overseas education, the Wald statistic is very low and non-significant and should be interpreted with caution. Removal of these variables from the model did not improve the model fit or its predictive efficiency and therefore they have been retained. It is likely that with a larger sample, these variables would in fact be of some importance in the prediction of outward production, a positive rather than a negative influence could be expected.

R&D intensity is important here and firms which invest more in research and development are more likely to establish outward production links than those which make little or no investment. In the case of the high technology firms in the sample, R&D is an important activity integral to the firm's core business. R&D activity has been found elsewhere however to be associated with competitiveness in both domestic and export markets and is associated with firms which are generally innovative, proactive and growth oriented.

Firms which have cooperated with another on an innovation for which they have not themselves applied for IPR protection are again less likely to form outward production links, although in this model the variable has no individual influence (partial correlation) on the likelihood of the event occurring. Accurate interpretation is difficult since the question, as mentioned above, does not ask for a distinction between domestic and cross-border cooperation. However, as the firms in question have not applied for IPRs themselves, it is likely that their role in the cooperation was minor (e.g. working with a supplier on the latter's project), or the experience was negative and the firm's position weak. Informal interviews conducted by the researcher at a DTI convention for technology based small firms indicated that intellectual property is a sore point for many

small firms involved in cooperation projects, especially where ownership of resulting technology was not established at the outset of the agreement. By implication, such problems may be more serious in informal cooperations, or projects evolving gradually or set-up on an ad-hoc basis.

No product, market or industry factors have been included in the model and there is no evidence that specialisation or otherwise is of any importance here. Level of competition in the UK market, equally, is not part of the model. From the evidence here therefore, it would seem that outward production links are less of a reactive response to domestic market conditions, but are associated with a general intensification of outward overseas activities of the firm. Specific reference to firm capabilities and competencies is not made, but the importance of export success factors would take such competencies as implicitly assumed.

Generally, the model is of good fit and predictive efficiency, although the true value of the last three variables is in doubt. The most important factors are associated with export development and growth. Firm age, industry and investment in R&D are of importance, but individually have little impact on the odds for outward production.

Inward Cross-Border Marketing Activity

Table 8.7 Logistic Regression: Inward Marketing							
Independent Variables	B	S.E.	Wald	df	Sig	R	EXP(B)
Software content (L/H)	.3097	.1766	3.0761	1	.0795*	.0660	1.3630
Product Complexity (L/H)	.2849	.1929	2.1805	1	.1398	.0270	1.3296
Industry Applications (L/H)	-.4830	.1435	11.3258	1	.0008***	-.1944	.6169
UK Substitutes (L/H)	.3480	.1443	5.8144	1	.0159*	.1243	1.4162
Other firm IPR ^a	-.9570	.4535	4.4541	1	.0348*	-.0997	.3840
University Research Depts. ^b	-.7042	.2599	7.3419	1	.0067**	-.1471	.4945
Trade Fairs ^b	.5857	.2767	4.4807	1	.0343*	.1003	1.7962
Distributors/Agents ^b	.5571	.2168	6.604	1	.0102*	.1366	1.7455
n (cases)	178						
Initial -2LL	246.76						
Final -2LL	144.89						
Model χ^2	101.87***						
Goodness of fit	184.52						
Efficiency	82%						
*** Sig at $\leq .001$	a dummy variable	df = 8					
** Sig. at $\leq .01$	(ref cat = 0).						
* Sig at $\leq .05$	b frequency of contact						

$$\text{Prob (inward marketing)} = \frac{1}{1 - e^{-Z}}$$

where Z = [- .31(level of software content) + .28(level of product complexity) - .48(level of industry applications) + .35(level of UK substitutes) - .96(other firm IPR) - .70(freq. of contact university research depts) + .58(freq. of contact with trade fairs) + .56(freq. of contact with distributors/agents)]

The dependent variable *inward marketing* includes importing, importing with UK distribution and UK based marketing service/consultancy. Eight variables are included in the inward marketing logistic regression model,² (Table 8.7). Product market characteristics are strongly reflected in this model for inward marketing. Taking the variables with a positive impact on the likelihood of inward marketing links occurring, two product characteristics are important to the model. *An increase in the level of software content and an increase in the level of product complexity will have the effect of increasing the chances of inward marketing taking place.* This would suggest that the more complex the product and the higher its intellectual content, the more likely is the firm to import. By inference, what may be imported is specialised components, material or know-how from overseas. *The competitive state of the domestic market is*

² Comment as previous footnote

also a factor and as the level of UK substitutes increases, so does the likelihood of inward marketing links. Taken together with the two variables already discussed, the most likely explanation is a need for product differentiation.

One aspect which is more difficult to explain is import activities with UK distribution. Intuitively, this activity would be associated with higher levels of industry applications and hence market opportunity. Drawing on the small firm literature here for interpretation, it is more likely that the small firms in the sample are supplying niche markets, an interpretation which would fit the other product factors in the model which point to an increase in the likelihood of inward marketing activity where products are complex, with high intellectual content and most likely highly differentiated.

Frequency of contact with trade fairs and distributors/agents are also significant factors and as frequency of contact increases, so does the likelihood of inward marketing. Contact with suppliers does not feature in this model, which is surprising considering that it is predominantly import activity which is taking place here. As the firms in the sample are very small however, it is likely that imports are of small quantities or made on an ad-hoc basis. To some extent this would explain the intermediary role of foreign-based agents and distributors. Another feasible explanation is that inward and outward marketing activities are somewhat reciprocal, at least to the extent that channels may be common to both activities. This interpretation is supported by the finding reported above, that early internationalisation activity often involves both inward and outward links during the same value activity stage. This argument is not supported by the outward marketing model reported below.

Three variables have a negative impact on the chances of inward marketing taking place. Firstly, an increase in industry applications in the UK market for the firms product or technology decreases the likelihood of inward marketing. *Expressed another way, firms with products or technologies with more general applicability are less likely to import than those with a narrow range of product/technology applications.* The model accommodates predictions for firms with specialised, complex and specific products and those with more general applicability. *Secondly, contact with university research departments reduces the likelihood of inward marketing links and might suggest that component/technology needs are being satisfied through R&D arrangements.* As the university R&D units in question are based overseas, it is also likely that firms with this type of contact are themselves specialised R&D firms. Thirdly, cooperative innovation with another firm where the latter made application for IPRs is again

important and significant in this model, and again has a negative effect on the chances of marketing related inward cross-border links being made.

Overall, this is a strong model with good predictive efficiency and good fit. All selected variables bar one are highly significant and each has some individual as well as collective influence on the odds concerning the predictability of inward cross-border marketing.

Outward Cross-Border Marketing Activity

Independent Variables	B	S.E.	Wald	df	Sig	R	EXP(B)
Turnover Growth	-.0058	.0052	1.2602	1	.2616	.0000	.9942
Industry			7.0555	4	.1330	.0000	
Industry (plastics) ^a	.0758	1.0105	.0056	1	.9402	.0000	1.0788
Industry (biotech) ^a	2.5796	1.2687	4.1341	1	.0420*	.0984	13.1912
Industry (medinst) ^a	-1.7171	1.0753	2.5496	1	.1103	-.0499	.1796
Industry (electinst) ^a	-.7443	.8712	.7299	1	.3929	.0000	.4751
Year of foundation	-.0465	.0155	8.9938	1	.0027**	-.1781	.9546
Foreign nationals ^a	1.4280	1.0355	1.9019	1	.1679	.0000	4.1705
International ratio	.0418	.0163	6.5892	1	.0103*	.1443	1.0427
Concentration production	.0210	.0113	3.4368	1	.0638	.0807	1.0213
Professional Associations ^b	-1.0305	.5119	4.0522	1	.0441*	-.0965	.3568
University Research Depts ^b	-.9338	.5128	3.3164	1	.0686	-.0773	.3930
Customers ^b	2.6044	.6830	14.5384	1	.0001***	.2385	13.5231
Suppliers ^b	-2.1445	.6843	9.8202	1	.0017**	-.1884	.1171
Distributors/agents ^b	1.8935	.5826	10.5644	1	.0012**	.1971	6.6426
n (cases)	159						
Initial -2LL	220.42						
Final -2LL	70.64						
Model χ^2	149.78***						
Goodness of fit	89.94						
Efficiency	90%						
*** Sig at $\leq .001$		^a dummy variable		df = 14			
** Sig. at $\leq .01$		(ref cat = 0).					
* Sig at $\leq .05$		^b frequency of contact					

The dependent variable *outward marketing* includes UK based export, foreign agent/distributor export, integrated export and marketing service/consultancy overseas.

$$\text{Prob (outward marketing)} = \frac{1}{1 - e^{-Z}}$$

where Z = [-.01(turnover growth) +.07(industry)-.05(year of foundation) + 1.43(foreign nationals) +.04(international ratio) +.02(concentration production) + -1.03(freq. of contact with prof. associations) -.93(freq. of contact with university research depts) +2.60(frequency of contact with customers) -2.14(freq. of contact with suppliers) +1.89(freq. of contact with agents/distributors)]

Eleven variables have been included in the logistic regression model for outward marketing,³ (Table 8.8). A number of variables included in the model are positively associated with the likelihood of the event taking place. Membership of either of two industry sectors, plastics and biotechnology will increase the likelihood of outward marketing taking place. While membership of the plastics sector has no partial correlation to the event and therefore membership alone has no predictive ability, membership of the biotechnology industry is significant, has a relatively small partial contribution to the model, but has a very pronounced effect on the chances of outward marketing taking place (column Exp(B)). *Indications here are that firms in the biotechnology industry are more involved in export activity than are those in the other high technology sectors included in this survey.* Membership of either electronic instruments or medical instruments sectors renders firms less likely to be involved in outward marketing activity, but in either case there is little partial contribution and the effect on the odds is not particularly pronounced.

Firms with founders who are foreign nationals are more likely to be involved in outward marketing, but this factor alone is not a particularly good predictor. Surprisingly, founders with foreign language capability, overseas work experience or education are variables which have not been included in this model. Tentatively, a deep rooted predisposition towards overseas markets may be more important here than language capability or experiential learning. Additionally, predisposition of founding members may be less important than the same values amongst firm members overall. This is however tentative and remains an issue for future research.

An increase in concentration on production activities increases the chances of outward marketing links taking place. This supports the point made earlier that production and exporting are mutually supportive, if not mutually dependent, for small firms bearing in mind that the dependent variable in the outward production model included contract-out manufacture, while here the independent variable includes only in-house production

³ Comment as previous footnote.

since it is measured by the proportion of employees in that function in the firm. *An increase in the firm's international turnover ratio increases the chances of outward marketing links taking place.* While this variable is likely to be an effect rather than a cause of the link, it is worth considering that it is a measure of the proportionate value of the firm's income from overseas to its total income, including all overseas activities as well as exports sales. The extent to which the measure reflects a general increase in the firm's overseas activity compared to export alone cannot be determined here. Export performance variables had to be removed from the model as their inclusion distorted the data and prevented a model from being built.

Frequency of contact with customers and distributors/agents are positively and significantly associated with outward marketing links and any increase in frequency of contact has a very strong positive effect on the likelihood of outward marketing taking place. While contact with customers and distributors/agents is clearly an effect rather than a cause here, what comes over very clearly from the model is that maintenance of the links is extremely important if commercially viable links are to be made and retained. Firms which make more efforts in terms of keeping contact with overseas buyers and intermediaries are those which are more likely to export or become involved in overseas marketing and distribution activities.

Several factors have a negative effect on whether or not the firm will become involved in outward overseas marketing activity. The first is turnover growth which indicates that higher growth rates are less likely to be associated with exporting activity. There are three main issues here, the first as discussed above relates to the association of high growth rates with smaller and younger firms and together with the negative association of foundation date, *indications are that very new firms are less likely to establish outward marketing links.* The second is that firms undergoing an intensive growth period may be concentrating on the overall performance of the firm rather than a narrow range of activity such as international sales, but, the third is that "growth rate" as measured here, as a percentage increase in turnover over a three year period is an inadequate discriminator between firms of different sizes, ages and stages of development. Taken in the basest sense the measure differentiates between firms which are experiencing growth and those which are not. *Firms with lower growth rates therefore are the ones which are most likely to establish outward marketing links.* Although there is evidence in the export literature to support such reactive motivations for international expansion, the researcher rejects that interpretation due to doubts about the adequacy of the measure, and the fact that that interpretation would be at odds with other findings reported here.

Contact with professional associations and university research departments are negatively associated with outward marketing. The nature of the firms in the sample suggests that *firms which are R&D specialists or concentrating on pre-competitive R&D are unlikely to have overseas links which are solely concerned with marketing*. The final variable with a negative association is contact with suppliers. As contact with suppliers increases, the chances of outward marketing taking place diminish. Indications are that exporting firms do not necessarily import. To some extent this is surprising as it is contrary to the interpretation of reciprocal in-out sales contacts from the inward marketing model. Taking a resource/competence base view however, the apparent paradox is to some extent explained. The inward marketing model emphasises highly specialised firms as those importing from abroad. In the outward model, there is no indication of specialisation or of firms attempting to meet specialised resource needs other than firm growth per se. This would explain an absence of contact with overseas suppliers, but the negative association, without further investigation, defies further explanation.

The outward marketing model is of good fit and predictive ability but is more difficult to interpret than the other models presented. *The main variables included are industry, growth, age and frequency of contact with overseas links, none of which give any real explanation of why outward marketing and distribution links take place*. Of importance here is that the independent variables, i.e. firm, product, industry, founder and management characteristics, are all concerned with the firm's basic characteristics and its role and competitive stance in the domestic market. Few of these factors, and none relating to specialisation, competence or size, have been included in the model and it is worthwhile considering explanations for their deletion during the model building process. *Overall, it would seem that domestic factors are of little importance in the establishment of outward marketing links*. The inclusion of two industries as strong positive predictors in the model could indicate that the industries themselves are global or international in nature and the sample firms are responding to opportunities presented by the market. *Success, in terms of the establishment of export related links would appear, from evidence presented here, to be associated with an international predisposition (foreign nationals), sustainable output (concentration on production) and effort (contact with customers and distributors/agents)*. Somewhat surprisingly, contact with trade fairs does not feature in this model, neither do any product or marketing factors.

Generally, the model is disappointing. The process of combining variables into inward and outward value chain links has masked any differences in factors associated with different forms of exporting, and especially between external and integrated export channels. Future further analysis and replication of the technique with a larger sample or a sample confined to exporting firms would provide the opportunity to disaggregate export categories.

Formal Cross-Border Cooperation

Independent Variables	B	S.E.	Wald	df	Sig	R	EXP(B)
Export Department ^a	-1.6421	.6307	6.7792	1	.0092**	-.1731	.1936
Export Growth	.0049	.0036	1.8676	1	.1717	.0000	1.0049
Industry			8.6446	4	.0706	.0636	
Industry (plastics) ^a	.9351	1.0885	.7380	1	.3903	.0000	2.5474
Industry (biotech) ^a	1.5765	.9940	2.5156	1	.1127	.0569	4.8380
Industry (medinst) ^a	-1.0751	.8828	1.4830	1	.2233	.0000	.3413
Industry (electinst) ^a	1.2754	.8411	2.2995	1	.1294	.0433	3.5803
Customisation (L/H)	-.5875	.2097	7.8501	1	.0051**	-.1916	.5557
UK Substitutes (L/H)	.2764	.2225	1.5426	1	.2142	.0000	1.3184
R&D (% Turnover)	.0332	.0321	1.0679	1	.3014	.0000	1.0337
Year of foundation	.0219	.0145	2.2857	1	.1306	.0423	1.0222
Application for IPRs ^a	-2.0761	.7478	7.7068	1	.0055**	-.1892	.1254
International ratio	.0356	.0117	9.2488	1	.0024**	.2132	1.0362
Concentration R&D	-.0849	.0369	5.3021	1	.0213*	-.1439	.9186
Concentration production	-.0218	.0134	2.6556	1	.1032	-.0641	.9784
n (cases)	115						
Initial -2LL	159.42						
Final -2LL	89.99						
Model χ^2	69.43***						
Goodness of fit	99.3						
Efficiency	85%						
*** Sig at $\leq .001$		^a dummy variable		df = 14			
** Sig. at $\leq .01$		(ref cat = 0).					
* Sig at $\leq .05$		^b frequency of contact					

The dependent variable *formal cooperation* includes general cooperation agreements as well as those specific to R&D cooperation projects, technology sharing agreements and distribution agreements (Table 8.9).

$$\text{Prob (formal cooperation)} = \frac{1}{1 - e^{-Z}}$$

where Z = [- 1.64(export department) + .01(export growth) +.93(industry) -.59(level of customisation) +.28(level of UK Substitutes) +.03(R&D % turnover) +.02(year of foundation)

-2.08(application for IPRs) +.03(international ratio) -.08(concentration R&D)
-.02(concentration production)]

It could therefore be expected that technology factors, product/market factors and export factors would be included in the model and that like the outward marketing model, might be disappointing in its ability to select good predictors. The expected mix of variables is included in the model but the results here are in fact quite informative.

Taking the positive variables first, *an increase in the firm's international ratio will result in an increase in the odds for formal cooperation.* This could be either a cause or an effect of the cooperation, but either way it is very significant. *Added to this, an increase in export growth will also result in an increase in the odds for formal cross-border cooperation.* The partial correlation for export growth suggests that this variable has no individual contribution to make to the model and concerns about the adequacy of the growth measures remain. Intuitively, formal cooperation activity with international partners could be expected to lead to a sudden or rapid increase in exports through contacts made through the course of the arrangement. Evidence however is not reliable, especially as the Wald statistic is low and non-significant.

Membership of any of the three industries, plastics, biotechnology and advanced electronic instruments increases the odds of formal cooperation taking place quite substantially. The plastics industry however has no individual relationship with the dependent. Formal cooperation would seem to be endemic to biotechnology and electronic instruments, but the advanced medical instruments sector reduces the likelihood for formal cooperation if firms are members.

An increase in the level of UK substitutes increases the chances of formal cooperation taking place but only in combination with other factors. As all types of cooperation are included here, the motivations could be vested in a need to develop new products or technology, a need for effective distribution into foreign markets, or production and technology sharing needs. *General reasons overall, from evidence here, are likely to be needs based and associated with market expansion or specialisation and concentration on specific value chain activities.*

The year of foundation is positively associated with involvement in formal cooperation, hence younger firms are more likely to be involved in this type of cross-border arrangement than are older firms. However, most formal cooperation links in this sample have been established during the five to ten year period prior to the survey. This period reflects the recession years of the late 1980s early 1990s. This period was also

one of tremendous reorganisation of industrial activity at global level. Down-sizing, restructuring and concentration on core activities by large MNEs, together with the technology race resulted, inter alia in the contracting out of peripheral activities, and the emergence of numerous and various cooperative arrangements. Such trends, competitive pressures, resource constraints and pressures from regional and national technology initiatives are some of the background issues which have induced small firms to seek collaborations or to compete through "flexible specialisation". While these issues have been discussed in previous chapters, it is worth reiterating the issues here in relation to the results of the cooperation model. A very tiny proportion of firms in this sample had received EU funding for cooperative projects. However another issue is the emergence of "relay centres", enterprise and consultancy initiatives which put considerable emphasis on "partner search" and networking activities during this period and cross-border cooperation was overtly encouraged. *While the underlying motivations for cooperation may be resource-based, the changing competitive structure of industry at international as well as local level is an important issue here.*

An increase in R&D intensity (% turnover investment in R&D) is associated with an increase in the likelihood of formal cross-border cooperation. Turning to the negative factors, an increase in concentration of employment in R&D activity has the opposite effect and is associated with a decrease in the odds for formal cooperation taking place. The ability of the model building technique to differentiate between the effects of those two variables, which both measure R&D intensity is remarkable. *Interpretation is important and the most likely explanation is that firms which invest in external R&D (in this case through formal cooperation) are less likely to have invested in in-house R&D (employment of R&D personnel) and vice versa.*

Application for IPRs is highly significant and also a negative influence on the odds for formal cooperation. Firms which have made no application for IPRs are more likely to become involved in formal cooperation agreements than those which do not. Explanation is likely to lie in the specific type of cooperative agreement but generally, if the agreement is concerned with the development of product or process technology, the result could be explained by pre-competitive R&D. In view of the small nature of firms in the sample, involvement is more likely to reflect a lack of proprietary technology and the need to develop it. The inclusion of distribution agreements as part of formal cooperation however clouds the issue and application of the logistic regression equation to specific cases would be useful here. In the case of firms which have established distribution agreements, the negative association of IPR applications might be indicative of standard and uncustomised technology/products and the model in fact indicates that

higher levels of customisation decrease the odds. *An alternative view is that formal cooperation precludes the need for IPR protection since, at least in the case of distribution agreements, the external market is eliminated.*

The final variable with a negative association, "concentration on production", together with the previously discussed "concentration on R&D" decreases the likelihood of formal cooperation agreements taking place. *Again the explanation might lie in the internalisation/externalisation decision alternatively expressed as the in-house development versus contract out development where formal cooperation provides the means of partially internalising part of the value chain while leaving other activities open to the external market (Casson, 1992, see also Chapter 4).* Resource needs are therefore met without (in the case of the smaller firm) unrealistic investment or loss of autonomy.

Overall, the model has a very strong and significant chi-square and a predictive efficiency of 85%. While interpretation of the model relies heavily on the researchers knowledge of the sample firms and literature pertinent to cooperation and small technology based firms, the variables included in the model, when applied to any individual firm would be more clearly interpretable. The results are very interesting and merit further investigation in a follow-up study.

Summary

The logistic regression models have served three main purposes:

1. Identification of factors which interactively and collectively are important to and associated with the establishment of cross-border links by value chain activity.
2. Selection of factors which collectively are most important in the establishment of each type of value chain activity.
3. Estimation of the probability of a cross-border link occurring from a list of factors which, in the literature, have been associated with firm development and growth.

Bivariate analysis of key characteristics with types of cross-border link identified association between individual characteristics and the establishment of specifically defined links.

Firm size was found to be of particular importance in importing of all types and overseas manufacture. Multivariate analysis however indicated that *size alone* was not especially important in determining whether or not a firm would form cross-border links except in the case of inward and outward research links. *Age was not found to be a significant factor with any type of cross-border link when examined through bivariate analysis, but was in fact important in multivariate analysis for outward production links and outward marketing links where longer established firms were found to have been more likely to form such links.* The opposite was true with formal cooperation where more recently established firms were more likely to be involved in that type of activity.

While firm age, size, industry and turnover have not been found to be individually important, together these factors can be considered to be causal or influencing factors in the international expansion of small firms. The extent to which a firm is limited in its expansion by small size, or young age may be very much dependent on its role in industry, its links with other industry members, especially MNEs, and industry stage of development. *While firm age, in terms of experience is not significantly important, the date when firms are established may be of more consequence.* There is evidence in the results which suggests that firms established more recently are more likely to be involved in formal cooperation projects. This is likely to reflect the effect of the recession years in the late 1980s and 1990s and the trend towards, and emphasis on cross-border collaboration by policy makers. *The economic climate at the time of any firm expansion activity should be taken into account in small firm studies to a much greater extent than it generally is at the moment. Again, there is a tremendous need for longitudinal studies and survey replication work in this area.*

Bivariate analysis associated firm's independence or non-independence with cross-border R&D cooperation and distribution in the UK for an overseas firm. This factor was not important in any of the logistic regression models. Whether the firm is independent or not, for small high technology firms, would seem to be important only for specialised activities and resource benefits associated with equity ownership, however, there were few non-independent firms in the sample and interpretation should be made with caution.

Similarly, whether the firm evolved from another organisation was found to be important for inward distribution and contract-in manufacture, but again, links were very specific and do not appear to have led to other benefits in terms of widespread cross-border activity for the firms involved. *The multivariate models picked up*

"foundation method" as important to inward production links but otherwise foundation method is not important.

R&D intensity in bivariate analysis was found to be strongly significant for both inward and outward R&D links and also, more interestingly, for agent/distributor exporting and importing with UK distribution. *Multivariate analysis reflected the importance of R&D intensity for inward and outward research links and formal cooperation and outward production.* Problems associated with colinearity however prevented all R&D measures from being included in the model-building process and it is likely that R&D intensity is of much more importance in the cross-border linkage activity of the sample firms than is reflected here. Follow-up studies would be necessary to determine whether early R&D links are important in subsequent marketing and distribution arrangements. In the models presented, R&D intensity does not seem to be important at the marketing and distribution end of the value chain.

Industry was not found to be important in the bivariate analysis for any type of cross-border link other than "import with UK distribution" and "contract-in manufacture". Industry however, was a variable which appeared consistently in all the multiple regression models except "inward R&D" and "inward marketing". This is particularly interesting especially as *the models where industry is included indicate that different industries make different contributions to the odds of the cross-border value-chain links taking place.* While neither industry nor firm characteristics severally can explain the formation of cross-border value chain links, *a combination of firm and industry factors are clearly important in the internationalisation of small high technology firms.* Much more cognisance needs to be taken of small firm's role and position in its industry, and indeed in the structure and stage of development of the industry in future research.

As discussed above bivariate analysis was restricted due to empty cells and low cell counts. Combining cross-border links into value chain activities had the effect of increasing cell counts and expanded the analysis to include a much larger number of independent variables, including performance indicators. From the analysis, it is clear that a considerable number of factors in combination are important in predicting whether or not any individual firm will establish a particular type of cross-border link. In terms of international expansion, this casts doubt on traditional export-> license-> to production scenario. Clearly, from the results shown here, small firms, certainly those in high technology sectors, are not restricted in their choice of cross-border activity by size, age, or stage of development. *Excluding country factors, international expansion is likely to follow the pattern suggested by the firm's growth and development,*

independently, and in conjunction with its role in a dynamically changing industry. Thus, industry forces are likely to play a major part. Another development here is that inward links are important in the firm's international development but inward/outward links are not necessarily reciprocal as the network literature often suggests. Here, inward and outward links of the same value chain activity have been associated with different sets and values of cause and effect factors. The inward aspect of internationalisation of small firms is clearly interesting but sadly neglected in the literature. Increasing globalisation of industries and its impact on small firms will no doubt draw attention to the pressing need for empirical research in this area.

Summary Comments on Regression Models

In answer to the question "Why does internationalisation begin?", the ultimate answer must lie in the motivations, aspirations and strategy of entrepreneurs or management teams. This study, taking a more resource-based perspective has examined the characteristics of small high technology firms, key components of their product markets, international predisposition and frequency of linkage activity and has attempted to identify factors associated with different types of cross-border link.

It was found that very different sets of variables were associated with each of the three types of value chain links R&D, production and marketing and whether the links were inward or outward. Selected variables in general were most often found to be associated with the specialisation of the firm's activity rather than specifically with size, age or stage of growth.

Inward and outward links, and links associated with different value chain activities were often found to take place simultaneously, suggesting strongly that for small firms, international expansion is part of a holistic growth process which is not necessarily export led. *The incidence of research related factors in the models is evidence that cross-border interaction between firms in R&D activities is an important part of the internationalisation process and may provide the opportunity to develop relationships which later will result in commercial success in foreign markets.*

The almost complete absence of investment or internalisation activity in the sample of small firms suggests that these activities represent a later growth stage consolidating or intensifying earlier growth activity. Early cross-border growth for small high technology firms is most likely to take place through the establishment and management of external links rather than through integration or internalisation. Links formed tend to reflect the nature of the firm's specialisation or activity and are likely to be strongly associated with the firm's competencies and capabilities and resource needs at the time.

How Does International Expansion Begin And Progress?

The question, "How does internationalisation begin and progress?" is concerned with the type of cross-border link which firms establish first, and the combination and order of links formed over time. In examining the chronology of link formation, this section of the analysis addresses issues from the export development school and the internalisation school concerning the types of foreign market entry mode established by firms and the order or sequence in which they are formed. From both schools of thought, the prescribed sequence tends to be the export -> licensing -> direct investment, moving from low risk, low cost and low commitment to much higher levels of risk etc. (Bilkey and Tesar, 1977; Luostarinen, 1980; Cavusgil, 1984; Buckley and Casson, 1985; Simyar and Argheyd, 1987; Root, 1987). From the more holistic view of international expansion taken here the main propositions are:

- that the international expansion of small technology based firms may begin with cross-border links other than indirect export, and
- that modes of cross-border business are not mutually exclusive but consist of a number of inter-related activities in the form of inward/outward and cooperation links, and
- that patterns of international expansion are much more diverse than the internationalisation literature has conventionally suggested.

The procedure followed for this part of the thesis consisted of event analysis based on three sets of information provided by the sample firms, these were:

- the foundation date of the firm,
- a comprehensive list of cross-border links (activities) established by the firms and
- the date on which each cross-border activity first took place.

Analysis involved structuring the data in a way which facilitated a search for events, sequences and patterns of activity in the data. Much of the structuring and analysis was carried out manually by mapping out events on a series of matrices on the dimensions of type of business activity, date of event, firm identity and age. Analytical software for event analysis proved unsuitable in practice for the relatively small data set used in this survey. That type of software has tended to be developed by the life insurance industry and the medical health sector, where thousands rather than a couple of hundred case histories may be available for analysis. *Manual data manipulation revealed a very*

rich event history of 195 firms which were able to provide a chronology of their cross-border activities.

Overview of Linkage Formation

Rates of Formation

The first step was to determine the average time taken for firms to establish each type of link. This was done on the basis that if some types of link are more difficult, more risky, more costly and require more experience than others, then a holistic examination of the rates of formation of different types of links should reveal the conventionally accepted sequence, that being indirect to direct exporting followed by licensing, then other non-investment contractual modes, followed by direct investment in production activities overseas. The frequency distribution (Table 8.10) shows the length of time from the foundation of the firm to the establishment of each type of link. Examining the frequencies and their distribution first of all, of particular interest is the number of links which were established in year zero, i.e. at firm start-up. *All types of links except contract out R&D and investment in overseas production were found to occur within the first year of life of some of the firms in the sample.*

The mean number of years to form each type of link varied considerably and ranged from just over 3 years to almost 17 years. Examining the spread of distributions, *export links were found to have a skewed spread with more firms establishing this type of activity early in their life.* The same pattern of distribution was found for all types of export link. Import links were found to have slightly less skewed distributions, indicating a slightly higher number of firms beginning these activities early and a flattened pattern indicating a fairly even incidence of firms starting import activities at different time periods in their lives. *Contract-in and out manufacturing, and inward and outward technical service and consultancy show very flat distributions and show no particular tendency for firms to begin these activities either earlier or later in their lives.*

Formal cooperation agreements again, tend to be established early, whereas less formal R&D cooperation showed no particular concentration in any time period. Other distributions not discussed have too few numbers to give any clear picture of the distribution.

Looking down the columns, there appears to be a tendency for the establishment of new links tends to fall off when firms are around 4 - 6 years of age and then resume in the next three year period before tailing off thereafter. *The overall impression from the table is that there is a concentration of cross-border link formation activity early in the*

lives of the sample firms. There is also a tendency for export activities to begin almost immediately for more than 50% for those who established local intermediary links, and over 60% of those establishing export activities through overseas based agents and distributors.

The table indicates very clearly that trade links, both inward and outward are the types of cross-border activity most common in the sample and that many of these activities are established early. Evidence presented in the table indicates that contract manufacture, technical and marketing services, and R&D related activities may also occur very early in the firms' lives.

Type of Link Established	Firms	Number of Years after Foundation					Mean years
		Zero	1 to 3	4 to 6	7 to 10	>10	
<u>Technology Links</u>	n	f	f	f	f	f	x
Cross-border cooperative R&D project	68	16	15	7	12	18	7.5
<u>Inward Links</u>							
Imports from overseas based supplier	147	61	32	15	14	27	6.4
Distribution of imports in the UK	77	23	16	11	12	15	8.6
Contract R&D for overseas firm	52	7	20	9	10	6	7.2
Tech. serv./cons in UK for os firm	52	12	16	8	5	12	8.8
Mgmt/mkg serv./cons in UK for os firm	23	7	4	2	5	5	10.8
Contract mft. in UK for os firm	89	13	24	16	12	24	9.2
Licensing-in tech. from os firm	17	3	3	3	2	6	13.5
Other inward involvement	17	6	3	1	0	7	7.0
<u>Outward Links</u>							
Exp. through UK based intermediary	85	25	20	12	12	16	5.9
Exp. through foreign based agent/dist.	117	34	39	11	15	18	6.0
Exp. through co reps/branches os	53	14	12	10	3	14	9.7
Licensing out tech. to os based firm	20	3	3	4	3	7	10.4
Contract-out mft to os based firm	25	3	7	5	3	7	11.0
Contract-out R&D to os based firm	16	0	5	2	3	6	16.5
Mgmt/mkg serv./cons performed os	18	2	4	4	5	3	6.9
Tech. serv./cons. performed os	41	7	9	7	6	12	8.2
Production in os sub. (<=50% equity)	3	0	1	1	0	1	14.0
Production in os sub. (>50% equity)	5	0	1	2	0	2	8.2
Other outward links	8	1	3	3	1	0	3.5
<u>Formal Cross-Border Coop. Agreements</u>							
Technology sharing agts	15	2	5	3	1	4	6.9
Non-equity joint production agts	8	1	4	1	1	1	4.6
Comp. R&D, mfg and mkg consortia	9	2	2	1	3	1	6.4
Dist agts with suppliers of compl. products	38	9	13	3	6	7	5.6

Note percentages do not add up to 100 because of rounding.

Rank Order of Linkage Formation

To determine whether the conventional sequence of events is present in this sample, the mean time taken to form each link, from the table above, was placed in rank order and compared to the categorisation and sequence determined from extant Finnish studies (Table 8.11). The time taken for firms in this sample to form each type of cross-border link was calculated and entered in the table below in rank order by the mean time taken.

<u>Years after Foundation</u>			<u>Type of Link Established</u>	<u>Luos. 1980</u>	<u>Luos. '94</u>
<u>Firms</u>	<u>Rank</u>	<u>Mean</u>			
<u>n</u>		<u>Years</u>			
8	1	3.50	Other outward links		Out
8	2	4.63	Non-equity joint production agreements		Co-op
38	3	5.55	Dist agrnts with sups of compltry prods		Co-op
85	4	5.99	Exporting through UK based intermediary	NIMO	Out
117	5	6.03	Exporting through foreign based agent/distributor	DIMO	Out
147	6	6.42	Imports from overseas based supplier		In
9	7	6.44	Comprehensive R&D, mfg and mkg consortia		Co-op
15	8	6.93	Technology sharing agreements		Co-op
18	9	6.94	Mgmt/marketing service/cons performed overseas	NIMO	Out
17	10	7.06	Other inward involvement		In
52	11	7.23	Contract R&D for overseas firm		In
68	12	7.54	Cross border cooperative R&D Project		Co-op
41	13	8.20	Technical service/consultancy performed overseas	NIMO	Out
5	14	8.20	Production in overseas subsidiary (>50% equity)	DIPO	Out
77	15	8.58	Distribution of imports in the UK		In
52	16	8.75	Technical service/cons in UK for overseas firm		In
89	17	9.21	Contract manufacture in UK for overseas firm		In
53	18	9.75	Exporting through co reps/branches based overseas	DIMO	Out
20	19	10.45	Licensing out technology to overseas based firm	NIPO	Out
23	20	10.83	Mgmt/mkg service/cons in UK for overseas firm		In
25	21	11.00	Contract-out manuf to overseas based firm	NIPO	Out
17	22	13.53	Licensing-in technology from overseas firm		In
3	23	14.00	Production in overseas subsidiary (<=50% equity)	DIPO	Out
16	24	16.50	Contract-out R&D to overseas based firm		Out

The order attained here is quite different from either of the Finnish studies. *Formal cooperative agreements related specifically to joint production and distribution agreements were found to be formed first, followed by indirect and then direct exporting.* Licensing-out technology, contract and investment production and contract-out R&D all take longer to establish and tend to support the conventional pattern.

Inward activities, which might be expected to occur early in the list appear much later with a mean 8 years or more for import activities and UK based services for overseas

based firms. This is particularly interesting as small firms are expected to undergo a period of development in the domestic market before venturing outwards into overseas markets. The stimulus for overseas investment might be expected to come from unsolicited orders, contact with agents and distributors, overseas suppliers and other foreign network contacts. From this perspective, *inward links could be expected to precede outward links but overall, this does not seem to be the pattern here.*

The earlier of the Finnish studies treated international expansion as an outward expansion process and outward cross-border links were categorised as "foreign market entry modes". Luostarinen (1980, p.117) categorised market entry modes along the dimensions of firm commitment, investment, and political risk and suggested that firms move from non-investment marketing modes (NIMO) to direct investment marketing modes (DIMO) to non-investment and direct investment production modes (NIPO and DIPO).

Applying Luostarinen's (1980) categorisation to the table, his sequence of events from non investment to direct investment marketing and non-investment to direct investment production is reflected in the rank order attained here, although not as clearly as might be expected. Marketing and production activities here, however, are interspersed with inward activities, outward service activities and R&D activities, the latter of which were not included in the 1980 model.

Fundamentally, the pattern of outward development from least risk, least investment to higher risk and investment is supported by the findings presented here. Incorporated in this sequence of events are unexplained inward and cooperative internationalisation activities. Applying Luostarinen and Hellman's (1994) inward, outward and cooperative classification to the results attained here, a sequence emerges which is fundamentally different from the inward-> outward-> cooperation sequence identified by the latter researchers. Here cooperation and outward activities occur earlier than some inward activities.

It is important to note that comparison of the findings here with those of previous studies by Luostarinen et al. is not a direct comparison due to differences in the nature of the data and its presentation. The approach taken differs from Luostarinen's (1980) approach. The latter researcher aggregated cross-border activities into direct and indirect investment, marketing and production activities, and confined his study to outward links. In the analysis of event sequence data in this study, a full break-down of cross-border links was retained and both inward and outward links included. In addition,

while Luosarinen provided a head count of the number of times each of his categorisations occurred first, here the average time taken to form each type of link was ranked.

The mean time to establish each type of link is definitely not a representation of the sequence of activities taken by firms in the sample. However, for the sample holistically, bearing in mind the size of the firms, and that the links recorded are first links, the average length of time taken to form any particular type of link should reflect, as suggested above, differences in levels of investment, risk, commitment and experience required for that particular type of cross-border activity. While the results do provide some support for that order of events, *classical outward export and investment activities are interspersed with inward activities in the order: import, contract-in R&D, technical services and contract manufacture, marketing services/consultancy and license-in of technology*. The early occurrence of cooperation agreements differs from both earlier studies and requires some explanation. The cause and effect factors associated with cross-border events are discussed in the first section of this chapter.

Patterns of Cross Border Linkage Formation

The average length of time taken to establish different types of cross-border link says something about the nature of the links themselves but nothing very much about the international growth and expansion of the firms. *The implicit assumption here is that international expansion or growth is characterised by sequences and patterns of cross-border activity*. In order to examine the sequence and pattern of events on a firm by firm basis, the first cross-border link of each type established by each firm was recorded by the year in which it occurred. Subtraction of those dates from the foundation date of each firm in the sample allowed the establishment of cross-border activity to be mapped out on a matrix. Several matrices were produced, mapping out cross-border activity by time, country, type of link, and by event. The matrices were very large and have not been replicated in the thesis due to their size and the raw nature of the data which they contain. An abbreviated example is given in Table 8.14. Interpretation of the matrices is summarised in the discussion and short tables included in the rest of this chapter.

Examination of the matrix showed that *cross-border activity by individual firms tended to consist of several different types of cross-border activity which were established at particular periods of time*. It was also found that these *flurries of activity were followed by gaps in time during which no new types of cross-border activity were established*. International expansion appeared to take place spasmodically with clusters of activity of

various types, followed by gaps of varying lengths. International expansion is therefore treated here as having two main stages:

- event stages, and
- non-event or "gap" stages, and

that the process may begin either by "cross-border events" in which case international expansion begins immediately, or by a "gap" in which case a period of domestic activity takes place before international expansion begins.

Composition of Cross-Border Events

Examining the first event only, just under half of the firms (48%) established a single cross-border link at this stage of their international development (Table 8.12). This means that over half of the firms established more than one link type in the first instance. The table indicates that combinations of links may include both inward and outward links of the same or different value chain activity. Most commonly, link combinations included marketing in either inward or outward directions and combinations without marketing links were rare (10%).

Table 8.12 **Composition of First Cross-Border Event Stage**

	f	%
All Firms With First Cross-Border Event Stage Data	195	100
Firms with a <u>single inward</u> link only	58	30
Firms with a <u>single outward</u> link only	35	18
Marketing/Distribution Combinations		
Firms with <u>either</u> inward <u>or</u> outward mkg/dist.	176	90
Firms with inward <u>but not</u> outward mkg/dist.	88	45
Firms with outward <u>but not</u> inward mkg/dist.	47	24
Firms with inward <u>and</u> outward mkg/dist.	41	21
Firms with links <u>other than</u> marketing/distribution	19	10
Combinations of Inward Mkg/Dist. with Production and/or Research		
All firms with inward mkg/dist.	129	66
Firms with inward Mkg/dist <u>and</u> <u>inward</u> production <u>and/or</u> research	31	16
Firms with inward Mkg/dist <u>and</u> <u>outward</u> production <u>and/or</u> research	16	8
Combinations of Outward Mkg/Dist. with Production and/or Research		
All firms with outward mkg/dist.	88	45
Firms with outward Mkg/dist <u>and</u> <u>inward</u> production <u>and/or</u> research	20	10
Firms with outward Mkg/dist <u>and</u> <u>outward</u> production <u>and/or</u> research	15	7
Combinations of Links with No Marketing/Distribution		
All firms with combinations not including mkg/dist.	19	10
Inward production only	5	*
Outward production only	5	*
Inward research only	3	*
Outward research only	1	*
Outward production and technology sharing cooperation	2	*
Inward production and inward research	2	*
Inward production and inward and outward research	1	*
* fractional proportion		

NB. Combinations shown are broken down by inward and outward combinations of the same value chain activity and separately by combinations of different value chain activities with either inward or outward link directions. The table illustrates the diversity of linkage activity but not its complexity. Many of the firms experience cross-border events with complex combinations of value chain and inward/outward activities.

International Expansion: Event Analysis

As firms in the sample were relatively young, very few reported more than four event stages (see Table 8.14). Links formed were categorised into first, second, and third stage events and all subsequently formed links as fourth stage events. All types of cross-border links formed at each event stage were recorded together with the length of time taken to reach that event stage and the duration of gaps between events.

Firms were found to exhibit differing combinations of cross-border links at any particular stage. As 90% of firms were found to have cross-border marketing and distribution links, combinations reported in Table 8.12 are based on the presence or absence of marketing/distribution, and combinations of these activities with production and research related links. Only 10% of firms were found to have single links or combinations of links which did not include marketing/distribution activity.

Evidence indicates that the sample firms are split into two almost equal groups distinguished by the nature of their linkage activity. *Almost a half (48%) were found to form a single link only in the first year of their cross-border activity, while 52% formed more than one type of link with some firms launching immediately into quite intense combinations of inward and outward activity spanning the value chain.* This latter group of firms is exhibiting behaviour contrary to what would be expected from step/stage approaches to internationalisation where small firms are expected to begin the process cautiously. *More than half of firms in this sample appear to be "plunging" into cross-border activity rather than "dipping their toes in the water".* Just under a half however do begin internationalisation more cautiously, or perhaps reactively with a single uni-directional mode.

Based on the understanding that small firms are often specialists in a particular value chain activity, a patterns which might be anticipated would be reciprocal inward-outward links in the same activity. Links or channels established could be expected to accommodate a two-way flow of goods, services, knowledge and expertise, intellectual property and payments. In particular, such a pattern would be anticipated for marketing/distribution where import/export processes are often performed by the same intermediary organisations. *Somewhat surprisingly, only 20% of firms were found to have both inward and outward marketing and distribution links at the first event stage.* Almost 70% were found to have either inward or outward marketing/distribution, but not both. Taking into account the fact that direct reciprocity develops over time and the focus here is on first events, it could still be expected that the flow would eventually become two-way, especially if the process is performed by an experienced intermediary

rather than the firm itself. However there is no indication in this sample that export/import through intermediaries is more common at the first event stage than later in the firms' development, which would support that view. Evidence here suggests that inward or outward marketing/distribution links are formed separately to meet very specific needs or goals of the firms associated either with an inflow or outflow of activity.

Despite the low incidence of directional reciprocity in marketing/distribution linkage formation, links formed were not overall uni-directional. Nor were they confined to a single value chain activity. *More than a third of firms with outward marketing/distribution also had cross-border production and/or research activities and over a third again of those with inward marketing/distribution reported having established production and/or research links.* Bi-directional links occurred between marketing/distribution activities (20%), almost a quarter of outward marketers established inward production and or research in the same year and more than 10% of inward marketers had outward production and/or research. There was also evidence of inward and outward research and production combinations where no marketing or distribution activities were reported.

Evidence reported and discussed here is based on each firm's *first* cross-border activities only. Combinations of types of links are varied and complex and the complexity increases when subsequent event stages are also examined.

Important Implications from First Cross-Border Events

There are a number of important implications which may be drawn from the analysis of the first stage event:

- international expansion of small firms may begin with any type of value chain activity and links formed may be inward or outward,
- firms may begin international expansion through: a). a single type of cross-border link, or b). through combinations of links; differences in the development and performance of firms beginning in these two modes is an important area for future research,
- initial international expansion may involve specific combinations of inward/outward value chain activities which are not necessarily directly reciprocal. Efficiency and synergy in linkage combinations is an

important concern both for internationalising firms and for future research,

- *while trade links remain the most common form of cross-border activity for small internationalising firms, for many, production and research links appear to be integral to the international expansion process.* Future research needs to focus on the provision of advice to firms and government on the international expansion of production and research activities at early stages in the firms' development. Making the assumption that this is the domain of large, experienced firms could render firms in the small firm sector vulnerable to failure, through lack of appropriate advice, and possible exploitation.
- the diversity of combinations of early cross-border links suggests that these may be linked to specific needs, competencies and goals of firms rather than to a specific stages of development in a pre-ordained internationalisation process,
- evidence of reciprocal activity in first event stage and in sequence across stages suggests that the development of relationships is important in international expansion. Relationships and internationalisation patterns do not necessarily develop from relationships with agents as there is considerable evidence in this study of early cross-border links, formed by small firms, independent of agent /distributor modes.

International Expansion: Gap Analysis

Almost half of the firms with cross-border links established them in the first year of the firm's life. These firms therefore did not undergo any period of purely domestic activity. While linkage events here include all types of cross-border activity, cross-reference to the frequency Table 8.13 indicates that a considerable number of export links are established very early suggesting that internationalisation in the conventional outward direction does take place with immediate effect for some firms. Conversely just over a half (54%) undergo at least one year of development in the domestic environment before establishing any cross-border links. *The general tendency for this sample is for the period of domestic expansion to be very short.*

Scanning the distributions, all are skewed towards shorter gaps. *The tendency therefore is for firms to establish cross-border links at specific time periods with relatively short breaks in between.* Differences in lengths and patterns of gaps and events are likely to be associated with the growth rates of individual firms and the nature of their internal development, including formalisation, and specialisation of functions, technologies and products.

Gap	Firms n	Duration of Gaps (years)					Range x
		Zero %	One %	2 - 5 %	6 to 10 %	≥10 %	
1	192	46	13	17	10	14	90
2	141		33	51	9	7	19
3	95		41	44	11	4	17
4	48		35	44	19	2	18

Note percentages do not add up to 100 because of rounding.

Patterns in international expansion were found to vary a great deal. Typically, a number of cross-border business activities tended to be undertaken over a very short time period, often within the same year with a gap of several years before another group of activities commenced. *Periods which saw firms very active in establishing new forms of cross-border activity were followed by periods during which no new activities were undertaken.*

Incremental internationalisation did seem to be the pattern for a few firms, which gradually added to their cross-border activities over a series of consecutive years. The sequence of events however did not necessarily follow the conventional pattern of increasing involvement, risk and investment.

Table 8.14 Firms with Four or more Event-Stage International Expansion History

Firm End Date	1st Event			2nd Event			3rd Event			Subsequent Events		
	Inward	Outward	Coop Gap	Inward	Outward	Coop Gap	Inward	Outward	Coop Gap	Inward	Outward	Coop Gap
1987	IM		0	IM2		1		OM,OM2,OM3	1	IR2,IP2,IP,IR	OP,OM4	1
1982	IP		10	IP2		1		OR	1	IM2	OM,OM2,OM3, OP,OP3	2
1977	IM2		0	IP2		3	IM	IM	5	IP,IR	OP,OP3	3
1975	IM		0	IM2		5		IP	9	IP2		1
1973	IM		10	IP		6		OM2	1	IM2		4
1982	IM		0	IP2,IP		1		IR2	1	IM2	OM2,OP,OR2, OP2	2
1982	IM		8	IR2,IP,IP2		1		OM2	1	OM		1
1962	IM		0	IR2,IP		13		OM2,OP,OR2	12	OP,OR2		1
1988	IR2		0	OP2		4	IM2,IP2	IM2,IP2	1	IP	OM,OM2	1
1985	IM		1	OM		4	IR2,IP2	OR	1	IP		2
1981	IM		1	OM2		9		OM3	1	IP2	OM,OP2	2
1979	IM		1	OM		3		OM3	3	IP		7
1978	IM		0	OM		2		OM2	1	IR2	OM3	1
1976	IM		0	OM2		2		OP2	4	OM		8
1968	IM		2	OM2		12		OM4,OP2	6	IP2,IP		1
1963	IM		0	OM2		4		OM	3	IM2,IP,IR	OM3,OP,OR2	4
1962	IM		7	OM2		1		IM2	5	IR2,IP	OM	5
1975	IM		0	OP,OR2		3		OM	5	IP		4
1971	IM,IM2		5	OM2,OM3		3		IP2,IP	2	IM2,IM3	OM,OR,OP2	6
1959	IM,IM2		7	OM2		6		OP2	5	OM		6
1983	IM,IM2		0	OM2,OR,OP2		1		OM	3	IR	OR,OP2	1
1984	IM		0	IR		2		OM3,OP3	3	IP2,IM3	OP3	1
1981	IM		0	OM2		2		OP	1	IP,IP2	OP2	4
1983	IM		0	IP		1		OM	1	OP	T	5
1985	IM		0	IM2,IP2		2		OM2	6	OP2	D	1
1984	IM,IM2,IR		0	IP2,IP		1		OM,OP2	1	OM3	D	6
1984	OM2		1	IM		5		IM2	3	IM2		1
1970	OM2		5	IM		3		IM2	3	OM,OM3,OM4		9
1900	OM2		68	IM		4		IP	6	IR2,IP2		10

Firm End	1st Event				2nd Event				3rd Event				Subsequent Events				
	Inward	Outward	Coop	Gap	Inward	Outward	Coop	Gap	Inward	Outward	Coop	Gap	Inward	Outward	Coop	Gap	
1982	OR			4	IR2,IP2			1	OR2	OR2			1	IM2	OM2,OP2		4
1984	OM			0	OP2			7	IR2,IP2				1	IP	OM2,OR		2
1974	OM2			4	OM3			8	IM2				2	IM	OP2	D	1
1947	OM2			28	OM			3	IM				5	IM2	OM3		4
1987	OM2			1	IR2			1	IM				1		OR		3
1983	OM2			3				1	IP				1	IM,IM2		C,D	1
1971	OM2,OM4,			5	IM,IM2	OM		3	IP2				3	IP			1
1969	IM	OM,OM2		1	IP			19					1	IP			19
1962	IM	OM		4	IP2			3		OM2			1	IR2,IM3,IP	OR,OR2,OM4		2
1983	IM	OM		0	IM2	OM2		7	IP				2	IR2	OM3	D	1
1974	IM	OM		0	IM2	OM2		1		OM3			4	IP			6
1983	OM,OM2	D		0	IP			2		OM4,OP2			1	IM2			6
1978	IM2	D		0	IM			1		OM2			3	IR2,IM3,IP,IR	OM,OR,OP		3
1990	IM,IM3	OM,OM2,	C,D	0		OP2		3					1	IP,IR	OM4		1
1988	IM3,IP	OM2,OP2	T	2		OR,OP		2						IM			2
1986	IM,IP2	OM,OM2,	T	1		OP3	J	1					1	IR2,IP	OM3,OR		1
1989	IP	OM2,OM3,	D	0	IM	OM		1		OP			2	IR2,IP2			2

Key	Event = cross-border links established for the first time by firms in a particular year.	OM = UK based export
Gap = the length of time taken for a firm to move from one event to the next, measured in years. The first gap is the number of years from the date of firm foundation to the first cross-border event.	OM2 = overseas agent/distributor export	OM3 = integrated export (own overseas reps. or branch)
IM = import from overseas supplier	OM3 = integrated export (own overseas reps. or branch)	OM4 = management/marketing consultancy performed overseas
IM2 = import plus distribution in the UK	OR = license out technology to overseas licensee	OR2 = R&D contracted out to overseas based firm
IM3 = marketing or management service/consultancy for overseas firm in the UK	OP = manufacturing contracted out to overseas based firm	OP2 = technical service/consultancy performed overseas
IR = license-in technology from overseas	OP2 = technical service/consultancy performed overseas	OP3 = investment in overseas production
IR2 = R&D performed under contract in UK for overseas based firm	T = formal technology sharing cooperation agreement	J = formal joint production agreement
IP = manufacturing performed under contract in UK for overseas based firm	C = comprehensive R&D, production and marketing agreement	D = Formal cooperative distribution agreement
IP2 = technical service/consultancy performed in the UK for overseas based firm	D = Formal cooperative distribution agreement	

International Expansion: Typical Patterns

In order to identify patterns and sequences in linkage formation, the event history matrices were rotated around the dimensions, date of event, type of event, firm identification, age of firm and rate of link formation (gap analysis). A sample of the matrices is illustrated in Table 8.14. In addition, firms were clustered by the type of links made at each cross-border event stage. What emerged strongly was that there was little evidence of a "typical" pattern or sequence of events which could be said to reflect the conventional internationalisation models, rather:

- there are common starting points, most commonly importing, but progression varies both in the types and combinations of links formed and in the periods of time over which links are formed,
- there are patterns in the data but they reflect **intensity** of activity and these occur at event stages specific to individual firms rather than in any particular sequence. Firms may begin with *intense* link formation and add to these initial activities over time, or begin gradually with possible *intense* periods at later stages,
- there are indications that firms **concentrate** on a particular type or combination of links formed. This is evident for some firms in periods of intense link formation, and for others which had more but similar links over time,
- some firms form a wide range of types of link covering all aspects of the value chain,
- *some types of link are common to a number of firms at specific periods of time.* Formal cooperation links for example are concentrated in the period from the late 1970s to the present with more occurring recently. *There is also a tendency for older firms in the sample (pre 1960s) to have commenced export or import with little or no expansion into new types of link over the years.*

Sequence and Pattern in Link Formation

The main purpose of this part of the analysis was to identify "typical" sequences or patterns in the international expansion of small high technology firms. The chronology presented by much of the internationalisation literature of a gradual movement from indirect to direct export through licensing and other contractual arrangements to foreign direct investment, is present for a few firms but is far from "typical" for this sample.

There were patterns in the data, but these were associated with an apparent intensity in link formation which occurred for some but not all firms, and where they did occur they took place at different periods in the lives of the firms concerned.

Exploring this further, three groups of firms were extracted from the sample:

- new starts (firms established between 1990 and 1995),
- firms with an initial, but no subsequent cross-border event, and
- firms which provided data on at least four periods of cross-border link establishment (firms established prior to 1990).

Examining these groups, it was found that although patterns vary, five different patterns which were shared by groups of firms could be identified based on types and combinations of link and the gaps between:

Domestic Firms Firms which had never formed any cross-border links.

Reluctant Developers/

Export Specialists Firms which form a single link only which might be either import or export, with few if any additional types of links formed over time. These firms tended to be older with an average foundation date of around 1975. These firms tended towards two extremes, those with very low dependence on income from overseas, and those with very high international ratios. The latter group are evidently strong exporters whose cross-border activity is confined to overseas sales. The former had little international involvement and are most likely to import/export on an ad hoc basis. The vast majority of these links reported by firms in this group were trade related.

*Conventional
Developers*

Firms in this group tended to form simple inward links followed by simple outward links in subsequent years. While some firms followed the conventional export development sequence, there were also firms here which moved from export to import activity. In addition, advanced modes, i.e. direct export, research and/or production links were as likely to be included in first or early links as import activities and indirect export. While firms in this group add to their cross-border repertoire of

activities gradually, there is a great deal of variation around the conventional pattern.

*Rapid
Developers*

Firms in this group tend to experience more complex first events (including several types of activity) but in either an inward or outward direction. Subsequent periods of activity tend to consist of one of a number of activities in the opposite direction. Subsequent events tend to occur after short periods of time and suggest that activities therein are a result of established relationships and/or experience as well as the development of the firm.

*International
Entrepreneurs*

Borrowing the label from Oviatt and McDougall (1994), the firms in this group tend to experience first events which are commensurate with or soon after the foundation date of the firm. First events tended to be complex and links established could include a range of value chain activities in both inward and outward directions. Formal cooperation agreements were often part of the early cross-border activities of these firms. This group of firms were predominantly young and most were new starts. The few firms in this group with an event history of five years or more continued to add to their repertoire of cross-border links over the next few years and these could include additional cooperative agreements

A small extract from the spreadsheet from which the above patterns were identified is presented in Table 8.14. For the sake of clarity and brevity, "new starts " and firms with few event stages have not been included in the extract. The patterns above have not been numbered because they do not represent a sequence of events, but rather alternative expansion patterns experienced by the sample firms. Nor have the patterns been ranked in any order because the importance of the patterns has not been assessed in this study and remains an issue for future research. The patterns identified are not intended to be a comprehensive list, nor is each pattern mutually exclusive of the next, as the data has shown that there is a great deal of variety in the modes, time periods and patterns of establishment of cross-border activity amongst the sample firms.

What is clearly very important here is the intensity of cross-border link formation (i.e. within a particular period of time) and the diversity of activity (the combination of types

of links and their direction over the life of the firm). This point is discussed further in the next chapter.

Concluding Comments from Event Analysis

Finally, some pertinent points emerge strongly from the data:

- Import is almost always included in the first event but its role in the further development of cross-border activities has not been established here.
- Import is not however a requisite for international expansion as firms beginning the process with export links have been found to commence import activities later on.
- Cross-border production and research activities may occur as first, or early cross-border links, but they are almost always accompanied by trade links. Again however, there is no evidence that cross-border trade is a requisite starting point or vehicle for cross-border links involving other value chain activities.
- Complex inward/outward links involving several value chain activities are more likely to be formed by younger firms. While brevity of corporate memory may have had some influence on the results here, the increasing globalisation of high technology industries in recent years is assumed to play a role in exposing small firms to international influences.
- In general, younger firms progress more rapidly from one event to the next, or rather, events tend to blur into a steady progress in establishing cross-border activities.

Analysis of international expansion through an examination of cross-border link formation over time has identified a number of key points with exciting implications for future research. Much of the data manipulation reported in this chapter was done painstakingly through manual coding, cutting and pasting of the data. Possibilities for statistical model building of event data and interpretation for causal factors is possible with larger samples and presents possibilities for follow-up study and long term longitudinal research on the international expansion of small firms.

Where Do Formal/Investment Links Come In The Life Of The Firm And Its Stage Of International Expansion?

Formal Cross-Border Links

Formal and investment links which are examined here are direct export links (firm's own representation abroad), investment in overseas production facilities (minority or majority) and formal cooperation agreements which involved substantial investment by the firms concerned.

Export modes are frequently categorised according to the level of commitment required by the exporting firm, and export development studies suggest that firms move from least commitment modes (local intermediary based export) through overseas based (foreign agent/distributor based export) to direct involvement or integrated export channels (company sales representatives or branches overseas). Examination of export links formed by the sample firms indicated that there was little if any support for the conventional export route. In general, firms' export activities commenced either with indirect exporting or foreign agent/distributor exporting. Firms which commenced with foreign agents/distributors were found to follow-up with indirect exporting as frequently as firms which followed the reverse sequence. It was also just as likely for firms to pursue both modes simultaneously.

Integrated exporting (through company sales representatives and/or branches) was undertaken by some firms as a first event international activity but this mode tended to be one of a number of different types of cross-border activity commenced simultaneously. Most often, integrated exporting occurred at later stages in the firms' international expansion but was not necessarily preceded by other types of export activity. The results here tend to support the assertion that firms commence export activities which involve high commitment/investment later in their international expansion than low involvement export modes, *but* integrated export is not necessarily preceded by indirect or agent/distributor export.

Integrated production links (minority/majority investment in overseas production) were reported by only eight firms in the sample, which represents less than 4%. From this, *it can be concluded that as a general rule, small/young firms do not, or are not able to invest in overseas production,* a finding which is supported by literature from export and investment studies of internationalisation. The pattern or sequence of events however can not be generalised from the few cases here. The individual cases are interesting in their own right however.

The oldest firm in the sample to invest in overseas production was established in 1956 and took 37 years to make the investment, which was in fact the only cross-border activity it reported in its event history to date. Two firms made investments in overseas production following previous import and export links over a relatively lengthy period of time and thus seemed to support the conventional process. An alternative pattern was presented by another three firms which invested in overseas production very early, i.e. within the first five years of their lives, and in each case the firms were involved in formal cooperation agreements and reported complex combinations of cross-border link types. Another firm, which took longer (12 years) to make its investment in overseas production indicated complex link formation together with cooperation in its 12th year, which had been preceded only by import and contract-in manufacture. One firm which reported an early formal cooperation agreement confined its subsequent links to date to inward and outward research activities and investment in overseas production.

There are far too few cases of investment in overseas production in this sample to draw any firm and generalisable conclusions other than that it is uncommon for small/young firms, even those in high technology sectors. *The tendency for half of the 8 firms with this type of link to have had previous or concurrent involvement in formal cross-border cooperation agreements suggests that examination of cooperation agreements as "platforms for" or "accelerators of" the international involvement and expansion of small firms is worthy of future research effort.*

Formal cooperation agreements tended to be formed immediately after firm establishment or very early in the life of the firm. Firms which reported formal cooperation as a third or subsequent event tended to have very short gaps between event stages, with cooperation within an average of 7 years from the conception of the firm. *Cooperative arrangements, irrespective of whether they were specialised (e.g. technology sharing, or distribution arrangements) tended to be accompanied by a range of different value chain links whether concurrently formed or occurring at different times in the life history of the firm.* Whether the cooperation itself facilitates the links or is a mode of activity attractive to firms with a predisposition towards cross-border links can not be determined from this study, but returning to the point made in the previous paragraph, it does seem that formal cooperation agreements may be an important facilitator or stimulus in the international expansion of small firms.

Formalisation in the Firm

Few firms in the sample exhibited evidence of having formalised export and R&D activities, i.e. specifically defined functional departments (Table 8.15). A total of 85 firms claimed to have established an R&D department and the same number had applied for applications for protection for IPRs. Over a half of firms with R&D departments

(53%) had established them at inception or within their first year and the mean rate of establishment was just over two years. Almost a quarter however (24%), established their R&D departments 7 years or more into the life of the firm. Indications here are that there are two distinct types of firm here, or patterns of growth. A similar distribution is evident in the case of IPR applications, with 41% making applications in the first three years and just under 40% after 7 years. Application for IPRs generally was found to take longer with a mean time of 8 years.

The distribution for time taken to form cross-border cooperative R&D projects was very flat and although the mean rate was almost 8 years, the even distribution would suggest that this activity could occur at any time and would therefore not be a good indicator of development.

Only 33 firms in the sample had established export departments and nine of these were set-up in the first year of the firm's life, an unexpected finding since other studies (e.g. Cavusgil, 1984) suggest strongly that formalisation of export activities takes place after considerable export experience.

Type of Formalisation	Number of Years after Foundation					Mean \bar{x}
	Zero f (%)	1 to 3 f (%)	4 to 6 f (%)	7 to 10 f (%)	≥ 10 f (%)	
<u>R&D</u>						
Time to Set-Up R&D Department n = 85	45 (53)	12 (14)	8 (9)	5 (6)	15 (18)	2.21
<u>Intellectual Property</u>						
Time to make first application for IPR protection n = 85	15 (18)	20 (23)	17 (20)	12 (14)	21 (25)	8.01
<u>Co-operative R&D</u>						
Time for first cross-border co-operative R&D project n = 68	16 (24)	15 (22)	7 (10)	12 (18)	18 (26)	7.54
<u>Export Arrangements</u>						
Time for Export Department Set- Up. n = 32	9 (28)	8 (25)	5 (16)	4 (12)	6 (19)	5.31

Note percentages do not add up to 100 because of rounding.

Further investigation found that 20 (61%) of firms with export departments had evolved from other organisations and 9 (27%) were not independent at the time of the survey. Cross-tabulation of either measure with the existence of an export department did not give a significant Pearson chi-square indicating that subsidiarity to and evolution from other organisations is not associated with early establishment of export departments.

The distribution also suggests that age is immaterial in the establishment of export departments but there were too few cases in the sample to establish this through cross-tabulation. Firm size however was found to be a factor and larger firms (in terms of

turnover) were more likely to have export departments than smaller firms (Pearson chi-square = 6.36, sig = $\leq .05$).

Generally, it was felt that findings relating to the formalisation of the firm were inconclusive. The existence of formal departments may be indicative of a change to formal management style, a more functional organisation structure, or emphasis on a specialised activity as suggested in the literature (see especially Scott and Bruce, 1987), but, examination of the time taken to establish formal structures is not indicative of development stages here.

Summary of Chapter Results

This chapter had three main aims:

1. To determine whether combinations of firm characteristics and conditions are associated with, and therefore explain, international expansion through specific link types.
2. To describe on a firm by firm basis, the internationalisation process of small high technology firms and identify specific patterns, if any, in the process.
3. To identify specific stages in the international development of the firm based on the formation of internal (investment) or integrated links, and on the formal structure and strategy of the firm.

In respect of the first objective it proved possible to build statistical models, with good predictive ability, based on a value chain categorisation of cross-border links and formal cooperation links in both inward and outward directions. The explanatory variables selected for each model differed in combination and in the extent to which each influenced the mode of cross-border activity. Evidence suggested fairly consistently that while firm age and firm size were of little or no significance in the types of link formed, associated factors relating to resource needs, capability and specialisation were of importance. Much cross-border activity seemed to be related to the presence or absence of resources capability and competence such as R&D or production capability. Evidence relating to the influence of firms' previous links was not pronounced, but it appears that those which emerged from other organisations or were not wholly independent were less innovative and less inclined to internationalise than other firms. It is possible that strong links with other firms, rather than simulate expansion, may limit its scope.

The marketing models indicated much less influence from domestic product and market factors than might be expected if the "reactive" start to international activity is accepted.

In this sample, strategy and foreign country factors may be found to be of more importance in the establishment of cross-border marketing and distribution, and if so, would suggest a proactive approach to international expansion than is generally supposed in some studies of small firm export development.

The formal cooperation model provided some evidence that contingency factors may be important in international expansion and while the age of the firm is not particularly important, the period of time in which it is established, or begins its expansion may be of more importance. The economic climate or current political ethos could have significant influence on the nature and direction of small firm growth.

Examination of the internationalisation process of the sample firms was extremely interesting and while there was evidence that some firms follow the export development route, the deviation from that *norm* was marked. It is suggested here that the international expansion of small high technology firms is characterised by differences in the intensity and diversity of cross-border activity at specific periods of time. In addition, the rate of internationalisation differs amongst firms.

Examining evidence presented over both Chapters 7 and 8, the argument is advanced that international expansion reflects the internal growth and development needs of the small firm. Modes of cross-border activity are likely to be selected strategically based on both resource needs and market needs, and are likely to involve both inward and outward components. The most important variables would appear to be resources, capabilities and competencies which drive both inward and outward links.

The final section of the chapter attempted to determine whether there were stages in the development of the firm based on the time taken to establish R&D and export departments (formal structuring), applications for IPRs (indicators of the development of formal strategy) and formal cooperative R&D. Results were inconclusive and this remains very much an issue for future research. In terms of international development, it did appear that foreign direct investment in production activities and integrated export may be later stage developments and may represent a consolidation of activity established through external links. In the case of the former though, there were very few instances in the sample. From a transaction cost perspective, that interpretation would make sense in terms of simplifying communication with the external market and increasing control over foreign country based activities.

How Important Are These Activities To Firm Development And Growth?

One research question remains unanswered and that is the importance of cross-border linkage activity to firm development and growth. To some extent this question has been answered in both Chapter 7 and 8 where particular types of link were associated with indicators of firm performance and growth. This chapter however has suggested that it might be cross-border *events* rather than individual link-types or foreign market entry modes which are important vis-à-vis firm growth and development. It is likely that “entrepreneurial flair” or “management strategy” determine the specific combinations of links formed and how they are controlled and managed. Success in terms of the firm’s international growth and development, may be determined by its ability to seek out, establish and manage its external links, not only domestically but also internationally, especially where industries and markets are international or global.

This introduces exciting possibilities for future research. Determination of the international expansion of small firms (which can also be described as the early development of the multinational firm) may be tracked through examination of cross-border linkage patterns. The explanatory variables in this study being expanded to include strategy and foreign country factors for more comprehensive explanation.

Finally, the last chapter of this thesis discusses the findings of this research in relation to existing theory and discusses the contributions and limitations of this research.

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Chapter 9

Conclusions and Recommendations

Chapter Objectives

- *To discuss the research findings in relation to the research questions and objectives developed in Chapter 5.*
- *To discuss the research findings in relation to a major OECD cross-national study of SME globalisation.*
- *To assess the contributions of this thesis in respect of knowledge development and the development of theoretical and methodological approaches to small firm internationalisation.*
- *To identify implications for firms, policy makers and for future research.*

Introduction

This final chapter of the thesis summarises the results of the research and discusses the findings and their implications in relation to the research questions and the objectives of the study. Contributions of the thesis to current knowledge are discussed in relation to the development of theory on small firm international expansion and to the development of conceptual and methodological approaches to the topic. Finally, the chapter and the thesis are concluded in a discussion of the implications of the study, and recommendations for future research. The recommendations are presented as a series of explicit research propositions which were developed from the analysis of the thesis findings.

Findings in Relation to the Research Questions

How does Internationalisation Begin and Progress?

International expansion was found to begin with cross-border links other than indirect export. Some firms experienced a period of domestic growth prior to the formation of any cross-border links but almost half were involved in some kind of international business activity either immediately or within the first year of the firm's life. There was some evidence of firms following the conventional export development pattern but generally, internationalisation was found to be much more varied and complex than that approach suggests.

Examination of the cross-border links formed on the dimensions of direction and value chain activity, found that international expansion could begin with any type of link, R&D, production or marketing/distribution. These links could be either inward or outward and as such may reflect either the resource needs of the firm, or the need to exploit firm capabilities or competencies.

Patterns of international expansion were found to vary considerably and while some firms may form a single link type, equally, they might begin with very varied combinations of inward and outward links and different value-chain combinations. Combinations of links were not generally found to be directly reciprocal in most cases. That is, firms did not necessarily establish both inward and outward R&D links simultaneously. Indications are that while specialisation in a particular form of business activity are important, the goals or resource needs of the firm are also significant factors in the type and pattern of international expansion adopted.

There was some evidence of reciprocity in the types of links formed in the first event stage and in sequence across the stages suggesting that the development of relationships is important in international expansion. There was insufficient evidence however to support the contention of the network approach that the internationalisation process follows the route of established relationships and their networks.

Trade links were found to be the most common form of cross-border activity but the sample firms were obviously not restricted to those modes and for many, production and research links appeared to be integral to the international expansion process.

Importantly, it was found that there was considerable diversity in the combinations of early cross-border links formed. This suggests strongly that the types of links formed are more likely to be associated with specific needs, competencies, goals and aspirations of the firm rather than with stages in a “pre-ordained” internationalisation process.

While there was only a little evidence to support the conventional export development route of internationalisation, there was clear evidence of patterns in the data. Patterns identified described at least five different patterns of international development, these were described in Chapter 8 as:

- Domestic Firms
- Reluctant Developers / Export Specialists
- Conventional Developers
- Rapid Developers
- International Entrepreneurs.

These patterns represent exciting challenges for future research which emerge from the following summary points. Firstly, firms may be clustered by the types and combinations of link types formed at periods of time specific to individual firms. Another dimension on which firms may be clustered is the rate of internationalisation based on intensity of activity within event stages, and the duration of gaps between. Expressed more simply, the patterns in the data may be found to reflect “intensity” of activity at points in time important in terms of the development and growth of the firm per se.

There was also evidence that firms specialise in the type and combinations of links formed as regards value chain activity. This is very different from the export

development pattern of internationalisation which reflects marketing activities only, at least in the first few stages. Evidence here suggests strongly the contention that the international expansion of the small firm is part of a more holistic growth and development process, at least in its formative period. By way of contrast, some firms were found to form a wide range of link types covering all aspects of the value chain, suggesting overall development of the firm rather than concentration on specific functional activities.

Chronological analysis of the types and patterns of cross-border links formed suggested that contingency variables definitely need to be taken into account in studies of internationalisation. It was apparent that there were trends in cross-border activity at different time periods e.g. formal cooperation agreements tended to be recent occurrences. It was also noted that complex combinations of links were more likely to occur amongst younger firms and generally the trend is one of increasing intensity of internationalisation activity in recent times and an internationalisation process more rapid than has been the case in the past.

International growth and development through internalisation was also examined through the event analysis procedure. Integrated export (through company sales representatives and branches) tended to occur as a later event in the internationalisation process. Importantly though, it was not necessarily preceded by other forms of export and did occasionally occur as a first event. Interesting was that integrated export often occurred simultaneously with other forms of export activity, clearly as part of a planned growth and development strategy.

Integrated/internalised production links (minority or majority investment in overseas production) was reported by less than 4% of firms. Although the results suggest that small/young firms do not make such investments as a general rule, those which did, did not necessarily do so after a lengthy internationalisation process, or following the sequential steps suggested by stage models.

Formal cooperation tended to occur very early in the life of the firm and results, although inconclusive, suggest that such arrangements are an important catalyst of internationalisation involving firms in a range of value chain activities and complex linkage patterns.

Why Does International Expansion Begin?

The firms included in this study were small, under 200 employees and most under 50 employees. They were also young, and could be described as technology intensive. At least two thirds of the firms were totally independent and very few had previous contacts with organisations based overseas. The extent of contact with the international environment was high and over 85% of firms reported some kind of contact with individuals or organisations overseas.

Determination of why international expansion might begin was made by examining the characteristics of the firms, their products, markets / industries and management of overseas contacts with specific types of overseas links and with indicators of growth and development.

Overall, assessment of the results in Chapter 7 suggests that individual firm characteristics and conditions have little if any effect on firm internationalisation. The major exception to this is the consistent association of research related activity with measures of international performance and growth. In general, the more R&D/innovation intensive firms are, the more likely they are to have higher levels of international ratio, and they are likely to export to a greater number of countries than firms with less R&D involvement. Firms which were established specifically to exploit a technological or scientific innovation were also found to be more dependent on overseas based activity than those which were not.

The size of firms was found to be of some importance as regards international ratio and the number of export countries, but in general, size was not associated with measures of growth and development. The age of the firm was not found to be important in relation to international growth and development. In general, the only real indication of association or causality between individual firm characteristics and international growth and development was in the level of involvement in R&D.

Examination of the proliferation of link types established by the firms in the study (see Table 7.11) indicates that trade links are those most commonly formed. Both import and export were activities undertaken by a majority of firms and the involvement of more than half of the sample firms in direct export activity suggests a strategic or at least proactive motivation towards international expansion.

Further examination of individual cross-border link types with firm characteristics indicated that association between these variables was not significant in most cases and often not clear-cut where it was (see Tables 7.15 to 7.21). Considering the incremental

steps of the export development models, it might be expected that firms might reach a critical age, and/or size and then develop export links. There was little support for that approach in the results. Age was found to bear no relation to the formation of any type of cross-border link and firm size was as likely to affect import as it was export links. Within the sample firms then, domestic growth and development of the firm is not in itself a trigger for the formation of cross-border links.

In general, examination of firm characteristics with types of cross-border links were interesting only in that they failed to support more conventional views of internationalisation. The only clear indication of causality was found in the association of investment in R&D with the formation of cross-border R&D links which was evident in inward, outward and cooperative research based links.

Marketing, or export explanations of internationalisation suggest that product or market factors are those which trigger the process. In particular, competitive home markets and very specialised products have been amongst those associated with initial international activity. Findings here were interesting. Firms with high technology and more involvement in innovation were found to be more dependent on overseas sales. Similarly, more complex products were associated with higher international to domestic turnover ratios. Standardisation and customisation of products (response to market/industry conditions) were not however found to be important in association with measures of international growth and development. Of particular interest was the negative association of the number of substitute products in the UK with international activity (Table 7.22), which appears to directly refute the reactive move into export markets advanced by some studies.

In terms of causality, the most important results are again associated with R&D activity, innovation and product complexity. Determination of whether these factors are push or pull factors in relation to internationalisation is beyond the scope of this study. However, it is clear that technology, innovation and the nature of the product are the key factors in the internationalisation of high technology firms.

Efforts made by management in establishing and maintaining contact with overseas individuals and organisations was found to affect the growth and development measured as international ratio, export growth and the number of export markets. Turnover growth was not affected. Factor analysis indicated three patterns of contact which reflected contact with overseas research, trade contacts and contacts with professional organisations. Increases in frequency of contact with overseas research and overseas trade contacts were both found to be associated with higher levels of

international ratio and numbers of export markets. While it could be expected that contact would increase as business increases, it should be noted here that indirect export requires little if any contact by firms with overseas markets and R&D links, being focused on research activity have an indirect effect on the turnover of the firm. There is some indication of causality here, therefore and it is suggested that contact with overseas individuals and organisations plays an important strategic role in the international growth and development of the small firm.

Overall, the results of the analysis in Chapter 7 are important in their failure to support firm size and age as causal factors in the internationalisation process. Rationally, these factors alone would not be causal factors in relation to international expansion but it could be expected that very small, very young firms might be prevented from beginning internationalisation. No evidence to that effect was found here. In addition, if small firms always begin internationalisation through export modes, it could be expected that product/market factors, or factors related to the firms' competitive stance or performance in the domestic market might be associated with the type of cross-border links established, or indicators of export performance. That argument was not supported in this study and there were some indications that specialisation in, or emphasis on a particular value chain activity influences the type of cross-border link formed and hence the subsequent pattern of internationalisation. This was particularly true of firms' involvement in R&D, innovation and complex high technology products which influenced the type of links formed and also the level of overseas activity.

The identification of individual factors which influence the international expansion and growth of the firm are not particularly useful in determining whether or not a small firm will expand overseas and what modes it might include in the process. Logistic regression analysis (Chapter 8) attempted to determine on a firm by firm basis, the likelihood of inward and outward R&D, production, marketing/distribution or formal cooperation links being formed.

It was found that different combinations of variables were important in respect of the formation of each type of value chain link. In each model constructed the variables differed in respect of their individual effect on the probability of that cross-border link type being formed, and in their combined effect with other variables. In general, it was found that *individual* firm characteristics, market/industry conditions etc. had very little effect. Rather, it was the interaction of different combinations of factors for each firm which contributed to the overall probability of a particular type of cross-border link occurring. This brings to mind the description, used elsewhere in this thesis, of small firms as "bundles of competencies and capabilities" (original source unknown). Far

from being a homogenous group, small firms vis-à-vis their international expansion differ widely in the way they “assemble” and mobilise their resources and competencies.

Examination of the logistic regression models provides clear evidence that small firms differ in their make-up, but, and more importantly here, the factors influencing the formation of cross-border link types vary according to the special circumstances and conditions of each firm. This suggests very strongly that international expansion mode and the internationalisation pattern followed by each firm should not be a uniform progression through various export modes but should reflect business modes appropriate to the activities and goals of the firms. This suggests two further arguments. The first is that there is much more considered strategy behind small firm internationalisation than they have generally been given credit for and second, that they may be much more vulnerable and less knowledgeable about the opportunities but also the challenges and threats posed by the internationalisation of technology and the business environment than might be supposed.

In terms of an explanation of international expansion, or at least the cross-border activity of small high technology firms, this was sought from a number of theoretical approaches. Examination of the results in general suggest that resource-based issues are fundamental to the formation of cross-border links. Firms which are R&D intensive or established to exploit an innovation were found to be less likely to establish outward R&D links than those with less active R&D involvement. This suggests that outward R&D links are sought when the firm lacks in-house capability. Resource needs, capability and specialisation were found to be major determining factors in the establishment of inward R&D links. This pattern is similar for those firms which form inward production links especially contract-in manufacture which occurs where indications are that the market is well developed, competitive and in which small firms serve niche markets through the production of standardised technology.

Resource-based explanations were not so useful in explaining outward production. Here the formation of outward production links was associated with the development and performance of the firms' export activities and investment in R&D. Explanation here can be found to some extent in the internalisation approach which suggests that overseas production occurs when the firm is sufficiently well developed to support investment overseas. Important here is that outward production includes contract or transactional production links suggesting that, irrespective of whether overseas production represents investment or contract arrangements, the home base needs to be reasonably well operationally developed to support such activity. It is interesting to

note that *size* and *age* are not factors included in the outward production model but evidence of established export and R&D activity are. Picking up the point made at the end of Chapter 4, that cost structures vis-à-vis investment in production have been changing (i.e. changes such as the micro scale of modern technology have significantly reduced investment costs), the most likely explanation is that the development of the firm (capabilities, competence and experience) is important to a greater extent than size, age and investment potential. This perspective draws on the underlying assumptions of Johanson and Vahlne's (1977, 1990) models, which state that *knowledge*, especially experiential knowledge are important in the internationalisation process and certainly, in the statistical model reported here, that would appear to be the case for outward production links. Returning to resource-based explanations, it is possible here that *knowledge*, gained from international involvement, is a firm resource requisite for the development of overseas production.

Inward marketing links were found to be associated with the firms' resource needs, but also, by inference, their capabilities and knowledge in domestic markets with high levels of substitute products. It would appear that their expertise is sought by overseas firms for import and UK distribution where the market is very competitive. Outward marketing was found to be associated with an international predisposition, sustainable output and managerial effort (frequency of contact with customers and distributors/agents). In general, firms with higher levels of turnover were more likely to establish outward marketing and age was of some importance in the outward marketing model. These findings suggest that export activity does require some basic foundation conditions for links to be established successfully and even amongst the small firms in this study, there is some evidence that the size and age of the firm are of some relevance. Contrarily though, the event analysis reported previously lends little support to the idea of sequential development.

Of some importance as regards the growth and development of small firms is the absence of any real explanatory variables in the marketing models. Adequate explanation for export activity is clearly not to be found amongst firm characteristics and domestic market/industry conditions. This suggests quite strongly that for small firms in high technologies at least, strategy and foreign market factors may be those which provide the triggers or motivations for international growth. There are several possibilities here:

- that small high technology firms have express intentions to expand internationally,

- that these firms are drawn into international markets through their involvement in international/global industries,
- that local markets are underdeveloped vis-à-vis their technology or have an inadequate infrastructure to support domestic development

The formal cooperation model produced some very interesting results which are summarised in Chapter 8. In summary there appeared to be two explanations of firms' involvement in formal cooperation arrangements. These were resource based explanation where R&D needs were being met through the arrangement, and internalisation explanations. In the latter, the cooperation arrangement appeared to eliminate the need for protection for IPRs, and in terms of in-house versus external R&D development served as a partial internalisation of specific value chain activities. Drawing on the event analysis and evidence from elsewhere in the results, firms with R&D links frequently have other value chain links also. In addition, cooperative arrangements were found to involve complex patterns of linkage formation over short periods of time and further, these types of arrangement were found to be mostly recent phenomena. This means of reducing the transaction costs associated with external links may represent a concerted, strategic move by small technology based firms to reduce the risks of rapidly changing, turbulent and internationally dispersed industries and markets. These are however ideas open to considerable further investigation. In the view of the researcher however, the most important issue emerging from the latter discussion is that *knowledge*, in this case in the form of firm specific assets and of the extent of the market is what determines the development and growth of the firm. That knowledge together with effective strategic management of external links provide the main clues to this form of international expansion of small high technology firms. These points are picked up later in the chapter and discussed in relations to theoretical developments.

Returning to the question "why does international expansion begin?", the analysis indicated that combinations of firm and industry factors were important in explaining the international expansion of individual firms, the mode of international expansion undertaken, and the pattern of development.

Firm age, size and industry were not individually important but together these factors had differing effects in causing or influencing the international expansion of small firms. Age in terms of chronological development was not important but experience, capability and the internal development of the firm was. Two issues which emerged from the multivariate analysis were that contingency variables are of some importance in

small firm internationalisation, e.g. economic climate, political ideology, industry structure and the international involvement of the industry are all factors which may influence small firms. This should be evident in patterns of activity examined over long periods of time.

The final answer to the question is that different combinations of variables were found to influence the formation of each type of value chain link and, combinations also differed by whether the links were inward or outward. Factors of particular importance were specialisation in a specific value chain activity, but there was also evidence that firms' competencies, capabilities and resources are the factors which largely determine their internationalisation. Explanation for international expansion was sought from several theoretical areas and development of a model or theory of the international growth and development of small firms needs to be eclectic, or at very least to draw together key factors from established theory. From this analysis the most pertinent points at which established theory could converge or be integrated are *knowledge* and *external links*. This suggestion is developed further below.

How Important are Cross-Border Linkage Activities to Firm Development and Growth? Discussion at the end of Chapter 8 suggested that the answer to this question is inconclusive. In actual fact it tends to raise a number of further important questions in relation to the international expansion of small firms.

Summarising first of all the individual factors which were found to influence international growth and development, firms which are more innovative, which have high rather than low technology and which invest more in technology, have higher growth rates than others. Firms with more complex products, with high technology products and processes and which are more innovative, again, have higher international ratios. High levels of competition in the domestic market appear to act as a barrier to international expansion keeping these firms busy at home. Technology factors again, in particular technological innovativeness and product complexity influenced export growth and number of export countries.

In terms of the importance of cross-border linkage activities on firm development and growth, this question remains largely unanswered but the analysis raises important and exciting issues for future research. One indication that cross-border links are important is the association between the frequency of contact with overseas partners and the international growth and development of the firm. Effort in that respect is clearly of some significance and, from a network perspective, the establishment of links or bonds

is important for the development of cross-border relationships, an acknowledged starting point for internationalisation.

Of considerable importance in answer to this question is the diversity of types of links formed by firms at early stages of their international growth, and the patterns by which such links are formed over time. The fact that small firms do form international links early in their lives suggests that these are of some considerable importance to them since, except where the approach is from outside, overseas contacts are not necessarily easy to establish.

The influential factors, indicated by logistic regression as important to the formation of cross-border links indicate that different goals or objectives are being met through the types of links formed by firms. Most importantly, the types of links established at early stages of firms' development may establish whether the firm will internationalise, what pattern the process will take and the extent to which it will be successful in terms of growth, development, performance and competitiveness in international markets.

The cross-border activities of small firms in their formative years are therefore of some importance to the firms themselves and to government policy makers, it could be found that some patterns of activity are more likely to lead to success than others. Lessons to be learned include those relating to the identification, establishment and management of external contacts, and more importantly for small firms, how those external contacts could be used to provide access to resources, and provide knowledge on technology, business practice and international markets. In addition, it should be possible to learn from firms which successfully combine link types and strategies, to reduce the transaction costs and risks associated with international business activity.

These questions are important in themselves but at this point an integration of some of the key issues from theory begins to emerge. Examination of external link formation at early stages in the life of small firms could facilitate integration or convergence of behavioural/network approaches to firm growth which examine and describe patterns of development but are weak on performance, and economic/internalisation approaches which offer explanations for static one-off decisions but struggle with apparently non-rational behaviour and dynamic contexts.

Further statistical analysis of the data in this research has been planned with a view to addressing some of the issues. In particular, it is planned to develop the analysis towards the determination of the intensity or performance of linkage activity in relation

to international growth and development. Some questions which emerged from analysis of the event data include:

1. Which type of links are typically established together?
2. Are there typical patterns of linkage activity?
 - mode intensity (i.e. number of modes established in 1 year).
 - mode diversity (i.e. number of modes established in 1 year x number of countries in that year)
 - geographic concentration (number of modes concentrated in each country).
3. Can firms be statistically clustered/grouped by linkage patterns?
4. Do firm characteristics differ by linkage patterns?
5. Are particular linkage patterns associated with performance (growth rates, turnover levels, overseas/domestic turnover ratio)?
6. Are particular linkage patterns associated with firm characteristics (independent variables)?
7. Are particular linkage patterns associated with company/industry factors, entrepreneur factors, linkage management activity?

Investigation into appropriate statistical procedures which might be used to explore and interpret the data is in progress. It is likely however that further survey research with a larger sample will be necessary to develop and assess the validity of the measures suggested above.

The first two questions in the list have at least partially been addressed through the event analysis described and discussed in Chapter 8 and earlier in this chapter. In general it was found that marketing/distribution links were almost always included with links of other value chain activity, and that integrated/internalised links were not especially common to the sample firms. Otherwise, any combination of links seemed to be possible.

In terms of linkage activity, manipulation of the data on chronological dimensions indicated five patterns of activity. These patterns were based on the intensity of activity at specific event periods, and the duration of time between events. Possibilities for generating measures of cross border activity based on the intensity of activity have been explored and present challenging opportunities for further analysis as indicated in the remaining four questions of the seven listed above.

One of the most important reasons for pursuing this line of questioning is the need to identify firms with growth potential for a number of reasons including the granting of government assistance or support, and the need to establish best practice amongst firms for bench-marking purposes. One of the research reports studied in the early stages of this thesis related to the competitiveness and growth potential of small high technology firms (Rothwell and Dodgson, 1992). Those authors suggested that such firms exhibit the following characteristics:

- aggressively growth oriented
- highly export oriented
- vigorously new product oriented
- strongly market oriented, and
- intensively externally networked.

The first four factors have been associated with international expansion, the final point however is one which has not been adequately studied in relation to the internationalisation of small firms. There is a clear need to pursue this point and this study has made an important step in that direction, especially as regards the performance of firms internationally in relation to their linkage patterns.

Findings in Comparison to the 1997 OECD Report on SME Globalisation

The publication of a cross-national study of small firm globalisation a few months before the completion of this thesis was especially interesting to the researcher. This section of the chapter takes the opportunity of making a few comparisons and comments on this study in relation to selected findings from the OECD report. The results of the 1997 OECD report on globalisation and SMEs is especially interesting as the research took place concurrently with this study. The results of an 18 country study provide important points of reference for this and other studies of small firm internationalisation.

The OECD report acknowledges the inward and outward aspects of SME globalisation and suggest that these represent, “new challenges for outward expansion and growth”, and that, “inward globalisation poses new competitive challenges” (OECD, 1997, p7). This study has suggested additionally that inward links from abroad may stimulate, or act as vehicles for firm growth and development. This may especially be the case

where inward links provide access to resources and technological knowledge which the small firm otherwise would not have.

The OECD study found that most SMEs internationalise by an evolutionary strategy based on exports and imports, but a growing proportion avoid that strategy and move immediately to a more global approach (OECD, 1997, p8). The findings of this study lend little support to the former statement and considerable support to the latter. This study found that most small firms in the sample did in fact follow internationalisation patterns which differed from the conventional evolutionary export approach. This could be expected from the sample however which consisted of high technology firms renowned for their rapid internationalisation in industries especially subject to globalisation forces. However, results in both studies may be affected by their different conceptual approaches.

This study from the outset examined cross-border links as part of a holistic growth process. An approach which to some extent depends on the use or development of a sampling frame which includes firms pursuing all possible modes of cross border activity. In the case of very small firms selecting or constructing the data base requires some rigour to ensure that the population domain includes firms of interest to the study (see the extensive discussion of data bases in Chapter 6). A full understanding of the early internationalisation processes of small firms is conceivably hindered or even biased due to the inadequacy of available data for survey work. The OECD report suggests implicitly that this is an important consideration.

Examination of the individual country reports making up the OECD study indicated variability in research design and in the sampling frames used in instances where survey research was the main mode of study. Some country reports concentrated on exporters, others attempted to examine other types of firms but were limited by the directories and government statistics used for sampling which tend to be limited to export data and occasionally investment. In some country reports, notably Australia, government statistics were acknowledged as inadequate or unreliable in their reporting of the international activities of SMEs. The UK report was based on a literature review, a survey of 1000 *exporting* firms, seven SME interviews and discussion with government departments etc.. This *export* focus was fairly common across the countries, the most holistic review being provided by Finland where longitudinal studies of SME globalisation have continued since the 1970s (Luostarinen et al, see previous chapters for discussion and references).

The most important factors emerging here are that firstly, there is a world-wide trend for a group of SMEs to internationalise rapidly through non-conventional modes and processes and secondly, that this phenomenon is widely under-researched and currently not well understood. This thesis has made a comparatively small (by OECD scale) but important contribution to the much needed study of the internationalisation processes of firms which are most likely to benefit from, or feel the impact of globalisation forces.

Another finding of the OECD report was that SMEs use many different strategic options in combination to achieve their internationalisation, and these strategies are becoming more complex (OECD, 1997, p7). The findings of this study on cross-border link formation certainly lend support to that statement. Even in very early formative years, some small firms in this study were found to establish widely differing combinations of value chain links and inward/outward links reflecting either resource needs or strategies for the exploitation of firm assets. In support of the OECD result this study also suggests that patterns of link formation are becoming more complex and are developing more rapidly.

The OECD report indicates that SME's size and maturity make a difference to the firms' propensity to commence international activity. This study, which was confined to smaller and younger firms and specific industry sectors found these variables to be less important than the firms' experience and competence. While this statement appears in some respects to be contradictory, results here suggest that firms which concentrate on development may build up experience and capability more quickly than others. An important implication here is that international competence or capability may be developed through appropriate training or other infrastructural support.

The report found that certain strategic factors e.g. marketing and distribution were more internationalised than others. This study looked at the issue in a slightly different way. It was found that marketing and distribution links were much more common than other strategic value chain activities, but there was nothing to suggest that small firms did not or could not internationalise their R&D and production activities. This is an important issue as regards the type of support which is provided for internationalisation by governments, in general emphasis is almost always on exporting (marketing and distribution).

The OECD report found the internationalisation process to be accelerating. The event and gap analysis in this report added support to that statement. Firms undergoing internationalisation processes in recent years tended to exhibit more complex events,

and much shorter gaps between events than the older firms in the sample. In addition, young firms tended to experience a very short period of domestic activity before establishing cross-border links, or established these immediately.

The points discussed above are some of the key issues emerging from the OECD report which are comparable with the findings and approach of this study. Much of the OECD report is concerned with the development of an index of SME globalisation to measure the extent of internationalisation activity which is undertaken by SMEs.

Findings in Relation to the Research Objectives

The first four objectives (box 5.3) have been discussed fully in relation to the research questions earlier in this chapter. The fifth objective was to comment on models or theoretical frameworks predicting the pattern of international growth and development of firms with specific reference to small technology based firms. Discussion throughout the results section has drawn on theory for explanation of the findings. The main issues are presented here as arguments which state the study findings and implications in relation to the main theories. The following arguments are advanced:

- The nature/mode of international expansion for small high technology firms will depend on the firm's capabilities/resource needs and will take place through the establishment of cross-border links in specific value chain activities.
- Consistent with the network/behavioural school, internationalisation is through the development of links with external organisation.
- Contrary to the network/behavioural school, for small high technology firms links formed are more likely to be part of a proactive expansion strategy than an evolutionary learning process.
- Consistent with the internationalisation/export development school, international expansion is likely to be a gradual process but stages/modes are not bounded by the functional export sales approach and will incorporate other value chain activities.
- Consistent with the internalisation approach, integration/internalisation is more likely to occur later in the international development of the firm

but may not follow the export -> licensing -> overseas production route, rather any of these activities may take place early in the development of the firm but are likely to be managed through contract (management of external resources) in early stages and consolidated through greater investment and/or integration at a later stage.

- Consistent with the Greiner (1972) model of firm growth in the domestic context, international expansion appears to take place spasmodically with flurries of activity followed by gaps of varying lengths between.
- Contrary to the internationalisation approach, stages of development are likely to be much more varied, more strategy determined than incremental, and , except in a few cases, are unlikely to be linear.
- Consistent with the network/behavioural school and specifically Johanson and Vahlne's (1990, 1977) model, learning and experiential knowledge are likely to be important components of the international expansion process of small firms but more widely interpreted as a firm resource, competence or specific asset than the more narrow psychic distance/market knowledge interpretation.

The above points indicate that the results of this study are consistent with some aspects of established theory, but contrary to others. Network and internationalisation approaches describe aspects of the process, while resource based and internalisation / transaction cost approaches offer some explanation of mode decisions. Explanation of very small firm internationalisation is challenging because of the relative inseparability of specific functions, aspects and directions of small firm growth. Theoretical approaches, as discussed in Chapter 5, tend to be too narrow in their explanation to encompass the many different forms and directions of early growth. Results here however, indicate that there are areas of convergence amongst the theories which could be usefully integrated towards a composite explanation of small firm internationalisation. Areas of convergence identified in this study are knowledge, as a firm specific asset, and external / internal links. Points of convergence are illustrated in Box 9.1. The different theoretical approaches examine knowledge and links in different ways which are identified and listed in Table 9.1.

Taking the points from Table 9.1 into consideration, and drawing on the findings of the research, it is possible to advance arguments which cross the boundaries of the main theoretical approaches.

Firstly, establishment of external links amongst the sample firms would seem to be less of an organic, evolutionary networking process than a strategic response to resource needs and the need to exploit firm advantages. Small firms are renowned for their networking capabilities and it would be naive to suppose that such skills are not transferable to international or global markets. Evidence that the sample firms are able to establish production, R&D and marketing and distribution links with overseas partners at early stages in their development has been presented in this study. The absence, in most cases, of a sequential flow from one export link to another more risky or committed export link type, suggests that while relationships are important, the first consideration for firms here is to establish links which reflect the nature of their business at specific periods of time.

Secondly, the establishment of links, whether inward or outward, is associated with different combinations of firm capabilities, competencies and resources. From evidence here, it would appear that firms which are successful in internationalisation are those which have developed and grown in terms of their competencies and capabilities. Learning and knowledge are important here, but this goes further than the country / market knowledge approach often discussed in relation to internationalisation.

Thirdly, the common acceptance, across all theoretical approaches that small firm internationalisation takes place, at least initially, through transactional means or informal links, is confirmed by this study. The limitations of the small firm resource base in almost all cases precludes the possibility of expansion through internalisation. However, and this is seen as a major issue for future research, internalisation / transaction cost approaches over the last 20 - 30 years have concentrated almost exclusively on explanations of growth through internalisation, as the name implies. The usual association of internalisation with ownership and control restricts the explanatory capability of the approach to firms with adequate resources to make cross-border investments. In the internalisation model *resource problems and issues* are implicitly ignored. Modifying the *ownership* and *control* assumptions in the internalisation approaches to *influence over external links* would allow the model to explain more adequately, differences between external /transactional forms of international expansion on a continuum from influence to control with ownership occurring as a consolidation of business activities in a particular foreign market.

Changing the emphasis of the internalisation approach towards external links, and incorporating the resource dimension amongst firm specific assets (rather than ownership advantages) opens up the potential for explaining, not only the choice of cross-border business modes but for incorporating the dynamic process of internationalisation. This latter explanation is currently not included in the static internalisation model.

Box 9.1 Theoretical Approaches to International Expansion of Small Firms/ Points of Convergence and Potential Integration

Internalisation Approaches

Links

- Production chain
- External contractual/transactional
- Internal integrated ownership

Knowledge

- Competitive focus
- Market Imperfection
- Ownership advantage
- Bounded by opportunity.

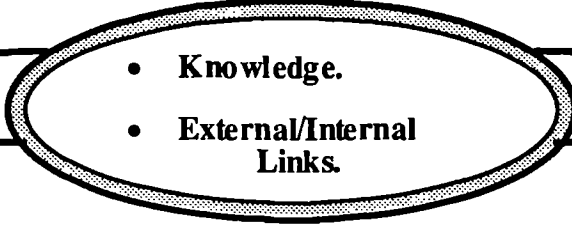
Resource-Based Approaches

Links

- Value chain innovation/production
- Technology transfer inward/outward/collaborative

Knowledge

- Growth/development focus
- Bundles of resources, capabilities, competencies
- Accumulation/exploitation
- Bounded by extent of protection.



Internationalisation Approaches

Links

- Trade - mostly export
- External outward transactional exchange
- Internal integrated channel ownership/control

Knowledge

- Product/market focus
- Market development experiential
- Bounded by resources ie size, age, experience

Network Approaches

Links

- Relationships/bonds economic financial technical knowledge social
- External trust-based/reciprocal cooperative contractual

Knowledge

- Learning focus
- Growth/development
- Bounded by extent of network

Table 9.1

Approaches to Firm Growth and Development: Knowledge and Links

	Internalisation	Internationalisation	Resource-based	Network
Focus	production chain	export development	firm growth & development	relationships (bonds)
Emphasis	ownership/control cost/risk	sales volume/profit geographic spread	knowledge, other resources	network development and growth
Discipline	economics	marketing/distribution	technology management, business strategy	behavioural
Type of Links	external (transactional) internal (integrated)	independent/ contractual	R&D, production, commercial	economic, financial, technical, knowledge, social.
Importance of Links	demarcation of MNE boundary and control	as customers and/or intermediaries	access, use, control and transfer of resources	systems based, organic expansion
Direction	In/Out	Out	In/Out	Complex/multi-directional
Role of Knowledge	market imperfections firm specific assets	experiential export process/ country market	as a resource	demarcation of boundaries of network
Interest in Knowledge	competitive	management confidence, and competence	proprietary, technology transfer	market knowledge, shared resource
Bounds on Knowledge	bounded by opportunism	bounded by entry mode and size/age of firm	governance structures	bounded by network structure/ membership

Contributions of this Research

Contributions to the Development of Theory

The Development of a Model

Buckley and Chapman (1997) indicate that there are essentially three ways to tackle an explanation of the internationalisation of firms. The first they suggest is to adopt a prospective model. In this approach the initial conditions are established and (independent variables) and the research determines how the independent variables impact on internationalisation (the dependent variable). The second approach they identify is a retrospective approach, which is one in which the researcher takes the end-point (current state) and looks back over time to ascertain how this point was reached. The third approach is longitudinal research which attempts to examine processes as they happen over a period of time.

This study has combined elements of the first two approaches in that the conceptualisation included a *prospective method*. The prospective method is evident in the research constructs or explanatory variables, i.e. the characteristics of the firm, and specifically the value chain activities, the external links of the firm dimensionalised as inward/outward links and integrated/transactional links, and the growth and development of the firm considered on performance and structural dimensions. The explanatory variables included in the research, drawn from extant research on the subject indicate prospective method in the research approach.

The retrospective method is evident in that the research looks back at the historical international growth and development of the sample firms from the point of time at which the survey was conducted. The purpose of the research however was exploratory and one of its main aims was to provide a strong empirical foundation on which to build future research. The information collected and discussed in this thesis provides a substantial guide as to what to look out for in a truly longitudinal study. One of the problems in ethnographic, or real-time research, is that events may not be seen as significant and therefore not picked up by the researcher. In observation studies, where the researcher records everything, that possibility would not arise, but in longitudinal studies of firm growth and development, where the researcher cannot possibly observe all activities over a substantial time period, a method must be devised to ensure that all relevant information is collected. This research, which has made considerable efforts to combine elements of some of the most important studies of internationalisation from

different theoretical approaches, has provided a more holistic perspective than most previous research.

The framework, and areas of questioning and reasoning developed in this study could be easily adapted to a forward looking longitudinal study of small firm internationalisation, taking a sample of start-up firms and tracking their external cross-border links over a number of years.

Theoretical Development

This study does not purport to have developed a new theory or model of small firm internationalisation. It does however claim to have made important advances in the conceptualisation of the research problem and in the research method employed. In terms of theoretical development, synthesis of the literature and discussion of the results of the study suggest that for small firms, and in particular start-up firms there are issues of importance common to a number of theoretical approaches. These issues, the formation of external links, and the firm's knowledge are important components of the three main theoretical approaches employed in this study and represent potential points of integration or convergence between these approaches. It was suggested in Chapter 5 that explanation of small firm internationalisation is most likely to emerge from a synthesis of transaction costs/internalisation approaches and resource based approaches to firm growth. Interpretation of the results suggests that the points of integration may be, as suggested above, external links and knowledge, but more importantly, these issues also converge with network/behavioural and internationalisation explanations of international expansion. The areas of convergence amongst the aforementioned theoretical approaches are illustrated in Box 9.1. In addition differences in the ways the approaches examine and discuss the role of knowledge and external links in the growth and development of the firm are identified in Table 9.1.

Has a new theory or model been developed here?

The answer is no, not yet. However the researcher feels that progress has been made in the development of knowledge on small firm internationalisation and that through a process of continued synthesis and convergence of theory and method the development of a theory of small firm internationalisation is not far away.

Indications are that this theory will emerge from a convergence of the internalisation approach with resource or knowledge based approaches. Emphasis in the MNE literature has for a long time concentrated on and extolled the virtues of internalisation as the most cost effective expansion route with the added benefits of control. The

benefits of *externalisation* have to a very large extent been neglected and have only really come into the fore since the recession years of the 1980s to 1990s where upon *ownership* and *risk* became less attractive in light of diminished and highly competitive markets. As *externalisation* is most likely to be the expansion path followed by small firms, this side of the theory deserves more attention than it has hitherto been paid. As the starting point of MNE development too, the small firms sector deserves more thorough and more rigorous research than it has been given in the past.

Contributions to the Development of a Conceptual and Methodological Approach

Advances on Previous Research

This research represents a step forward in conceptual and empirical study of small firm internationalisation. Drawing on Andersen's (1993) suggestions for improving internationalisation models, his five points are discussed in relation to this study.

1. *"- The delineation of theoretical boundaries, ensuring the explication of assumptions which bound the theory (values, scope, time) should be amplified"*.

Efforts have been made to state as explicitly as possible, the boundaries of the study and the assumptions which have been made in developing the research design, constructs and measures. These issues have been discussed thoroughly in Chapters 5 and 6. To summarise, the study was one of firms of 200 employees or less, in explicitly named high technology sectors, based in England and Scotland which were found to be technology intensive and/or active in scientific/technological innovation. The approach was eclectic, drawing on internalisation approaches, internationalisation models, network and resource based theories for conceptual development and constructs.

2. *"- The models lack explanatory power. This implies vagueness in the purpose of the models. Why or how the process takes place or how to predict the movement from one stage to the next are not properly addressed. Little time has been paid to the time dimension to the process"*.

Considerable attention was paid to the time dimension in this study. Cross border events were analysed longitudinally for patterns or stages in the international expansion and development of the firm over the period of time from their inception to the date of the study. As the analysis identified events consisting of varying density in terms of the number and type of cross border links established, explaining movements between

stages is not appropriate. However while intuitive interpretation and explanation for the events has been made based on the theory and rich empirical evidence in the literature, it is acknowledged that considerable more work needs to be done on the causal factors associated with cross borders activity in the development of small firms. This study was limited to firm characteristics and product/market/industry conditions with some attention being paid to entrepreneurial capability and managerial commitment in terms of frequency of contact with overseas contacts. There is considerable scope for follow up studies of a qualitative nature to determine why specific links were made and the sequence of events leading up to each arrangement. There is also scope for further empirical work with a refined questionnaire and an expansion of the range and scope of explanatory variables.

3. “- *More attention should be paid to the convergence between theoretical and operational level*”.

In this statement Andersen is calling for theories and models to meet the criterion of testability. In the construction of this research design, as many variables as possible were measured on ratio scales. This has the advantage of giving more precise results and also expands the possibilities in terms of validation through subsequent study and in the range of statistical techniques available for analysis. Much of the information collected in the survey was *factual* rather than *attitudinal* which facilitates easier comparison between studies. There is considerable scope in this study for further refinement of the statistical models used, and tests of validity.

4. “- *The empirical design must be adapted to the theoretical model*”.

Andersen's main criticism here is with the cross sectoral nature of internationalisation surveys. This study did incorporate a cross sectoral dimension, but it did concentrate on narrowly defined sub-sectors within high technology sectors. The problem as seen by this researcher goes further than the problems of comparing firms across widely differing industry sectors. The problem is rather related to a failure of internationalisation survey research to:

1. Recognise and take cognisance of the heterogeneity of small firms.
2. Acknowledge contingency perspectives, i.e. the circumstances, climate and specific times at which firms make their internationalisation decisions.

This study was specifically confined to firms of 200 employees or less, and including age and size, attempted to differentiate between firms on their R&D intensity, ownership structure, foundation method, development of proprietary technology, products, market and industry factors and commitment to overseas contacts. Within the realms of possibility this list is short. In terms of the contributions of this research some progress has been made to an opening out of the understanding of small firm international expansion. The choice of event analysis and probability modelling is seen by the researcher as a step forward as it replaces the *inevitability* of the step/stage models with an estimation of likelihood of events taking place based on factors contingent to individual firms. The problems of longitudinal research have not been solved in this study but the event analysis suggests developments in research design for both the construction and analysis of large scale surveys and smaller scale long term chronological studies of the international development of small firms.

The final point made by Andersen (1993) is that step/stage models should have the potential to explain the initial stages of entry into international markets. This issue has to a large extent been fudged by most studies and the starting point of internationalisation is either assumed to be indirect export or is unclear. One significant contribution made by this study is the determination that there is no common initial entry mode. Initial entry mode is very much firm specific and is likely to be associated with the precise or specialised nature of the firm's activities. It is also evident that inward activities are likely to have some influence on the outward international expansion process. Explanation is partial and should be subject to considerable future investigation. In particular it is important that future research addresses the question as to why firms establish cross border links, rather than or in addition to domestic links.

Policy Implications

The extent to which small, high technology firms are involved in cross-border business activities at a very early stage in their development has not been fully recognised in the literature. This study has indicated that small high technology firms in the UK are extensively linked in a range of cross-border activities. From a policy perspective, there are at least three major concerns here. *The first* is to provide appropriate support and advice to small firms which is relevant to all modes of cross-border activity and addresses the growth and development needs of the firm. Better long-term *export* success might be achieved by the small firm sector if the early stages of cross-border link formation are encouraged and supported. Early stages would include R&D links,

production links and service activities as well as marketing and distribution and should include both inward and outward links. *The second* is to recognise the vulnerability or naiveté of small firms in their early involvements with foreign partners, particularly as regards the transfer of technology. *The third* and possibly most important, is to recognise that cross-border links may be used by small high technology based firms to augment their resource base and tap into external sources of capital, expertise, technological knowledge and business expertise. Small firms could be encouraged to become more adept at establishing and managing their cross-border links. Specifically, from the results of this thesis, there would seem to be three key concerns for small firm policy, these are:

- the flow of goods, technological knowledge, capital and revenue into and out of small firms, especially where the net flow is out of the domestic economy,
- the retention of small high technology firms in the local environment which means, especially where the role of the firms is one of flexible specialisation, providing an infrastructure and support mechanism to stimulate the start-up of small firms and support sustained growth.
- to promote and encourage links between small firms and locally or overseas based MNEs that will support, direct and encourage their international expansion.

Other than export guarantees and export advice, the UK has no specific policy concerned with internationalisation. Small firm policy (see Chapter 2 for a full discussion), at the present time is concerned with redressing market imperfections which discriminate against small firms, and the provision of supporting infrastructure while withdrawing direct financial assistance. Advice and training provided by government might be more effective if the emphasis was geared more towards the growth and development of small firms in an international context rather than, more narrowly, on their export needs. Technology initiatives which actively encourage cross-border collaboration (see Chapter 3 for a full discussion) could be integrated with current government export services to stimulate post, as well as pre-competitive technology transfer. To some extent the “one-stop-shop” type initiatives might address such issues.

Generally, is not surprising that the literature on small firm internationalisation is dominated by studies of export development. International trade theory (fully summarised in most international economics and business texts) emphasises the gains

from trade which will be realised by trading nations. Reinforced more recently by the competitive strategy school (eg Porter, 1990) which indicates that a nation's competitiveness depends on the capacity of its industry to innovate and upgrade, this concept has been central to government policy on firm internationalisation. Exporting is encouraged and supported by government and both aid and advice is frequently available to small potential and continuing exporters. Inward foreign direct investment is also encouraged to bring in capital and technology with the aim ultimately to stimulate and upgrade the nation's industrial base. Aid and advice for other forms and modes of international expansion is patchy and at present lacks a synthesised policy framework. There is some help for technology intensive firms within the auspices of technology transfer programmes which encourage cross-border collaboration; international expansion of the firm however is secondary to the main objective of speeding up the innovation process. Government attitudes towards outward direct investment have, since the 1970s tended to be neutral (Dunning, 1993, p568-9) with no specific policy to encourage or assist firms intending to make direct investments abroad.

While trade links remain the most frequently occurring links both inward and outward, the importance of other value chain activities are worthy of a great deal more attention than they have hitherto been paid by academics and policy makers alike. The growth of small firms is, and has to be a holistic process reflecting strongly the firms' capabilities and resources and also its role in the industry. In an increasingly international economy, small firms need to become experts in seeking, establishing, managing and nurturing both inward and outward cross-border links.

Small Firm Management Implications

This thesis has established that small high technology firms are often involved in international activity from very early stages in their development. It has also been suggested here that the international expansion of small high technology based firms is likely to occur through transactional arrangements and specifically through external links.

From a management perspective, firms clearly need to be willing to be able to inter-act cross-culturally. Specific issues include the need to search for suitable links within international markets and industries rather than within a more familiar and geographically close local market. As regards growth and development, the mode of cross-border activity and combination of link types are as important if not more important than choice of "export market". The challenge for these firms is to reduce the transaction costs of international business by means such as collaboration, piggy-

backing, licensing and extensive cross-border external networking. The dangers include the establishment of links which drain rather than augment the firms' resources or which are difficult to manage. The most fundamental issue is perhaps that owner/managers of small high technology firms need to be able to assess their capabilities, competencies and strengths, and also their resource needs vis-à-vis international or global markets. In that respect their strategy is likely to emphasise the need to exploit or augment their resources in the first instance through external informal and formal transactional links with other firms and organisations, some of which will be foreign.

Limitations of this Research

The main limitations of the research are indicated by its parameters, i.e. the assumptions made and its boundaries in terms of value, scope and time, all of which are discussed in Chapter 5. In addition the following points should be considered before making general assumptions from the findings to the small firm sector.

- In this survey, firms have only been asked to provide details of first links and no information is available on continuing activity with each mode or in each country.
- Information on termination of any particular mode or country activity has not been sought.
- First links may be one-off or "toe in the water" attempts to establish cross-border links and may have little relevance to the final internationalisation pattern. The main argument in defence of the approach taken is that corporate memory is more likely to recount significant events in the development of the firm, therefore the links reported may be considered to be those important to the firm development. In addition, trial and error, is a learning process and links formed, but subsequently discontinued, are likely to add to the firm's experiential knowledge of international business activity. One of the challenges for those providing support for small internationalising firms may be to increase the chances of cross-border links becoming positive rather than negative learning experiences.
- the research is exploratory and essentially is limited by a "small" sample size in relation to the possibilities presented by statistical event analysis.
- the research is retrospective and previous events have been analysed in relation to the firms' current state.

Issues for Future Research

The conceptual approach to this study (discussed in detail in Chapter 5) was exploratory in nature and formulated the research problem as a series of objectives, research questions and assumptions. The analysis of the research findings, including the desk research (synthesis of the literature) and data analysis have indicated that there are a number of important issues which could usefully be explored in future research. The most important points can be expressed as specific propositions for future research.

Proposition 1. External linkages are important in the development and growth of small, high technology firms both domestically and internationally.

- 1.1 That small high technology firms in general will exhibit a propensity to form external links and cooperate with other organisations.
- 1.2 That external linkages are crucial to the development of small high technology firms and where these linkages are cross-border, they will influence the nature and direction of the internationalisation process.
- 1.3 That for any one firm, international linkage activity may involve any or all of R&D, production and technical development, and manufacture and marketing.

Proposition 2. That the impetus for the internationalisation of small high technology firms will be vested in the need to exploit firm specific capabilities and / or the need to augment the resource base of the firm.

- 2.1 That international expansion of small high technology firms is likely to be influenced by the need to exploit technological and other forms of firm specific capabilities. These will determine the mode of internationalisation, and the rate of internationalisation.
- 2.2 That the nature of internationalisation (internalisation v. external links) will depend on the specificity of assets, in particular technological knowledge and the extent to which
 1. Each asset needs to be combined with externally held assets in order to make sale or transfer possible.
 2. Each asset can be protected (opportunism, bounded rationality), (development of innovations, application for IPRs).

Proposition 3: That small firm internationalisation is more likely to begin through external transactional arrangements than through internalisation.

- 3.1 That successful internationalisers will be those small firms which devise strategies to select links appropriate to growth. These are likely to be those which facilitate resource augmentation, minimise transaction costs and facilitate access to further links and learning experiences.

Proposition 4: That small high technology firms' internationalisation is more likely to take place through independent modes than formal cooperative modes.

4.1 That cooperative ventures are likely to be more significant as modes of international expansion in recent years than previously.

4.2 Where formal cross-border cooperation does occur, it may be undertaken for one or a combination of three reasons:

1. To reduce transaction costs in large, uncertain international markets.
2. To augment the firms' resource/knowledge base.
3. To compensate for inadequate infrastructural provision in the domestic market.

Proposition 5 That successful international growth and development of small firms will depend, inter alia, on:

1. The competencies, capabilities and resources of the firm itself. 2. The nature and stage of the firm's innovative activity. 3. The nature of technology being transferred. 4. The industry and stage of industry development.

2. The ability of small high technology firms to establish and manage cross-border links appropriate to their business activities and resource needs, and which will facilitate subsequent development.

Proposition 6. That small NTBFs (firms established specifically to exploit a scientific or technological advantage) exhibit different characteristics than technology intensive firms in general and are international from start-up.

6.1 That NTBFs are more likely to be NIVs (new international ventures) than technology intensive firms in general and that this phenomenon will be linked to the research intensity of the firm.

6.2 That small NTBFs exhibit a faster rate of internationalisation than technology intensive firms in general.

6.3 That for NTBFs firm development, innovation processes and internationalisation processes are inter-dependent and inter-linked at the early stages of a firm's life.

Conclusions

The purpose of this thesis was to examine the international expansion processes of small firms in specified high technology sectors with a view to the development of theory. Analysis of the survey results indicated that cross-border activity is common to small high technology firms and may consist of inward or outward links of any or all of the main value chain activities of R&D, production and marketing/distribution. Outward internationalisation could begin with any mode of cross-border activity although trade links were found to be the most common. Analysis suggested that firms differed by the types and combinations of external links they formed, the rate at which links were developed and the period of time between periods of international development. It was found that the type of link firms formed, whether inward or outward, and the main value chain activity reflected by the link type, was related to the

nature of the firms' business, characteristics and competencies. The most important contributions of this research were in the development of a conceptual and methodological approach which examined internationalisation at the level of the small firm, rather than specific firm characteristics such as firm age, or firm size. The thesis also made important steps towards an integration of theoretical explanations of the international development of the firm, and by incorporating resource considerations into established internalisation theory, and outlined possibilities for theoretical explanation of small firm internationalisation decisions and processes. The exploratory nature of the research design was intended to explore the international expansion of very small firms at early stages in their development, a field which has received little attention in the past and suffers from an under-developed literature considering the current importance of the topic. This thesis, concluded by formulating a number of propositions for future empirical research, based on the findings and implications of this study.

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Appendix 1
Statistical Procedures

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Statistical Procedures

Independent Variables: Data Reduction

Independent variables in this study are the firm characteristics. Nine basic characteristics were selected. Five of these characteristics (independent variables) size of firm (employees), size of firm (turnover), age of firm, level of R&D intensity (R&D % of 1993 turnover) and R&D intensity (% of 1993 FTEs), were recorded as ratio data, with the exception of turnover, which was recorded on an interval scale.

The ratio data was re-categorised into class groups and recorded as interval data. The size of the class groups was determined by the distribution and thus as far as possible, groups were constructed with even numbers of variables across the distribution. The meaningfulness of the data was also taken into account and for example, in categorising firms by age into class intervals, two separate classes for firms under ten years old were constructed in order to capture the different experience of new start firms. Firms between the age of 11 and 25 years have been collapsed into one category for convenience and because firms at that stage are likely to encounter less extreme changes in performance than those in the first few years of life.

The remaining four independent variables: firm independence, foundation method, NTBF status and industry sector are variables which fall into discrete categories and are thus nominal data. Two of these: firm independence and method of foundation were collapsed into two categories each because of the very small number of firms falling into the more detailed categories listed in the questionnaire. Level of firm independence is therefore measured simply as "wholly independent" or "not wholly independent" while method of firm foundation becomes either "new start" where the firm had no previous corporate existence, or "evolution" where the firm emerged from another organisation.

Independent variables where possible were reduced as discussed to nominal or interval data for statistical analysis where consistency across a number of variables is appropriate eg. in testing for association amongst independent variables where there are very few responses in some dependent variable categories.

Independent Variables

Independent Variables Regrouped for Analysis		
<u>Size of Firm (employees) n = 213</u>	f	(%)
Less than 10	56	(26)
11 to 20	52	(25)
21 to 50	78	(37)
51 to 200	27	(13)
<u>Size of Firm (turnover) n = 210</u>	f	(%)
Less than £0.5m	59	(28)
£0.5m to £0.9m	55	(26)
More than £0.9m	96	(46)
<u>Age of Firm n = 212</u>	f	(%)
New (5 years or less)	42	(20)
Young (6 to 10 years)	53	(25)
Adolescent (11 to 25 years)	80	(38)
Mature (26 years and over)	37	(18)
<u>State of Independence n = 213</u>	f	(%)
Wholly Independent	164	(77.0)
Not wholly independent	49	(23)
<u>Mode of Foundation n = 212</u>	f	(%)
New start up	135	(64)
Evolution	77	(36)
<u>R & D Intensity (percent of turnover 1993) n = 181</u>	f	(%)
Zero	20	(11)
1% to 5%	84	(47)
6% to 20%	49	(27)
21% to 100%	28	(16)
<u>R & D Intensity (percent of employees 1993) n = 182</u>	f	(%)
Zero	51	28
1% to 10%	62	34
11% to 20%	32	18
21% to 100%	37	20
<u>NTBF n = 213</u>	f	%
Yes	79	37
No	134	63
<u>Industry Sector n = 212</u>	f	%
1. Plastics and Composites	22	10.4
2. Biotechnology/Pharmaceuticals	34	16.0
3. Adv. medical instruments/appliances	48	22.6
4. Electronic equip/instruments for industry	54	25.5
5. Other	54	25.5

Selecting Statistical Tests

In selecting tests for statistical procedures, the most important determinant is the type of data. Data is categorised into: nominal data which effectively consists of numerical labels but with no numeric value, ordinal data which is essentially nominal data but where there is an order imposed, interval data where data is arranged into groups of equal value, and ratio data where each datum has a specific numerical relationship with all others. The type of data is determined by the scale of measurement of the variables. In this study most of the data was either dichotomous or ratio although two questions incorporated scales. The choice of statistical procedure is also determined by the size of the sample, the size of sub-samples and the structure of the data within the data set. For this reason, the first statistical procedures carried out involve descriptive and exploratory procedures such as frequencies, cross-tabulations, Chi-square tests, T-tests and correlations to determine the nature of the data, its adequacy for further testing and to check for the presence of outliers. These types of procedure familiarise the analyst with the data, and provide the opportunity to determine whether the assumptions on which specific tests depend are met by the data set. Chapter 7 of the thesis reports on much of the preliminary data exploration. In selecting the more complicated statistical procedures Tables A1.1 and A 1.2 detail the decision process.

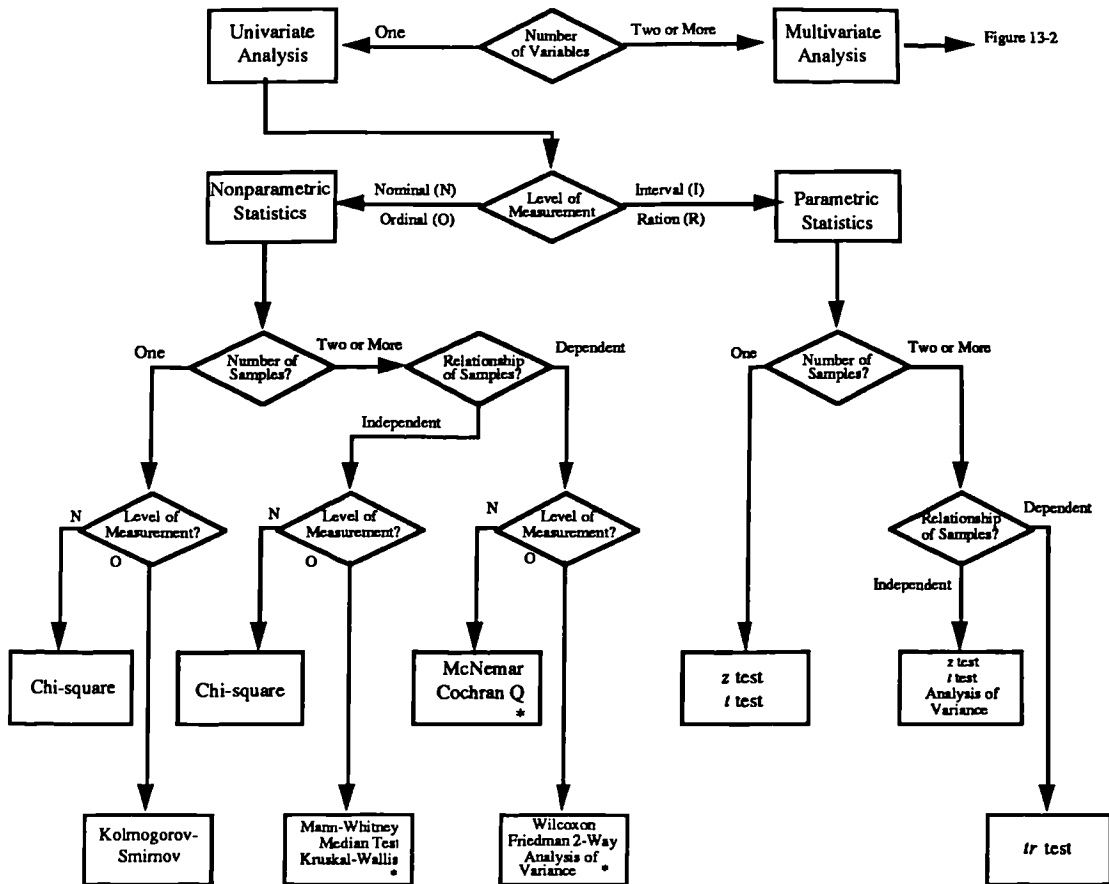
Cross-Tabulation

Cross-tabulation is a procedure which can be used with data on scales as weak as nominal or ordinal. The procedure is easy to apply and interpret and is flexible and robust (Alreck and Settle, 1995). Any type of data is appropriate as long as it is in categories, there needs to be a limited number of categories as variables are arranged in a matrix. Each cell in the matrix should contain at least five cases.

Use of Chi-Square

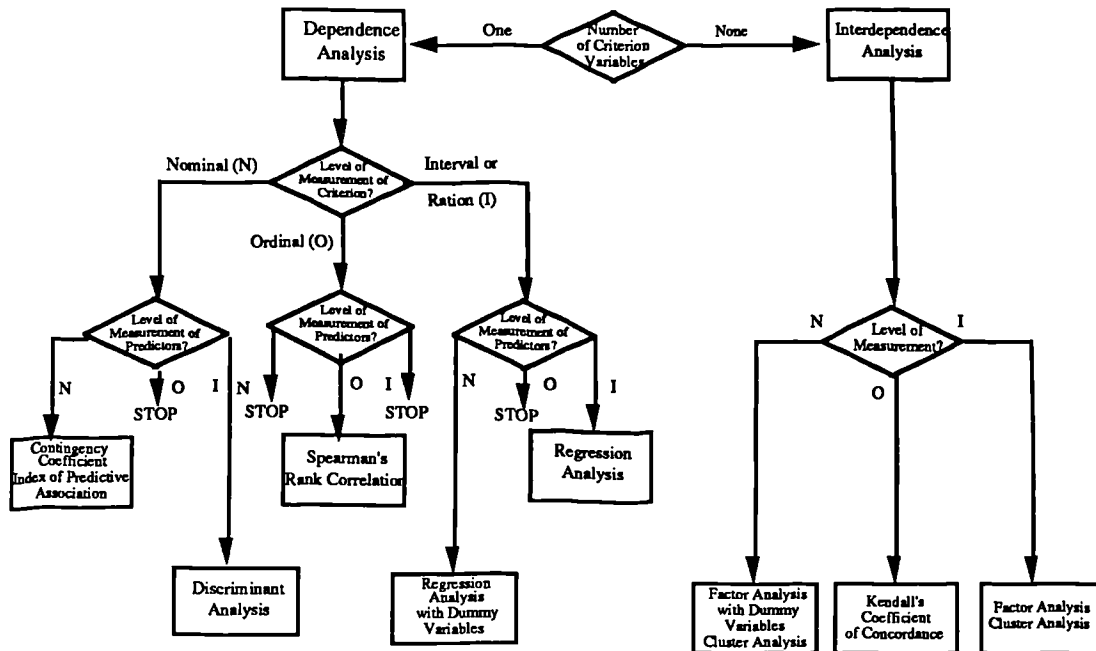
Where two samples are being compared in a cross-tabulation procedure, the chi-squared test for two independent samples may be applied. This test is a non-parametric test which may be applied to data as weak as nominal or ordinal scaling. The hypothesis is generally that the two groups being tested differ in the extent to which the proportion of cases from each group fall into the ascribed categories. If the proportions differ there is group by variable interaction, if there is no difference, there is no interaction (Siegal, 1988).

Flow Diagram for Choosing a Univariate Statistical Test



*These tests are not discussed in this book, although they are useful for some problems in marketing research.

Flow Diagram for Choosing a Multivariate Statistical Test



Interpretation of Chi-Square (χ^2)

The Chi-squared statistic measures the extent to which the actual frequency in the cells differs from the expected frequency. The closer the actual and expected frequencies are, the lower the value of χ^2 . A high χ^2 value indicates that there is disproportionality between the two samples. The significance level indicates whether the disproportionality is due simply to sampling error. The lower the level of significance, the less chance that the disproportionality arises purely from sampling error and the greater the chance of real difference in group by variable interaction across the cells.

Not significant - the variables are probably not related in the sample.

Significant - in the population as a whole, distributions across rows are likely to differ systematically from column to column and vice versa.

Factor Analysis

Factor Analysis: Analytical Procedure

In survey research, factor analysis is typically used for data reduction to reduce a large number of statements to a few factors (Alt, 1990, p49). In exploratory research,

it may be used to search for structure among a set of variables (Hair et al. 1995, p367). It may also be used to confirm the extent to which data meet the expected structure of the analyst. In this case, it is expected that different types of business activity will necessitate different patterns in contact frequency. For example, it might be expected that contact with a research lab may need to take place less frequently than contact with a regular customer or supplier.

To access the extent to which frequency of contact with overseas bodies and individuals affects international performance, overseas contacts which exhibited similar behaviour in terms of contact frequency were grouped by means of a common factor analysis. From the resulting factors, scales were constructed and tested for reliability. Each scale was then subjected to a 1-way anova test to determine whether, and the extent to which contact frequency is associated with firm performance. The procedure followed therefore was:

1. Construct factors to identify patterns of behaviour exhibited in relation to different types of overseas contact.
2. Construct cumulative scales from the factors and test their reliability.
3. Test the association between the resulting scales and the performance (growth and development indicators).

Factor Analysis: Constructing the Factors

In constructing the factor analysis, the decisions were based on alternatives and specifications recommended by Hair et al. (1995, pp365-405). As the research is exploratory and in this particular part of the analysis, the intention was to group variables rather than cases, it was decided to use an 'R-type' analysis (based on correlations between variables) and extract factors using a 'common factor analysis' rather than a component analysis. The former type of analysis is concerned with common variance shared by the factors, which is of interest in this study, the latter is concerned with total variance which is not.

The data was examined to determine whether or not it met the assumptions necessary for factor analysis as suggested by Hair et al. (1995). In summary:

- The sample, containing 213 cases was well above the preferred sample size of 100 or above.

- The number of correlations amongst the variables with correlations above .3 was considered adequate to proceed. Adequacy was confirmed by a Bartlett Test of Sphericity which proved to be strongly significant (Table 7.24). Accepting the limitation of this test, which becomes more sensitive to correlation as sample size increases, a measure of sampling adequacy was attained to validate the result. The Keyser-Meyer-Olkin test produced a result of .83, well above the .5 minimum acceptable level.
- Factor analysis should not contain both dependent and independent variables in a single factor analysis. In this case, only the dependent variable 'frequency of contact' with overseas bodies, individuals and institutions was included.

The number of factors extracted may be predetermined by the analyst or determined statistically during the procedure. In this case, the latter approach was taken which resulted in 3 factors which were subjected to a Varimax rotation, the result of which is presented in Table 7.24. The purpose of the rotation is to produce a simpler, more meaningful set of results without altering their value. Varimax does this by converting loadings to scores between +1 and -1 which indicate the strength of association between the individual variable and the factor on which it loads. Overall, the model constructed was considered to be parsimonious and representative of the data set.

Factor Analysis: Interpreting the Factors

The factor loadings, i.e. the figures listed under headings Factor 1, Factor 2, and Factor 3 in Table 7.24 were generally considered to be significant, for a sample size of 200 or more, at .4 or above. Each factor loading indicates the correlation between the variable and the factor on which it is loaded. The figures in bold typeface indicate the variables which have a significant or nearly significant factor loading. The three factor together account for 55% of the variance in the sample. This might be improved if the variable 'chambers of commerce' was to be dropped from the model.

There were two main purposes in constructing a factor analysis. The first was to determine whether overseas contact variables could be grouped according to patterns in contact behaviour in order to make subsequent analysis of frequency of contact

with firm performance more meaningful. For example, it would not be appropriate to compare the frequency of research contact with frequency of customer contact in relation to export growth as these activities are likely to vary considerably in the extent to which contact needs to be made. The factor analysis identified three factors which represent different patterns of contact activity. The second, and subsidiary purpose was that of data reduction and has resulted a grouping of 13 variables into 3 factors. The factors were subsequently used to construct compound scales.

Reliability of Scales

Scales were constructed from the variables selected by Factor Analysis and were tested using the SPSS alpha test for reliability. Nunnally's (1978) suggested cut-off of .7 was used as the appropriate criterion. Variables which produced a low item to total correlation were deleted. The subsequent alpha scores for the scales used were above the .7 criterion and were retained.

Logistic Regression

Logistic regression is a statistical modelling process built around the probability of an event occurring or not occurring. Similar to multiple regression which can be adapted to incorporate binary independent variables but assumes a continuous dependent variable, logistic regression can deal with a binary dependent, here the establishment, or not, of a particular type of cross-border link. In this thesis, a series of dichotomous questions on the formation of 7 inward cross-border links, 10 outward cross border links were reduced to three value chain links (production, research and marketing) in both inward and outward directions and formal cooperation (reciprocal directions), giving a total of 7 types of linkage activity. These were coded as having established a link (1) or not (0) and were the dependent variables for a series of logistic regression models (see also main text). Logistic regression essentially is an estimate of an event occurring (Norusis, 1994, p2) and is represented in the case of a single independent variable by the expression:

$$\text{Prob (event)} = \frac{1}{1 + e^{-(B_0 + B_1 X)}}$$

where: B and B₀ are coefficients estimated from the data using the maximum likelihood method (coefficients that make observed results most "likely" (Norusis, 1994, p3), and

X is the independent variable, and
e is the base of the natural logarithm (2.718 approximately).

Where there is more than one independent variable, a model may be produced which is denoted by:

$$\text{Prob (event)} = \frac{1}{1 + e^{-Z}}$$

where: $Z = B_0 + B_1X_1 + B_2X_2 + \dots + B_pX_p$

The main reason for carrying out this procedure was primarily to explore the interaction between independent and dependent variables and observe whether there were different patterns between the performance, growth and characteristics of firms establishing each type of value chain link, and then to identify independent variables which may predict the formation of each type of cross-border link. The aim therefore is to identify groups of firms sharing characteristics and circumstances which collectively predict a particular type of cross-border activity. While discriminant analysis, cluster analysis or factor analysis might be used, the assumptions of these techniques are not satisfied by the nature of the data here which include a large number of independent variables including all of categorical, interval and ratio data classifications. Logistic regression requires the satisfaction of far fewer assumptions (Norusis, 1994, p1). Another reason for the choice of method is the skewed nature of some of the frequency distributions (see Ch 7). One method dealing with skewness is to convert data to natural logarithms. As logistic regression uses the natural logs of the independent variables in its calculations, it automatically deals with any problem related to skewness.

Diagnostics

Collinearity

Collinearity occurs where the independent variables are correlated with one another and cause problems in linear regression procedures. Small levels of collinearity can be expected (Menard, 1995, p65) and are not especially important but as correlation increases, the number of estimates of the regression coefficients increases and therefore the chance of finding a unique solution decreases. Menard (1995, p66) suggests that levels of collinearity equivalent to an R^2 of .8 or more could seriously affect the results.

A linear regression procedure, which produces the 'tolerance' statistic for collinearity was run, using the same dependent and independent variables that would be used in the logistic regression procedure. Following Menard's suggestion that a tolerance of $\leq .20$ is of concern while a tolerance of $\leq .10$ might indicate a serious collinearity problem, the following variables were found to be of major concern.

Independent Variable	Tolerance
UK IPRs	.081210
OS IPRS	.082865
Employment in production	.103552
Employment in R&D	.058810
R&D intensity (employees)	.070394
Academic conferences	.091668

Norusis (1994b, p485) suggests that where two independent variables are highly correlated, only one should be used in the regression model. Menard (1995, p67) suggests that there is no easy solution and combining or eliminating variables may cast doubt on the theory used to construct the measures in the first place. Discretion in both construction and interpretation of the model is important here and it was decided that the three variables concerned with IPRS could be combined without losing information or altering the logic in the construction of the variables. Employment in R&D and R&D intensity, although use in different ways are essentially measuring the same phenomenon and it was therefore decided to replace the second measure (R&D intensity) by another variable which measured the same thing as a percentage of turnover rather than employment. This eliminated the direct linear association. No substantive sense could be made of the linearity detected in "academic conferences" and it was therefore decided to retain the measure in the model building process. A rerun of the tolerance test after adaptation of the problematic variables was found to have eliminated the problem in the case of the IPRs but there was still a strong linear relationship between employment in production and employment in R&D. As these measures were considered to be severally important, it was decided to deal with the problem at the interpretation stage (Menard, 1995; Hair et al, 1995, p127).

Model Building Procedure

1. All blocks of independent with dependent variables were run separately using the ENTER command.
2. Examined Goodness of Fit, classification table and plots and overall significance of model. Where unsuitable the following steps were pursued.
2. Each block was checked for low and non-significant Wald statistics and these were deleted from the list of variables selected.¹
3. Run backward LR as a check on variables selected (selection however based on manual identification of significant variables from forced entry procedure).
4. Entered selected variables together and repeated previous steps.
5. Selected final solution variables, examined plots, classification tables, Goodness of Fit, Model χ^2 and plots.
7. Interpreted model, interaction effects and coefficient probabilities.

Interpreting the models

Interpreting logistic regression models involves checking the Goodness of Fit of the model and then interpreting the effect of individual variables on the model. The Goodness of fit can be established in several ways; by examination of a histogram or plot of the predictability of independent variables for the dependent variable, the model χ^2 , and parameter estimates for the model before and after variables have been added.

¹Selection of variables for inclusion in the subsequent and final stages of model building involved examination of the Wald statistics and levels of significance. Variables with a very low Wald which was also non-significant were eliminated, and all other variables entered into the final model. The procedure was repeated in a manual stepwise process until the model could not be further improved by the addition or deletion of variables. This process overcomes the problems which might arise from the very tight criteria for variable selection in automatic stepwise procedures. Bendel and Afifi (1977) and Menard (1995), suggest that the criteria, usually adopted in such procedures, of selecting only variables with a significant Wald of ≤ 0.05 as too narrow for exploratory research where the primary objective is the identification of good predictors over and above the exclusion of poor ones. The partial correlations of variables were also examined as an indication of the extent to which individual variables interact with the dependent. Where partial correlations were very high the model was built with and without that variable to determine the best model improvement.

SPSS output includes a classification table which predicts the estimated probability of the model correctly predicting 1 or 0 (binary dependent variable). This alone is only an indication of whether the model is a good fit since it predicts only whether the estimated probability is equal to or less than one half.

The histogram or plot is more revealing and ideally responses should be clustered at either side of .5 (on a scale of 0 - 1). The more the responses are grouped at either end, the better the model is at correctly predicting the event (in this case the formation of cross-border links). In the event where responses are clustered around the .5 the model is less able to correctly predict the event and judgement should be reserved).

The parameter estimate or likelihood of the model is a very small number and is usually presented as -2 x the log likelihood. A model with a perfect fit gives a -2LL of zero. SPSS output includes the -2LL of the model with no variables and the -2LL of the model with all variables added. A reduction in the final -2LL from the initial value indicates an improvement in the fit.

The model χ^2 is the difference between the -2LL with no variables and that of the complete model, and tests the null hypotheses that the coefficients of all terms in the current model are zero. A small significance level ($\leq .05$) indicates that the null hypotheses (that the variables in the model have no effect on the dependent variable) should be rejected. NB Interpretation of the model χ^2 in logistic regression is different from that described in the section on Chi-Square above (where the null hypotheses is that the groups are independent and is rejected if the χ^2 is significant) Menard, 1994, p21; Demaris, 1992, p5). Here a high level of significance indicates the "badness of fit" of the model rather than the "goodness of fit" and a significant result $\leq .05$ indicates that the variables included do have some predictive effect on the dependent variable. The null hypothesis that the coefficients are all equal to zero should be rejected (Menard, 1995; Norusis, 1994).

SPSS output produces statistical tables of the independent variables in relation to the dependent. The columns include the regression coefficient which are the odds of the independent variable predicting the dependent. The regression coefficients are shown in two columns (β and $\text{Exp}(\beta)$) the first denotes the actual odds, the second is the change in the odds if the independent variable is increased by one unit (eg from 0 - 1) (Norusis, 1994, p7).

The Wald statistic performs the same function as the t statistic in multiple regression but has a chi-squared distribution. Very low Wald statistics are suspect and the significance associated with them may be misleading.

The partial correlation (\mathfrak{R}) is the relation between the independent variable and the dependent variable (-1 to +1). A positive value indicates that as the value of the independent variable increases, so does the likelihood of the event, conversely, a negative value indicates a corresponding decrease in the likelihood of the event. The smaller the values of \mathfrak{R} (closer to 0) the smaller the partial contribution of the variable to the model.

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Appendix 2
US SIC Codes

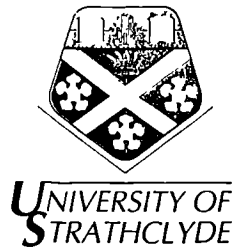
New and Emerging Technologies

US SIC Codes

(Roughly Equivalent to UK High Technology Categories)

2821	Plastic Materials, synthetic resins and non-vulcanisable elastomers
2822	Synthetic Rubber (vulcanisable elastomers)
2823	Cellulose man-made fibres
2824	Synthetic organic fibres, except cellulose
2831	Biological products
2833	Medicinal chemicals and botanical products
2834	Pharmaceutical preparations
3663	Satellites
3674	Semiconductor and related devices
3693	Radiographic X-ray, fluoroscopic X-ray apparatus and tubes, electro-medical and electro-therapeutic apparatus
3728	Aerospace equipment
3811	Engineering, laboratory, scientific and research instruments and associated equipment
3823	Industrial instruments for measurement, display and control of process variables and related products
3841	Surgical and medical instruments and apparatus
3842	Orthopaedic, prosthetic and surgical appliances and supplies
7391	R&D laboratories

Appendix 3
Pilot Survey Documentation



February, 1995

Mr Peter G Elmore
Laboratory Sales (UK) Ltd
246 Whitworth Road
Rochdale
Lancs

Dear Mr Elmore

**Survey of Small Firms in New Technologies:
External Links and Development**

This letter is to inform you of a research project which I am conducting on the development of small firms in new technology sectors. I would also like to take this opportunity to ask for your assistance in the project by completing and returning the attached questionnaire in the reply paid envelope enclosed.

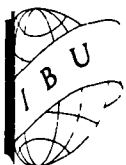
The focus of the research is on the extent to which small firms utilise linkages with other firms and organisations during the course of their development and whether such linkages enable firms to expand into international markets. It is known that firms such as yours have developed considerable expertise in developing links with other organisations but little is known about how such links contribute to firm development and increased profitability. This research aims to establish whether effective management of external links will improve firm performance.

If you assist in this research project by completing the questionnaire you will be providing information which ultimately may be used to stimulate development programmes for small firms. In addition you may find the process of filling in the questionnaire useful in providing a different perspective on your business. More importantly, you will receive a summary report of the survey findings detailing the practices of firms in your industry sector.

I would be grateful if you could spare some time to complete the questionnaire. If however you feel unable to do so, for whatever reason, please return the questionnaire to me unanswered.

Yours sincerely,

Marian Jones
Researcher



STRATHCLYDE INTERNATIONAL BUSINESS UNIT

STENHOUSE BUILDING, 173 CATHEDRAL STREET, GLASGOW G4 0RQ
Tel: 041-552 4400 Telex: 77472 UNSLIB G Fax: 041-552 2802

Director: Professor Neil Hood Assistant Director: Dr Michael C McDermott



Survey of Small Firms in New Technologies: External Links and Development

Background and Purpose of Research

This research is concerned with the problems faced by small, frequently young firms in new technology sectors. Small firms in general face the problem of trying to set up and operate with very limited resources, especially time for management and staff training and development, finance for expansion and access to knowledge on industry or technology development.

In new and emerging technologies the aforementioned problems are exacerbated by the complexity of technology, the need for a broad spectrum of knowledge inputs, the need for new and often expensive production systems, and difficulties related to marketing and the distribution of products in new, small and often international markets.

Existing research in the area has shown that small firms frequently address such problems by linking up with other firms and institutions, often on a very informal basis, in order to share knowledge or resources. Little is known about the extent to which firms form such links, but it is recognised that small firms co-operating with other organisations may be in a vulnerable position, especially when they are in the early stages of technological development, or where links have been made with large, powerful and often foreign organisations.

This survey, the first step in an on-going research project on the external links and development effects in small firms, is intended primarily to identify the types of links small firms have established and the extent to which these links stretch across national borders. Secondly, the survey is intended to ascertain the contribution such links have made to the development of small British firms in new technology sectors.

Your participation in this project, by completing the attached questionnaire, will represent a significant contribution to knowledge in this little researched area, will be greatly appreciated by the researcher and ultimately will provide knowledge which should benefit both small firms and policy makers.

A preliminary report of the survey findings will be made available to participants who provide details of their name, company and address on the final page of the completed questionnaire

Marian Jones



Survey of Small Firms in New Technologies: External Links and Development

Questionnaire

General Instructions and Comments

- 1. The questionnaire has been designed for ease of completion. In most cases alternative answers have been provided and you are required only to tick the appropriate boxes.*
- 2. Not all sections of the questionnaire will be applicable to your firm. Please indicate where a section or question is not applicable and move on as appropriate.*
- 3. All references to a year, e.g. 1993, refer to the financial year. Where you do not have absolute figures, please make a rough estimate.*
- 4. Where the word "foreign" has been used, it refers to any organisation/individual which is non-British.*
- 5. Any comments you would like to make about any aspect of the questionnaire, or additional comments about your firm, will be most welcome.*

Confidentiality

Individual firm responses will be treated with strictest confidentiality. Any result published will be aggregated across the sample of firms, and will make no mention of individuals or individual firms.

Section A: Firm Characteristics

1. Identification

Please tick if you would like a copy of the research results?

What is your firm's name? _____

Firm address _____

Firm Telephone Number _____

What is your position in the firm? _____

Are you a founder of the firm? Yes No

2. Categorisation

Please indicate the description that best describes your firm by ticking the appropriate box:

(please tick one only)

Wholly independent

Independent but supervised* by another firm(s)

Up to 20% of the capital is held by another firm(s).

Joint venture: more than 20% of the capital is held by another firm(s).

Wholly owned subsidiary which was previously an independent firm

Other, please describe _____

(*a firm which is independent but "supervised" is wholly independent but receives advice, direction, the use of equipment, facilities etc. from another, usually large firm, which has no current equity stake in the smaller firm)

If your firm is not wholly independent, please indicate the country in which the headquarters of your partner/parent firm(s) is located. _____

3. Classification

Into which of the following categories does your firm fall?

(please tick one only)

Plastics and Composites

Medicinal and pharmaceutical compounds

Advanced medical instruments and appliances

Other, please state _____

Office use only

1,1

4

5

8

9

10

11

13

How many employees, including working directors and managers, does your firm currently have on its payroll?(if a subsidiary, estimate only for your own organisation)

Office use only

14

How many people in your firm are currently employed full-time in:

Research and development

17

Production

20

Marketing and distribution

23

Other, please state _____

26

4. Foundation

In what year was your firm founded?

29

Was your firm founded specifically to develop a scientific/technical innovation?

Yes No

33

How many people were involved in founding the firm?

34

How many of the founders are still with the firm?

36

How many of the founders have been educated to:

Post-graduate level

38

First Degree level

40

Other, please state _____

42

In what way was your firm founded?

(please tick one only)

New start-up

Spin-off from another firm

Spin-off from a university

Merger

Management/worker buy-out

Takeover

Other, please state _____

44

If your firm was not a new start-up, please state the country(ies) in which the former organisation(s) are based?

45

46

48

50

Section B: Research and Innovation

5. Innovation

Office use only

Since foundation has your firm made any technical/scientific innovation?

Yes

No

(if no please move to question 6)

52

If yes, was your firm's first technical/scientific innovation made:

(please tick one only)

Independently of other organisations

Jointly with other British organisation(s)

Jointly with other foreign organisation(s)

Jointly with both British and foreign organisation(s)

Other, please state _____

53

Please indicate whether your firm has made any application for patent (including copyright and/or design protection) since its foundation

Yes

No

54

If your firm has made patent application, under which arrangement(s) has application been made?

(please tick all which apply)

European Patent Convention (EPC)

Patent Co-operation Treaty (PCT)

Individual country patent applications,

55

56

57

58

If you have made individual country applications, please list the first five countries for which application has been made (including the UK if applicable)

59

60

62

64

66

68

6. Product and Technology

How would you categorise your major product on each of the following attributes?

Office use only

(Please indicate by ticking the appropriate boxes on the scale provided)

	Low			High		
	1	2	3	4	5	
Technology	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	70 <input type="checkbox"/>
Standardisation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	71 <input type="checkbox"/>
Software content	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	72 <input type="checkbox"/>
Complexity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	73 <input type="checkbox"/>
Cost	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	74 <input type="checkbox"/>
Other, please state _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	75 <input type="checkbox"/>

Do you have a department specifically for research & development?

Yes No

76

What percentage of your total annual turnover did you devote to research and development in 1993?

77

The following list represents typical stages of technology development. Please indicate, for your major product, the level of your firm's **current** involvement in each stage by ticking the appropriate box on the scale next to each item.

79

	Very Minor Involvement			Very Major Involvement		
	1	2	3	4	5	
Basic research: Exploration of basic scientific principles.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	80 <input type="checkbox"/> 5 <input type="checkbox"/>
Applied research (Development): Focus of scientific principles on specific applications.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	21 <input type="checkbox"/> 6 <input type="checkbox"/>
Engineering: Development of the applied principles into a product/tool.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	2 <input type="checkbox"/> 7 <input type="checkbox"/>
Implementation (Use/manufacture): Use of that tool or product to accomplish a task/production of the product in volume.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	3 <input type="checkbox"/> 8 <input type="checkbox"/>
Commercialisation: Marketing/Distribution of that product.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4 <input type="checkbox"/> 9 <input type="checkbox"/>

Section C: Informal External Links and Co-operation

7. Membership and Affiliation

Office use only

Does your firm/firm members, currently have membership in any of the following associations?

(please tick all that apply)

- CBI
- Chambers of commerce
- Trade or employers associations
- Professional associations
- Alumni associations
- Other, please state _____

- 10
- 11
- 12
- 13
- 14
- 15
- 16

Does your firm have membership in any similar organisations in other countries?

- Yes
- No

17

If Yes, please list the type of association and the country(ies) with which your firm is involved (list 3 only)

Type of Association	Country
_____	_____
_____	_____
_____	_____

- 18 21
- 19 23
- 20 25

8. Informal links and Partners

Has your firm, since foundation, cooperated on an informal basis* with other organisations?

- Yes No
- (If no please move to section D)

27

(* informal co-operation here refers to any instance where your firm has worked together with a partner, for a period longer than that necessary to effect a one-off sale, but where there is no formal agreement and contributions of capital, technology or other assets are small).

If yes, what part has informal cooperation played in the development of your firm in each of the following areas:

Office use only

	Very Minor Part			Very Major Part		
	1	2	3	4	5	
Expanded range of expertise	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	28 <input type="checkbox"/>
Assisted in development of specialist services	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	29 <input type="checkbox"/>
Source of market information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	30 <input type="checkbox"/>
Provided access to new foreign markets	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	31 <input type="checkbox"/>
Improved financial and market credibility	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	32 <input type="checkbox"/>
Shared research and development costs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	33 <input type="checkbox"/>
Developed new product/process	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	34 <input type="checkbox"/>
Developed technology applications	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	35 <input type="checkbox"/>
Helped to keep current customers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	36 <input type="checkbox"/>
Gained access to and spread cost of new equipment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	37 <input type="checkbox"/>
Assisted in staff and management development	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	38 <input type="checkbox"/>
Provided knowledge of Marketing/distribution processes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	39 <input type="checkbox"/>
Provided knowledge of new technology	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	40 <input type="checkbox"/>

With which of the following types of partner have you cooperated informally in the last year?

	(please tick all that apply)		
	British	Foreign	
Customers	<input type="checkbox"/>	<input type="checkbox"/>	41 <input type="checkbox"/>
Suppliers	<input type="checkbox"/>	<input type="checkbox"/>	42 <input type="checkbox"/>
Firms with complementary technology (which are not customers or suppliers)	<input type="checkbox"/>	<input type="checkbox"/>	43 <input type="checkbox"/>
Firms with complementary products/markets (which are not customers or suppliers)	<input type="checkbox"/>	<input type="checkbox"/>	44 <input type="checkbox"/>
Higher education institutions	<input type="checkbox"/>	<input type="checkbox"/>	45 <input type="checkbox"/>
Government departments	<input type="checkbox"/>	<input type="checkbox"/>	46 <input type="checkbox"/>
Others, please state _____	<input type="checkbox"/>	<input type="checkbox"/>	47 <input type="checkbox"/>
			48 <input type="checkbox"/>

If you have cooperated informally with a foreign organisation, was the most recent arrangement

	(please tick one only)	
Initiated by your firm	<input type="checkbox"/>	
Initiated by a foreign partner(s)	<input type="checkbox"/>	
Initiated by a third party	<input type="checkbox"/>	
Initiated through a government /enterprise programme	<input type="checkbox"/>	
Other, please state _____	<input type="checkbox"/>	49 <input type="checkbox"/>

Has informal cooperation with foreign partners, on any occasion, led to a viable business proposition with an organisation overseas?

Yes No 50

If no, is it likely to within the next year?

Yes No 51

Section D: External Links Through Contract Arrangements

9. Contract Arrangements (Excluding Cooperation Agreements)

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Does your firm have any contract arrangements, with other organisations, of the following types:

- | | | |
|---|--------------------------|-----------------------------|
| Research and Development contracts | <input type="checkbox"/> | 52 <input type="checkbox"/> |
| Manufacturing contracts | <input type="checkbox"/> | 53 <input type="checkbox"/> |
| Technology (licensed-in to your firm) licensing contracts | <input type="checkbox"/> | 54 <input type="checkbox"/> |
| Distribution (by your firm for another) contracts | <input type="checkbox"/> | 55 <input type="checkbox"/> |

If none of the above apply, please tick here and move to section E

If yes, does your firm have contract arrangements with organisations which are:

- British? Foreign? both British and Foreign? 57

To what extent have inter-firm linkages, through contract arrangements, contributed to the development of your firm in each of the following areas:

	Very Minor Contribution			Very Major Contribution		
	1	2	3	4	5	
Access to production know-how/equipment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	58 <input type="checkbox"/>
Access to new technology	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	59 <input type="checkbox"/>
Shorten development lead times	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	60 <input type="checkbox"/>
Supplement in-house skills	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	61 <input type="checkbox"/>
Access to complementary products	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	62 <input type="checkbox"/>
Gain knowledge of new UK markets	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	63 <input type="checkbox"/>
Gain knowledge of new overseas markets	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	64 <input type="checkbox"/>
Access to technological know-how	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	65 <input type="checkbox"/>
Access to new industry sectors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	66 <input type="checkbox"/>
Source of revenue	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	67 <input type="checkbox"/>

10 Contract Research and Development

Do you contract out Research & Development? Yes No 68
(If no, please go to question 10.1)

If yes, are the organisations to which you contract out R&D

- British? Foreign? both British and Foreign? 69

Was the organisation to which you most recently contracted out R&D

- Located in Britain?
 Located overseas? 70

What percentage of the total value of your firm's Research & Development was contracted out to other organisations in 1993?

Percent of Total Research & Development which was Contracted out

- | | | |
|-----------------------------------|---|-----------------------------|
| 0% <input type="checkbox"/> | 21 - 30% <input type="checkbox"/> | |
| 1 - 10% <input type="checkbox"/> | 31 - 50% <input type="checkbox"/> | |
| 11 - 20% <input type="checkbox"/> | over 50% _____ <input type="checkbox"/> | 71 <input type="checkbox"/> |
- (please state)

10.1 Does your firm perform Research and Development under contract for other organisations?

Yes No

(If no, please go to question 11)

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72

If yes, are the organisations for which you perform Research and Development:
British? Foreign? both British and Foreign?

73

Was the organisation for which you most recently performed contract R&D

Located in Britain?

Located overseas?

74

What percentage of the total value of the Research and Development, performed by your firm in 1993, was done under contract for other organisations?

Research & Development done for others as Percent of Total

0%

21 - 30%

1 - 10%

31 - 50%

11 - 20%

over 50% _____

(please state)

75

11 Contract Manufacturing

Does your firm manufacture for other organisations, under sub-contract agreement?

Yes No

(If no, please go to question 11.1)

76

If yes, are the organisations for which you manufacture under sub-contract:
British? Foreign? both British and Foreign?

77

Was the organisation for which you most recently did manufacturing under sub-contract

Located in Britain?

Located overseas?

78

What percentage of your total manufacturing output in 1993 was done by your firm, for other organisations under sub-contract?

Percent of total 1993 manufacturing output done for others

0%

21 - 30%

1 - 10%

31 - 50%

11 - 20%

over 50% _____

(please state)

79

11.1 Does your firm have any manufacturing done under sub-contract by other organisations?

Yes No

(If no, please go to question 12)

80

If yes, are the organisations which manufacture for you:

British?

Foreign?

both British and Foreign?

81

Was the organisation which most recently did manufacturing for you:

Located in Britain?

Located overseas?

82

What percent of your firm's total manufacturing output in 1993 was done for you by other firms under contract?

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Percent of your total manufacturing output 1993 done by others

- 0%
- 1 - 10%
- 11 - 20%
- 21 - 30%
- 31 - 50%
- over 50% _____
(please state)

3

12 Agency Contracts

Does your firm act as agent/distributor, in the UK market, for the distribution of other firms' products/services?

Yes No

(If no, please go to question 13)

4

If yes, are the firms for which you act as agent in the UK market:

British? Foreign? both British and Foreign?

5

Was the organisation for which you most recently acted as agent/distributor in the UK market:

Located in Britain?

Located overseas?

6

What percentage of your total annual turnover for 1993 was attributable to agency activities in the UK market?

Agency Activities as Percent of Total Annual Turnover (1993)

- 0%
- 1 - 10%
- 11 - 20%
- 21 - 30%
- 31 - 50%
- over 50% _____
(please state)

7

13 License-In Contracts

Do you license-in technology from other organisations? Yes No

(If no, please go to question 14)

8

If yes, are the firms from which you license-in technology:

British? Foreign? both British and Foreign?

9

Please indicate the date and country from which you first licensed-in technology

Date Country _____

10

14

Section E: Formal External Links and Co-operation

14 Cooperative Research & Development

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Has your firm been involved in a Co-operative Research & Development Project?

Yes No
(If no, please move to question 15)

15

If your firm has been involved in a Cooperative Research and Development Project, were the partners with whom you worked in your first project:

(Please tick all which apply)

- Research and development corporations?
- Public research institutes?
- Other manufacturing firms?
- Higher education institutions?
- Other, please state _____

16
17
18
19
20

How was that cooperative research and development project funded?

(Please tick all which apply)

- British government/enterprise initiative funding
- Funding from associated firms
- Funding through an industry/trade association
- European Community funding
- Other, please state _____

21
22
23
24
25

Were the other organisations involved:

British? Foreign? both British and Foreign?

26

Please indicate the importance of your first cooperative research and development project to the development of your firm in each of the following areas:

	Very Minor Importance			Very Major Importance		
	1	2	3	4	5	
Gained access to new technology	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	27 <input type="checkbox"/>
Source of technical knowledge	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	28 <input type="checkbox"/>
Shortened development lead times	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	29 <input type="checkbox"/>
Made contact with Agents/distributors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	30 <input type="checkbox"/>
Development of new product/process	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	31 <input type="checkbox"/>
Supplemented in-house skills	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	32 <input type="checkbox"/>
Source of market knowledge	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	33 <input type="checkbox"/>
Supplemented in-house R&D capacity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	34 <input type="checkbox"/>
Financed firm expansion into manufacturing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	35 <input type="checkbox"/>
Secured future production/marketing contracts in the UK	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	36 <input type="checkbox"/>
Secured future production/marketing contracts overseas	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	37 <input type="checkbox"/>
Other, please state _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	38 <input type="checkbox"/>

15 Formal Cross-Border Cooperation

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Please indicate whether your firm has been involved in any formal cross-border co-operative arrangements* of the following types:

(please tick all which apply)

- | | | |
|--|--------------------------|-----------------------------|
| Technology sharing agreements | <input type="checkbox"/> | 39 <input type="checkbox"/> |
| Non-equity joint production agreements | <input type="checkbox"/> | 40 <input type="checkbox"/> |
| Comprehensive R&D, manufacturing and marketing consortia | <input type="checkbox"/> | 41 <input type="checkbox"/> |
| Distribution agreements with suppliers of complementary products | <input type="checkbox"/> | 42 <input type="checkbox"/> |

(* a formal cross-border co-operative arrangement here refers to interfirm co-operation, that spans national boundaries, in product development, manufacture, or marketing, which is not based on one-off sales and includes substantial contributions by partners of capital, technology, or other assets).

If your firm has been involved in any type of formal cross-border co-operative arrangement, please indicate the importance of your firm's first co-operative arrangement to the development of your firm in each of the following areas:

	Very Minor Importance		Very Major Importance			
	1	2	3	4	5	
Secured sources of supply	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	43 <input type="checkbox"/>
Improved market access	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	44 <input type="checkbox"/>
Secured market access	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	45 <input type="checkbox"/>
Source of technical knowledge	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	46 <input type="checkbox"/>
Over-came non-tariff barriers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	47 <input type="checkbox"/>
Completed product range	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	48 <input type="checkbox"/>
Provided systems solutions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	49 <input type="checkbox"/>
Source of market knowledge	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	50 <input type="checkbox"/>
Economies of scale in production	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	51 <input type="checkbox"/>
Economies of scale in distribution	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	52 <input type="checkbox"/>
Exploited production cost differences	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	53 <input type="checkbox"/>
Access to new product/technology	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	54 <input type="checkbox"/>
Development of new product/technology	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	55 <input type="checkbox"/>
Source of funding	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	56 <input type="checkbox"/>
Joint R&D	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	57 <input type="checkbox"/>
Access to facilities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	58 <input type="checkbox"/>
Other, please state _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	59 <input type="checkbox"/>

16 Equity Links

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In the last 3 years, has any foreign-owned organisation made an investment in your firm involving:

(tick all which apply)

- Equity capital involving more than 20% of the total equity capital of the firm 60
- Venture capital involving an equity stake 61
- Venture capital with no equity stake involved 62
- Other, please state _____ 63

If no investments have been made, please tick here and move on to Section F

If an investment has been made, please indicate the country in which the organisation making the largest investment is headquartered.

Country _____

Please indicate whether the organisation making that investment was previously:

- A supplier to your firm 67
- A customer of your firm 68
- Other relationship, please state _____ 69
- No previous relationship 70

Please indicate whether the foreign organisation making the investment was one with:

(please tick all which apply)

- Complementary process technology Complementary markets 71 72
- Complementary product technology Complementary products 73 74
- Other, please state _____ 75 76

Was the foreign organisation which made the largest investment in your firm:

(please tick one only)

- a small firm (< 50 employees) a large firm (>500 employees)
- a firm with 51-200 employees a higher education institution
- a firm with 201-500 employees a government department
- other, please state _____ 77

**Section F: Independent Cross-Border Activity
(Exporting, Licensing-out and Foreign Production)**

If your firm has no involvement in Exporting, International Licensing or Production Overseas, please tick here and move on to Section G

17 Exporting

Is your firm involved in exporting Yes No
(If no please go to Question 18)

If yes, in which year did your firm make its first export and to which country?

Year of first export

Country of first export _____

Please indicate the extent to which each of the following factors influenced your firm's decision to begin exporting

	Very Minor Influence		3	Very Major Influence		
	1	2		4	5	
Previously established contacts overseas	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	6 <input type="checkbox"/>
Limited home market	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	7 <input type="checkbox"/>
Drawn by customers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	8 <input type="checkbox"/>
Part of multi-national network	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	9 <input type="checkbox"/>
Excess capacity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	10 <input type="checkbox"/>
Strong non-equity link with large overseas firm	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	11 <input type="checkbox"/>
Equity link with overseas firm	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	12 <input type="checkbox"/>
Market opportunities abroad	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	13 <input type="checkbox"/>
Previously established R&D links	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	14 <input type="checkbox"/>
Followed informal international links	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	15 <input type="checkbox"/>
Unsolicited order	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	16 <input type="checkbox"/>
Operate in small but international niche	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	17 <input type="checkbox"/>
Other, please state _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	18 <input type="checkbox"/>

What percentage of total annual turnover in 1993 was attributable to exports?

Export as a percentage of turnover in 1993

Please indicate your organisation's growth in exports in each of the last 3 years by entering the percentage change from the previous year in the boxes provided.

Growth in exports	Percentage Change from Previous Year (please indicate + or -)		
	1991	<input style="width:100px;" type="text"/>	
	1992	<input style="width:100px;" type="text"/>	22 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
	1993	<input style="width:100px;" type="text"/>	25 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
			28 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

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Which of the following statements best describes your firm's current situation.?

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(please tick one only)

We are irregular, intermittent exporters to a few foreign markets.

31

We are actively involved in exporting, do so on a regular basis and systematically explore export opportunities.

We are committed to exporting on a long-term basis and are exploring the possibilities of foreign licensing or production.

We have a broad international spread of activities involving widely differing market servicing modes in pursuit of competitive advantage.

32

18 Licensing-Out

Do you license-out technology to foreign organisations Yes No
(If no please go to Question 19)

33

Please indicate the date and country of your first license-out arrangement

34

Date

Country

38

Did your firm export to that country before the license-out arrangement was established? Yes No

40

Please indicate whether your firm was involved in any of the following cross-border activities before it first licensed out technology to any foreign organisation

exporting
overseas production
contract/cooperative R &D

contract manufacturing
licensing-in
other

41

43

45

19 Investment in Overseas Production

Has your firm made any investment in overseas production? Yes No

47

If your firm has no involvement in overseas production please tick here and move on to Section G

48

Is your firm involved in overseas production through

(tick all which apply)

A subsidiary wholly owned by your firm

49

A subsidiary in which your firm holds more than 20% of the equity

50

A subsidiary in which your firm hold 20% or less of the equity.

51

Other, please state

52

Please indicate the date and country of your first involvement in overseas production.

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Date Country _____

53
57

20 Nature of Investment

Please indicate whether your first involvement in overseas production consisted of:

- A greenfield investment? An acquisition/merger?
An equity joint venture? Other, please state _____

59

If your first involvement in overseas production was not a greenfield investment, was the other firm involved:

- A previous customer? A previous agent/distributor?
A previous supplier? Other relationship, please state _____

60

Please indicate whether your firm was involved in any of the following cross-border activities before it first became involved in overseas production

- exporting contract manufacturing
licensing contract/cooperative R & D
other, please state _____

61 62

63 64

65

21 Reason for Investment

Please indicate the extent to which each of the following factors influenced your firm's decision to invest in overseas production.

	Very Minor Influence			Very Major Influence		
	1	2	3	4	5	
Access to foreign-based technology	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	66 <input type="checkbox"/>
Market opportunities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	67 <input type="checkbox"/>
Industry better developed abroad	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	68 <input type="checkbox"/>
Protect our interests in that market	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	69 <input type="checkbox"/>
Response to competitive threat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	70 <input type="checkbox"/>
Drawn by agent/distributor	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	71 <input type="checkbox"/>
Secure position in distribution network	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	72 <input type="checkbox"/>
Evolution of previous cross-border arrangement	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	73 <input type="checkbox"/>
Other, please state _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	74 <input type="checkbox"/>

Section G Company Data

22 Please estimate your total annual turnover in 1993?

- | | |
|---|---------------------------------------|
| Less than £250 000 <input type="checkbox"/> | £1m to £4.9m <input type="checkbox"/> |
| £250k to £490k <input type="checkbox"/> | £5m to £10 <input type="checkbox"/> |
| £0.5m to £0.9m <input type="checkbox"/> | Over £10m <input type="checkbox"/> |

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23 Please indicate your organisation's growth in turnover in each of the last 3 years by entering the percentage change from the previous year in the boxes provided.

Turnover	Percentage change from previous year (please indicate + or -)
	1991 <input style="width: 80px;" type="text"/>
	1992 <input style="width: 80px;" type="text"/>
	1993 <input style="width: 80px;" type="text"/>

76
 79 5,1
 2

24 Please indicate the percentage of turnover in 1993 which was attributable to

Contract R&D	<input style="width: 80px;" type="text"/>	%		5 <input type="checkbox"/> <input type="checkbox"/>
Contract manufacturing	<input style="width: 80px;" type="text"/>	%		7 <input type="checkbox"/> <input type="checkbox"/>
Consultancy	<input style="width: 80px;" type="text"/>	%		9 <input type="checkbox"/> <input type="checkbox"/>
Product sales	<input style="width: 80px;" type="text"/>	%		11 <input type="checkbox"/> <input type="checkbox"/>
Royalties.	<input style="width: 80px;" type="text"/>	%		13 <input type="checkbox"/> <input type="checkbox"/>
Other, please state _____	<input style="width: 80px;" type="text"/>	%		15 <input type="checkbox"/> <input type="checkbox"/>

25 Please indicate the percentage of turnover which, in 1993, was attributable to:

Your firm's business activities in the UK	<input style="width: 80px;" type="text"/>	%		17 <input type="checkbox"/> <input type="checkbox"/>
Your firm's business activities overseas	<input style="width: 80px;" type="text"/>	%		19 <input type="checkbox"/> <input type="checkbox"/>

Please indicate by ticking the appropriate box on the scale, the extent to which you agree with each of the following statements:

	Do Not Agree			Completely		
	At All			Agree		
	1	2	3	4	5	
Considerable time and effort is spent by our firm on identifying and developing links with other organisations.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	21 <input type="checkbox"/>
Inter-firm cooperation has been crucially important to the development of our firm.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	22 <input type="checkbox"/>
Inter-firm cooperation is fraught with difficulties and where possible we prefer to "go it alone".	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	23 <input type="checkbox"/>
Inter-firm co-operation has proved to be an interesting and rewarding experience and we intend to establish further links.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	24 <input type="checkbox"/>

Thank you for taking the time to complete the questionnaire.

All information given will be treated in confidence.

Appendix 4
Response to Pilot Study

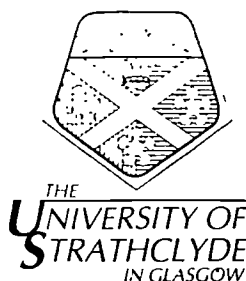
Phd Pilot Survey

	Pilot Name	Intro	1st Mail	Response	Reminder	Response	Sections	Use	Comments
1	* Supergrip Industrial	7.11.94	15.11.94	G/A	-				
2	* Takara Belmont UK Ltd	7.11.94	15.11.94	18.11.94	-		ABC only	P	No time
3	* Ronsheim & Moore	7.11.94	15.11.94	-	08.12.94				
4	* E Kemper Ltd	7.11.94	15.11.94	-	08.12.94				
5	* Cryoparts Ltd	7.11.94	15.11.94	-	08.12.94				
6	* South Eastern Plastics	7.11.94	15.11.94	G/A	-				
7	* Viabiotics Ltd	7.11.94	15.11.94	-	08.12.94				
8	* Blease Medical Equipment Ltd	7.11.94	15.11.94	-	08.12.94				
9	* Thompson Medical Co Ltd	7.11.94	15.11.94	-	08.12.94				
10	* Newco	7.11.94	15.11.94	-	08.12.94				
11	* D.R. Adams	7.11.94	15.11.94	18.11.94	-		AG only	P	wrong sector
12	* Superion Ltd	7.11.94	15.11.94	-	08.12.94				
13	* Howarde Lloyd & Co Ltd	7.11.94	15.11.94	-	08.12.94				
14	* Biomen Ltd	7.11.94	15.11.94	-	08.12.94				
15	* SandalIn International Ltd	7.11.94	15.11.94	G/A	-				
16	* NMI Safety Systems Ltd	7.11.94	15.11.94	-	08.12.94				
17	* Steeper (Orthopaedic) Ltd	7.11.94	15.11.94	-	08.12.94				
18	* AMS Biotechnology	7.11.94	15.11.94	28.11.94	-		ABCDEF G	U	
19	* Hyox Systems Ltd	7.11.94	15.11.94	-	08.12.94				
20	* Audio Medical Devices Ltd	7.11.94	15.11.94	-	08.12.94				
21	* Bitrez Ltd	7.11.94	15.11.94	-	08.12.94				
22	* Amba Medical Ltd	7.11.94	15.11.94	28.11.94	-		ABCDEF G	U	
23	* Chataooga Group Ltd	7.11.94	15.11.94	-	08.12.94				
24	* V G Microscopes Ltd	7.11.94	15.11.94	-	08.12.94				
25	* G A Ferguson & Co Ltd	7.11.94	15.11.94	-	08.12.94				
26	* Ganmill Ltd	7.11.94	15.11.94	28.11.94	-		ABDFG	U	
27	* Flavex Ltd	7.11.94	15.11.94	-	08.12.94				
28	* Oakworth Chemical Co Ltd	7.11.94	15.11.94	G/A	-				
29	* Medik CI Ltd	7.11.94	15.11.94	-	08.12.94				
30	* Compounding Ingredients Ltd	7.11.94	15.11.94	-	08.12.94				

Phd Pilot Survey

31	*	F J Cossins & Sons(Leeds) Ltd	7.11.94	15.11.94	G/A	-						
32	*	Queensgate Instruments Ltd	7.11.94	15.11.94	6.12.94	-				ABCDEF	U	
33	*	Antec International Ltd	7.11.94	15.11.94	-	08.12.94						
34	*	Hyatt Workwear Ltd	7.11.94	15.11.94	-	08.12.94						
35	*	South Western Garments	7.11.94	15.11.94	-	08.12.94						
36	*	Medix	7.11.94	15.11.94	-	08.12.94						
37	*	Good Hearing Earmouids Ltd	7.11.94	15.11.94	G/A	-						
38	*	Sterlmedix Ltd	7.11.94	15.11.94	5.12.94	-				ABCEFG	U	
39	*	Adhesive Coatings Ltd	7.11.94	15.11.94	-	08.12.94						
40	*	Caleray Ltd	7.11.94	15.11.94	-	08.12.94						
41	*	Coversate Clothing Ltd	7.11.94	15.11.94	-	08.12.94						
42	*	Cue & Jones Ltd	7.11.94	15.11.94	-	08.12.94						
43	*	Hi- Bond Resin Eng Ltd	7.11.94	15.11.94	G/A	-						
44	*	DBS Chemicals	7.11.94	15.11.94	-	08.12.94						
45	*	Interspiro Ltd	7.11.94	15.11.94	17.11.94	-				none		
46	*	Chaseway Packaging	7.11.94	15.11.94	-	08.12.94						
47	*	Europa Scientific Ltd	7.11.94	15.11.94	-	08.12.94						refused
48	*	B&H Surgical Instrument Makers	7.11.94	15.11.94	29.11.94	-				none	NU	

Appendix 5
Restructured Questionnaire



Survey of Small Firms in New Technologies: External Links and Development

Questionnaire

General Instructions and Comments

- 1. If your firm is a subsidiary of another, please answer questions in relation to the subsidiary and not to the organisation as a whole.*
- 2 All references to a year, e.g. 1993, refer to the financial year. Where you do not have absolute figures, please make a rough estimate.*
- 3 Where the word "foreign" has been used, it refers to any organisation/individual which is non-British.*
- 4 The questionnaire has been designed for ease of completion. In most cases alternative answers have been provided and you are required only to tick the appropriate boxes. or enter estimates.*
- 5 Not all sections of the questionnaire will be applicable to your firm. Please indicate where a section or question is not applicable and move on as appropriate.*

Confidentiality

Individual firm responses will be treated with strictest confidentiality. Any result published will be aggregated across the sample of firms, and will make no mention of individuals or individual firms.

Section A: Firm Characteristics

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1 What is your position in the firm? _____

2 Are you a founder of the firm? Yes No

3 In what year was your firm founded?

4 Was your firm founded specifically to develop a scientific/technical innovation? Yes No

5 If you answered "yes" to Q4, please describe that innovation _____

6 If you answered "yes" to Q4, do you have/have you applied for proprietary rights for that innovation (ie intellectual property rights such as patent, copyright or design protection)?

	In the UK	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
	Overseas	Yes <input type="checkbox"/>	No <input type="checkbox"/>	

7 How many people were involved in founding the firm?

8 How many of the founders are still with the firm?

9 In what way was your firm founded? (please tick one only)

- a) New start-up (the firm did not evolve/emerge from another organisation)
- OR
- b) Evolution:
 - Spin-off from another firm
 - Spin-off from a university
 - Merger/takeover
 - Management/worker buy-out
 - Other, please state _____

10 If your firm evolved from another organisation (as in question 9b above), please state the country(ies) in which the former organisation(s) were based at the time your firm was founded?

1 Please indicate the description that best describes your firm by ticking the appropriate box:

(please tick one only)

- Wholly independent
- Independent but supervised* by another firm(s)
- Up to 20% of the capital is held by another firm(s).
- Joint venture: more than 20% of the capital is held by another firm(s).
- Wholly owned subsidiary which was previously an independent firm
- Other, please describe _____

(*a firm which is independent but "supervised" is wholly independent but receives advice, direction, the use of equipment, facilities etc. from another, usually large firm, which has no current equity stake in the smaller firm)

2 If your firm is not wholly independent, please indicate the country in which the headquarters of your partner/parent firm(s) is located. _____

Into which of the following industry categories does your firm fall?

(please tick one only)

- Plastics and Composites
- Biotechnology/pharmaceuticals
- Advanced medical instruments and appliances
- Electronic Equipment/instruments for industry (other than medical)
- Other, please state _____

How many employees, including working directors and managers, does your firm currently have on its payroll?(if a subsidiary, state only for your own organisation)

3 How many people in your firm are currently employed full-time in:

- Research and development
- Production
- Marketing and distribution
- Other, please state _____

4 What is your firm's major product? _____

5 How would you categorise your major product on each of the following attributes?

(Please indicate by ticking the appropriate boxes on the scale provided)

	Low					High
	1	2	3	4	5	
Technology	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Extent of technological innovation by your firm	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Level of software content	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Level of product complexity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Level of standardisation (product/production)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Level of customisation to customer specifications	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Number of industry applications	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Availability of alternative products in the UK market	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Section 2: Research, Development, Technology and Innovation

Office is

- 18 Do you have a department specifically for research & development? Yes No
- 19 If you answered "yes" to Q18, in what year was the research and development department set up?
- 20 What percentage of your total annual turnover did you devote to research and development in 1993?
- 21 How many full-time equivalent personnel did you have employed in research and development in 1993?
- 22 Since foundation has your firm made any scientific/technical innovations, for which proprietary rights (ie. intellectual property rights such as patent, copyright or design protection) have been granted to /applied for by your firm? Yes No
- 23 If you answered "yes" to Q22, in what year was application for proprietary rights made?
- 24 Has your firm been involved in the development of a scientific/technical innovation for which another firm has been granted/has applied for proprietary rights (ie. intellectual property rights such as patent, copyright or design protection)? Yes No
- 25 If you answered "yes" to Q24, was the other firm: (please tick one only)
 based in the UK
 based overseas
- 26 Has your firm ever been involved in a cooperative research and development project in which some/all of the partners are from organisations based overseas? Yes No
- 27 If you answered yes to Q26, please state the year in which your firm first became involved in that cooperative research and development project and the country in which the project was based.
 Year
 Country
- 28 How was that first cooperative research and development project funded?
 (Please tick all which apply)
 British government/enterprise initiative funding
 Funding from associated firms
 Funding through an industry/trade association
 European Community funding
 Other, please state _____

inward Links

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32 Has your firm been involved in any of the following activities in the UK with overseas-based firms? Please indicate, in each case, the year your firm first became involved in the activity and the country in which the overseas firm with which you were first involved was based.

	Yes	No	Year of first involvement	Country-base of first overseas firm	
Import of products/components/materials from an overseas-based supplier	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Distribution of an overseas-based firm's products in the UK market	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Research and development performed in your firm under contract for an overseas-based firm	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Technical service/consultancy performed in the UK for overseas-based clients.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Management/marketing service/consultancy performed in UK for overseas-based clients.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Manufacturing performed in your firm under contract for an overseas-based firm	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Licensing-in of technology from an overseas-based firm	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Other involvement with overseas-based organisations where the activity takes place in the UK, please state the nature of the activity/ies.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

Outward Links

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33 Please indicate whether your firm has been involved in any of the following cross-border business activities. Please indicate the year and country in which your firm first became involved in each activity.

	Yes	No	Year of first involvement	Country of first Involvement	
Exporting through a UK based intermediary	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Exporting through a foreign based agent/distributor	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Exporting through overseas-based company representatives/sales branch	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Licensing out of technology to an overseas-based firm	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Manufacturing performed by an overseas-based firm under contract for your firm	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Research and development performed by an overseas-based firm under contract for your firm	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Management/marketing services/consultancy performed overseas by your firm's personnel	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Technical service/consultancy performed overseas by your firm's personnel	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Overseas production in a subsidiary in which your firm has an equity stake of up to 50%	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Overseas production in a subsidiary in which your firm has an equity stake of 50% or over	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Other overseas involvement, please state the nature of the activity/ies. _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

Cross-Border Cooperation Agreements

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34 Please indicate whether your firm has been involved in any formal cross-border co-operative arrangements* of the following types, and state the year of first involvement in each case:

	Yes	No	Year of first involvement	
Technology sharing agreements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Non-equity joint production agreements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Comprehensive R&D, manufacturing and marketing consortia	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Distribution agreements with suppliers of complementary products	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

(* a formal cross-border co-operative arrangement here refers to interfirm co-operation, that spans national boundaries, in product development, manufacture, or marketing, which is not based on one-off sales and includes substantial contributions by partners of capital, technology, or other assets).

Stage of Internationalisation (If your firm does not export, please move to question 40)

- 35 a) Does your firm have a department dedicated specifically to export operations? Yes No
- b) If yes, in what year was this department set-up?
- 36 To how many countries does your firm currently export?

37 Please list the countries to which your firm currently exports in order of importance to your firm, (please list up to 10 if possible; where 1 = most important, and 10 = least important)

1 _____	6 _____	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
2 _____	7 _____	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
3 _____	8 _____	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
4 _____	9 _____	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
5 _____	10 _____	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

38 Please indicate, if applicable, the value of your firm's exports in 1993 £

39 Please indicate your organisation's growth in exports (if applicable) in each of the last 3 years by entering the percentage change from the previous year in the boxes provided.

Growth in exports	Percentage Change from Previous Year (please indicate + or -)	
	1991 <input type="text"/>	<input type="checkbox"/> <input type="checkbox"/>
	1992 <input type="text"/>	<input type="checkbox"/> <input type="checkbox"/>
	1993 <input type="text"/>	<input type="checkbox"/> <input type="checkbox"/>

Section D Company Data

40 Please estimate your total annual turnover in 1993?

Less than £250 000	<input type="checkbox"/>	£1m to £4.9m	<input type="checkbox"/>
£250k to £490k	<input type="checkbox"/>	£5m to £10m	<input type="checkbox"/>
£0.5m to £0.9m	<input type="checkbox"/>	Over £10m, please indicate _____	

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41 Please indicate your organisation's growth in turnover in each of the last 3 years by entering the percentage change from the previous year in the boxes provided.

Turnover

Percentage change from previous year
(please indicate + or -)

1991	<input style="width: 100%;" type="text"/>	<input type="checkbox"/> <input type="checkbox"/>
1992	<input style="width: 100%;" type="text"/>	<input type="checkbox"/> <input type="checkbox"/>
1993	<input style="width: 100%;" type="text"/>	<input type="checkbox"/> <input type="checkbox"/>

42 Please estimate, if possible, the percentage of turnover in 1993 which was attributable to

Sales of products manufactured by your firm	<input style="width: 100%;" type="text"/>	%	<input type="checkbox"/> <input type="checkbox"/>
Payments for contract manufacturing	<input style="width: 100%;" type="text"/>	%	<input type="checkbox"/> <input type="checkbox"/>
Payments for contract R&D	<input style="width: 100%;" type="text"/>	%	<input type="checkbox"/> <input type="checkbox"/>
Fees for management/marketing consultancy/services	<input style="width: 100%;" type="text"/>	%	<input type="checkbox"/> <input type="checkbox"/>
Fees for technical consultancy/services	<input style="width: 100%;" type="text"/>	%	<input type="checkbox"/> <input type="checkbox"/>
Royalties for licensed-out technology.	<input style="width: 100%;" type="text"/>	%	<input type="checkbox"/> <input type="checkbox"/>
Other, please state _____	<input style="width: 100%;" type="text"/>	%	<input type="checkbox"/> <input type="checkbox"/>
Total	= 100	%	

43 Please indicate the percentage of turnover which, in 1993, was attributable to:

Your firm's business activities in the UK	<input style="width: 100%;" type="text"/>	%	<input type="checkbox"/> <input type="checkbox"/>
Your firm's business activities overseas (excluding exporting)	<input style="width: 100%;" type="text"/>	%	<input type="checkbox"/> <input type="checkbox"/>
Exporting	<input style="width: 100%;" type="text"/>	%	<input type="checkbox"/> <input type="checkbox"/>
Total	= 100	%	

44 Your time and effort in completing this questionnaire is very much appreciated. If you could help further by participating in the next stage of this research project which will involve a short telephone interview with the researcher, please indicate:

Yes No

Please tick if you would like a copy of the research results?

What is your firm's name?

Firm address

Firm Telephone Number

*Thank you for taking the time to complete
the questionnaire. All information you have
given will be treated in confidence.*

Appendix 6
Framework for Statistical Analysis

**Survey of Small Firms in New Technologies:
External Links and Development.**

Framework for Statistical Analysis II

Marian Jones

Q	V	Variable Labels	Values	R/c	Variable Labels	Values	R/c	Variable Labels	Values
1	v1	'Position in Firm'	1'MD' 2'FD' 3'Mkg D' 4'prod' 5'tech' 6'exp'	1					
2	v2	'Founder'	1'yes' 2'no'						
3	v3	'Date of Foundation'	numeric	vv3	'years since foundation'	1995-v3	vv3g	'firm age in years'	1'5 or less', 2'6-10' 3'11-25' 4'>26'.
4	v4	'NTBF'	1'yes' 2'no'						
5	v5	'Innovation Type'	-						
6	v6	'IPR in UK'	1'yes' 2'no'						
7	v7	'IPR Overseas'	1'yes' 2'no'						
8	v8	'Original Founders'	numeric						
9	v9	'Remaining Founders'	numeric						
9	v10	'Form of Foundation'	1'new start' 2'firm SpO' 3'uni SpO' 4'merger' 5'buy out' 6'other'	vv10	'foundation form'	1'new start', 2'evolution'.			
10	v11	'1st Founding Country'	1 - 74 and						
	v12	'2nd Founding Country'	101 - 107						
	v13	'3rd Founding Country'							
11	v14	'Independence level'	1' indep' 2' super' 3' major' 4' minor' 5' aegsub' 6' other'	vv14	'independence'	1' independent', 2' not independent'			
12	v15	'Partner/Parent Location'	1 - 74 and 101 - 107						
13	v16	'Industry'	1' plastic' 2' biotech' 3' medinst' 4' electinst' 5' other'						
14	v17	'Number of Employees'	numeric	vv17	"firm size by employees"	1'<10' 2'11-20' 3'21-50' 4'51- 200'.			
15	v18	'Employment in R&D'	numeric						
	v19	'Employment in Production'	Sum v18 to v21=v17						
	v20	'Employment Mkg/Dist'							
	v21	'Employment Other'							

16	v22	'Product'	-						
17	v23	'Technology'	1 'v low'						
	v24	'Technological Innovation'	2 'low'						
	v25	'Software Content'	3 'med'						
	v26	'Product Complexity'	4 'high'						
	v27	'Standardisation'	5 'v high'						
	v28	'Customisation'							
	v29	'Industry Applications'							
	v30	'UK substitutes'							
18	v31	'R&D Department'	1 'yes' 2 'no'						
19	v32	'Date R&D Dept Set Up'	numeric	vv32	'time for RD set-up'	1900+v32-v3			
20	v33	'R&D % of Turnover'	numeric	vv33	'R&D intensity'	1 'zero' 2 '1-5' 3 '6-20' 4 '21-100'			
21	v34	'R&D FTEs 1993'	numeric	vv34	'R&D intens (emp)'	'v34/v17x100'	vv34g	'R&D FTEs % est'	1 'zero' 2 '1-10' 3 '1-20' 4 '21-100'
22	v35	'Subsequent IPRs'	1 'yes' 2 'no'						
23	v36	'Year IPR Application'	numeric						
24	v37	'Other Firm IPR'	1 'yes' 2 'no'						
25	v38	'IPR Firm Location'	1 'UK' 2 'overseas' 3 'both'						
26	v39	'Cross-Border R&D Cooperation'	1 'yes' 2 'no'						
27	v40	'Year Cross-border R&D'	numeric						
	v41	'Country base Cross-border R&D'	1 - 74, 101 - 107						
28	v42	'UK Govt Funding'	1 'yes' 2 'no'						
	v43	'Associated Firms Funding'	(not mutually exclusive categories)						
	v44	'Industry trade association'							
	v45	'EU Funding'							
	v46	'Other funding'							
29	v47	'Foreign Nationals'	1 'yes' 2 'no'						
	v48	'Foreign Languages'	1 'yes' 2 'no'						
	v49	'1st Language'	1 - 21						
	v50	'2nd Language'							
	v51	'3rd Language'							
	v52	'4th Language'							
	v53	'5th Language'							
	v54	'6th Language'							
30	v55	'Educated Overseas'	1 'yes' 2 'no'						
	v56	'Worked Overseas'	1 'yes' 2 'no'						

31	v57	'Chambers of Commerce'	7'never' 6'less ann' 5'annual' 4'bi ann' 3'quarter' 2'monthly' 1'more freq'							
	v58	'Trade Employers Associations'								
	v59	'Professional Associations'								
	v60	'Alumni Associations'								
	v61	'University Research Departments'								
	v62	'Public Research Institutions'								
	v63	'Comp/ Indbased R&D Units'								
	v64	'Trade Fairs'								
	v65	'Academic Conferences Seminars'								
	v66	'Research Colloquia'								
v67	'Customers'									
v68	'Suppliers'									
v69	'Distributors Agents'									
v70	'Other'									
32	v71	'Import'	1'yes' 2'no'							
	v74	'Distribution in UK'								
	v77	'R&D in UK'								
	v80	'Technical Service or Consultancy'								
	v83	'Mgt or mkt service or consultancy'								
	v86	'Contract Manufacturing'								
	v89	'License In'								
	v92	'Other Inward Activity'								
	v72	'Yr 1st Import'		numeric (99= unknown year)						
	v75	'Yr 1st Distribution'								
v78	'Yr 1st R&D'									
v81	'Yr 1st tech service or cons'									
v84	'Yr 1st mgt or mkt serv or cons'									
v87	'Yr of 1st Contract Mfg'									
v90	'Yr of 1st License In'									
v93	'Yr of 1st Other Inward'									
v73	'Ctry 1st Import'	1 - 84 and 101 - 107								
v76	'Ctry 1st Distribution'									
v79	'Ctry 1st R&D'									
v82	'Ctry 1st Tech service or Cons'									
v85	'Ctry 1st mgt/mkt serv or cons'									
v88	'Ctry of 1st Contract Mfg'									
v91	'Ctry of 1st License In'									
v94	'Ctry of 1st Oth Inward'									

33	v95	'UK based Export'	1'yes' 2'no'						
	v98	'Agent Distributor Export'							
	v101	'Reps Branch Export'							
	v104	'License Out'							
	v107	'Manufacture Out'							
	v110	'Contract Out R&D'							
	v113	'Overseas Mkg Mfg consultancy'							
	v116	'Technical Service or Consultancy'							
	v119	'Minority Owned Subsidiary'							
	v122	'Majority Owned Subsidiary'							
	v125	'Other Overseas Involvement'							
	v96	'Year 1st UK based export'							
v99	'Year 1st agent distributor export'								
v102	'Year 1st Reps Branch Export'								
v105	'Year 1st License Out'								
v108	'Year 1st Manufacture Out'								
v111	'Year 1st Contract Out R&D'								
v114	'Year 1st Overseas Mkg Mfg cons'								
v117	'Year 1st TechService or Cons'								
v120	'Year 1st Min Owned Subs'								
v123	'Year 1st Maj Owned Sub'								
v126	'Year 1st Oh Overseas Invmt'								
v97	'Country 1st UK base Export'	1 - 84 and 101 - 107							
v100	'Country 1st ag/ distr export'								
v103	'Country 1st Reps Branch Export'								
v106	'Country 1st License Out'								
v109	'Country 1st Manufacture Out'								
v112	'Country 1st Contract Out R&D'								
v115	'Ctry 1st Overseas Mkg Mfg cons'								
v118	'Ctry 1st Tech Service or Cons'								
v121	'Country 1st Min Owned Subs'								
v124	'Country 1st Maj Owned Subs'								
v127	'Country 1st Oh Overseas Invmt'								
34	v128								
	v130	'Joint Production'							
	v132	'Comprehensive Consortium'							
	v134	'Distribution Agreement'							
	v129	'Year 1st Technology Sharing'	numeric (99= unknown year)						
	v131	'Year 1st Joint Production'							
	v133	'Year 1st Comp Consortium'							
	v135	'Year 1st Distribution Agreement'							
35	v136	'Export Department'	1'yes' 2'no'						
	v137	'Year Export Department Set up'							

36	v138	'Number Export Countries'	numeric				vv138g	'number of export markets'	1'0' 2'1-5' 3'6-10 4'11-20' 5'21 and over'
37	v139 v140 v141 v142 v143 v144 v145 v146 v147 v148	'1st Export Country' '2nd Export Country' '3rd Export Country' '4th Export Country' '5th Export Country' '6th Export Country' '7th Export Country' '8th Export Country' '9th Export Country' '10th Export Country'	1 - 84 and 101 - 107						
38	v149	'Export Value 1993'	numeric	v149g	'value of exports 1993'	1'£1-10k' 2'1£1-50k' 3'£51-100k' 4'£101-500k' 5'£501-1000' 6'£1001k and over'			
39	v150 v151 v152	'Export Growth 1991' 'Export Growth 1992' 'Export Growth 1993'	numeric (999 '1st year' 998 'unknown increase 997 'unknown decrease')	v150av	'Average export growth 1991-1993'	mean(v150, v1 51, v152)	vv150avg	'Average export growth 1991-1993'	1'negative' 2'zero' 3'1-10' 4'11-30' 5'31-100' 6'101 and over'
40	v153	'Turnover 1993'	1'<£0.25m' 2'£0.25-0.49m' 3'£0.5- 0.9m' 4'£1.0-4.9m' 5'£5.0-10m' 6'>£10m'	vv153	'firm size by turnover'	1'<£0.5m' 2'£0.5m- £0.9m' 3'more than £0.9m'			
41	v154 v155 v156	'Turnover Growth 1991' 'Turnover Growth 1992' 'Turnover Growth 1993'	numeric (999 '1st year' 998 'unknown increase 997 'unknown decrease')	v154av	'average turnover growth 1991-1993'	mean(v154, v1 55, v156)	vv154avg	'average turnover growth 1991-1993'	1'negative' 2'zero' 3'1-10' 4'11-30' 5'31-100' 6'101 and over'
42	v157 v158 v159 v160 v161 v162 v163	'Manufactured product sales' 'Contract Manufacturing' 'Contract R&D' 'Manager/ marketing Consultancy' 'Technical Consultancy' 'License Out Technology' 'Other Payments'	numeric total = 100						

43	v164 v165 v166	'UK Business' 'Overseas Business excl Export' 'Exporting'	numeric total = 100	vv165	'percent ovseas turn 1993'	v165+v166'	vv165g	'percent ovseas turn 1993'	1'0'21'-10'3'11- 100'
44	v167 v168 v169 v170	'Further Participation' 'Copy' 'Town' 'Country'	1'yes' 2'no' 1'yes' 2'no' not coded 1' Scot' 2'Eng' 3'no dat'						

Country Labels 1'unknown 2'miscel' 3'australia' 4'austria' 5'bahamas' 6'barbados' 7'belgium' 8'brazil' 9'canada' 10'china' 11'croatia' 12'cyprus' 13'denmark' 14'egypt' 15'eire' 16'ethiopia'
17'finland' 18'france' 19'germany' 20'ghana' 21'greece' 22'holland' 23'hong kong' 24'hungary' 25'iceland' 26'india' 27'indonesia' 28'iran' 29'israel' 30'italy' 31'japan' 32'jordan'
33'kenya' 34'kuwai' 35'korea' 36'lithuania' 37'luxembourg' 38'malaysia' 39'malta' 40'mauritius' 41'mexico' 42'morocco' 43'new zeal' 44'nigeria' 45'norway' 46'oman' 47'pakistan' 48'peru'
49'philippines' 50'poland' 51'portugal' 52'qatar' 53'romania' 54'saudi' 55'seathia' 56'singapore' 57's africa' 58's korea' 59'spain' 60'sri lanka' 61'sweden' 62'switzerland'
63'taiwan' 64'thailand' 65'trinidad' 66'turkey' 67'uae' 68'uganda' 69'usa' 70'ussr' 71'venezuala' 72'zimbabwe' 73'uk' 74'chile/

Area Labels 101'africa' 102'benelux' 103'ec' 104'far east' 105'mid east' 106'scand' 107'australasia'

Language Labels 1'unknown' 2'miscel' 3'french' 4'german' 5'spanish' 6'italian' 7'dutch' 8'portuguese' 9'swedish' 10'greek' 11'japanese' 12'russian' 13'arabic'
14'afrikaans' 15'punjabi' 16'urdu' 17'danish' 18'chinese' 19'none' 20'norwegian' 21'polish'/

Appendix 7
Preliminary Cross-tabulation

Preliminary Descriptives And Cross-Tabulations

Firm Foundation - Evolution from Foreign Organisations		
Country of Former Organisation	f	valid %
Unknown	1	1.5
Holland	2	3.0
Sweden	1	1.5
Switzerland	1	1.5
USA	8	11.9
UK	54	80.6
n = 67		

Country of Partner/Parent Firm		
Country	f	%
Unknown	1	2
Australia	1	2
Austria	1	2
Belgium	1	2
Eire	1	2
Finland	1	2
Germany	1	2
Japan	1	2
Luxembourg	1	2
Switzerland	3	6
USA	12	25
UK	24	50
(n=48)		100

IPRs in UK	IPRs Overseas	
	No	Yes
	No	164
Yes	12	36

Sources of Funding of Cooperative R&D			
Source of Funds	f	valid %	n
British Government/enterprise initiative funding	11	15.5	71
Funding from Associated Firms	58	81.7	71
Funding through an industry/trade association	1	1.4	71
European Community Funding	7	9.9	71
Other	4	5.6	71

Major Product Attributes: Correlation							
Innovation	r=.5780 p=.000** *						

Software	r=.3610 p=.000** *	r=.2263 p=.002**					
Complexity	r=.3991 p=.000** *	r=.3248 p=.000***	r=.4010 p=.000** *				
Standardisation	r=.0675 p=.342	r=.1027 p=.149	r=.0255 p=.722	r=.0810 p=.259			
Customisation	r=.0510 p=.475	r=.0132 p=.854	r=-.1251 p=.082*	r=.0603 p=.402	r=-.1452 p=.041**		
Industry applications	r=.1957 p=.006**	r=.0501 p=.487	r=.0550 p=.448	r=.1345 p=.063*	r=-.1094 p=.000** *	r=.2853 p=.000** *	
Alternatives in UK	r=-.1880 p=.008**	r=-.2247 p=.002**	r=-.0289 p=.689	r=-.0670 p=.353	r=-.0060 p=.993	r=-.0124 p=.861	r=.0855 p=.234
.05 = * .01 = ** .001 = ***	Technol	Innov	Software	Complex	Standard	Custom	Ind Appl

E.FITF Number of Export Blankets

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Zero	1.00	30	14.1	16.9	16.9
1 thru 5	2.00	51	23.9	28.7	45.5
6 thru 10	3.00	35	16.4	19.7	65.2
11 thru hi	4.00	62	29.1	34.8	100.0
	.	35	16.4	Missing	
Total		213	100.0	100.0	
Mean	2.725	Median	3.000	Mode	4.000

Valid cases 178 Missing cases 35

EXPGR Average export growth 91 to 93

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
neg or zero	1.00	41	19.2	27.7	27.7
up to 10%	2.00	34	16.0	23.0	50.7
Over 10%	3.00	73	34.3	49.3	100.0
	.	65	30.5	Missing	
Total		213	100.0	100.0	
Mean	2.216	Median	2.000	Mode	3.000

Valid cases 148 Missing cases 65

TURFIDC Average turnover growth 91 to 93

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
neg or zero	1.00	30	14.1	16.4	16.4
up to 10%	2.00	51	23.9	27.3	44.3
Over 10%	3.00	102	47.9	55.7	100.0
	.	30	14.1	Missing	
Total		213	100.0	100.0	
Mean	2.393	Median	3.000	Mode	3.000

Valid cases 183 Missing cases 30

INTPRT Percent overseas turnover 1993

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Zero	1.00	41	19.2	19.9	19.9
1 thru 10	2.00	36	16.9	17.5	37.4
11 thru 50	3.00	80	37.6	38.8	76.2
51 thru 100	4.00	49	23.0	23.6	100.0
	.	7	3.3	Missing	
Total		213	100.0	100.0	
Mean	2.565	Median	3.000	Mode	3.000

Valid cases 206 Missing cases 7

Count	neg or z up to 10 Over 10%				Row Total
	1.00	2.00	3.00	Total	
1.00	11	7	18	36	
less than 10	30.6%	19.4%	50.0%	24.3%	
11-20	26.6%	20.6%	24.7%		
	7.4%	4.7%	12.2%		
	.4	-.6	.1		
2.00	10	11	13	34	
11-20	29.4%	32.4%	38.2%	23.0%	
	24.4%	32.4%	17.8%		
	6.8%	7.4%	6.8%		
	.3	1.5	-1.5		
3.00	14	12	30	56	
21-50	25.0%	21.4%	53.6%	37.8%	
	34.1%	35.3%	41.1%		
	9.5%	8.1%	20.3%		
	-.6	-.3	.8		
4.00	6	4	12	22	
51-200	27.3%	18.2%	54.5%	14.9%	
	14.6%	11.8%	16.4%		
	4.1%	2.7%	8.1%		
	.0	-.6	.5		
Column Total	41	34	73	148	
Total	27.7%	23.0%	49.3%	100.0%	

Chi-Square Value DF Significance

Pearson 3.24332 6 .77775
 Likelihood Ratio 3.18753 6 .78497
 Mantel-Haenszel test for linear association .46230 1 .49655

Minimum Expected Frequency = 5.054

WU17 Firm size by Employees by EXPMK Number of Export Markets

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EXPMK

Count	Zero				1 thru 5				6 thru 10				11 thru 40				Row Total
	1.00	2.00	3.00	4.00	1.00	2.00	3.00	4.00	1.00	2.00	3.00	4.00	1.00	2.00	3.00	4.00	
1.00	10	21	8	5	10	10	11	15	10	10	11	15	15	15	46	44	
less than 10	22.7%	47.7%	18.2%	11.4%	21.7%	21.7%	23.9%	32.6%	21.7%	21.7%	23.9%	32.6%	21.7%	21.7%	25.8%	24.7%	
11-20	33.3%	41.2%	22.9%	8.1%	33.3%	19.6%	31.4%	24.2%	5.6%	5.6%	6.2%	8.4%	1.0	-1.2	.8		
21-50	5.6%	11.8%	4.5%	2.8%	5.6%	5.6%	6.2%	8.4%	1.0	-1.2	.8						
51-200	1.2	3.2	-1.3	-3.8	8	17	12	27	12.5%	26.6%	16.8%	42.2%	26.7%	33.3%	34.3%	43.5%	
	1.2	3.2	-1.3	-3.8	8	17	12	27	4.5%	9.6%	6.7%	15.2%	-1.2	-1.2	1.5	64	
	1.2	3.2	-1.3	-3.8	8	17	12	27	-1.2	-1.2	-1.2	1.5	2	3	4	15	
	1.2	3.2	-1.3	-3.8	8	17	12	27	8.3%	12.5%	16.7%	62.5%	6.7%	5.9%	11.4%	24.2%	
	1.2	3.2	-1.3	-3.8	8	17	12	27	1.1%	1.7%	2.2%	8.4%	-1.2	-1.9	-1.4	3.1	
	1.2	3.2	-1.3	-3.8	8	17	12	27	-1.2	-1.9	-1.4	3.1				24	
Column Total	30	51	35	62	178	178	178	178	16.9%	28.7%	19.7%	34.8%	100.0%	100.0%	100.0%	100.0%	

Chi-Square Value DF Significance

Pearson 25.84335 9 .00217
 Likelihood Ratio 27.12563 9 .00133
 Mantel-Haenszel test for linear association 18.97172 1 .00001

Minimum Expected Frequency = 4.045
 Cells with Expected Frequency < 5 = 2 DF 16 (12.5%)

UU17 Firm size by Employees by INTRAT Percent overseas turnover 1993

INTRAT

Count	INTRAT				Row Total
	Zero	1 thru 10	11 thru 50	51 thru 100	
Row Pct					
Col Pct					
Tot Pct					
Adj Res	1.00	2.00	3.00	4.00	
	14 26.4%	10 18.9%	20 37.7%	9 17.0%	53 25.7%
	34.1%	27.8%	25.0%	18.4%	
	6.8%	4.9%	9.7%	4.4%	
	1.4	.3	-.2	-1.4	
	12 23.5%	9 17.6%	19 37.3%	11 21.6%	51 24.8%
	29.3%	25.0%	23.8%	22.4%	
	5.8%	4.4%	9.2%	5.3%	
	.7	.0	-.3	-.4	
	15 20.0%	12 16.0%	32 42.7%	16 21.3%	75 36.4%
	36.6%	33.3%	40.0%	32.7%	
	7.3%	5.8%	15.5%	7.8%	
	.0	-.4	.9	-.6	
	0 .0%	5 18.5%	9 33.3%	13 48.1%	27 13.1%
	.0%	13.9%	11.3%	26.5%	
	.0%	2.4%	4.4%	6.3%	
	-2.8	.2	-.6	3.2	
Column Total	41 19.9%	36 17.5%	60 38.8%	49 23.8%	206 100.0%

Chi-Square Value DF Significance

Pearson 15.61747 9 .07531
Likelihood Ratio 19.43762 9 .02172
Mantel-Haenszel test for linear association 8.62471 1 .00932

Minimum Expected Frequency = 4.718
Cells with Expected Frequency < 5 = 1 DF 16 (6.54)

UW17 Firm size by Employees by TURNGR Average turnover growth 91 to 93

TURNGR Page 1 of 1

Count	neg or z up to 10 Over 10%				Row Total
	Row Pct	Col Pct	Tot Pct	Adj Res	
	1.00	2.00	3.00		
less than 10	11 23.4%	8 17.0%	28 59.6%	47 25.7%	
11-20	6 13.3%	15 33.3%	24 53.3%	45 24.6%	
21-50	9 13.2%	22 32.4%	37 54.4%	68 37.2%	
51-200	4 17.4%	6 26.1%	13 56.5%	23 12.6%	
	Adj Res				
	-0.6	.9	-1.4		
	3.3%	8.2%	13.1%		
	6.0%	4.4%	15.3%		
	15.7%	27.5%			
	1.5%	-1.9	.6		

Column Total 30 51 102 183
Total 16.4% 27.9% 55.7% 100.0%

Chi-Square Value DF Significance

Pearson 5.27214 6 .50941
Likelihood Ratio 5.42154 6 .49099
Mantel-Haenszel test for linear association .06702 1 .79572

Minimum Expected Frequency = 3.770
Cells with Expected Frequency < 5 = 1 DF 12 (8.3%)

UU153 Firm Size by Turnover by EXPGR Average export growth 91 to 93

EXPGR Page 1 of 1

	Count	neg or z up to 10 Over 10%			Row Total
		1.00	2.00	3.00	
UU153	1.00	12	8	14	34
less than \$0.5m	35.3%	23.5%	41.2%	23.0%	
	29.3%	23.5%	19.2%		
	8.1%	5.4%	9.5%		
	1.1	.1	-1.1		
	2.00	13	8	17	38
\$0.5m - \$0.9m	34.2%	21.1%	44.7%	25.7%	
	31.7%	23.5%	23.3%		
	8.8%	5.4%	11.5%		
	1.0	-.3	-.7		
	3.00	16	18	42	76
more than \$0.9m	21.1%	23.7%	55.3%	51.4%	
	39.0%	52.9%	57.5%		
	10.8%	12.2%	28.4%		
	-1.9	.2	1.5		
Column Total	41	34	73	148	
Total	27.7%	23.0%	49.3%	100.0%	

Chi-Square Value DF Significance

Pearson 3.74699 4 .44133
Likelihood Ratio 3.77370 4 .43750
Mantel-Haenszel test for linear association 3.11526 1 .07756

Minimum Expected Frequency - 7.811

Number of Missing Observations: 65

UU153 Firm Size by Turnover by EXPNK Number of Export Inquiries

EXPNK Page 1 of 1

	Count	Zero				Row Total
		1 thru 5	6 thru 10	11 thru 15	16 thru 25+	
UU153	1.00	11	18	12	4	45
less than \$0.5m	24.4%	40.0%	26.7%	8.9%		
	36.7%	35.3%	34.3%	6.6%		
	6.2%	10.2%	6.8%	2.3%		
	1.6	1.9	1.3	-4.2		
	2.00	11	14	7	14	46
\$0.5m - \$0.9m	23.9%	30.4%	15.2%	30.4%		
	36.7%	27.5%	20.0%	23.0%		
	6.2%	7.9%	4.0%	7.9%		
	1.5	.3	-.9	-.7		
	3.00	8	19	16	43	67
more than \$0.9m	9.3%	22.1%	18.6%	50.0%		
	26.7%	37.3%	45.7%	70.5%		
	4.5%	10.7%	9.0%	24.3%		
	-2.6	-1.9	-.4	4.2		
Column Total	30	51	35	61	177	
Total	16.9%	28.8%	19.8%	34.5%	100.0%	

Chi-Square Value DF Significance

Pearson 25.52315 6 .00027
Likelihood Ratio 28.52024 6 .00007
Mantel-Haenszel test for linear association 20.53925 1 .00001

Minimum Expected Frequency - 7.627

Number of Missing Observations: 36

WU153 Firm Size by Turnover by INTRAT Percent overseas turnover 1993

INTRAT

Count Row Pct Col Pct Tot Pct Adj Res	Zero				1 thru 10				11 thru 50				51 thru 100				Row Total	
	1.00	2.00	3.00	4.00	1.00	2.00	3.00	4.00	1.00	2.00	3.00	4.00	1.00	2.00	3.00	4.00	Row Total	Total
WU153 less than \$0.5m	15 26.8%	9 16.1%	21 37.5%	11 19.6%	15 26.8%	9 16.1%	21 37.5%	11 19.6%	15 26.8%	9 16.1%	21 37.5%	11 19.6%	15 26.8%	9 16.1%	21 37.5%	11 19.6%	56 27.3%	56 27.3%
60.5m - \$0.9m	17 31.5%	7 13.0%	18 33.3%	12 22.2%	17 31.5%	7 13.0%	18 33.3%	12 22.2%	17 31.5%	7 13.0%	18 33.3%	12 22.2%	17 31.5%	7 13.0%	18 33.3%	12 22.2%	54 26.3%	54 26.3%
more than \$0.9m	9 9.5%	20 21.1%	40 42.1%	26 27.4%	9 9.5%	20 21.1%	40 42.1%	26 27.4%	9 9.5%	20 21.1%	40 42.1%	26 27.4%	9 9.5%	20 21.1%	40 42.1%	26 27.4%	95 46.3%	95 46.3%
Column Total	41 20.0%	36 17.6%	79 38.5%	49 23.9%	41 20.0%	36 17.6%	79 38.5%	49 23.9%	41 20.0%	36 17.6%	79 38.5%	49 23.9%	41 20.0%	36 17.6%	79 38.5%	49 23.9%	205 100.0%	205 100.0%

Chi-Square

Value

DF

Significance

Pearson 13.16737 .04045
Likelihood Ratio 13.63943 .03148
Nantel-Haenszel test for linear association 5.33881 .02086

Minimum Expected Frequency - 9.483

Number of Missing Observations: 8

WU153 Firm Size by Turnover by TURIDR Average turnover 1993

TURIDR

Count Row Pct Col Pct Tot Pct Adj Res	neg or = up to 10 Over 10%			Row Total	
	1.00	2.00	3.00	Row Total	Total
WU153 less than \$0.5m	16 21.3%	9 19.1%	28 59.6%	47 25.8%	47 25.8%
60.5m - \$0.9m	11 23.9%	12 26.1%	23 50.0%	46 25.3%	46 25.3%
more than \$0.9m	9 10.1%	30 33.7%	50 56.2%	89 48.9%	89 48.9%
Column Total	36 16.5%	51 28.0%	101 55.5%	101 55.5%	101 55.5%

Chi-Square

Value

DF

Significance

Pearson 7.19466 .12535
Likelihood Ratio 7.41345 .11559
Nantel-Haenszel test for linear association .60708 .43567

Minimum Expected Frequency - 7.582

Number of Missing Observations: 31

UU14 State of Independence by EXPGR Average export growth 91 to 93

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EXPGR		neg or z up to 10 Over 10%			Row Total	
Count	Row Pct	Col Pct	Adj Res	1.00	2.00	3.00
1.00	33	28.4%	17.6%	.4	26	57
Wholly indepede	28.4%	76.5%	17.6%	-.3	22.4%	49.1%
2.00	8	19.5%	5.4%	-.4	25.0%	16
not wholly indep	25.0%	21.9%	5.4%	-.4	23.5%	50.0%
Column Total	41	5.4%	10.8%	.3	34	73
Total	27.7%	23.0%	10.8%	-.4	23.0%	49.3%
Row Total	116	78.4%	21.6%		116	148

Chi-Square	Value	DF	Significance
Pearson	.18445	2	.91190
Likelihood Ratio	.18564	2	.91136
Mantel-Haenszel test for linear association	.06397	1	.80033

Minimum Expected Frequency - 7.351

Number of Missing Observations: 65

UU14 State of Independence by EXPMK Number of Export Markets

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EXPMK		1 thru 5			6 thru 10	11 thru 16	Row Total
Count	Row Pct	Col Pct	Adj Res	1.00	2.00	3.00	4.00
1.00	22	16.2%	12.4%	-.4	43	25	46
Wholly indepede	16.2%	73.3%	12.4%	-.4	31.6%	18.4%	33.8%
2.00	8	19.0%	4.5%	.4	19.0%	10	16
not wholly indep	26.7%	25.8%	4.5%	.4	15.7%	28.6%	38.1%
Column Total	30	4.5%	9.0%	.4	28.7%	19.7%	62
Total	16.9%	26.7%	9.0%	.4	28.7%	19.7%	34.8%
Row Total	116	23.6%	25.8%	-.5	38.1%	25.8%	23.6%

Chi-Square	Value	DF	Significance
Pearson	2.57512	3	.47111
Likelihood Ratio	2.71603	3	.43111
Mantel-Haenszel test for linear association	.31878	1	.57211

Minimum Expected Frequency - 7.079

Number of Missing Observations: 35

UU14 State of Independence by INTRAT Percent overseas turnover 1992

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INTRAT		Count				Row Total	Col Total	DF	Significance
Count	Row Pct	1 thru 10	11 thru 50	51 thru 100	100	Row Total	Col Total	DF	Significance
Zero	1.00	32	65	31	158	158	49	3	.07843
Wholly independe	20.3%	19.0%	41.1%	19.6%	76.7%	76.7%	23.8%	3	.09274
	78.0%	83.3%	81.3%	63.3%	15.0%	15.0%	8.7%	1	.11359
	15.5%	14.6%	31.6%	15.0%	-2.5	-2.5			
	.2	1.0	1.2	-2.5					
not wholly indep	2.00	9	15	18	48	48	206	3	.07843
	18.8%	12.5%	31.3%	37.5%	23.3%	23.3%	100.0%	3	.09274
	22.0%	16.7%	18.8%	36.7%	8.7%	8.7%		1	.11359
	4.4%	2.9%	7.3%	8.7%					
	-2	-1.0	-1.2	2.5					
Column Total	41	36	80	49	206	206	100.0%		
Row Total	19.9%	17.5%	38.8%	23.8%	100.0%	100.0%			

Chi-Square Value DF Significance

Pearson 6.80346 3 .07843
Likelihood Ratio 6.42327 3 .09274
Mantel-Haenszel test for linear association 2.50351 1 .11359

Minimum Expected Frequency - 8.388

Number of Missing Observations: 7

UU14 State of Independence by TURNER Average turnover growth 91 to 93

Page 1 of 1

TURNER		Count			Row Total	Col Total	DF	Significance	
Count	Row Pct	neg or z ero	up to 10	Over 10	Row Total	Col Total	DF	Significance	
Zero	1.00	22	34	85	141	141	2	.05017	
Wholly independe	15.6%	24.1%	60.3%	77.0%	77.0%	77.0%	2	.06312	
	73.3%	66.7%	83.3%	46.4%	18.6%	18.6%	1	.07967	
	12.0%	18.6%	46.4%	2.3	-2.1	-2.1			
	-1.5	-2.1	2.3						
not wholly indep	2.00	8	17	17	42	42	183	2	.05017
	19.0%	40.5%	40.5%	23.0%	23.0%	23.0%	100.0%	2	.06312
	26.7%	33.3%	16.7%	9.3%	9.3%	9.3%		1	.07967
	4.4%	9.3%	9.3%	2.1	-2.3	-2.3			
	.5	2.1	-2.3						
Column Total	30	51	102	183	183	183	100.0%		
Row Total	16.4%	27.9%	55.7%	100.0%	100.0%	100.0%			

Chi-Square Value DF Significance

Pearson 5.62102 2 .05017
Likelihood Ratio 5.52355 2 .06312
Mantel-Haenszel test for linear association 3.07155 1 .07967

Minimum Expected Frequency - 6.885

Number of Missing Observations: 30

UU10 Mode of Foundation by EXPGR Average export growth 91 to 93

Page 1 of 1

EXPGR		Count		Row Pct		Col Pct		Tot Pct		Adj Res		Row Total	
neg or z up to 10 Over 10%		%		%		%		%		%		%	
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00
1.00	28	24	43	29.5%	25.3%	45.3%	59.7%	19.0%	16.3%	29.3%	.6	95	64.6%
2.00	13	10	29	25.0%	19.2%	55.8%	31.7%	8.8%	6.8%	19.7%	-1.2	52	35.4%
Total	41	34	72	27.9%	23.1%	49.0%	40.3%	14.8%	13.1%	49.0%	-0.6	147	100.0%

Chi-Square	Value	DF	Significance
Fearson	1.52718	2	.46599
Likelihood Ratio	1.53267	2	.46471
Mantel-Haenszel test for linear association	1.03413	1	.30919

Minimum Expected Frequency = 12.027

Number of Missing Observations: 66

UU10 Mode of Foundation by EXPNK Number of Export Markets

Page 1 of 1

EXPNK		Count		Row Pct		Col Pct		Tot Pct		Adj Res		Row Total	
Zero		%		%		%		%		%		%	
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00
1.00	19	36	20	16.7%	31.6%	17.5%	34.2%	10.7%	20.3%	11.3%	22.0%	114	64.4%
2.00	11	15	15	17.5%	23.8%	23.8%	34.9%	6.2%	8.5%	8.5%	12.4%	65	35.6%
Total	30	51	35	16.9%	28.8%	19.8%	34.5%	16.9%	16.8%	19.8%	34.5%	179	100.0%

Chi-Square	Value	DF	Significance
Fearson	1.67667	3	.64013
Likelihood Ratio	1.68147	3	.64172
Mantel-Haenszel test for linear association	.15570	1	.69314

Minimum Expected Frequency = 10.678

Number of Missing Observations: 36

	Count	neg or z up to 10 Over 10%			Row Total
		1.00	2.00	3.00	
UW33		7	1	4	12
Zero	1.00	58.3%	8.3%	33.3%	9.3%
		18.4%	3.4%	6.5%	
		5.4%	.8%	3.1%	
		2.3	-1.2	-1.1	
1 thru 5	2.00	17	16	31	64
		26.6%	25.0%	48.4%	49.6%
		44.7%	55.2%	50.0%	
		13.2%	12.4%	24.0%	
		-.7	.7	.1	
6 thru 20	3.00	8	9	18	35
		22.9%	25.7%	51.4%	27.1%
		21.1%	31.0%	29.0%	
		6.2%	7.0%	14.0%	
		-1.0	.5	.5	
21 thru 100	4.00	6	3	9	18
		33.3%	16.7%	50.0%	14.0%
		15.8%	10.3%	14.5%	
		4.7%	2.3%	7.0%	
		.4	-.6	.2	
Column Total	38	29	62	129	
Total	29.5%	22.5%	48.1%	100.0%	

Chi-Square	Value	DF	Significance
Pearson	6.51082	6	.36846
Likelihood Ratio	6.21441	6	.39961
Nominal-Haenszel test for linear association	.93732	1	.33297

Minimum Expected Frequency = 2.698
 Cells with Expected Frequency < 5 = 3 of 12 (25.0%)

EXPINTK Number of Export Markets

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Count	1 thru 5	6 thru 10	11 thru 15	Row Total
1.00	4	6	3	14
2.00	13	21	11	45
3.00	3	9	9	21
4.00	5	7	7	19
Total	25	43	30	153
Row Pct	16.3%	28.1%	19.6%	100.0%
Col Pct	28.0%	21.4%	20.0%	27.5%
Tot Pct	10.0%	18.0%	13.3%	14.4%
Adj Res	1.00	2.00	3.00	4.00
	28.6%	42.9%	21.4%	7.1%
	16.0%	14.0%	10.0%	1.8%
	2.6%	3.9%	2.0%	.7%
	1.3	1.3	.2	-2.4
	17.3%	28.0%	14.7%	40.0%
	52.0%	48.8%	36.7%	54.5%
	8.5%	13.7%	7.2%	19.6%
	.3	.0	-1.5	1.0
	7.1%	21.4%	21.4%	50.0%
	12.0%	20.9%	30.0%	38.2%
	2.0%	5.9%	5.9%	13.7%
	-1.9	-1.1	.3	2.2
	22.7%	31.8%	31.8%	13.6%
	20.0%	16.3%	23.3%	5.5%
	3.3%	4.6%	4.6%	2.0%
	.9	.4	1.6	-2.4
Column	25	43	30	55
Total	16.3%	28.1%	19.6%	35.9%

Chi-Square	Value	DF	Significance
Likelihood Ratio	17.53810	9	.04093
Fisher's Exact Test	19.84212	9	.01891
Linear Association	.57755	1	.44727

Expected Frequency = 2.288
 Expected Frequency < 5 = 5 DF 16 (31.3%)

FCG Intensity by INTRAT Percent overseas turnover 1993

INTRAT Page 1 of 1

Count	10	20	30	40	Row Total
Row Pct	26.3%	36.8%	21.1%	15.8%	10.7%
Col Pct	14.7%	23.3%	6.0%	6.5%	1.7%
Tot Pct	2.8%	4.0%	2.3%	1.7%	-1.1
Adj Res	.8	2.4	-1.6	-1.1	
1.00	5	7	4	3	19
2.00	21	13	37	13	84
3.00	6	3	22	16	47
4.00	2	7	4	14	27
Column Total	34	30	67	46	177
Row Total	19.2%	16.9%	37.9%	26.0%	100.0%

Chi-Square	Value	DF	Significance
Goodness of Fit	33.36743	9	.00012
Likelihood Ratio	33.96903	9	.00009
Nominal	13.37366	1	.00026
Linear Association			

Expected Frequency = 3.220
 Observed Frequency = 5 - 4 DF 16 (.2504)

5.0 Intensity by TURNGR Average turnover growth 91 to 93

TURNGR Page 1 of 1

Count	Row Pct	Col Pct	Tot Pct	Adj Res	1.00	2.00	3.00	Row Total
1 00					3	6	8	17
	17.6%	35.3%	47.1%					10.8%
	12.0%	13.6%	9.1%					
	1.9%	3.8%	5.1%					
	.2	.7	-.8					
2 00					14	21	40	75
	18.7%	28.0%	53.3%					47.8%
	50.0%	47.7%	45.5%					
	8.9%	13.4%	25.5%					
	.9	.0	-.7					
3 00					5	13	25	43
	11.6%	30.2%	58.1%					27.4%
	20.0%	29.5%	28.4%					
	3.2%	6.3%	15.9%					
	.9	.4	.3					
4 00					3	4	15	22
	13.6%	18.2%	68.2%					14.0%
	12.0%	9.1%	17.0%					
	1.9%	2.5%	9.6%					
	-.3	-1.1	1.2					
Mean	25	44	68					157
Total	15.0%	28.0%	56.1%					100.0%

square ----- Value ----- DF ----- Significance -----

3.06770
3.16402
1.81275

0
6
1

.80030
.78900
1.7818

FLD FTEs percent establishment by EXPGR Average export growth 91 to 93

EXPGR Page 1 of 1

Count	1.00	2.00	3.00	Row Total
Row Pct	11	6	13	30
Col Pct	36.7%	20.0%	43.3%	23.1%
Tot Pct	29.7%	20.0%	20.6%	
Adj Res	8.5%	4.6%	10.0%	
	1.1	-1.5	-1.0	
	13	13	23	49
	26.5%	26.5%	46.9%	37.7%
	35.1%	43.3%	36.5%	
	10.0%	10.0%	17.7%	
	-1.4	.7	-1.3	
	5	4	16	25
	20.0%	16.0%	64.0%	19.2%
	13.5%	13.3%	25.4%	
	3.8%	3.1%	12.3%	
	-1.0	-1.9	1.7	
	8	7	11	26
	30.8%	26.9%	42.3%	20.0%
	21.6%	23.3%	17.5%	
	6.2%	5.4%	8.5%	
	.3	.5	-1.7	
Column Total	37	30	63	130
Total	26.5%	23.1%	48.5%	100.0%

Chi-Square	Value	DF	Significance
	4.17191	6	.65342
	4.13784	6	.65803
	.30050	1	.58357

Chi-Square Significance = 5.769

Exhibit 1: FTEs percent establishment by EXFTEK Number of Export Markets

EXFTEK Page 1 of 1

Count	Zero				1 thru 5				6 thru 10				11 thru 15				Row Total	
	1.00	2.00	3.00	4.00	5	10	15	20	25	30	35	40	45	50	55	60	Row Total	Col Pct
1.00	10	15	6	8	25.6%	38.5%	15.4%	20.5%	19.4%	14.0%	6.5%	9.8%	3.9%	5.2%	1.8	39	25.5%	
2.00	6	11	11	30	10.3%	19.0%	19.0%	51.7%	24.0%	35.5%	3.9%	7.2%	19.6%	2.9	58	37.9%		
3.00	4	6	6	12	14.3%	21.4%	21.4%	42.9%	16.0%	19.4%	21.1%	7.6%	1.7	26	16.3%			
4.00	5	8	8	7	17.9%	28.6%	28.6%	25.0%	20.0%	25.8%	12.3%	4.6%	1.2	28	18.3%			
Column Total	25	40	31	57	16.3%	26.1%	20.3%	37.3%	100.0%									

Chi-Square Value DF Significance

Continuity Correction = 16.19740 9 .06287
 Likelihood Ratio = 16.22403 9 .06335
 Fisher's Exact Test for Linear Association = .77961 1 .37726

N of Valid Cases = 4.575
 Expected Frequency < 5 = 2.00 16 (12.5%)

... R&D FTEs percent establishment
 ... INTRAT Percent overseas turnover 1993

INTRAT		Count				Row	Col	Total
		1 thru 10	11 thru 50	51 thru 100	100	100	100	Total
Count	Row Pct	Col Pct	Tot Pct	Adj Res	1.00	2.00	3.00	4.00
1	18	13	12	6	49			
	36.7%	26.5%	24.5%	12.2%	27.8%			
	51.4%	44.8%	18.2%	13.0%				
	10.2%	7.4%	6.8%	3.4%				
	3.5	2.2	-2.2	-2.6				
2	10	4	33	13	60			
	16.7%	6.7%	55.0%	21.7%	34.1%			
	28.6%	13.8%	50.0%	28.3%				
	5.7%	2.3%	18.8%	7.4%				
	-8	-2.5	3.4	-1.0				
3	4	5	13	9	31			
	12.9%	16.1%	41.9%	29.0%	17.6%			
	11.4%	17.2%	19.7%	19.6%				
	2.3%	2.8%	7.4%	5.1%				
	-1.1	-1.1	.6	.4				
4	3	7	8	18	36			
	8.3%	19.4%	22.2%	50.0%	20.5%			
	8.6%	24.1%	12.1%	39.1%				
	1.7%	4.0%	4.5%	10.2%				
	-1.9	.5	-2.1	3.7				
Column Total	35	29	66	46	176			
Total	19.9%	16.5%	37.5%	26.1%	100.0%			

Chi-Square	Value	DF	Significance
	38.72353	9	.00001
	37.98660	9	.00002
	18.05241	1	.00002

... Expected frequency = 5 108

4. RFD FTEs percent establishment
TURNOVER Average turnover growth 91 to 93

TURNOVER Page 1 of 1

Count	Row Pct	Col Pct	Tot Pct	Adj Res	1.00	2.00	3.00	Row Total
100	14.3%	14.7%	21.0%	1.00	13	16	20	41
100	14.3%	14.7%	21.0%	2.00	31.7%	28.6%	48.8%	20.3%
100	14.3%	14.7%	21.0%	3.00	26.9%	35.6%	22.7%	15.9%
100	14.3%	14.7%	21.0%	4.00	8.3%	10.3%	12.8%	15.9%
100	14.3%	14.7%	21.0%	5.00	.5	-.1	1.1	1.1
100	14.3%	14.7%	21.0%	6.00	14.3%	20.6%	32.1%	50
100	14.3%	14.7%	21.0%	7.00	34.6%	35.6%	36.4%	15.9%
100	14.3%	14.7%	21.0%	8.00	5.1%	10.3%	20.5%	15.9%
100	14.3%	14.7%	21.0%	9.00	1	-.1	1	1
100	14.3%	14.7%	21.0%	10.00	2	8	10	20
100	14.3%	14.7%	21.0%	11.00	6.9%	27.6%	65.5%	16.6%
100	14.3%	14.7%	21.0%	12.00	6.7%	17.8%	21.6%	16.6%
100	14.3%	14.7%	21.0%	13.00	1.3%	5.1%	12.7%	16.6%
100	14.3%	14.7%	21.0%	14.00	1.3	-.2	1.1	1.1
100	14.3%	14.7%	21.0%	15.00	5	8	17	30
100	14.3%	14.7%	21.0%	16.00	16.7%	16.7%	56.7%	14.2%
100	14.3%	14.7%	21.0%	17.00	21.7%	17.8%	19.3%	14.2%
100	14.3%	14.7%	21.0%	18.00	3.7%	5.1%	10.9%	14.2%
100	14.3%	14.7%	21.0%	19.00	2	-.3	0	1.1
100	14.3%	14.7%	21.0%	20.00	23	45	68	156
100	14.3%	14.7%	21.0%	21.00	14.7%	28.8%	50.4%	104.8%

Count	Row Pct	Col Pct	Tot Pct	Adj Res	1.00	2.00	3.00	Row Total
100	14.3%	14.7%	21.0%	1.00	13	16	20	41
100	14.3%	14.7%	21.0%	2.00	31.7%	28.6%	48.8%	20.3%
100	14.3%	14.7%	21.0%	3.00	26.9%	35.6%	22.7%	15.9%
100	14.3%	14.7%	21.0%	4.00	8.3%	10.3%	12.8%	15.9%
100	14.3%	14.7%	21.0%	5.00	.5	-.1	1.1	1.1
100	14.3%	14.7%	21.0%	6.00	14.3%	20.6%	32.1%	50
100	14.3%	14.7%	21.0%	7.00	34.6%	35.6%	36.4%	15.9%
100	14.3%	14.7%	21.0%	8.00	5.1%	10.3%	20.5%	15.9%
100	14.3%	14.7%	21.0%	9.00	1	-.1	1	1
100	14.3%	14.7%	21.0%	10.00	2	8	10	20
100	14.3%	14.7%	21.0%	11.00	6.9%	27.6%	65.5%	16.6%
100	14.3%	14.7%	21.0%	12.00	6.7%	17.8%	21.6%	16.6%
100	14.3%	14.7%	21.0%	13.00	1.3%	5.1%	12.7%	16.6%
100	14.3%	14.7%	21.0%	14.00	1.3	-.2	1.1	1.1
100	14.3%	14.7%	21.0%	15.00	5	8	17	30
100	14.3%	14.7%	21.0%	16.00	16.7%	16.7%	56.7%	14.2%
100	14.3%	14.7%	21.0%	17.00	21.7%	17.8%	19.3%	14.2%
100	14.3%	14.7%	21.0%	18.00	3.7%	5.1%	10.9%	14.2%
100	14.3%	14.7%	21.0%	19.00	2	-.3	0	1.1
100	14.3%	14.7%	21.0%	20.00	23	45	68	156
100	14.3%	14.7%	21.0%	21.00	14.7%	28.8%	50.4%	104.8%

2 96500
3 20121
85180

U4 RTBF by EXPGR Average export growth 91 to 93

EXPGR Page 1 of 1

Count	1.00	2.00	3.00	Row Total
Row Pct	28	18	47	93
Col Pct	30.1%	19.4%	50.5%	62.8%
Tot Pct	68.3%	52.9%	64.4%	
Adj Res	18.9%	12.2%	31.8%	
	.9	-1.4	.4	
1.0	13	16	26	55
	23.6%	29.1%	47.3%	37.2%
	31.7%	47.1%	35.6%	
	8.8%	10.8%	17.6%	
	-.9	1.4	-.4	
Column Total	41	34	73	148
	27.7%	23.0%	49.3%	100.0%

Chi-Square Value DF Significance

Pearson 2.02317 2 .36364
Likelihood Ratio 1.99543 2 .36872
Nagelkerke test for linear association .04877 1 .82521

Minimum Expected Frequency = 12.635

Number of Missing Observations: 65

U4 RTBF by EXPGR Number of Export Markets

EXPGR Page 1 of 1

Count	1.00	2.00	3.00	4.00	Row Total
Row Pct	22	36	20	32	110
Col Pct	20.0%	32.7%	18.2%	29.1%	61.8%
Tot Pct	23.3%	70.6%	57.1%	51.6%	
Adj Res	12.4%	20.2%	11.2%	18.0%	
	1.4	1.5	-1.6	-2.0	
1.0	8	15	15	30	66
	11.8%	22.1%	22.1%	44.1%	38.2%
	26.7%	29.4%	42.9%	48.4%	
	4.5%	8.4%	8.4%	16.9%	
	-1.4	-1.5	.6	2.0	
Column Total	30	51	35	62	148
	16.9%	28.7%	19.7%	34.8%	100.0%

Chi-Square Value DF Significance

Pearson 6.40572 3 .03476
Likelihood Ratio 6.48067 3 .06344
Nagelkerke test for linear association 6.02446 1 .014

Minimum Expected Frequency = 11.461

Number of Missing Observations: 35

016 Industry by TURNGR Average turnover growth 91 to 93

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TURNGR	Count	neg or z up to 10 Over 10%				Row Total
		1.00	2.00	3.00	%	
plastic	1.0	5	7	8	20	11.0%
		25.0%	35.0%	40.0%		
		17.2%	13.7%	7.8%		
		2.7%	3.8%	4.4%		
		1.2	.7	-1.5		
boitech	2.0	2	6	18	26	14.3%
		7.7%	23.1%	69.2%		
		6.9%	11.8%	17.6%		
		1.1%	3.3%	9.9%		
		-1.2	-.6	1.5		
medinst	3.0	7	11	26	44	24.2%
		15.9%	25.0%	59.1%		
		24.1%	21.6%	25.5%		
		3.8%	6.0%	14.3%		
		.0	-.5	.5		
electinst	4.0	7	15	22	44	24.2%
		15.9%	34.1%	50.0%		
		24.1%	29.4%	21.6%		
		3.8%	8.2%	12.1%		
		.0	1.0	-.9		
other	5.0	8	12	28	48	26.4%
		16.7%	25.0%	58.3%		
		27.6%	23.5%	27.5%		
		4.4%	6.6%	15.4%		
		.2	-.5	.4		
Column Total	29	51	102	182		
	15.9%	28.0%	56.0%	100.0%		

Chi-Square Value DF Significance

Pearson 5.73869 8 .67642
 Likelihood Ratio 5.86675 8 .66216
 Mantel-Haenszel test for linear association .06283 1 .83203

Minimum Expected Frequency = 3.187
 Cells with Expected Frequency < .5 = 2 OF 15 (13.3%)

Number of Missing Observations: 31

Industry by INTRAT Percent overseas turnover 1993

Page 1 of 1

Count	INTRAT					Row Total
	Zero	1 thru 10	11 thru 50	51 thru 100	4.00	
1.0	10 45.5%	2 9.1%	8 36.4%	2 9.1%	2 10.7%	22 10.7%
2.0	5 15.2%	5 15.2%	11 33.3%	12 36.4%	12 36.4%	33 16.1%
3.0	6 12.5%	8 16.7%	19 39.6%	15 31.3%	15 31.3%	48 23.4%
4.0	9 18.4%	10 20.4%	20 40.8%	10 20.4%	10 20.4%	49 23.9%
5.0	11 20.8%	11 20.8%	21 39.6%	10 18.9%	10 18.9%	53 25.9%
Column Total	41 20.0%	36 17.6%	79 38.5%	49 23.9%	49 23.9%	205 100.0%

Chi-Square Value DF Significance

Pearson 16.92356 12 .15250
Likelihood Ratio 15.73897 12 .20349
Mantel-Haenszel test for linear association .07078 1 .79020

Minimum Expected Frequency = 3.863
Cells with Expected Frequency < 5 = 2 OF 20 (10.0%)

Number of Missing Observations: 8

Industry by EXPNK Number of Expert Markets

Page 1 of 1

Count	EXPNK					Row Total	Row Pct
	Zero	1 thru 5	6 thru 10	11 thru 15	16 thru 20		
1.0	4 21.1%	7 36.8%	4 21.1%	4 21.1%	4 21.1%	19 10.7%	
2.0	6 21.4%	6 21.4%	6 21.4%	6 21.4%	6 21.4%	28 15.8%	
3.0	6 14.3%	12 28.6%	4 9.5%	4 9.5%	20 47.6%	42 23.1%	
4.0	7 15.9%	12 27.3%	8 18.2%	8 18.2%	17 38.6%	44 24.9%	
5.0	7 15.9%	13 29.5%	13 29.5%	11 25.0%	11 25.0%	44 24.9%	
Column Total	30	50	35	62	177		
	16.9%	28.2%	19.8%	35.0%	100.0%		

Chi-Square

Value

DF

Significance

Pearson 10.61037 12 .56257
Likelihood Ratio 10.95207 12 .53303
Montel-Haenszel test for linear association .12775 1 .72076

Minimum Expected Frequency = 3.220
Cells with Expected Frequency < 5 = 3 DF 20 (15.0%)

Number of Missing Observations: 36

Industry by EXPGR Average export growth 91 to 93

EXPGR Page 1 of 1

Count	1.00	2.00	3.00	Row Total
Row Pct	3	4	7	14
Col Pct	21.4%	28.6%	50.0%	9.5%
Tot Pct	7.3%	11.8%	9.6%	
Adj Res	2.0%	2.7%	4.7%	
	-.6	.5	.1	
1.0	6	6	12	24
	25.0%	25.0%	50.0%	16.2%
	14.6%	17.6%	16.4%	
	4.1%	4.1%	8.1%	
	-.3	.3	.1	
2.0	12	8	19	39
	30.8%	20.5%	48.7%	26.4%
	29.3%	23.5%	26.0%	
	8.1%	5.4%	12.8%	
	.5	-.4	-.1	
3.0	12	10	14	36
	35.3%	27.8%	36.9%	24.3%
	29.3%	29.4%	19.2%	
	8.1%	6.8%	9.5%	
	.9	.8	-1.4	
4.0	8	6	21	35
	22.9%	17.1%	60.0%	23.6%
	19.5%	17.6%	28.8%	
	5.4%	4.1%	14.2%	
	-.7	-.9	1.4	
Column Total	41	34	73	148
	27.7%	23.0%	49.3%	100.0%

Chi-Square Value DF Significance

Pearson 3.92950 8 .86343
Likelihood Ratio 3.96405 8 .86035
Mantel-Haenszel test for linear association .03139 1 .85938

Minimum Expected Frequency = 3.216
Cells with Expected Frequency < 5 = 2 OF 15 (13.3%)

Number of Missing Observations: 65

U4 NTEF by TURNGR Average turnover growth 91 to 93

TURNGR Page 1 of 1

Count Row Pct Col Pct Tot Pct Adj Res	neg or z up to 10 Over 10%			Row Total
	1.00	2.00	3.00	
0	22 18.5%	34 28.6%	63 52.9%	119 65.0%
1.0	8 12.5%	17 26.6%	39 60.9%	64 35.0%
	4.4%	33.3%	38.2%	
	-1.0	9.3%	21.3%	
		-.3	1.0	

Column 30 51 102 183
Total 16.4% 27.9% 55.7% 100.0%

Chi-Square Value DF Significance
Pearson 1.44778 2 .48486
Likelihood Ratio 1.48248 2 .47652
Nagelkerke test for linear association 1.42867 1 .23198

Minimum Expected Frequency = 10.492

Number of Missing Observations: 30

U4 NTEF by INTRAT Percent overseas turnover 1993

INTRAT Page 1 of 1

Count Row Pct Col Pct Tot Pct Adj Res	Zero				Row Total
	1.00	2.00	3.00	4.00	
.0	36 27.5%	28 21.4%	45 34.4%	22 16.8%	131 63.6%
1.0	5 6.7%	8 10.7%	35 46.7%	27 36.0%	75 36.4%
	17.5%	13.6%	21.8%	10.7%	
	3.6	1.9	-1.7	-3.1	

Column 41 36 80 49 206
Total 19.9% 17.5% 38.8% 23.8% 100.0%

Chi-Square Value DF Significance
Pearson 22.76971 3 .00005
Likelihood Ratio 24.54845 3 .00002
Nagelkerke test for linear association 22.15375 1 .00000

Minimum Expected Frequency = 13.107

Number of Missing Observations: 7

1995 Firm Age in Years by EXPGR Average export growth 91 to 93

Page 1 of 1

EXPGR	Count	neg or z up to 10 Over 10%			Row Total
		1.00	2.00	3.00	
1.00	7	0	12	19	
1.00	36.8%	.0%	63.2%	12.8%	
2.00	9	9	22	40	
2.00	22.5%	22.5%	55.0%	27.0%	
3.00	14	17	28	59	
3.00	23.7%	28.8%	47.5%	39.9%	
4.00	11	8	11	30	
4.00	36.7%	26.7%	36.7%	20.3%	
Column Total	41	34	73	148	
Total	27.7%	23.0%	49.3%	100.0%	

Chi-Square	Value	DF	Significance
Linear by Linear	9.60777	6	.14217
Linear by Quadratic	13.83325	6	.03156
Linear by Cubic	1.67668	1	.19537

Chi-Square = 4.365
 Linear by Quadratic = 1.677
 Linear by Cubic = 1.677

EXPINK Number of Export Markets

Page 1 of 1

Count	EXPINK					Row Total
	1 thru 5	6 thru 10	11 thru 15	16 thru 20	21 thru 25	
Row Pct	17.2%	27.6%	24.1%	31.0%	16.3%	29
Col Pct	16.7%	15.7%	20.0%	14.5%	16.3%	16.3%
Tot Pct	2.8%	4.5%	3.9%	5.1%	5.1%	16.3%
Adj Res	.1	-.1	.7	-.5	-.5	
1.00	5	8	7	9	29	
2.00	10	14	13	10	47	
3.00	10	21	13	26	70	
4.00	5	8	2	17	32	
Column Total	30	51	35	62	178	
Total	16.9%	28.7%	19.7%	34.8%	100.0%	

Chi-Square	Value	DF	Significance
Pearson	11.65189	9	.23365
Continuity Correction	12.48695	9	.18723
Likelihood Ratio	2.13476	1	.14399
Fisher's Exact Test			
Nominal			
Ordinal			
Linear-by-Linear Association			
Natural			
Expected			
Expected Frequency	4.868		
Expected Frequency	5	1 DF	16.1634

Table Firm Age in Years by INTRAT Percent overseas turnover 1993

INTRAT Page 1 of 1

Count	INTRAT				Row Total
	Zero	1 thru 10	11 thru 50	51 thru 100	
Row Pct					
Col Pct					
Tot Pct					
Adj Res					
1.00	8	7	11	13	39
few 5 years or 1	20.5%	17.9%	28.2%	33.3%	19.0%
2.00	12	9	19	13	53
young 6 to 10 ye	22.6%	17.0%	35.6%	24.5%	25.9%
3.00	12	12	37	16	77
middle-aged 11 to	15.6%	15.6%	48.1%	20.8%	37.6%
4.00	8	8	13	7	36
mature 26 years	22.2%	22.2%	36.1%	19.4%	17.6%
Column Total	40	36	80	49	205
Total	19.5%	17.6%	39.0%	23.9%	100.0%

Chi-Square	Value	DF	Significance
Linear association	6.72705	9	.66551
Fisher's Exact Test	6.62076	9	.67654
Linear association	.29474	1	58720

Adjusted Frequency = 6.322

3. Firm Age in Years by TURNGR Average turnover growth 91 to 93

TURNGR Page 1 of 1

Count	1.00	2.00	3.00	Row Total
Row Pct	6	6	18	30
Col Pct	20.0%	20.0%	60.0%	16.4%
Tot Pct	20.0%	11.8%	17.6%	
Adj Res	3.3%	3.3%	9.8%	
	.6	-1.1	.5	
1.00	5	9	34	48
2.00	10.4%	18.8%	70.8%	26.2%
3.00	16.7%	17.6%	33.3%	
	2.7%	4.9%	18.6%	
	-1.3	-1.6	2.5	
9	9	22	38	69
	13.0%	31.9%	55.1%	37.7%
	30.0%	43.1%	37.3%	
	4.9%	12.0%	20.8%	
	-1.0	.9	-1.1	
10	10	14	12	36
	27.8%	38.9%	33.3%	19.7%
	35.3%	27.5%	11.8%	
	5.5%	7.7%	6.6%	
	2.1	1.6	-3.0	
Column Total	30	51	102	183
	16.4%	27.9%	55.7%	100.0%

Chi-Square Value DF Significance

Continuity Correction = 13.97676 6 .02990
 Likelihood Ratio = 14.12029 6 .02832
 Pearson Chi-Square = 5.13678 1 .02342
 Fisher's Exact Test =

Expected Frequency = 4.918
 Minimum Expected Frequency = 1.00

Appendix 8
T-Tests Prior to Logistic Regression

T-Tests Prior to Logistic Regression

Independent Variables	Dependent Variables										
	Inward			Outward			Inward+Outward			FC	
	R	P	M	R	P	M	Agg R	Agg P	Agg M	Agg coop	
Firm											
Age											**
NTBF				**	*	*	*			*	*
UK IPRs					*						
Overseas IPRS	*			*	*		**				
Foundation		*									
Independence	*							*			
Size (employees)	*	**	*		**		**	**			
Specialisation R&D	***			**			***	***			
Specialisation Production	*			*	*		*				*
Specialisation Marketing											
Technology & Market											
Technology	*						**	*			
Innovation				*		*					
Software		*	*								
Product Complexity											
Standardisation											
Customisation		**						**			
Industry applications			*							*	
UK Substitutes	**										
R&D department	***	*		***	***	**	***	***	***		*
R&D Intensity (Turn)				***			*				
R&D Intensity (Emp)	*			*			**				
Subsequent IPRS				**	*	*	*			*	
Coop Other Firm IPR		*	*	*				*	**		
Cooperative R&D	***	**	*	***	**		***	**	***		**
Personnel											
Foreign nationals											
Foreign Languages	**		*		*		**	*			
Overseas education	*	*									
Overseas Work Experience	**			**	**		***	*			

T-Tests Prior to Logistic Regression cont'd

Independent Variables	Dependent Variables									
	Inward			Outward			Inward+Outward			FC
	R	P	M	R	P	M	Agg R	Agg P	Agg M	Agg coal
Link Management										
Ch of Comm	**				*	***	*			
Trade Assoc.					**	**				
Professional Assoc.	*	*			**		*	*		
Alumni Associations										
University Res labs	**				*		*			
Public Res labs						**				
Ind Res labs	***	**		**		*	**	**		**
Trade Fairs	**	*	**		***	***	*	*	***	**
Academic Conferences	***	**		*	***	**	**	**		***
Res Colloquia	**			**	*	**	**	*	*	*
Customers	***	***	*	*	***	***	***	***	***	*
Suppliers			**			***		*	*	
Distributors/Agents	***	***	**		**	***	**	***	***	***
Performance Growth										
Export Department			*			***			***	**
Export Countries	*	*	*		**	***	*	*	***	**
Export Value	**		*	*	**		**			**
Export Growth			***			**				
Turnover	*	*	***		*	**		*	***	
Turnover Growth										
International Ratio	***	***	**	***	**	***	***	***	***	***
Turnover Growth (cat)										
Export Growth (cat)			**			***			***	*
Int Rat (cat)	***	***	***	***	**	***	***	***	***	***
Key						Significance				
R = research link						* ≤ .05				
P = production link						** ≤ .01				
M = marketing/distribution link						*** ≤ .001				
FCOAL = formal cooperation										