THE DEVELOPMENT OF TOP MANAGEMENT TEAMS IN A 'LESS FAVOURED' REGION

Evidence from Scottish Technology-based Ventures

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ABSTRACT

The human resources contained within a top management team (TMT) are thought to be significant in determining firm performance. However, technology-based ventures are often identified as being deficient in commercial and managerial expertise. This underlines the importance of understanding how high-quality TMTs are constructed. This thesis examines the formation and development of TMTs within Scottish high-technology ventures. In doing so, it challenges popular existing theoretical conceptualisations, which are typically universal and deterministic in their explanations of TMT evolution. Instead, this research conceptualises TMT development as a highly context-dependent and heterogeneous phenomenon. Two contributions are important here:

Firstly, unlike most popular models of TMT development, this research underlines an important 'pre-founding' influence. Using human and social capital theories, it illustrates how the dominant career paths and incubating organisations within a regional context dictate the emergence of heterogeneously resourced entrepreneurial teams. This, in turn, has significant implications for subsequent TMT development. Secondly, the study relegates focus on overall development *patterns* and, instead, examines the actions and behaviours made by the existing team during specific periods of TMT modification. This places the existing team, and the decisions they make in the face of wider context-specific stimuli, at the heart of how TMTs develop. The purpose here is to build towards theoretical explanations for what are the fundamental *building blocks* of TMT development.

Scotland represents a region where managerial expertise deficiencies have been highlighted as a challenge to growth within key technology-based industry sectors. As what has been described as a 'less favoured region', the research context offers a counterbalance to those studies conducted within exceptionally performing regional economies, such as Silicon Valley. By placing context at the forefront, the study portrays TMT formation and development as it occurs as part of a wider 'ecosystem'. Using a multiple case study approach, which details the formation and development narratives for TMTs within eighteen Scottish technology-based ventures, the study advances a number of emergent findings. It also suggests future research directions concerning how the mechanics of TMT modification are understood, as well as forwarding a number of implications for practice.

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1. RESEARCH INTRODUCTION

1.1 – INTRODUCTION TO THE STUDY

The romanticised notion of the lone entrepreneurial hero represents one of the most popular and ingrained images associated with the concept of entrepreneurship (Cooney, 2005; Drakopoulou Dodd and Anderson, 2007). However, empirical evidence suggests that it is more common for the management of entrepreneurial ventures to be directed by teams (Cooper and Daily, 1997; Harrison et al, 2004). This is particularly true of ventures operating in high-technology sectors, where specialist technical skills and understanding of unique regulatory challenges must often be combined with entrepreneurial, management, and leadership expertise (Oakey, 2003; Hayton and Zahra, 2005; Wright et al, 2007). Extant research indicates that the human resources possessed by a management team, and, in particular, those held at a strategic or leadership level (Hmieleski and Ensley, 2007; Blackburn et al., 2013; Lockett et al., 2013), are significant in influencing firm growth and performance (Knockaert et al., 2011; Blackburn et al., 2013; Schjoedt et al., 2013; Zhao et al., 2013). The primary purpose of this thesis is to examine how such human resources are assembled and developed as top management teams (TMT) within technology-based ventures.

Crucially, this study of TMT development is conducted within the context of a regional economy that has been described variously as 'less-favoured' (Birch, 2011) and 'peripheral' (Leibovitz, 2006; Mason and Brown, 2012) in comparison to those exceptionally performing regional economic concentrations upon which theoretical positions are most frequently founded. The selected research context of Scotland represents an archetypal example of an 'old industrial' region (Hassink, 2005; Hodson, 2008; Houston et al., 2008) that has sought to utilize its existing research base in order build associated technology industries and ultimately take the 'high road' to economic improvement (Peters et al., 2000; Leibovitz, 2006). However, a growing narrative surrounding Scotland's technology commercialisation objectives identifies evidence of deficiencies in commercial or upper-level management

expertise within the TMTs of indigenously developed technology ventures (Leibovitz, 2006; Houston et al., 2008; Harrison et al., 2010b; Mason and Brown, 2012). This is likely to have significant implications for the growth of technology sectors. Studies that focus on exceptionally performing regional clusters are able to afford themselves the implied luxury to assume both strong managerial labour production (Angel, 2000; Henry and Pinch, 2000) and an abundant availability of regionally located resources (Saxenian, 1994). Such assumptions are not made here. By placing the research within the context of a less prominent region, the study highlights how the wider business environment is inherently interconnected with our understanding of TMT development.

The research takes an interpretative approach in examining the context-embedded nature of TMT formation and development. This is achieved primarily through the construction and analysis of qualitative case studies that detail the development narratives of eighteen Scottish-based technology venture management teams. Data collection and analyses focus firstly on uncovering the career histories of founders and how these contribute to the origin of the TMT. Subsequent TMT developments patterns are then constructed and analysed through Critical Incident Technique (Chell, 2004; 2014), which is used to identify the actions and behaviours that characterise distinctive points of TMT modification.

The thesis contributes to knowledge by building theoretical explanations for the "path-dependent, contextual, idiosyncratic nature" of TMT development (Breslin, 2008: 131). It does this firstly by exploring how TMTs originate. Examination of founding member career histories highlights how the particular incubating organisations within certain regional environments impact the initial emergence of heterogeneously-resourced management teams (Lawton Smith, 1991; Henry and Pinch, 2000; Burton et al., 2002; Harrison et al., 2004; Sorensen and Fassiotto, 2011). This strengthens the conceptual links between the human and social capital of entrepreneurs and the genesis of entrepreneurial teams, underlining an important 'pre-founding' influence on subsequent TMT development. Secondly, following the rationale of contemporary views on firm growth (Levie and Lichtenstein, 2010;

McKelvie and Wiklund, 2010; Blackburn et al., 2013), the thesis relegates focus on the overall development *patterns* of TMTs and, instead, examines actions and behaviours occurring at instances of TMT modification. Thus, existing teams, and the decisions they make in the face of wider environmental stimuli, are placed at the heart of TMT development. In this sense, TMT development is viewed simply as a non-sequential and heterogeneous series of reconfigurations to the dominant management logic. Finally, the study contributes to the fledgling but growing scholarly literature that focuses on high-tech industry development in Scotland (McCann, 1991; Raines et al., 2001; Galbraith et al., 2008), which raises a number of implications for practice.

1.2 – STUDY BACKGROUND AND RESEARCH GAPS

The fundamental rationale of accumulating and combining managerial inputs is one that underpins a significant body of literature on the demography and composition of management and entrepreneurial teams (Smith et al., 1994; Beckman et al., 2007; Hmieleski and Ensley, 2007; Eisenhardt, 2013). This area of study largely takes its conceptual basis from the Upper Echelons perspective (Hambrick and Mason, 1984), which is itself an established concept within the field of Strategic Management. The Upper Echelons view emphasises links between the experience of top management team (TMT) members, key strategic decisions, and organisational performance. This rationale has translated well to small business and entrepreneurship research, becoming associated with theories of human and social capital to spawn numerous investigations in to how the human resources held by single entrepreneurs (Colombo and Grilli, 2005; Gimmon and Levie, 2010; Unger et al., 2011) and entrepreneurial teams (Ensley and Hmieleski, 2005; Delmar and Shane, 2006; Eisenhardt, 2013) can impact various performance measures, notably firm survival or firm growth. TMT experience and skills composition have also emerged as practical barometers that key stakeholders, such as investors, often utilise in attempting to assess the performance potential of new ventures (MacMillan et al., 1985; Goslin and Barge, 1986; Harrison et al., 2010a).

The TMT demography literature displays consensus on a few core observations concerning what a strong TMT should be. At the most basic level, it is larger teams that tend to be stronger, given that the resources available to a team fundamentally result from how many people are in it (Hambrick and D'Aveni, 1992; Dobbs and Hamilton, 2007). More specifically, numerous literature sources point to the *diversity* of particular skillsets held by a TMT as a key determinant of managerial team performance (Eisenhardt and Schoonhoven, 1990; Smith et al., 1994; Hayton and Zahra, 2005; Lockett et al., 2013). The focus here is placed on heterogeneous resources possessed by different team members and how these might work together in a complementary or synergistic fashion. Often it is human capital aspects, such as the complementarity of functional expertise or industry specific experience that are utilised as a means to measure the resources held by a TMT (Vyakarnam and Handelberg, 2005; Knockaert et al., 2011; Lockett et al., 2013). Although, clearly, TMT performance is also likely to be underpinned by effective member interaction, group cohesion, and management of conflict (Ensley et al., 2002; West, 2007; Leung et al., 2013).

To date, portrayals of how TMTs develop have relied heavily on 'lifecycle' principles (Beckman and Burton, 2008) similar to those that underpin popular staged models of firm growth (Greiner, 1972; Churchill and Lewis, 1983). Typically, this approach depicts the TMT forming in an embryonic state and subsequently developing through the addition of appropriately skilled new members and through the implementation of more formalised management structures. Thus, under this view, TMT development is characterised as process of 'professionalisation', in which the team grows from birth to maturity (Charan et al., 1980; Flamholtz and Randle, 2000; Wasserman, 2003; Beckman and Burton, 2008).

While lifecycle models appear to enjoy an inherent resonance amongst those attempting to understand processes of both organisational growth and management team development, their universal principles have been shown to lack validity when subjected to empirical scrutiny, particularly when tested across a range of contexts (Levie and Lichtenstein, 2010). In essence, this traditional view fosters a

universalistic approach, emphasising divorce between TMT development patterns and the context in which they occur. In contrast, many prominent areas of research suggest that more context-embedded approaches may be more informative to explaining the ways in which TMTs actually form and develop (Beckman and Burton, 2008; Breslin, 2008; Eisenhardt, 2013). These views encourage the identification of certain research gaps concerning how we understand the formation and development of management teams. These gaps represent the focus of this study and are discussed in the following sections:

1.2.1 – The Historical Origin of Management Teams

Beckman and Burton (2008: 3) highlight the popularity of the archetypal "garage entrepreneur" – epitomised by prominent figures such as Bill Gates – as a commonly assumed point of origin for subsequent management team development within technology-based ventures. However, this portrayal stands in stark contrast to many of the key underpinning theories that are used to explain the functioning of management teams, as well as to the bulk of empirical evidence. Human capital theory, for example, is key in describing the resources available to a team and how these can be associated with team performance. Yet, human capital theory suggests that far from being homogeneous, different teams are likely to emerge with vastly different levels of human resources at their disposal (Burton et al., 2002; Colombo and Grilli, 2005; Mosey and Wright, 2007; Sorensen and Fassiotto, 2011). This is because the resources held by founding team members – epitomised by human and social capital (Forbes et al., 2006) – are largely dictated by the prior experiences of those members, which are often highly heterogeneous. In multi-founder startups, this can mean multiple strands of historical influence on how, and in what condition, a founding team is initially assembled.

In short, the assumption that founding teams will always emerge in a homogeneous, immature state appears somewhat illogical. In recognition of this, the heterogeneous nature of entrepreneurial teams has increasingly featured as a focus for various academic studies. For example, Ensley and Hmieleski (2005) find noted differences between the behaviours of university spinout and non-university spinout founding

teams. Eisenhardt (2013) highlights distinctions between teams started by members with a relevant shared working background and those without. What emerges from these discussions is that a) TMTs originate in different states, and b) that state is dependent on the historical incubation of the TMTs founding members. In this sense, a highly significant element of any TMT development story occurs *prior* to the founding event.

This notion is underlined as a particularly pertinent issue in light of research suggesting that founding team composition is likely to impose a lasting imprint upon subsequent TMT development patterns (Beckman and Burton, 2008; Schjoedt et al., 2013). The early strategic choices of a TMT may set a subsequent development trajectory that "becomes difficult to change as resource commitments, and organizational cultures and structures are locked in" (Eisenhardt, 2013: 808). Thus, the consequences of key early decisions may actually become amplified, not dissipated, over time, resulting in path dependent development trajectories (Eisenhardt and Schoonhoven, 1990; Beckman and Burton, 2008).

In response to these issues, this study seeks to steer focus away from the assumption of a homogenous foundation for TMT development. By analysing the pre-founding histories of TMT founding members, the research explores the factors that determine how, and in what condition, TMTs emerge. This serves an important purpose in demonstrating how initial TMT development is strongly tied to the historical and spatial context in which founding members produced. In doing so, it strengthens the conceptual link between theories of human capital and conceptualisations of early TMT development.

1.2.2 – Deterministic TMT Development Patterns

The popular depiction of TMT development as a deterministic process of birth to maturity is one that also sits at odds with empirical evidence collected in studies of firm growth, the vast majority of which find no deterministic link between one stage of development and the next (Garnsey and Heffernan, 2005a; Wiklund et al., 2009). Some of the major challenges here clearly stem from ongoing tensions between the

desire of scholars to examine phenomena as they occur in context and the perceived need to produce abstracted theorisation (Zahra, 2007). However, it is abundantly clear that TMT development, as a phenomenon, has difficulty fitting neatly into the types of anthropometric metaphors that some scholars have espoused in association with firm growth (e.g. Cardon et al., 2005). Ultimately, such principles appear to hold limited explanatory power for how TMTs develop in practice.

This thesis adopts theoretical principles that are more amenable to the empirical realities of development pattern heterogeneity. An evolutionary approach, for example, implies that the key decisions made by TMTs (such as those related to changes in management composition) are a function of how internal strategic actions are taken in reaction to environmental stimuli (Aldrich and Martinez, 2001; Breslin, 2008). Aldrich and Martinez (2001: 50) argue that development does not "depend on strategic choices or environmental forces alone, but rather on the degree of fit between entrepreneurial efforts and environmental forces". Thus, under this view, the strategic decisions that define how a TMT develops cannot, and should not, be separated from their surrounding context (Blackburn et al., 2013). Instead, "process and context (strategy and environment) interact in a recursive continuous process" (Aldrich and Martinez, 2001: 42) to define the ways that existing teams modify their organisations to survive environmental instability. As such, an evolutionary view of TMT development emphasises the ongoing activities where existing teams engage with the external environment and then modify in order to exploit or adapt to that environment. These actions of modification underpin variations to the state of the team and serve as the building blocks of development. Under such a view, TMT development is conceptualised in this study as a heterogeneous series of reconfigurations to the existing management logic. In short, a team may develop through any number of 'phases of management' (Eggers et al., 1994), which may re-shape existing management in any number of ways. However, ultimately, to understand how a TMT develops, the challenge resides in understanding the actions and behaviours surrounding change events (McKelvie and Wiklund, 2010).

1.2.3 – The Influence of Contextual Variation

Extending considerations of contextual influence on TMT development, the largely aspatial nature of many studies in the broad field of technology entrepreneurship represents a final research gap that is addressed by this study. The influence that variety in wider business context can have on the observation of phenomena is perhaps intuitively obvious. However, many studies, at best, relegate the influence of context, and, at worst, proceed "as though the world existed on head of a pin – as though it were distanceless and spatially undifferentiated" (Massey, 1984: 49). Contrary to the prophesized 'death of distance', which was touted during the onset of globalisation (Cairncross, 1997), regional economies still display distinctive variation in the environmental conditions that they offer ventures (Felzensztein et al., 2013). It is this variation that has formed the cornerstone of research in to clusters of economic activity, and the unique characteristics that particular areas of economic concentration display (Saxenian, 1994; Porter, 1998).

In short, the wider business context matters (Welter, 2011). It ensures that TMTs are likely to face variances across a number of factors critical to their development, such as access to managerial labour (Florida, 2002b; Florida, 2002a), access to a supportive investment community (Harrison et al., 2010a), or access to growth opportunities in general (Lawton Smith et al., 2005; McMullen and Shepherd, 2006). These features cannot be divorced from those decisions that dictate how a TMT is modified over time. Perhaps even more damaging than the relegation of context from the debate (Zahra, 2007; Welter, 2011) is the tacit assumption that certain regional conditions are the norm. For example, the technology entrepreneurship literature has traditionally displayed a particularly strong tendency towards focusing on exceptionally performing regional clusters (Head et al., 1996; Mytelka and Farinelli, 2000). Most notable is the proliferation of studies that examine highly successful high-tech regions such as Silicon Valley or Boston's Route 128 area, which enjoy uniquely 'thick' labour markets (Angel, 1991; Saxenian, 1994; Florida, 2002b) and highly supportive regional conditions (Saxenian, 1985; Saxenian, 1994; Bernasconi et al., 2006). Intuitively, this is likely to encourage studies to assume a number of contextual conditions that do not necessarily resonate with realities faced within the

majority of economic regions. It is contended here that theorisation born out of a disproportionate focus on exceptionally performing economic regions may actually damage explanatory power of scholarly offerings.

1.3 – EXPLAINING THE RESEARCH FOCUS

Technology-based ventures represent a particularly appropriate group for the study of TMT development. Technology ventures are associated with capital intensive research and new product development processes (Xia and Roper, 2009), which typically necessitate higher-than-normal growth rates to ensure survival (Colombelli et al., 2013). This, in turn, incites the need to form management teams that can support more complex high-growth activities. Secondly, technology-based ventures offer a particularly relevant angle on the rationale of 'expertise combination', which underpins much of TMT demography literature (Beckman et al., 2007; Hmieleski and Ensley, 2007; Eisenhardt, 2013). The high level of technical expertise typically required to manage a technology-based venture represents a key extra dimension of human capital demand for management teams. However, the observation that technical expertise alone is unlikely to deliver commercial success has led many researchers to underline the importance of assembling a complimentary mix of 'commercial' or 'managerial' and 'technical' human capital within a TMT (Harrison and Leitch, 1995; Granstrand, 1998; Oakey, 2003; Park, 2005; Wright et al, 2007).

The notion of skills diversity represents somewhat of a 'double-edged sword' in terms of how the presence of multiple sources of expertise within a single team might impact group cohesion (Ensley et al, 2002; Chowdhury, 2005). This may be a particular issue for the combination of what are often characterised as competing logics between the technical and commercial spheres. For example, in their research on cross-functional teams, Love and Roper (2009) find that functional diversity tends to benefit technical phases of the innovation process (new product design and engineering), but often fails to translate those benefits during commercial marketing phases. The implication here is that the demands associated with commercial growth are perhaps more dependent on strategic cohesion and shared leadership direction. Thus, while TMTs are likely to require expertise inputs from a range of functions

and backgrounds, the effectiveness of technical and commercial skills combination is likely to be mediated by how knowledge and skills are channeled towards effective strategy.

Despite this, the availability of commercial expertise within technology-based venture TMTs represents an extremely prevalent strand of discussion throughout technology entrepreneurship research. It is often raised as a key challenge to organisational performance, and to policy objectives as a whole. A common narrative is that which portrays the commercially inexperienced 'techie' TMT. Numerous studies point to the problems faced by homogeneously skilled technical teams and how they find themselves truncated in terms of the range and depth of human resources required to guide the growth of a commercial enterprise (Franklin et al., 2001; Ensley and Hmieleski, 2005; Mosey and Wright, 2007; Wright et al., 2007). One particular group of ventures often associated with this narrative is university spinout research teams (Ensley and Hmieleski, 2005; Knockaert et al., 2008; Knockaert et al., 2011). Teams composed of top managers with predominately technical backgrounds are purportedly liable to struggle with the challenges of commercialisation, focusing primarily on 'technology push' rather than 'market pull' (Franklin et al., 2001; Millier, 2006; Wright et al., 2007). Extant research also indicates that they are likely to display difficulties in key commercial areas, such as:

- Developing business models and organisational vehicles to match their products to genuine industry needs (Mosey and Wright, 2007)
- Identifying and accessing appropriate target markets (Millier, 2006)
- Creating appropriate organisational structures (Van Bruystegem et al., 2008)
- Negotiating investment procedures (Druilhe and Garnsey, 2006; Wright et al., 2007)

With its high quality and established research institutions, Scotland has faced little issue with the production of entrepreneurs and other managerial labour sources with technical and research experience (Leibovitz, 2006; Birch and Cumbers, 2007; Houston et al., 2008). However, the narrative of commercial skills deficiencies has

become very much part of the conversation amongst key stakeholders within regional high-tech industries. As such, discussions surrounding the challenges faced by homogeneously skilled, technically focused, TMTs have been very much reflected at this policy level (Leibovitz, 2006; Birch and Cumbers, 2007; Mason and Brown, 2012).

1.4 – RESEARCH QUESTIONS AND APPROACH

The study attempts to offer an alternative to aspatial and ahistorical accounts of TMT development. The aim of the thesis is to generate a theoretical conceptualisation of TMT formation and development as it occurs in a particular business context. As part of this process, a number of research propositions are forwarded. The study was driven by the following research questions:

1. ***How do technology-based TMTs emerge?***

2. ***How does the modification and ongoing development of technology-based TMTs occur in conjunction with the wider business context?***

These research questions were explored through the inductive collection and analysis of eighteen case studies of TMTs in Scottish technology-based ventures. Case study teams were selected through purposeful theoretical sampling of three Scottish industries – Life Sciences, Optoelectronics, and Chemical Sciences. While there remains a lack of consensus over the specific definition of either high-technology firms or high-technology industries (Glasson et al., 2006; Mason and Brown, 2012), the three sectors were selected to provide an appropriate context for the phenomenon under study for a number of reasons. Firstly, a significant proportion of firms in these sectors display what researchers identify as high-technology characteristics (see Glasson et al., 2006). These characteristics encompass a strong focus on innovation (the introduction of new products, processes or services), a proportionately high R&D spend (the primary measure used by the OECD), a strong reliance on staff with a science, technology, or engineering background, and the intensive use of technology in operations and processes. Secondly, the chosen sectors are all included

within industry-focused definitions of technology activity. These are based largely on Standard Industrial Classification (SIC) categories (see Mason and Brown, 2012). Finally, while there are some notable contrasts between sectors, and indeed between particular subsectors, the three industries provide a broad representation of high-technology commercial activity within the chosen context of Scotland. All three share status as key growth sectors, and are focused on similar policy objectives around the commercialisation of existing research capacity, the development of clustered industry activity, and increased internationalisation (Scottish Optoelectronics Association, 2010; Chemical Sciences Scotland, 2012; Scottish Enterprise, 2013).

Cases were formed primarily through twenty-six semi-structured interviews with multiple TMT members in each case. Six supplementary interviews with key informants in each industry (investors, government advisors) were also conducted. For each firm, main interviews were conducted with individuals that have a key leadership position, namely an owner-founder or a CEO. In cases where the founder or owner were not interviewed this was due to the fact that strategic or operational authority was in the hands of an externally recruited individual. In all cases, an interview was conducted with an individual in a position of control over the strategic direction of the firm. These individuals were also all in a position to confidently comment on the full history of the firm, having had first hand experience of, or significant connections to the founding of the venture.

Primary interviews for the eighteen case studies utilised Critical Incident Technique, which is a qualitative interview procedure that investigates significant occurrences (events, incidents, processes or issues) and how responses are taken to manage these occurrences (Chell, 2004; Chell, 2014). Interviews formed the basis of a chronological TMT development narrative for each case, which identified when, why, and how TMT reconfigurations took place. Modifications to the TMT were identified through the use of two criteria identified by a review of the relevant literature. These were:

- **Changes to management personnel** - encompassing TMT member entry and exit

- **Changes in management structure** – encompassing significant changes to project management and operational systems, management communication procedures, or levels of bureaucracy

Narratives were then verified and augmented through extensive desk research (primarily from company websites, published news articles, and self reported CV/biographical data of TMT members). Completed narratives depicted a record of all changes made to the TMT, as well as career backgrounds of all incoming full-time recruits and board members. The narratives represented the first level of analysis, allowing the study to order, structure and interpret the collected data in order to identify relationships and underlying themes (Marshall and Rossman, 2006). Findings were divided in to 'pre' and 'post' foundation sections.

To address pre-founding influences on the TMT, the investigation examined career histories of founding and early core members within each TMT. For the most part, in-depth discussions were conducted with core TMT members to explore how different types of human and social capital were relevant to the formation and development of the TMT. This was important because rich, qualitative data offered insights into the nuances of particular human capital experiences or social capital resources that were valuable to the development of a management team. This portrayed a more complex and fine-grained discussion not easily captured by large-scale quantitative measures of 'talent', such as, for example, 'team members with a university degree' (e.g. Florida, 2002a).

For the post-development section, the research asked why, when, and how TMT development decisions were made. The analysis examined barriers and drivers associated with critical incidents in firm development and mapped the TMT development decisions and behaviours surrounding these. The use of critical firm development events was decided upon because it downplayed the assumption of

birth to maturity professionalization of TMTs. Instead, this approach emphasised heterogeneous development patterns, and how TMT development occurred in disjointed, or stagnated, as well as in progressively developing trajectories.

1.5 – DEFINING TOP MANAGEMENT TEAM MEMBERSHIP

The distinctions between entrepreneurial teams, top management teams, and other types of team are not always clear (Ucbasaran et al., 2003; Cooney, 2005; Neergaard, 2005). This section sets out the definition of TMT membership employed by the present study.

Perhaps the most general and frequently employed definition of the entrepreneurial team would be that of Kamm et al (1990) who refer to: two or more individuals, who are present at the pre-start-up stage of the firm, and who jointly establish a business in which they have equal financial interest. However, this study follows Cooney (2005) in viewing the Kamm et al (1990) definition is overly rigid. One point of contention relates to the need for 'equal financial interest'. Cooney (2005: 226) rightly points out that a more open interpretation of financial interest is required, moving him to define the entrepreneurial team as "two or more individuals who have a significant financial interest and participate actively in the development of an enterprise". However, what constitutes 'significant' is not specified. One key phrase in this definition is 'participate actively', suggesting that involvement is as important as investment in defining entrepreneurial team membership. Ultimately, for the purposes of this study, it is contended that the need for financial investment is too rigid a requirement for founding team membership. Instead, the thesis recognises team members as those who participate in 'collective leadership' (Lockett et al., 2013), typically through holding a role concerned within strategy formation.

As the founding team expands and external managers are recruited, it can prove difficult to define membership of a *top* management team. One problem is that recruited managers are often considered to be non-entrepreneurial agents responsible for management functions only, rather than being core leaders, or drivers of entrepreneurial direction (Ucbasaran et al., 2003). However, in addressing this,

Ucbasaran et al (2003) point out that there is often overlap between the roles of the entrepreneur and those of the management, to the point where they encourage research into the extent to which all members of a TMT contribute to typically entrepreneurial or venture driving functions. This perspective appears to hold well for small enterprises in which strategy is more fine-grained and strategic roles are often performed practically at 'ground level', as opposed to large firms that are more likely to separate the roles of policy formation from those of policy implementation (West, 2007). Given the reduction in structural complexity in the entrepreneurial setting, leadership decisions made at a strategic level tend to be more pronounced in their effects (Lockett et al., 2013), meaning that the contribution of externally appointed managers is likely to be more clear. Thus, the primary inclusion criterion is, again, involvement in the strategic decision-making processes of the venture.

Another factor likely to influence definition of the TMT is outside investment and the emergence of a board of directors. High-tech ventures must frequently seek external finance and this, of course, is likely to have an impact of the ownership structure of the firm (White et al., 2007). Here, appointed board members or investor representatives can display a wide range of involvement in guiding the strategic direction of the firm (Deakins et al., 2000; Harrison et al., 2010a; Knockaert and Ucbasaran, 2013). Therefore, at the level of firm maturity examined within this study, it is especially important to consider the overlap between duties of board members and those of the TMT members (Vanaelst et al., 2006; Gabrielsson, 2007). Again, the same inclusive definition of TMT membership is utilised, with board members being considered team members if they are significantly involved in strategy driving activities.

1.6 – THESIS STRUCTURE

The thesis is structured according to the following chapters (See Figure 1a):

Chapter Two reviews literature relevant to the examination of founding team member origin. The chapter utilises human, social, and financial capital as the conceptual means to explain how members carry resources from their prior

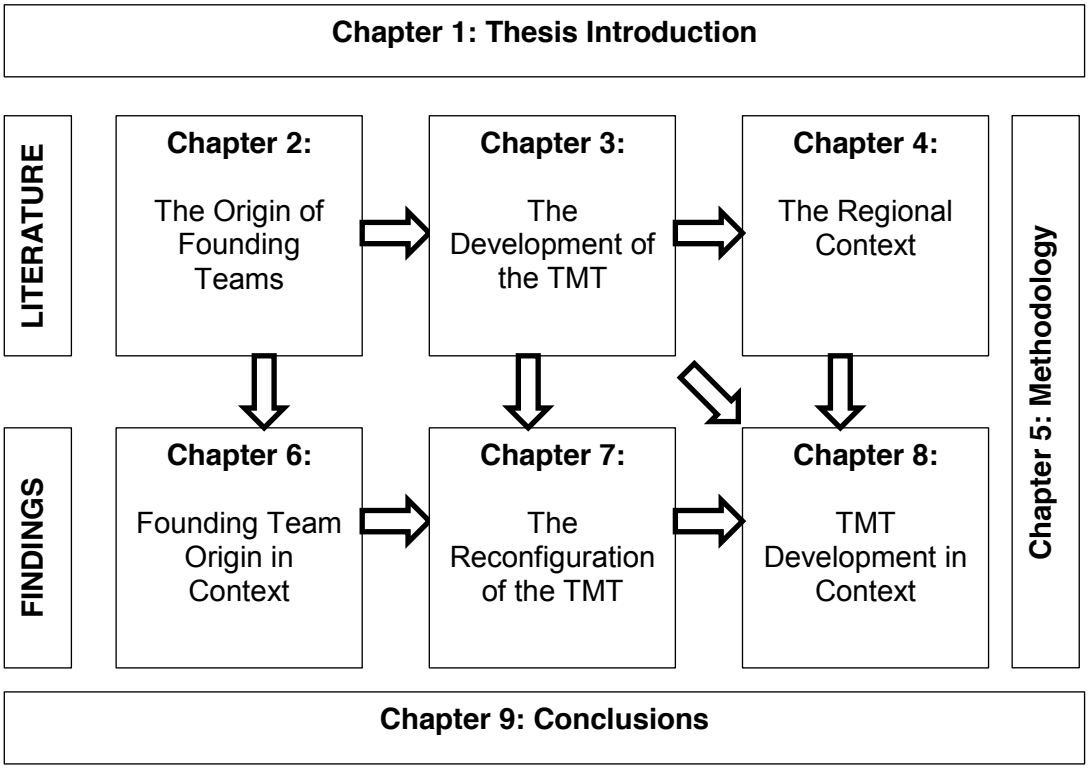
incubators in to their new teams. The discussion of human capital outlines how various types of prior experience translate in to the skillsets held by the founding TMT. Social capital underlines the reputational status held by the team, as well as the connections between initial members. Financial capital outlines recycled finance from previous activities, as well as links to sources of investment. These three concepts help to explain how, and in what states, TMTs emerge.

Chapter Three reviews literature relevant to the subsequent development of the TMT. Initially, highly popular models of staged growth are reviewed, and a lifecycle portrayal of TMT development presented, before being critiqued. However, the fundamental principle that the development of the TMT can be examined through identifiable stages is underlined as a useful concept. Outlining two categories of TMT modification, TMT development is conceptualised as a series of non-deterministic 'reconfigurations'. Here, reconfiguration decisions are underlined as a collective internal decision-making process taken in response to environmental stimuli.

Chapter Four reviews literature on the emergence and features of regional 'innovation systems' (Asheim and Coenen, 2005; Roper et al., 2006; Doloreux and Dionne, 2008). The discussion predominately focuses on how regional density, labour market thickness, and other forms supportive conditions are that created through firm growth and spinout processes. This acts as a foundation to present an overview of the wider business context faced by technology-based firms in Scotland (Roper et al., 2006; Mason and Brown, 2012; REAP, 2014).

Chapter Five outlines the methodological approach undertaken by the study. It details the theoretical sampling procedure behind the collection of cases, and outlines specific case exclusion criteria. A multiple-case study approach is presented, detailing the use of multiple semi-structured interviews and secondary research to form a chronological TMT development narrative for each firm. The use of Critical Incident Technique is highlighted both as a data collection aid and as means of analysis (Chell, 1998; Chell and Pittaway, 1998; Chell, 2014). The chapter details

Figure 1a: Thesis Structure



how analysis themes were built through the use of replication logic across cases (Eisenhardt, 1991) and how these were then subjected to a cross-case analysis.

Chapter Six presents findings on how TMTs originate from the selected business context. Analysis of founder career histories and qualitative interviews demonstrates how variations in founder experience dictates founding team condition. The discussion explains the processes through which appropriate team member skillsets are created. Analysis of early networking behaviour demonstrates why founding members assemble with fellow founders, and why they access different resources at different speeds. The final discussion considers the impacts that founding team condition may have on subsequent development.

Chapter Seven presents findings on post-formation development behaviours. Identifying ninety-seven TMT reconfiguration events across the sample, a cross-case

analysis discusses modification actions and behaviours in a thematic manner. The chapter also presents data on actions that are complimentary to overt TMT modification, namely the leveraging of the board of directors and internal learning through mentorship.

Chapter Eight ties chapters six and seven together by presenting exemplar narratives of TMT formation and development. Exemplar cases were chosen through identification of four distinct narrative categories, each depicting a different development 'story'. The presentation of exemplar cases serves the purpose of empirically portraying how ongoing TMT modifications are made in response to the conditions of and events arising from the surrounding business context. This supports a final discussion on Scotland-specific contextual influences.

Chapter Nine presents a final summary of the findings and contributions made by the study. Three sets of research propositions are forwarded as part of an overall conceptualisation of TMT formation and development in a 'less favoured' region. Implications for practice and directions for future research are also presented. The chapter concludes by reflecting on the knowledge claims made by the research.

2. PRE-FOUNDATION: THE ORIGIN OF FOUNDING TEAMS

2.1 – INTRODUCTION

This chapter examines key theoretical concepts underpinning the initial formation of TMTs. As part of the overall research approach taken by this thesis, it is considered that crucial aspects of TMT development occur prior to the point of initial formation. Extant literature offers a number of explanations behind the factors that can influence how, and in what condition, a TMT is initially formed. In particular, human and social capital theories provide insight in to how founders carry tangible and intangible resources into a new venture (and thus into a new TMT). The chapter moves to position discussions of TMT formation within these wider concepts. This serves two main purposes. Firstly, it provides a frame by which to conceptualise and analyse the starting conditions of TMTs. Secondly, it helps to attach the formation of teams to their historical and spatial context by emphasising the concept of the incubator organisation (Cooper, 1971; Cooper, 1973; Harrison et al., 2004). Following Aldrich and Martinez (2001), three dimensions are used to outline the condition in which a TMT emerges. These are human capital, social capital, and financial capital. These dimensions help conceptualise the possibility of heterogeneity in early TMT conditions, as opposed to assuming that all founding teams will originate in an embryonic state.

The issue of founding team heterogeneity is potentially important to understanding how TMTs develop. Numerous sources of extant literature cite strong associations between the knowledge and experience composition of founding teams and subsequent levels of TMT professionalisation (Eisenhardt, 2013; Schjoedt et al., 2013). Central to this perspective are observations that early leadership decisions imposed by the founding team can have a strong path dependent imprinting effect on how the TMT is shaped in the future (Beckman and Burton, 2008). As such, the aim of this chapter is to position subsequent discussions of TMT development within the context of initial team emergence.

2.2 – INCUBATORS AND THE CAREER PATH

By far the most dominant approach used to conceptualise and measure the human and social resources held by individuals lies in the analysis of career histories (Knockaert et al., 2008). Thus, by extension, the career histories of founding team members can be used to assess the resources held at and around the formation of a management team. Such a view offers a compelling alternative to the assumption of a homogenous state of initial foundation for TMTs. In particular it encourages research into the management of technology-based ventures to consider points of origin beyond the popular notion of the inventor-turned-entrepreneur, or the "lone college drop-out entrepreneur" (Burton et al., 2002: 229).

In order to assess heterogeneous founding team states, research must investigate the experiences and inputs that shape founding member experiences. Central to this view is the notion that founders, and by extension, founding teams are "organizational products" (Freeman, 1986: 39). In short, their experience and resource levels are overwhelmingly molded through their history spent within a variety of organisations (for example, school, university, social clubs, and, most prominently, through working history). These are referred to as incubator organisations (Cooper, 1971). Ultimately, the key message is that founding team state is likely to be strongly influenced by the incubation source.

The influence that incubation source has on the original human resource inputs evident within a founding team can be widely varied depending on a number of factors. The relevance of prior employment positions and the seniority of those positions clearly have an influence. So too, for example, do the nature (commercial or non-commercial) and size (established firm or small to medium enterprise) of the incubating organisation. For technology-based venture management teams, Mason and Brown (2012: 43) argue that "effective incubators need to provide their employees with exposure to best practice technology and intimate knowledge of markets in order to uncover business opportunities based on novel applications". In making a similar argument, Burton et al (2002) use the phrase 'coming from good stock' to refer to the advantages retained by those entrepreneurs that originate from a

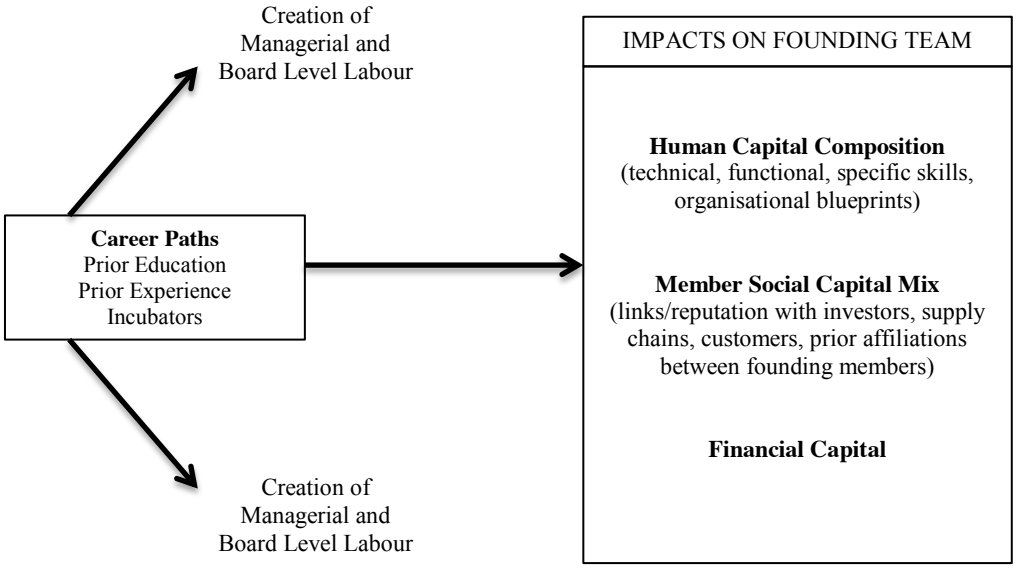
prominent former employer in a related industry (also see Sorensen and Fassiotto, 2011). The primary emphasis of these works is placed on prior exposure to market, or, at least, to important actors in the value chain of the new venture. It appears that it is largely for this reason that non-commercial environments such as universities (Ensley and Hmieleski, 2005; Leibovitz, 2006; Wright et al., 2007) and government research laboratories (Lawton Smith, 1998) are cited as less advantageous sources of venture spinout. While having a successful 'parent' firm is no ultimate guarantee of TMT performance (Lawton Smith, 1991), the breeding grounds that founding entrepreneurs emerge from can be directly linked to key features of the founding team; for example, its skills distribution, or the affiliations held between team members.

Furthering the incubator concept, Harrison et al (2004) argue that perceptions of an individual's experience cannot be simply restricted to one previous parent organisation. Instead, they argue that one must consider the influence of experience and resources that are accrued over an entire career. This view emphasises multiple sources of incubation, referred to commonly as the career path. The career path is defined here as an evolving series of work activities happening over time within one or more occupational or organisational contexts (Cappellen and Janssens, 2005). Consequently, the career path represents a wider ranging and particularly salient view of how a variety of educational and career experiences can shape the inputs that define the initial state of a management team (Casper and Murray, 2005: 53). These concepts provide the fundamental basis for the remaining discussion of this chapter (and, indeed, of the thesis as a whole). Founding team condition is discussed in this chapter as three distinct, but overlapping, capital forms.

2.3 – HUMAN CAPITAL

The creation of a new firm requires a certain amount of knowledge, skills, and other inputs related to human resources. In those ventures that are started by teams, multiple members provide various inputs. These inputs dictate the initial human capital stock of a TMT. Further, the diversity and complementarity of skills and experience held by a management team has been identified as a key determinant of

Figure 2a: Conceptualising Pre-Founding Influences on Founding Team State



organisational performance (Hambrick and Mason, 1984; Eisenhardt and Schoonhoven, 1990; Eisenhardt, 2013; Lockett et al., 2013). Thus, it is this combination of complimentary skills and experience that defines the fundamental rationale for the formation of a team. For technology-based firms, this perspective is most commonly referenced in conjunction with the combination of technical and commercial skillsets (Granstrand, 1998; Oakey, 2003).

The skills and knowledge held by team members are conceptualised in this study as human capital. Although the concept of human capital can be traced back to Adam Smith, it was economist Gary Becker (1964) who first popularised the term in reference to an overall 'stock' of knowledge and skills possessed by the US workforce. The concept was originally discussed from a labour economics perspective in an attempt to disentangle the various factors that explain wage or earnings differentiation (Thrane, 2008). In its contemporary form, human capital refers to "the skills and knowledge that individuals acquire through their investments

in schooling, on-the-job training, and other types of experiences" (Rauch et al., 2009: 925). In this sense, the prior education and career experiences of an individual represent their means of 'investing' in their future human capital stock. However, many definitions imply that the application of human capital should be also intrinsically linked to the creation of some form of value or outcome. This notion resonates particularly with the study of individuals in management and strategic positions, who are inherently involved in the pursuit of organisational goals and value creation. Equally, value-creating entrepreneurial behaviours, such as opportunity discovery, have been linked to the possession of both the tacit and explicit knowledge held by individuals (Davidsson and Honig, 2003). Consequently, the study adopts the definition of Forbes et al (2006: 229) in viewing human capital as "knowledge and skill that can be converted into valuable economic outputs".

The human capital that individuals carry in to a founding team, and how this determines the initial composition of a TMT, is typically discussed as a range of inherent characteristics (age, gender) and assigned traits relating to experience (functional background, industry specific experience, prior self-employment experience). The following sections outline a discussion of the human capital skills dimensions that are relevant to the composition of technology-based TMTs.

2.3.1 – Technical Skillsets and Experience

Entrepreneurial ventures that are based on technical products or services typically require at least one management team member who holds an advanced understanding of the underpinning technology. This human capital contribution is likely to derive from a related technical education and work experience in a technical role. Studies focusing on technology-based enterprises have moved to distinguish defined technical human capital from other forms of identifiable functional experience. For example, Colombo and Grilli (2005) differentiate between either technical or scientific and economic or managerial human capital inputs. Murray (2004a) notes that the traditional view of a technologist's contribution to an entrepreneurial firm focuses largely on the defined technical expertise that they offer. The idea that those with a technical background largely contribute very specialist technical expertise is

one that is particularly associated with first-time technology entrepreneurs. For example, the academic entrepreneurship literature often emphasises the specialist technical human capital contributed by former research scientists-turned-entrepreneurs (Franklin et al., 2001; Ensley and Hmieleski, 2005; Wright et al., 2006; Mosey and Wright, 2007).

However, beyond defined technical skills, which could be viewed largely as a prerequisite human capital source for a technology-based venture management team, prior technical experience has also been associated with additional contributions to human capital stock of founders or founding teams. Oakey (2003) argues that prior technical experience is often necessary for founders to 'buy in' to the technology on which their venture is based. The implication here is that technical understanding is important to effective communication of product features to key stakeholders, and, in particular, potential customers. Gimmon and Levie (2010) find that the academic reputation of venture founders has a positive influence on a venture's ability to secure investment. Equally, both Roberts (1991) and Colombo and Grilli (2005) note that previous technical expertise enhances new venture survivability. In short, technical expertise held within the founding team not only relates to requisite 'hard' skills, but may also act as a platform for the acquisition of other resources. Of course, while the presence of advanced technical knowledge is a necessary component of a technology-based venture TMT, technology entrepreneurship scholars frequently point out that technical knowledge alone is likely to be insufficient (Oakey, 2003; Leibovitz, 2006). This underlines the requirement to either develop or acquire business and management-related human capital inputs.

2.3.2 – Business and Management Expertise

The identification of distinctive management roles has emerged as a popular means to conceptualise business and management skills within a TMT. Bunderson and Sutcliffe (2002) identify this approach as resting on the assumption that each team member performs a specific functional role. Functional positions are typically operationalised by assigning each team member to a particular area of the business based on their job title, their responsibilities, and their prior experience. While such

assignments can be allocated to any member with any human capital background, this perspective shares strong associations with the portrayal of management capabilities as being consistent with traditional management functions. This depicts management expertise as being portable (Sullivan, 1999) and transferable to a number of business contexts (Baker and Aldrich, 1996). The specialist functional roles most commonly identified with the management of a commercial firm are Finance (McMahon, 2001; Geiger and North, 2006), Operations (Marcel, 2009), Marketing (Nath and Mahajan, 2008), Human Resource Management (Hayton, 2003; 2005), and Strategy (Angwin et al., 2009). Here, there are clear links with specific types of education and professional experience, particularly in the early to middle stages of a career. Other researchers highlight those functional skills that, while portable, are perhaps more attached to particular industry sectors. For example, functional marketing capabilities and how these encompass skills in sales, promotion, and advertising within specialist industries (Zhao et al., 2013).

The differentiation of managerial inputs through the use of functional criteria offers a useful means to define the roles and contribution of members within a TMT. However, according to some theorists, examining the state of the management team in these terms can encourage a false portrayal of the clarity of TMT roles. In a recent review of the subject, Menz (2012) highlights that management roles are often cross-functional, or, at least, that the actual activities of managers typically transcend functional allocations. Beckman and Burton (2008) underline this as an important point by differentiating functional expertise from the functional structures of the TMT. Again, in their view, management teams can display various levels of role definition, which do not always correspond to traditional functional positions. Indeed, within early-stage management teams in particular, it may be *expected* that management roles be less strictly defined. The concept of the owner-manager as a 'Jack of all Trades' rather than a functional specialist is important here (Lazear, 2004). For instance, Oakey (2003) argues that the performance of a wide range of functional roles may actually be necessary for the early survival of a venture.

This view promotes an alternative view on the commercial/business/management human capital components within a TMT. This emphasises the more general experiences gained from having strategic and organisational responsibility for a commercial operation. In their study of human capital influence on venture survivability, Gimmon and Levie (2010) make such a distinction, using the label 'business management expertise' to denote "the experience of managing a total business or project: profit and loss responsibility exercised by being either CEO or self-employed or a project manager". Thus, the focus here is on leadership and strategic responsibility across functions (Blackburn et al., 2013; Lockett et al., 2013), and not simply on a narrow functional specialism. Both of these views on the nature of 'business management' skills have validity, and both are readily observable within empirical studies. However, the distinction is an important one, particularly in the context of a study that examines developing ventures, where functional positions are perhaps less likely to be formalised.

The concept of business management experience as that of having previously had strategic or leadership responsibility is one that also aligns itself with less defined skillsets. Examples of these are aspects such as coping with change or articulating strategic vision (Kotter, 2001), as well as 'soft' skills such as communication (Leach and Kenny, 2000), 'directing people' (Badawy, 1993), and motivating (Kotter, 2001). Distinguishing leadership roles in this way raises important implications for the manner in which we view the state of a management team. In particular, it emphasises that there may be inequality in the importance of particular management roles. For example, a 'lead' entrepreneur may hold markedly increased responsibility for strategic direction than other functional managers. In this sense, managerial decisions are not necessarily an equal amalgamation of views from the various individual managers in a team, but, instead, may be disproportionately driven by particularly powerful team members (Cyert and March, 1963; Ensley et al., 2003). Understanding this encourages a view of management team composition that is alternative to strictly defined functional roles. It also has clear implications for team decision-making processes, which are likely to significant impact future TMT development trajectories.

2.3.3 – Industry Specific Experience

A number of researchers, including the early works of Becker (1964), distinguish between general and specific human capital (also see Rauch et al., 2009). Specific human capital represents expertise that is strongly attached to a particular context and cannot easily be transferred (Shepherd and Wiklund, 2006). Thus, it stands largely in contrast to the notion of defined functional management expertise. The most commonly discussed indicator of specific human capital is industry-specific experience (Bruederl et al., 1992). This refers to knowledge held by members that corresponds to the specific industry in which the new venture operates. Such experience is thought to aid strategic development and opportunity recognition through knowledge of profitable niches and common market behaviours (Rauch et al., 2009; Fern et al., 2012). Findings on the impacts of industry experience held by entrepreneurs and entrepreneurial teams are perhaps more robust than those on perhaps any other human capital aspect (Unger et al., 2011). In short, the relevance of founder industry backgrounds is evidently a clear consideration to an examination of founding team condition.

The importance of industry experience raises some significant implications regarding the prior career paths from which founding team members may emerge. The term 'industry experience' implies that the founder has developed their expertise in a related commercial organisation. While this is likely to be true, empirical research emphasises that the early part of such a career path is also likely to have encompassed an initial education and experience in a specific but relevant technical function (Almus and Nerlinger, 1999; Cooper and Park, 2008; Knockaert et al., 2011). This stands in contrast to the notion that business or professional education is the likely foundation for management experience and instead underlines technical backgrounds as the platform from which future 'commercial' expertise is developed (Almus and Nerlinger, 1999). It also blurs the dichotomy often drawn between technical and management expertise. For example, in reference to high-tech entrepreneurs in the Ottawa region, Harrison et al (2004: 1062-3) note "the typical career path was a relatively narrowly focused technical or research position early in

their career (influenced in part by their education) and a subsequent move into managerial roles such as technical sales or business development". The suggestion here is that technologists can broaden their experience by transitioning to more commercially applied roles, meaning that they hold both technical competence and industry specific commercial human capital. In short, technical expertise cannot be completely divorced from management or commercial functions.

2.3.4 – Prior Startup Experience

A number of researchers emphasise previous self-employment experience as a specialist source of human capital expertise. Again, human capital derived from prior entrepreneurial experience is associated with broad, cross-functional leadership advantages (Rauch et al., 2009). For example, in describing the expertise of habitual entrepreneurs-turned-board members, Zhang and Baden-Fuller (2008) refer to knowledge of 'venturing in general'. This depiction encompasses general strategic expertise as well as understanding of how to structure a growing venture. Other researchers emphasise prior start-up experience as an advantage in terms of the ability to process seemingly disparate information in order to assess opportunity potential (Davidsson and Honig, 2003; Baron and Ensley, 2006; Lockett et al., 2013).

Portfolio and habitual entrepreneurs in particular have been singled out as typically possessing greater human and social capital when starting a new venture (Wright et al., 1997; Westhead and Wright, 1998; Ucbasaran et al., 2006; Kirschenhofer and Lechner, 2012). Mosey and Wright (2007) note that habitual technology entrepreneurs hold distinct advantages over academic entrepreneurs in these respects. In seeking to explain this, a number of researchers have emphasised that habitual and portfolio entrepreneurs show a greater motivation towards growth and wealth generation (Westhead and Wright, 1998; Rauch et al., 2009). Another advantage is the likelihood that the prior ventures of habitual entrepreneurs would have been in a related industry. In this sense, there is a distinct possibility that prior entrepreneurial experience will provide technical and industry specific experience also. This observation is reflected by the findings of Colombo and Grilli (2005: 812), who, in their study of 506 Italian technology entrepreneurs, concluded "new technology-

based firms established by individuals who have greater work experience in technical functions in the same industry of the new firm and have been involved in prior entrepreneurial ventures exhibit superior growth, with all else equal".

A central process within how prior entrepreneurial experience is created is the concept of 'entrepreneurial recycling' (Mason and Harrison, 2006). When entrepreneurs exit a firm, they are likely to retain a variety of beneficial resources, both tangible and intangible. Thus, these resources may be, at least partially, transferred to the new founding team upon the formation of a new venture. In short, recycled entrepreneurs can act as an important source of "inherited knowledge" (Hayton and Zahra, 2005: 256) for founding teams. In this sense, both the growth activity of entrepreneurial ventures in particular technology fields and prevalent exit targets of firms (for example, trade sales, acquisitions, or Initial Public Offerings (IPO)), may have a great deal of bearing upon the ongoing 'production' of experienced new founding team members (Mason and Harrison, 2006; Mason and Brown, 2012).

2.3.5 – Organisational Blueprints

Finally, a number of researchers point to the importance of particular skillsets falling under what could be termed a 'management orientation' (Smith and Milner, 1983). This term, which is one of many similar labels, refers to capabilities surrounding the development of organisational structures, systems, and procedures. In the context of new venture creation, founders may be forced to, at least to some extent, 'start from scratch' in terms of organisational structures and standard operating procedures (Hmieleski and Ensley, 2007). Existing research indicates that inability to establish adequate organizational models, including professionalized management systems, is one of the major barriers to new firm development (Miller and Toulouse, 1986; Chan et al., 2006). Particular issues that have been noted are lack of adequate planning or appropriate systems for the coordination of firm activities (Barbero et al., 2011). This underlines what is a common challenge for entrepreneurial ventures in their attempts to transition to the more formal arrangements typically associated with established firms (Nadin and Cassell, 2007; Gilman and Edwards, 2008). Yet, there is strong

support to suggest that the implementation of more formal practices is important to the facilitation of growth. For example, a recent major study for the World Economic Forum (WEF) identified clear benefits for those companies with higher adoption rates of management systems, such as ISO quality management approaches (WEF, 2011).

For the purposes of this study, a broad understanding of the term 'structure' is required. Following Eisenhardt (2013: 812), the study uses the term to refer to "all manner of structures including formalization (e.g. rules and routines), centralization (e.g. hierarchy, verticality), span of control (e.g. scale of sub-units), coupling and structural embeddedness (e.g. tie strength, tie density), and specialization (e.g. role breadth)".

The pre-founding experience of initial TMT members is important to this human capital categorisation because founding entrepreneurs can replicate routines, cultures, and systems from previous places of work and apply them in the new venture (Sorensen, 1999; Burton et al., 2002; Sorensen and Fassiotto, 2011). Systems of work can often mirror prior experiences, frequently providing an early advantage to how the new venture operates and to how it structures itself for future growth (Beckman et al., 2007). In her early work of the growth of the firm, Penrose (1959) points to the importance of managers that develop intimate and tacit knowledge of a firm's organisational structures, standard operating procedures, organisational histories, and organisational culture. Thus, individuals can build a working knowledge of how organisations operate, and the systems they use. These are likely to be represented by a mix of formal and informal mechanisms (Leonard-Barton, 1992). While many of the cultural aspects and organisational routines learned through experience are specific to a particular firm, these competencies, along with more explicit knowledge about how to structure and organise firm activities, offer a degree of transferability that can be beneficial in future positions.

In describing this phenomenon, Baron et al (1999) use the term 'organizational blueprint', which provides an apposite sum up of how individuals may use their prior

experiences as a guideline for future new firm development. Blueprint types are, for the most part, discussed in two forms. One refers to prior exposure within a growing entrepreneurial firm, where individuals can experience the challenges of developing structures for rapidly changing organisational forms first hand. This, again, relates to knowledge of 'venturing in general' (Zhang and Baden-Fuller, 2008). The second emphasises blueprints transferred from established organisations, with sophisticated organisational structures. These blueprints have the advantage of being 'tried and test' through long-term development, but may face a mismatch with the small firm environment because of over-bureaucratisation. Ultimately, this highlights the challenge in transferring and applying only those aspects of former blueprints that are effective in the context of an entrepreneurial new venture.

2.4 – SOCIAL CAPITAL

Social capital is a concept used to depict the intangible assets that enable actors and organizations to access social resources embedded within a wider social context (Bourdieu, 1985). The concept encompasses many aspects of social exchange and shares a natural affinity with network theory. In their attempt to synthesise and define various theoretical perceptions of social capital, Anderson et al (2007) make an important distinction between these closely related concepts. Whereas networks represent the connections between social actors and the means to facilitate social exchange, social capital represents a stock of 'goodwill' held by those actors, which may be used to unlock access to other key resources. In this sense, "social capital is more akin to a key, rather than the resource itself" (Anderson et al., 2007: 264). This pool of goodwill can be built-up over any form of interaction – both socially and in the work environment – and therefore it is not necessarily accumulated deliberately (Aldrich and Martinez, 2001). Social capital is important to the examination of team formation because it helps us to understand the potential access that a team can have to a variety of key resources. The following sections detail the primary implications of social capital and network access to TMTs.

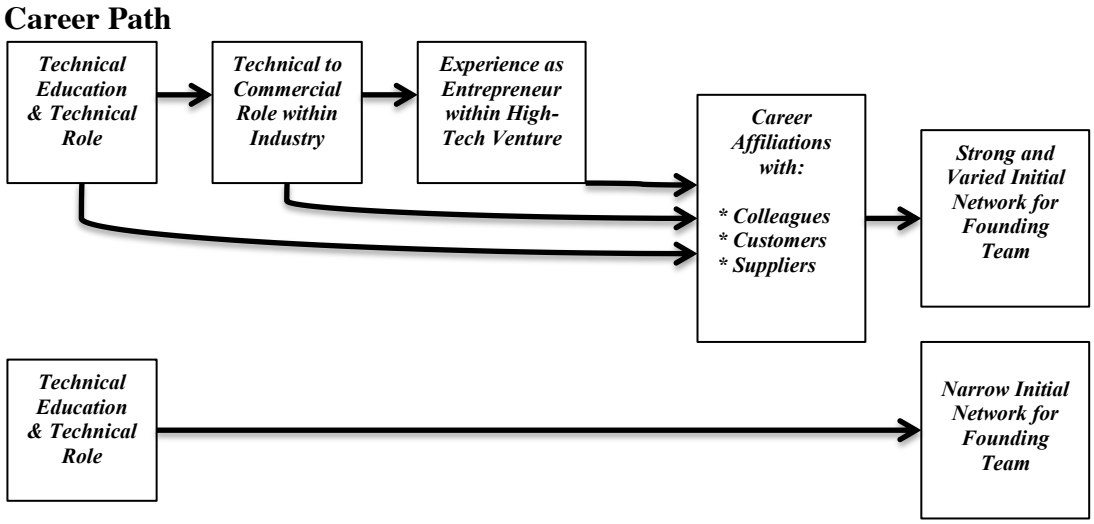
2.4.1 – Reputation and Firm Legitimacy

The smallness and newness of a new venture can be a liability, causing difficulties to the entrepreneur in their attempts to attain resources (Vyakarnam and Handelberg, 2005). However, the reputations held by TMT members can go a long way in establishing venture credibility and overall legitimacy in the eyes of important stakeholders (Certo et al., 2001; Lynall et al., 2003; Zhang, 2011). Burton et al (2002: 234) argue that "one of the key determinants of an individual's position in social structure is her career history, in particular her affiliation with different employers". Specifically, they highlight the quality or prominence of former employers as a key determinant of an entrepreneur's, and, by extension, an entrepreneurial team's reputation amongst the wider community. This can clearly prove to be a significant advantage to an early TMT because "the reputational capital derived from being affiliated with a prominent employer allows entrepreneurs to reduce the perceived uncertainty of their venture, thereby facilitating the acquisition of resources from third parties" (2002: 230). The importance of reputation is a feature also noted in other studies. For example, Harrison et al (2004) detail how technology entrepreneurs in Ottawa were able to more effectively access sources of investment if they had previously worked for Nortel, who were a prominent employer within the region. Essentially, we see the prior experience of founding team members acting as a signal of quality to investors, suppliers, and potential customers. As such, the initial reputation of founders clearly has the potential to be a key determinant of TMT condition.

2.4.2 – Prior Interactions and Specific Connections

If the prior experience of founding team members can dictate the general reputation of the team, it can also determine the existence and strength of specific relationships gained through pre-founding interactions. The build up of social capital and connections – chiefly through affiliations accumulated during the prior career - can be vital in developing or maintaining linkages to potential markets (Anderson et al., 2007), important suppliers and possible sources of finance (Bernasconi, 2006; Kirschenhofer and Lechner, 2012). Thus, the individual's network can be directly transferred into network relationships that benefit a new venture (Murray, 2004b).

Figure 2b: Prior Experience and Initial Team Member Affiliations



For TMTs, certain individuals represent attractive potential resources, simply because of the ties they possess with relevant stakeholders (Forbes et al., 2006). Again, the value of these ties can be assessed across a number of dimensions of the social capital and network concepts. Firstly, there is the diversity of network ties and how a team member's network position dictates the amount of contacts that they have (Burt, 1992). Secondly, there is the relevance of those contacts. For example, Mosey and Wright (2007) underline how university spinout teams often display strong networks in their particular field, yet find that many these networks are frequently irrelevant within the commercial domain. Finally, there is the strength of the relationship (Burt, 1992; Lin, 1999), which corresponds to the level of 'goodwill' that the team member has with a certain stakeholder.

2.4.3 – Connections Between Founding Team Members

Finally, social capital and network theories may help to explain how team members initially become involved with one another before assembling as a team (Forbes et al., 2006). Empirical research indicates that entrepreneurs are unlikely to form a team with unknown collaborators. This often has the effect of grouping together members with similar working, educational, or social backgrounds (Byrne, 1971). Such

behaviour is reflected by a number of studies that identify evidence of shared prior relationships between members of a team (Neiswander et al., 1987; Ruef et al., 2003; Williamson and Cable, 2003). These observations underline the concept of *team homophily* (Ruef et al., 2003), which is one of the two main rationales for member addition that is subsequently discussed in Chapter Three of this thesis. The notion that prior affiliations are likely to influence member choices means that researchers can look to the prior interactions of founding team members as a means to examine how teams come into existence (Murray, 2004a).

Exisiting literature predominately points to the presense of strong ties between members as the rationale for founding teams wishing to assemble with other members with whom they have expereince of their personalities and working habits (Aldrich et al., 1996). The suggestion here is that when entrepreneurs are deciding upon who to assemble their team with, assessments are made not only on the human captial of other members, but on a perception of 'fit' in terms of values or personality as well as other elements related to trust (Sapienza et al., 1991; Leung et al., 2013). Indeed, extant research indicates that, within some entrepreneurial teams, initial member choice champions elements of trust and social fit significantly more so than an assessment of skills contribution. For example, family firms (Brannon et al., 2013; Cruz et al., 2013), or teams composed of friends (Francis and Sandberg, 2000), frequently emphasise these socio-psychological aspects. This feature is also noted in conjunction with technology-based venture teams that spin off for academic institutions (Ndonzuau et al., 2002; Landry et al., 2006; Vanaelst et al., 2006). For example, first-time academic entrepreneurs frequently show tendency towards assembling their team with other members of their research team (Ensley and Hmieleski, 2005). This again underlines how skills diversity can be a secondary consideration. As Schjoedt et al (2013: 2) reflect, "human beings prefer to engage in entrepreneurship with people that they know, trust, and love more than with people they know less well, regardless of the skills and abilities the two groups bring to the table".

Investigating explanations that underpin what is considerable evidence of teams with overlapping, specialist, and narrow skillsets represents one of the primary inspirations for this study. While the same considerations or trust and social fit are evident in those teams assembled by former colleagues that worked together in a commercial environment, research suggests that these types of spinout teams are also more likely to hold advantages in their skills diversity (Leung et al., 2013). Again, this is largely dependent on the type of host organisation and the particular roles played within that organisation (Mason and Harrison, 2006; Cooper and Park, 2008). For example, in their Ottawa sample, Harrison et al (2004) again note that many project teams had originated from the prominent firm Nortel to form ready made entrepreneurial teams within new ventures. Other researchers point to teams that had formed from cross-organisation collaboration between members, for example, two or more individuals who had closely interacted through a supply chain relationship (Casper and Murray, 2005). The advantage in these cases was that, while teams retained a trusted working relationship, they were, given their origins from the commercial domain, more likely to have had members with experience across different business functions. In short, founders with significant industry experience were more likely to be able to enjoy the benefits of important career affiliations with other founders who held complimentary experience. It is partially for these reasons that scholars of team entrepreneurship frequently find that strong teams are "typically large, diverse, and have a prior working history together" (Eisenhardt, 2013: 814).

That said, not all teams are assembled through a shared history of significant interaction. For example, prior research has noted how public sector advisory services can introduce inexperienced entrepreneurs to advisors, who then join the team to act as 'surrogate entrepreneurs' (Franklin et al., 2001). Bernasconi (2006) notes how investors may deliberately assemble a management team during the early stages of firm development. Typically, scientists or technologists are "balanced by those with managerial profiles in line with the project's needs" (Bernasconi, 2006: 178). In these cases, examination of how the team assembled would not look towards prior career histories, but instead to the network brokers who acted to connect the

eventual founding team members (Burt, 2005). Given that they are deliberately composed of balanced and highly relevant human capital, investor-assembled teams theoretically offer excellent chances of development success (Bernasconi, 2006). Of course, the primary risk lies in the quality of personal relationships within the team (Ensley et al., 2002; West, 2007) and with investors (Bruton et al., 2000; White et al., 2007). Thus, the rational choice of diversely skilled fellow members is one that is often, in practice, tempered by socio-psychological considerations (whether consciously or otherwise).

2.5 – FINANCIAL CAPITAL

Finally, entrepreneurs are also dependent on financial capital in order to obtain key inputs necessary for the production of goods or services. As such, the financial capital initially possessed by the founding team represents the final category of team condition to be discussed. New ventures typically begin life with relatively little in the way of financial endowments. Frequently, owner-managers must apply a range of cost saving measures – for example, bootstrapping – and cash flow generating activities in order to negotiate periods of financial constraint. Of course, not all new firms come in to existence with limited resources, and those with larger initial endowments of financial capital are at an advantage in terms of how they might negotiate future development, particularly during the early, typically high-risk, stages (Ullah and Taylor, 2007). In their study, Colombo and Grilli (2005) underline the positive relationship between the wealth of individuals and the human capital that they hold.

As such, it is difficult to assess whether advantages stem from the 'wealth effect' or the 'capability effect'. However, all else being equal, firms that are established by wealthier owner-managers are likely to face less of the common challenges typically arising from resource constraints. Initial financial endowments can come from a variety of sources, including personal and family resources. In line with the focus placed here on prior careers of founding team members, it is worth considering how financial resources may be recycled from former career positions by individuals. This concept has particular relevance to habitual entrepreneurs, who may use the

capital proceeds from a successful exit as a basis to finance the initial stages of a new venture (Mason and Harrison, 2006; Beckman et al., 2007). This represents another notable potential advantage for those founding teams that are formed by entrepreneurs originating from a commercial background.

2.5.1 – Risk Capital

Technology-based firms are typically growth orientated, given their need for market expansion strategies that can justify frequently expensive research and development (R&D) requirements (Westhead and Storey, 1997). As such, growth-orientated firms, perhaps more so than the general population of small firms, are often reliant of sources of financial support beyond that possessed by the initial team (Westhead and Storey, 1997; Queen, 2002; Ullah and Taylor, 2007). Research has emphasised that traditional sources of debt finance – for example the banking system – often deem new technology-based ventures to be high risk, and, as a consequence, are reluctant to offer support (Ullah and Taylor, 2007). For most developed economies, this has placed the spotlight on the risk capital industry as a primary means to provide investment support to entrepreneurial technology firms (Harrison et al., 2010a). Thus, it is often the initial seed capital received by the founding team that is the best indicator of early financial condition.

Venture capitalists, in particular, have represented a major aspect of the research focus within globally prominent technology industries (Bygrave and Timmons, 1992; Harrison et al., 2010a; Gregson et al., 2013). Aside from the advantages afforded through the provision of finance, a number of researchers have emphasised added benefits that firms can experience through the involvement of venture capitalists. In particular, various studies have underlined the coaching or mentoring role of investors, and the advantages that this can inspire through entrepreneurial learning and added expertise (Cyr et al., 2000; Hellmann and Puri, 2002; Wright et al., 2003; Knockaert and Ucbasaran, 2013). Additionally, other researchers point to advantages stemming from those entrepreneurs that are able to leverage venture capitalists' position in the social system as a means to access further resources (Zhang and Baden-Fuller, 2008). These findings reveal how the various capital forms possessed,

or potentially possessed, by a founding team are frequently interlinked. In this short discussion alone, sources of financial support can be linked to both further human capital and further social capital advantages. This offers some explanation as to why venture capital backed firms grow more effectively and outperform similar non-VC backed firms (Gompers and Lerner, 2001).

2.6 – IMPLICATIONS OF FOUNDING TEAM CONDITION

The discussion presented in this chapter establishes that firms founded by individuals with certain capital resources can leverage their distinctive capabilities towards improved performance (Colombo and Grilli, 2005; Gimmon and Levie, 2010; Unger et al., 2011). This is an important consideration for the study of how TMTs might develop beyond formation and early stages. Existing research clearly supports the view that managerial resources held by a firm are likely to impact venture performance and growth (Hambrick and Mason, 1984; Hayton and Zahra, 2005; Blackburn et al., 2013). Importantly, however, the performance and growth trajectory of a venture is also likely to influence how a TMT develops in the future (Eisenhardt and Schoonhoven, 1990; Shane and Cable, 2002). This point is reflected within the seminal work of Penrose (1959), which underlines a fundamental principle underpinning theories of firm growth; namely that firm growth and firm management share a somewhat symbiotic relationship. Existing literature on firm growth frequently points to the association between growth and changes in the dominant management logic of an organisation. Typically, firm growth stages are illustrated as bottlenecks, where the dominant system of management must be modified in order to cope with new strategic developments (Greiner, 1972). Thus, if a firm does not experience growth, it may be less likely to, a) need to make changes to the management team, b) seek to make changes to the management team, or c) be able to make changes to the management team. Conversely, a firm experiencing rapid growth is likely to be forced into re-shaping its management composition. Thus, initial founding team condition may have a cumulative effect on subsequent TMT development.

The influence of founding team experience on subsequent growth and TMT development patterns is one that has gained some traction in contemporary scholarly discussions. Beckman and Burton (2008), for example, argue that founding team condition imposes a path dependent 'imprint' on subsequent TMT development. Notably, this is one of the relatively few scholarly articles to focus exclusively on the development of the team only, rather than on how teams impact the performance of the firm. This study finds "founding teams that begin with broadly experienced team members are more likely to attract broadly experienced executives" and "firms that begin with a range of functional structures are more likely to develop more complete functional structures" (Beckman and Burton, 2008: 18). Thus, the suggestion here is that inexperienced early teams, which theoretically have most need to develop their resource stocks and encourage compositional diversity, are actually less likely to do so. Conversely, more experienced early team, despite their theoretically diminished need for further development, are likely to experience the opposite. Furthermore, the study's results suggest that narrowly experienced founding teams are far less likely to be able to 'catch up' in terms of experiential diversity once a development path has been embedded. In her recent work on TMT links to firm performance, similar observations encourage Eisenhardt (2013) to note that management team development trajectories can be difficult to reverse once established.

The subject of founding team influence on subsequent development behaviours was also a prominent theme emerging from a recent special issue of *Entrepreneurship Theory and Practice*, which focused on various new venture teams (Schjoedt et al., 2013). A number of the discussions focused particularly on the notion that the initial leadership team of a firm can establish a trajectory for future development. Important considerations here concern the influence of strategic decisions made during early venture stages (Shrader and Siegel, 2007; Fren et al., 2012) or the growth intentions of founder-leaders (Wiklund and Shepherd, 2003a; Levie and Autio, 2013). Again, this indicates a clearly contrasting position to notions of the progressive professionalisation of the management team. These arguments essentially attack 'ahistorical' accounts of TMT formation and, in highlighting the importance of initial

conditions, they demonstrate that the origin of the management team may have significant influence on subsequent development.

2.7 – CHAPTER SUMMARY

This chapter sought to underline the significance of investigating historical and contextual influences on how, and in what condition, TMTs originate. To do this, the origin of the team was positioned within established theoretical perspectives on human capital and social capital. In contrast to the notion that management teams originate in an embryonic state, these perspectives highlight that the prior career experiences of founding team members are likely to have significant influence in dictating a wide variety of early TMT states. Notably, the prior experiences of founding members dictate skills and knowledge distribution within the early team. They significantly influence prior interactions between members, which is often the basis by which a team is assembled. They have a great bearing upon the reputational status and social positioning of the management team and the firm. Finally, they can even impact the availability of financial resources within the early team through the recycling of financial capital.

Furthermore, a growing body of literature suggests that these elements of early team condition are likely to significantly influence subsequent TMT development trajectories. This opens discussions surrounding the possibly path dependent nature of TMT development, and furthers the case for a historically and spatially contextualised study of how that development takes places. It is these observations that raise the first theoretical gaps and research questions for this study. It is reasoned that, in order to provide a more empirically accurate portrayal, TMT development should be examined from a pre-founding stages, with particular focus on the career experiences and incubators of founding members.

3. POST-FOUNDATION: THE DEVELOPMENT OF TOP MANAGEMENT TEAMS

3.1 – INTRODUCTION

This chapter explores the existing literature that underpins how TMTs develop after initial formation. The chapter commences by further exploring the relationship between firm growth and management team modifications. The theoretical offerings under this approach, which predominately correspond to lifecycle or staged portrayals, have been subject to multiple sources of criticism. In contrast to this popular perspective, this study recognises that TMT development patterns are unlikely to be homogenous when observed empirically. However, the lifecycle view represents a widely espoused segment of the literature, and offers some useful fundamental principles on which more refined views have been, and can be, based. In particular, this study adopts the fundamental principle that TMT development can indeed be conceptualised as a series of modifications or reconfigurations to the dominant management logic (following the same rationale as Levie and Lichtenstein (2010) on the conceptualistion of venture growth). Changes to the composition of management frequently occur in anticipation of, or response to, periods of strategic upheaval. To identify when modifications to the TMT occur, two observable features are outlined. The first of these concerns personnel changes brought on by member entry and exit. The second concerns changes to management or organisational structures. The chapter is then free to review existing views on both the rationale and the behaviours associated with why a TMT might be modified.

This line of enquiry takes its basis from the evolutionary notion of adaptation, which emphasises how organisations adapt to their environment (Low and MacMillan, 1988; Aldrich and Martinez, 2001). It places focus on exploring managerial actions, and how strategic choices (in this case the choice to development the TMT in some fashion) are taken in response to environmental stimuli (St-Jean et al., 2008; Blackburn et al., 2013). Thus, the chapter fundamentally emphasises the nature of the choices that ultimately define the manner in which TMTs develop.

3.2 – FIRM GROWTH AND MANAGEMENT CHANGES

Firm growth accounts for one of the central areas of focus throughout not only entrepreneurship and small business research, but also wider management and organisational theory (Levie and Lichtenstein, 2010; McKelvie and Wiklund, 2010). Within the field of entrepreneurship in particular, a significant body of research suggests a key role for relatively small populations of over-performing 'gazelles'; a term that describes rapidly growing young firms (Storey, 1994; Birch et al., 1997; Autio, 2012; Colombelli et al., 2013). The contribution of gazelle firms to the wider economy has been identified across a number of aspects. Prominent observations concern contributions to employment growth (Autio, 2007; Henrekson and Johansson, 2010), aggregate economic impact through productivity and export activity (Autio, 2012), and, in the case of high technology industries, impacts on innovation through the introduction of disruptive technologies (Colombelli et al., 2013). It is often difficult to separate the role of the entrepreneurial small firm from the idea of growth (Steffens et al., 2009; Blackburn et al., 2013). And, there are few sectors where the growth obligation resides more potently than in high technology industries, where typically capital intensive activities (Xia and Roper, 2009) often demand substantial investment returns.

Why is this important to an examination of TMT development? Put simply, the state of an organisation's management represents one of the central themes underpinning the study of firm growth. For example, Penrose's (1959) seminal work on growth principally highlights a dynamic process of interaction between management and resources that either encourages or constrains firm progression. Similarly, the popular linear model of managerial development presented by Greiner (1972) emphasises different stages of firm growth being characterised by changes in dominant management systems. Thus, the state of management team attributes, styles, and structures are often seen to be inextricably tied to the growth (or non growth) of a new venture (Goffee and Scace, 1995). As such, popularised models of firm development have also become a prevalent means by which theorists can portray the formation of management teams, with TMT development being mapped

against important aspects of firm development (Churchill and Lewis, 1983; Quinn and Cameron, 1983; Greiner, 1998a; Vanaelst et al., 2006; White et al., 2007).

In the approaches of both Penrose (1959) and Greiner (1972), emphasis is placed on how phases of 'revolution' or 'transition' result in the breakdown of previous management practices, requiring the firm to develop new management approaches before being able to progress. Periods of change often signify the need for strategic alteration, and thus imply the need for changes in management personnel, capabilities, competencies, as well as in organisational structures. Modifications in these areas represent the reconfiguration of the TMT. Scholars note that expansion of the firms places pressure on existing management and can act as a bottleneck to its successful growth (Oakey, 2003). The reasoning here is that the management practices and procedures that were successful at one stage of venture development will not only be unsuitable but may even be harmful to prospects of success at a subsequent growth stage (Greiner, 1972; Churchill and Lewis, 1983). If suitable modifications are not made then organisational growth is likely to be constrained (Barringer and Jones, 2004). Subsequently, during periods of 'evolution', these new management systems become integrated as part of normal organisational practice (at least, until the onset of the next period of crisis). In this sense, management practices are continually modified or dispensed with in order to make way for new management systems that befit new stages of growth (Greiner, 1972).

Blackburn et al (2013: 9) point out that "the factors that affect growth are not easily captured and modelled" (see Storey, 2011). However, the literature offers various explanations in terms of the factors that drive growth processes. At the core of most observable growth 'triggers' is the notion that the firm's management, and the strategic decisions that they make, inherently drive and define either the exploitation of opportunity or the mitigation of threat (St-Jean et al., 2008; Blackburn et al., 2013). This is, of course, a central consideration for this thesis; one that positions the focus on TMT development in terms of how and why decisions to modify the team are taken.

However, many researchers look instead to the particular factors that drive growth, as opposed to the strategic decisions that act as growth antecedents. This view falls under what McKelvie and Wiklund (2010: 264) term "Growth as an Outcome". For example, Gersick (1994) uses the term 'event-based triggers' to signify how the outcome of growth is often attributed to aspects such as increases in sales volume (Greiner, 1998a), the need for larger production runs (Van Bruystegem et al., 2008), the completion of strategic milestones, or the launch of a new product (Gersick, 1994; Forbes et al., 2006).

Other notable trigger events concern the powerful role that finance availability can play in the development of the firm. The nature of technology enterprises often dictates that there is a large gap between financial outlay and sales income, with each new stage i.e. prototype, product development, commercial development, new market expansion requiring some kind of investment (Oakey and Mukhtar, 1999; Bernasconi, 2006; Xia and Roper, 2009). As such, instances of significant financial investment can act to immediately trigger notable periods of firm growth. Alternatively, financial constraints can act as a barrier to growth plans (Oakey and Mukhtar, 1999; Ullah and Taylor, 2007). Consequently, some theoretical perspectives tie team evolution predominately to the emerging capital needs of high-technology ventures (White et al., 2007).

Alternatively, a body of the literature emphasises external growth triggers (Scott, 1973; Normann, 1977). For example, significant macro shifts in the business or competitive environment occurring during the development of the firm can force alterations in strategic direction and management approach (Virany and Tushman, 1986). Finally, some scholars have focused on growth drivers beyond those that might be associated with 'organic' development. McKelvie and Wiklund (2010) highlight alternative growth modes associated with acquisition activity. This offers a means of rapid growth through the combination of resources between two firms. However, some researchers have pointed out that gaining sustained growth performance from an acquisition-based growth mode is a process fraught with difficulty (Cartwright and Schoenberg, 2006; Zollo and Meier, 2008). There may

also be questions raised concerning the extent to which such strategies resonate with the vast majority of young technology-based ventures.

If it is considered team membership changes are far more likely in periods of strategic change than in periods of stability (Forbes et al., 2006: 242), then these events are seen to herald the arrival of these critical strategic junctures, which typically induce the need for the "additional human capital, social capital, and internal capabilities" that can enact strategic change. This rationale falls under what McKelvie and Wiklund (2010: 264) identify as an alternative, but complimentary, view within growth literature: "The Outcome of Growth". It is posited here that the two perspectives are likely to work in conjunction with one another. A venture's management enact and implement the strategic decisions that either incite or insulate against 'events'. However, equally, the repercussions of how those events are dealt with have implications for how dominant management configurations are shaped.

3.3 – TMT DEVELOPMENT UNDER LIFECYCLE PRINCIPLES

So-called 'lifecycle' or 'stage' models have dominated the theoretical conceptualisation of firm growth. The fundamental principles of this perspective have enjoyed significant face validity and are widely used as a teaching tool in business and management schools throughout the world (Levie and Lichtenstein, 2010). Indeed, the lifecycle portrayal of staged firm growth is one that is often intuitively accepted and that appears to resonate with a broad range of audiences. Perhaps the most well known of the stage models is the classic product lifecycle, which could be considered to be the archetypal depiction of basic lifecycle principles. Other well disseminated lifecycle models include those by Lippitt and Schmidt (1967), Greiner (1972; 1998a), Churchill and Lewis (1983b), and Quinn and Cameron (1983) (See Figure 3a).

In a recent comprehensive review of 104 stage-based growth models, Levie and Lichtenstein (2010: 318) sought to outline the fundamental assumptions underpinning the lifecycle perspective of company growth. Here, they identify that assumptions take their basis in an "organismic" analogy of firm development. Under

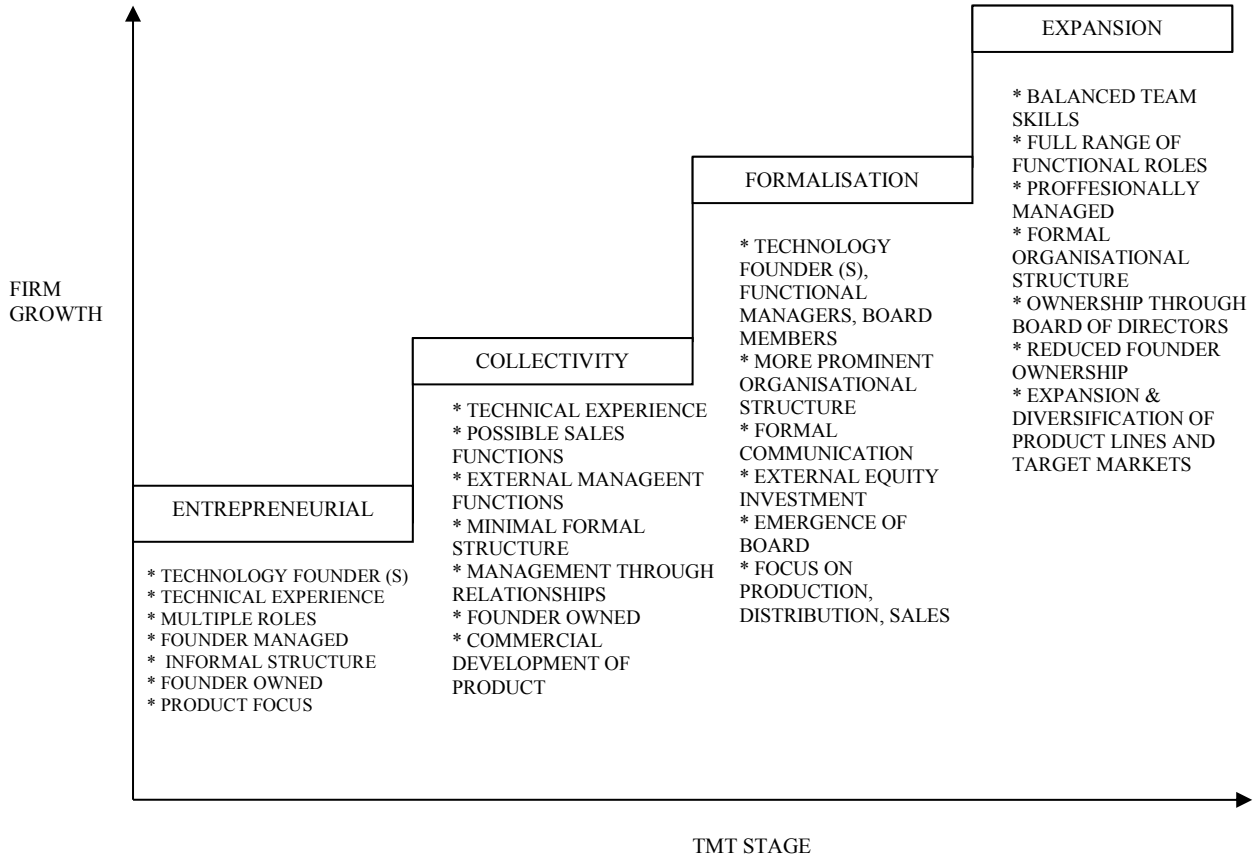
this view, organisations are portrayed as growing in a similar manner to the type of well-accepted biological development that one would expect in the life of a human or an animal. Within this analogy, Levie and Lichtenstein (2010) identify three fundamental assumptions. Firstly, models assume that the developing organisation will pass through identifiably distinct stages. Secondly, stages are portrayed as being sequential. Finally, that staged progression will see a continuing increase in organisational complexity, from an initial 'primitive state' to one of maturity (Van de Ven and Poole, 1995; Levie and Lichtenstein, 2010).

Beckman and Burton (2008) note that portrayals of TMT development under lifecycle principles have enjoyed a similar level of face validity as the application to firm growth in general. Typically, this perspective relays a story in which "successful high-technology firms are launched by specialized technological geniuses: Brilliant scientists found a company (frequently in a garage), then attract more broadly experienced executives and venture capital to bring the firm to the next level", then subsequently "executives are replaced as the firm outgrows their capabilities in a process of professionalization" (Beckman and Burton, 2008: 3). The relative levels of convergence that exist in lifecycle portrayals of both firm growth and TMT development make it possible to offer a depiction of team development under these principles. Here, four broad, but typical, stages and their characteristics are presented (See Figure 3a):

Stage 1 – The Entrepreneurial Stage

Referred to variously as the 'entrepreneurial' (Quinn and Cameron, 1983), 'creativity' (Greiner, 1998b), or 'birth' (Greiner, 1998b; Van Bruystegem et al., 2008) stage. This phase of firm development refers to a technology firm management team that consists of initial technologists, researchers, or scientists seeking to form their own start-up. Technology founders may seek the help of an advisory service, for example, a technology transfer office or legal expert (to aid in aspects such as securing initial patents). There may also be contact with external advisors concerning initial assessments of commercial potential. However, at this stage, these 'privileged witnesses' would largely perform an external role rather than being full team

Figure 3a: TMT Development Under Lifecycle Principles



* *Adapted from literature*

members (Vanaelst et al., 2006). At this stage, a team would typically display human capital strengths in very specific areas. The first of these sees experience that is heavily centred around research and development or product design skillsets (Vanaelst et al., 2006). The second typically sees human capital traits that are associated with entrepreneurial, innovative or creative behaviours (Gabrielsson, 2007).

Functional positions would likely be undefined, with initial founders operating in a multitude of roles (Oakey, 2003; White et al., 2007). Essentially, the management style will typically be one that is dictated by the personal control of the founder(s). Thus, the initial technology entrepreneur(s) would likely operate a 'jack of all trades'

approach to the various tasks involved in setting up a vehicle for the commercialisation of their technology (Churchill and Lewis, 1983; Vanaelst et al., 2006). Organisational structure at this stage would be largely simplistic and informal (Churchill and Lewis, 1983; Quinn and Cameron, 1983), with founders focusing on product rather than internal systems (Van Bruystegem et al., 2008). The goals of the team at this stage tend to be centred largely on the initial single product or service (Churchill and Lewis, 1983; Quinn and Cameron, 1983; Vanaelst et al., 2006). These goals not only include development of the research and subsequent product features but also encompass early networking to access potential market and fund raising opportunities (White et al., 2007). Other key objectives may relate to the process of protecting the product legally (Vanaelst et al., 2006) and to establishing the legitimacy of the firm in order to gain access to resources (Quinn and Cameron, 1983; Vyakarnam and Handelberg, 2005).

Stage 2 – The Collectivity Stage

The collectivity stage refers to an initial period of cohesion within the management team as it begins to develop explicit firm objectives (Quinn and Cameron, 1983). The team would still be expected to be predominately built from trusted relationships with immediate networks, for example, colleagues in the technical, research or scientific communities (Vanaelst et al., 2006). Some essential functions may be operated through external partners, for example, accounting. However, this stage may well see the addition of sales manager to control a limited number of employees (Churchill and Lewis, 1983). Human capital composition would likely remain dominated by technical expertise at this stage. This is reflected in the goals of the team, which, while placing more focus on internal systems and early market development, typically continue to be predominately product focused.

The style of management is likely to be defined by trust and informality as opposed to structure. Greiner (1998b) points to characteristics such as a sense of family and cooperation amongst members, psychological contracts, and human relations over organisational efficiency (Nadin and Cassell, 2007). Thus the team is likely to be bound by a relationship, for example a working history, a friendship, or even a

shared passion for the project, with management occurring through that relationship (Leung et al., 2013). Indeed, Kamm and Nurick (1993: 18) find that "the relationship may take top priority in the beginning". Clearly under such a management style levels of formalisation are likely to be low. Aspects associated with the team at this stage include informal communication mechanisms and team member compensation taking the form of ownership benefits or promises of future profits rather than immediate remuneration (Greiner, 1998b; Van Bruystegem et al., 2008).

Stage 3 – The Formalisation Stage

As the team moves further along the company life cycle, it would typically show a need for increased managerial and organisational capabilities in its members (Lynall et al., 2003). Functional specialisation should emerge and the team should be comprised of managerial personnel to head these functions (Churchill and Lewis, 1983; Quinn and Cameron, 1983; Greiner, 1998b). In short, this stage would expect to see the beginning of the development of a more balanced team in terms of the experience and skillsets of its members. Goals tend to shift from a heavily product-minded approach to one that also starts to consider both the internal organisation of the firm and the external sale of the product (White et al., 2007). For example, the team may start focusing on the marketing, sales and general commercial development of initial product line (Harrison and Mason, 1992), or on securing larger sources of funding (Vanaelst et al., 2006).

Van Bruystegem et al (2008) argues that, in order to ensure a smooth transition to the formalisation phase of growth, the entrepreneur must move away from an intuitive style of management and look to establish an elementary organisational structure to separate the various functions and activities of the venture. As such the managerial role of the founder(s) is likely to become diluted (Churchill and Lewis, 1983). Growth is now achieved through delegation of defined tasks within the management team (Quinn and Cameron, 1983). This clearly leads to a need for a more formal organisational structure. Management communication would become more efficient (Quinn and Cameron, 1983), planning and control systems would become more

sophisticated (Lynall et al., 2003) and roles within the team would become specialised and defined (Gabrielsson, 2007).

Stage 4 – The Expansion Stage

At this stage, it is expected that human capital composition of the team should be spread out over the key functional areas of the firm. Within these key areas, roles would be defined and there would be sufficient functional management talent to implement them (Churchill and Lewis, 1983; Vanaelst et al., 2006; Gabrielsson, 2007). The goals of the team would usually be focused around expanding into new markets, developing multiple product lines, or diversifying operations (Quinn and Cameron, 1983). Management may also concentrate on growing through new acquisitions (Greiner, 1998b). The organisation should now have made the transition from a founder-managed firm to a professionally managed firm (Gedajlovic et al., 2004). Management should now be decentralised, adequately staffed and experienced (Churchill and Lewis, 1983). The management team would be supported not only be the organisational structure but also by the organisational culture and overall values that have emerged through the formation period (White et al., 2007). Clearly, formalisation is a key feature of the team at this stage. One would now expect the structures, systems and operations of the organisation to be well established and for aspects such as communication and strategic planning to operate within these structures (Churchill and Lewis, 1983; Quinn and Cameron, 1983). At this stage the firm will typically have become a separate financial and operational entity from the initial owner/founder (Churchill and Lewis, 1983).

3.3.1 – Critiquing Lifecycle Principles

Lifecycle principles have, for a wide variety of reasons, been subject to significant criticisms. First and foremost, as was outlined in Chapter Two of this thesis, the assumption that a TMT will begin life in a homogeneous 'primitive' state is one that is contradicted by empirical evidence rooted in human capital theory. Beyond this, contemporary work on organisational growth has served to refute most of the other underpinning principles of the lifecycle approach (St-Jean et al., 2008; Levie and Lichtenstein, 2010; McKelvie and Wiklund, 2010; Blackburn et al., 2013).

A first point of criticism concerns the assumption that firms will grow to a significant degree, when, in fact, the empirical reality is that small businesses can vary considerably in their capacity for growth. This can be dependent on a plethora of macro factors, such as sector and location (Storey, 1994), or the internal management factors that have been discussed throughout this thesis, such as the growth orientations of firm leaders (Wiklund and Shepherd, 2003a). Further to this, the majority of small businesses *do not* grow to any significant degree (Coad, 2007; McKelvie and Wiklund, 2010). Indeed, many small firms do not *choose* to grow. As Birch (1987: 28), who utilised a large-scale longitudinal data set of US firms, ultimately contended, "Companies do not develop like human beings. Young, small firms, unlike youngsters and trees, do not necessarily grow. And not all large, old firms decline. We need to discard anthropomorphic inclinations and obtain a more sophisticated model of the economy, based upon empirical evidence rather than imagery". If the majority of firms do not grow significantly, then equally, this decreases the likelihood that points of strategic change will arrive to encourage the need for management changes. In short, if a firm's growth trajectory does not warrant alterations to the management then the TMT will be unlikely to change. In these cases, lifecycle projections of TMT development would become largely irrelevant as a means to further our knowledge of how TMTs develop.

Further, where growth does occur, it does not necessarily occur in a sequential fashion. Central to these criticisms is that argument that growth experiences are too heterogeneous (Wiklund et al., 2009) and that linear models of firm progression cannot possibly hope to provide any real form of predictive insight into how a diverse array of strategic choices and external factors will impact on venture development (St-Jean et al., 2008). Rather than being linear, growth patterns identified in a number of empirical studies have been described variously as 'disjointed', 'disconnected', or 'discontinuous' (Dodds and Hamilton, 2007; Mason and Brown, 2010). Periods of significant growth cannot be maintained indefinitely, and so growth is more likely to happen in spurts (Garnsey et al., 2006). Firms may experience periods of stagnation only to revive growth progress at a later date, or not, as the case may be (Storey, 2011). Garnsey and Heffernan (2005a: 675) argue that

"continuous growth is quite rare and that growth interruptions are created by both internal and external dynamics". Essentially, the argument that emerges here is that there is no deterministic link between one stage of firm development and the next (Garnsey and Heffernan, 2005a).

Extending this point of criticism, Mason and Brown (2010: 15) note that "a period of growth does not necessarily lead to further growth; reversal is equally possible". In short, firms can develop in any given direction from any particular state. Thus, firms may face periods of decline, and may even be required to downsize management operations. For TMTs, this undermines the notion that development is a relentlessly successful progression towards increased professionalisation. Just as critical strategic junctures can mark the beginning of a new phase for the management team, they can equally be points of failure or setback. For example, in their longitudinal study of membership and role change in a research-based technology start-up, Clarysse and Moray (2004) identify how a failed demo of an initial product line forced the firm to pursue a secondary product, which ultimately changed the fundamental composition of the team. Here, the team did not progress forwards in terms significant increases in functional human capital, degree of strategic scope, or levels of team formalisation. Rather, responses to market demand caused member exit at TMT level, as well as the development of a new business model. Equally, changes in strategic direction can see the management team changing *horizontally* (Forbes et al., 2006). Here, member entry and exit relates more to managerial reorganisation as opposed to progression.

Ultimately, Levie and Lichtenstein (2010) contend that lifecycle depictions of growth largely succeed in simply portraying the particular context in which a sample has been taken. Therefore, despite the fact that lifecycle models have been frequently utilised as universal frameworks for numerous influential studies, the surrounding context in which organisational behaviours take place still appears to be a significant driver of organisational growth patterns. A useful analogy for this is the symbiotic relationship displayed between a biological organism and its habitat. This perspective displays clear congruence with the evolutionary views followed in this

thesis (Aldrich and Martinez, 2001; Breslin, 2008). Indeed, if consideration is given to the average growth patterns of a Silicon Valley firm against that of an average Scottish region firm, then there are clear implications for TMT development trajectories being examined outwith environments of exceptional industry performance.

3.4 – IDENTIFYING THE RECONFIGURATION OF THE TMT

Despite these criticisms, some useful fundamental principles emerge from lifecycle-based research. Most notable is the notion that it is possible to observe the emergence of distinct and identifiable stages (both in terms of firm growth and of TMT development). Levie and Lichtenstein (2010) argue that this is one of the few core features of research under the lifecycle approach that appears to stand up to empirical scrutiny. The central point of criticism is simply that, while stages may be identifiable, they do not necessarily (nor perhaps are they likely to) occur in a consistent order. In short, unlike a biological organism, a TMT may go through any number of identifiable states, and in any order.

The possibility of identifying distinct phases of change is one that is helpful to conceptualising patterns of TMT development, particularly if they are likely to be heterogeneous, as empirical evidence suggests. Contemporary work on firm growth has very much embraced the heterogeneous nature of the phenomenon (St-Jean et al., 2008; Levie and Lichtenstein, 2010; McKelvie and Wiklund, 2010; Blackburn et al., 2013). In doing so, focus has been removed from portraying 'patterns' of growth or development and is instead placed on how growth occurs. Similarly, this research posits that it is important to uncover what happens at points of TMT 'reconfiguration'. Thus, one may ultimately conceptualise TMT development as a heterogeneous pattern of reconfigurations and how these represent distinct 'phases of management' (Eggers et al., 1994).

A central consideration for how growth occurs resides within the intersection between internal strategic choices and wider environmental stimuli. This underlines

Table 3a: A Historical Overview of Prominent Firm Growth 'Stage' Models

Author (s)	Year	Stages of Firm Growth Identified
Lippitt and Schmidt	1967	Birth ➔ Youth ➔ Maturity
Greiner	1972	Creativity ➔ Direction ➔ Delegation ➔ Co-ordination ➔ Collaboration
Katz and Khan	1978	Primitive System ➔ Stable Organization ➔ Elaboration of Structure
Churchill and Lewis	1983	Existence ➔ Survival ➔ Success ➔ Take-off ➔ Resource Maturity
Quinn and Cameron	1983	Entrepreneurial ➔ Collectivity ➔ Formalization and Control ➔ Elaboration of Structure
Scott and Bruce	1987	Inception ➔ Survival ➔ Growth ➔ Expansion ➔ Maturity

an important contribution from the business strategy literature (St-Jean et al., 2008; Blackburn et al., 2013). This view sees changes to the firm and to the management of the firm as being dependent on how firm strategy copes with the demands of the external environment. For example, Levie and Lichtenstein (2010) emphasise the need for existing management to have ongoing commitment to the identification and exploitation of value creating opportunities. In this sense, the way that a firm changes in growth terms is tied to what is essentially a continuous series of 'creative destructions' (Schumpeter, 1934). In giving more consideration to engagement with the external environment, a strategic perspective is clearly more context-embedded. It is also more sympathetic to variety in growth trajectories because it is amenable to decline and stagnation as well as growth.

Ultimately, it is the notion of commitment to enacting change that is key. The development of the firm is not simply regulated by the environment. To grow and develop, existing management must actively engage in identifying and exploiting what is available around them. For TMT development, this implies that existing management also actively shape the team and the general management approach in line with how they view and exploit value-creating opportunities. In the often-

Table 3b: Comparison of Lifecycle and Dynamic States Core Principles

	Stages of growth models	Dynamic states model
Assumption	**Organizations grow as if they were organisms**	**Each state represents management's attempts to most efficiently/effectively match internal organizing capacity with the external market/customer demand**
Propositions: what	Configuration of structural variables and management problems	Configuration of structural variables and organizational activities (aspirations)
Propositions: how	**A specific number of progressive stages**	**Any number of states**
	Sequence and order is predictable	Sequence and order may be predictable depending on context
	Incremental and punctuated transitions	Incremental and punctuated transitions, and emergence
Propositions: why	**Immanent program of development**	**Adaptive process of retaining the sustainability of a business model**
	Prefigured rules of development	Interdependent rules for development
	"Regulated" by environment	Driven by market change and opportunity creation

** Reproduced from Levie, J. and B. Lichtenstein (2010). "A terminal assessment of stages theory: Introducing a dynamic states approach to Entrepreneurship"*

uncertain context of firm growth, strategies and objectives are likely to be constantly shifting in response to stimuli, and therefore the most effective means of reconfiguration may not always be clear. As such, for the study of TMT development, a key consideration is gaining understanding of what reconfiguration decisions are made, as well as why and how they are made.

As prominent researchers such as Eisenhardt (2013) continue to underline the association between speed and flexibility in team-based strategic decision making and organisational performance, Levie and Lichtenstein's (2010) work on growth offers a helpful alternative view of the processes that actually occurs during phases of change. Under their 'dynamic states' perspective (See Figure 3b) Levie and Lichtenstein (2010: 333) use the term 'opportunity tension' to describe periods of uncertainty or opportunity in which those running the firm may reconfigure their practices. These periods of tension arise when the existing TMT encourage, recognise, or are exposed to a source of untapped market potential. Identifiable changes are noted when the management move to modify their organisational approach in order to extract value from this. Under the dynamic states approach, it is

the business model that is identified as the key representative of the firm's current configuration. However, equally, changes to management team composition may also be a likely consequence of key instances of environmental engagement. This encourages a view of TMT development that is context-dependent and open to both increased 'professionalisation' (Beckman and Burton, 2008) and downsizing. In order to view TMT development in this manner, there must be some means of identifying management modifications. Following a review of the literature, two primary categories of TMT change are presented here:

3.4.1 – TMT Personnel (Member Entry and Exit)

One of the clearest means that can be used to identify modifications within the TMT is the turnover of personnel. This encompasses both the expansion of the team through member entry, and the reduction of the team through member exit. Fundamentally, the members of a TMT represent its component parts, which, combined together, embody a significant element of the human and social capital held by a venture. Thus, the introduction of a new member is the primary means through which a venture may add additional capital resources (Ucbasaran et al., 2003; Forbes et al., 2006). Primarily, a new member is likely to be added in order to facilitate the development and implementation of strategies. Given the relationship between internal strategy and external stimuli, appointments are frequently made in anticipation of, or in response to, periods of upheaval or opportunity (Furtado and Karan, 1990). However, it must be noted that "the size of a team does not necessarily equate with the quality of human capital accumulated" (Ucbasaran et al., 2003: 110). Rather, it is the diversity and the complementarity of human and social capital stocks held by members that is underlined as a superior indicator of TMT quality (Talke et al., 2010).

Given the dominant focus on human capital accumulation within TMTs, the concept of member exit has been less frequently examined throughout the extant literature (Ucbasaran et al., 2003). However, exit is clearly a prominent feature of TMT development. Empirical evidence indicates that most venture teams will lose at least one founding member within the first five years of operation (Timmons, 1990;

Cooper and Daily, 1997). A number of explanations for member exit have been presented. For example, Beckman and Burton (2008) refer to the natural 'shedding' that occurs as management roles are shaped and less-involved TMT members or board members are recognised and subsequently leave their position. In this sense, member exit can represent a healthy means of 'trimming the fat' that can accumulate in new venture TMTs that have perhaps initially struggled to clearly identify their specific management needs. Other researchers point to some form of conflict within the team as the main explanation for member exit. 'Cognitive conflict', in which task-orientated disagreement arises from differences in perspective (Amason and Sapienza, 1997), may enact member exist through fall-outs and power-struggles. The replacement of a founding team member by majority shareholding financial backers represents an often discussed example of how conflict can result in member exit (White et al., 2007). Drivers of tension include a perceived loss of founder autonomy (Clarysse et al., 2007), threats to founder level of influence (Breslin, 2008), and challenges to strong personal visions of firm strategy (Harrison and Leitch, 1995). From the investor side, conflict, and subsequent exit is predominately driven by perceived lack of ability and/or poor performance (Bruton et al., 2000; White et al., 2007). In this sense, member exit may again be effective in improving the state of the TMT. However, conflict may also cause effective members to exit, thus reducing the quality of the team. There are also implications for the effectiveness of TMT dynamics or morale that can stem from the general upheaval caused by conflict (Ensley et al., 2002).

3.4.2 – Organisational and Management Structure

Major changes in organisational structure represent a second means of identifying TMT reconfigurations. This category continues with the broad definition of structure by Eisenhardt (2013) that was identified in Chapter Two of this thesis. The purpose of this category is to capture significant shifts in the dominant managerial approach that may occur with or without the introduction or exit of a TMT member. The identification of changes in management structure is perhaps more difficult than that of member entry. This is owing to the fact that approaches to dominant management structure can change incrementally over time. However, in discussing the growth of

firms and the associated development of management approach, 'increase in the extent of formal systems' is frequently placed amongst the highly cited categories of change (Levie and Lichtenstein, 2010). Primarily this relates to levels of organisational structure and bureaucracy within the management of the firm. It is structural changes at this level that may signify a change in dominant management logic. For example, the dominant management style may exhibit clear changes from a personal style (intuitive, informal communication, personality driven) to a bureaucratic one (rules, hierarchical layers) (Barker, 1993; Van Bruystegem et al., 2008).

A helpful indictor here is the extent of role definition within the management team. The extent to which functional management roles within the team are distinct and identifiable is an aspect that is readily highlighted throughout research following lifecycle notions of firm growth (Vanaelst et al., 2006). Beckman and Burton (2008: 4) define these aspects under the term "functional structure". For example, some TMT members may perform broad functions and operate under a 'jack of all trades' approach to management tasks (Churchill and Lewis, 1983; Vanaelst et al., 2006; White et al., 2007). However, reconfiguration of the dominant management logic may be signified when roles are redefined and delegated to others (Breslin, 2008). Other indicators of reconfiguration may be the introduction of new standard operating procedures, or a major overhaul of operations, which may be required to accommodate a new period of strategic upheaval/opportunity.

3.5 – THE RATIONALE FOR TMT RECONFIGUARATIONS

There are a number of key considerations underpinning why TMT reconfiguration decisions are made. The following sections present a discussion of the rationales for the modification of a TMT. Following the two identified categories of TMT reconfiguration outlined above, the discussion addresses the reasoning for *personnel* and *structural* changes.

3.5.1 – Member Entry

Much of the existing literature emphasises resource-seeking behaviour as the dominant explanation for the addition of a new TMT member. Under this stance existing management select new members in order to either: a) fill the gaps in their own competencies (Sandberg, 1992), or b) address perceived needs of the team as they relate to strategic goals (Kamm and Nurick, 1993). In this sense, recruitment processes are underpinned by both a rational self-assessment within the existing team in order that it can identify its resource needs (Larson and Starr, 1993), and by a rational assessment of the resources that a new member can provide. Continuing from the discussions outlined in Chapter Two of this thesis, capital theories – primarily human and social capital – offer a useful means to conceptualise the resources that a TMT may look to add with the addition of a new member (Forbes et al., 2006). For example, a TMT may seek particular human capital resources (functional skills, industry experience, technical expertise) or particular social capital stocks (relationships with customers, investors, reputation within industry) from the addition of new members. Implicit in the act of resource acquisition is that new resources held within the TMT will translate in to valuable outputs for the firm. Thus, member entry from a resource-seeking perspective emphasises an attempt to gain the most valuable resources for the most efficient level of expenditure (for example, wages, equity, bonuses) (Buchholtz et al., 2003). The resource-seeking explanation for member entry is one that largely underpins studies of TMT demography, which, in turn, cite the diversity and complementarity of resources held by team members as a major source of competitive advantage for an organisation (Barney, 1991; Eisenhardt, 2013). The implication here is that existing teams must conduct rational assessments of resource needs in order to be able to foster this heterogeneity.

An alternative explanation highlights the sociopsychological factors at play within member addition decisions. Just as the initial formation of a team may be driven by perceived trust and strong prior relationships between members (Neiswander et al., 1987; Ruef et al., 2003; Williamson and Cable, 2003), scholars have noted that similar influences can remain an important rationale for future member addition

decisions. Much of the literature that discusses chemistry and relational trust between members underlines the principle of similarity-attraction as a driving force for decision making (Byrne, 1971; Boone et al., 2004). This view is based on observations that interpersonal attraction is enhanced between individuals that share similar traits or experiences. The term 'homophily' is used to describe this tendency for individuals to associate themselves within homogenous groups (Ruef et al., 2003). Innate traits such as gender, ethnicity, or age may have an influence here. However, the similarity of social or working backgrounds have also been noted as important drivers of recruitment decisions. The phenomenon has been highlighted, for example, in technology firms founded by former engineers and how such teams show strong tendency towards the addition of TMT members with similar engineering backgrounds (Clarysse and Moray, 2004; Fayolle, 2006). Ensley and Hmieleski (2005: 1094) find a related situation in university spinout technology teams that "select a disproportionate number of TMT members from the university community".

Some clear implications arise from recruitment decisions based on interpersonal attraction rather than rational assessment of resource addition. Through what Neergard (2005: 270) describes as the "Huey, Dewey, and Louie effect", there is an obvious risk of encouraging homogeneity, rather than diversity, at management level (Schneider and Smith, 1998). This raises two central concerns for how TMTs are shaped. Firstly, it may negatively impact the range and complementarity of skillsets available to the TMT. Secondly, research suggests that heterogeneity of backgrounds is important to "adaptability and flexibility in dealing with difficult tasks involving demands for creativity and innovation" (Boone et al., 2004: 635). Thus, there are implications for how the team may function under conditions of change, for example, that which is experienced during rapid firm growth.

Given the observed importance of knowledge diversity in TMTs, it may seem peculiar that fostering commonalities between members should be a concern at all (whether as part of conscious or sub-conscious behaviour). However, the rationale for sociopsychological influences has its roots in a number of positive and practical considerations. First of all, there is the convenience and cost advantages associated

with assembling members that have a close association with one another. Forbes et al (2006: 228) point out that "close social networks provide inexpensive and trusted sources of information about available resources". In contrast, the challenges of searching further afield can act as a deterrent. A significant body of literature emphasises how commercially inexperienced technology venture founding teams, such as those emerging from university research departments, may lack the networks to approach members in wider industry circles (Wright et al., 2004a; Huggins, 2008). These gaps in network access are often discussed under the term 'structural holes' (Burt, 1992; Mosey and Wright, 2007). In this sense, a lack of social capital held by the existing team may be prohibitive to the search for heterogeneously experienced members.

A second key consideration underpinning sociopsychological influences resides in the possible implications for group cohesion within a TMT. Zajac and Westphal (1996) posit that demographic similarity amongst TMT members can act to solidify group identity. Thus, the reinforcement of worldviews through recruitment practices has associations with strong cultural identity within a team. On one hand, a sociopsychological perspective implies that this type of member addition is largely a subconscious process by which existing management can reinforce their own values and belief systems (Sapienza et al., 1991). On the other, socio-political explanations cite conscious attempts to "perpetuate and institutionalize managerial power" (Boone et al., 2004: 635). For either view, one central message is that similarity of members increases stability and reduces behavioural uncertainty in the workplace (Boone et al., 2004). Certainly, research suggests that teams containing members with similar demographic attributes are likely to face reduced levels of conflict, whereas teams with higher levels of heterogeneity may face higher costs associated with coordination and integration of members (Pelled et al., 1999; Beckman et al., 2007). Leung et al (2013) also contend that the selection of members with common bonds is an attempt to encourage high-quality relationships. This, these authors not, can act to increase the consistency and distinctiveness of the human resources held by a team. In short, whether conscious or sub-conscious, the sociopsychological view of

member entry places increased emphasis benefits arising from the TMT as a cohesive unit rather than as a set of individual resource inputs.

In many ways, the rational resource-seeking perspective could be seen as more of an ideal approach. At the most fundamental level, a wholly accurate rational assessment of a new member's human capital is likely to prove difficult, or even impossible. As Harper (2008) points out, rational selection offers hypothetical benefits only. The existing team's knowledge of how a recruitment action will affect future strategic performance is "at best tentative and open to refutation" (Pg.618). On the other hand, socio-psychological theories appear to be more sympathetic to both the idiosyncrasies of human behaviour and to the practicalities faced during member addition. Upon reviewing the existing literature, Forbes et al (2006: 232) argue while "new members of entrepreneurial teams *ought* to be chosen based on knowledge demands and resource connections, there is evidence that new member addition *as it actually occurs* may be better explained by social-psychological theories". Despite the apparent dichotomy, many studies are careful to point out that the two perspectives are not incompatible. For example, both Kamm and Nurick (1993) and Larson and Starr (1993) contend that considerations such as network access and perceived chemistry should, and often do, represent key elements of the search for resource-adding new members. However, ultimately, the message here is that at least some element of rationally assessed strategic criteria must be applied in order for member entry to be useful in a resource addition sense. Yet, equally, recruitment explanations founded in sociopsychological considerations may also, consciously or unconsciously, represent a form of rational assessment regarding how the functioning of the team is likely to impact performance.

3.5.2 – Organisational and Management Structure

A significant body of research focuses on how entrepreneurs create and apply organisational structures, processes, and systems within their firms. As was established in Chapter Two of this thesis, the ability to create appropriate management systems is central to how a firm supports its development (Miller and Toulouse, 1986; Chan et al., 2006). The growth of a venture is likely to drive

organisational complexity, which is, in turn, likely to demand systems of management capable of supporting the coordination of activities (Barbero et al., 2011). Equally, organisational structures represent a means by which a TMT can support the retention and manage the application of knowledge. Thus, the rationale for reconfiguring the dominant management approach on these terms typically represents an attempt to magnify effective knowledge flow and to coordinate this knowledge as firm activity.

Chapter Two underlined the importance of organisational blueprints (Baron et al., 1999) upon which founders could base the structure of their new venture. The suggestion here again is that TMTs are likely to begin life with varying levels of structural formality. Eisenhardt (2013) suggests that successfully developing TMTs are likely to emerge with, or quickly adopt, relatively formal levels of management structure – to the point where she emphasises 'slightly over-structuring'. The rationale here is that if firms grow, they will 'grow in to' the structural arrangements already in place. This view continues to reinforce the notion that TMT development paths can become locked in by key early structural decisions. On the other hand, Davis et al (2009) argue that positive firm activity can be severely undermined by a lack of structure. If systems are not in place to support activities and retain the knowledge applied in those activities, then strategic actions may largely amount to 'wheel spinning'.

While the overwhelming majority of studies in this area emphasise the importance of formalised planning and governance systems within growing organisations, many researchers highlight the tension between supporting existing activities in a structured manner and allowing the flexibility for adaptation. For instance, highly bureaucratic and hierarchical structures, which are the norm in many large, established organisations, may prove too rigid for to support the more rapidly changing state of a growing venture (Baron et al., 1999). Defined management roles may help clarity of task demands and provide important levels of support for TMT members, however, functional roles that are very strictly defined may stifle the ability of the TMT to react to growth opportunities. This view is reflected in the

work of Georgellis et al (2000) who, in their study of 300 London-based firms, argue that innovation in organizational processes is an essential partner to innovation in products and services. Ultimately this study identifies planning, change, and risk taking as the core competencies underpinning an entrepreneurial and growth-orientated posture. Similarly, Barringer and Greening (1998) contend that while formalised management structures are key in regulating firm activities, rapidly expanding entrepreneurial firms typically maintain flexibility in their strategic approach and core activities. In this sense, organisational structures and procedures are unlikely to be strictly prescriptive, but instead act as a platform for heuristics where new approaches and best practice can be constantly updated in response to opportunity (Eisenhardt, 2013).

Ultimately, while the rationale for formal management structures lies in the effective coordination of activities, there is clearly support for the notion that the TMT must be adaptable within those structures. This view is summed up well by Eisenhardt (2013: 814) who states "a balance between too much and too little structure is essential for high performance in dynamic environments. Firms with too little structure lack enough guidance to perform efficiently while firms with too much structure are too constrained and lack flexibility". In short, changes to management systems appear to be driven by the need to create a context where generative learning and the associated the ability to pursue opportunities is championed.

3.6 – RECONFIGURATION DECISION-MAKING

Having discussed what constitutes the reconfiguration of a TMT, as well as the rationale for why such actions take place, this section moves to examine how these decisions are made. To do this, two related, but distinct, perspectives on managerial decision making in general are outlined. The first emphasises decision-making processes as dependent on the respective interests and power held by different team members. In this sense, the discussion also approaches *who* makes TMT reconfiguration decisions. The second view emphasises the management of conflict and how the exchange of information leads to resolutions. These approaches have been utilised as a means to explain how most strategic decisions are approached and

taken. Clearly all decisions taken at a strategic level have implications for both firm growth and TMT development trajectories. Decisions resulting in a significant reconfiguration of the TMT simply represent one type of particularly important strategic action. It is on such decisions that the following discussion is primarily focused.

3.6.1 – The Political View

Under what Forbes et al (2006) label the political model, managerial decisions are seen as a function of the various interests held by the individuals that constitute the TMT (Cyert and March, 1963). A key underpinning principle of the view is that the members of an entrepreneurial team are not necessarily, and are, indeed, perhaps are unlikely to be, homogenous in their objectives and strategic approaches (Lim et al., 2013). Given this stance, the political view highlights how different members may advance different positions, and through varying levels of influence. Thus, a key dimension here is the distribution of power within the team. For example, in a team with an evenly distributed power dynamic, strategic decisions may be driven mostly by consensus. Other teams may have their decisions driven by a lead member, or by a coalition of lead members (Chua et al., 1999).

The factors determining power and influence amongst members are various. Individual TMT members may derive power from their human capital and its perceived importance to the functioning of the team. Power held collectively by particular alliances or factions within the team may be determined by pre-existing ties between members (noted particularly between founding team members) (Lim et al., 2013). Perhaps the clearest source of power originates from the ownership of the firm. In the early stages, founding members are likely to retain full, or at least, majority ownership of the venture and therefore hold much of the decision making power. In this sense, founding entrepreneurs hold somewhat of an obligation to lead decision-making processes during early formation, as they must exploit initial opportunities, establish initial structures, and set initial goals (Pearce et al., 2003). The power of founding members may remain an important feature of the TMT long after the initial stages, where entrepreneurs continue to act as lead members of the

team. Alternatively, this influence may dissipate. For example, as a TMT recruits more members, decision-making power may be delegated. Decision-making power may also be removed from the initial founders. Most commonly this would occur through the redistribution of equity resulting from outside investment (White et al., 2007). In these circumstances, the power of initial founder would become diluted as their ownership stake was diluted. It is a source of debate as to whether or not board members count as TMT members (given their often intimate involvement in strategic decision-making) or as outsiders (Clarysse et al., 2007). However, what is clear is that this power shift is likely to affect the decision making approach of the TMT. Indeed, the involvement of outside investors can even result in the removal of founder power altogether. For example, instances where powerful investors replace initial founders with externally appointed executives represent the archetypal shirt in power dynamics within a TMT (Bruton et al., 1997).

Understanding TMT decision-making under these terms has important implications for how teams develop. For instance, where human capital diversity is championed as an important feature of an effective team throughout much of the literature, heterogeneity of backgrounds and goals may also make consensus particularly difficult (Amason et al., 2006). Thus, while diverse teams contain more comprehensive sources of information on which to base strategic decisions, there may be a breakdown in effectiveness if a consensus resolution cannot be generated from what can be a wide variety of positions and approaches (Hmieleski and Ensley, 2007). In this sense, TMT human capital diversity is not necessarily effective on its own, with its value appearing to be at least partially dependent on the manner in which differing influences on important decisions are managed.

3.6.2 – Cognitive Decision Making and Conflict Management

Forbes et al (2006) distinguish the 'cognitive' model as a view of team decision-making that emphasises the manner in which information is collected, exchanged, and processed within a group. Unlike under a political perspective, the cognitive model implies that group members will at least attempt to reach consensus rather than pursuing varying goals. However, this encourages a number of important

observations regarding how interpersonal dynamics may influence the effectiveness of team decision-making. Central to this discussion, and to how the dynamics of group cohesion take place, is the concept of conflict. Ensley et al (2002) point out an important paradox in terms of how conflict affects group function. On one hand it can act as a source of animosity or resentment, where interpersonal dislike and disagreement can undermine the group's use of information and its attempts to generate an appropriate strategic response. On the other, conflict can act as a catalyst for creativity, encouraging effective decision-making through the "open exchange of ideas, the objective assessment of alternatives, and the rigorous contrasting of perspectives" (Ensley et al., 2002: 366). A similar observation is made by West (2007) who finds that effective team often display a moderate combination of differentiation (highly conflicting views) and integration (highly consistent views).

What this highlights is that even if the broad goals of team members are aligned, the dynamics of interaction can have a great deal of influence upon how solution generating information is gathered and communicated. Teams are to some extent reliant on cohesion, which underlines why there is a social-psychological rationale for the addition of members at all. Yet, at the same time, the ability to harness and take advantage of disagreement appears to be an aspect that is central to negotiating the uncertain and ambiguous context of new venture growth (Eisenhardt and Bourgeois, 1988; Ensley et al., 2002). Again, the political and cognitive models outlined here do not represent a dichotomy, but simply different lens on the same issue. In practice, the power dimension is likely to have a great bearing on conflict levels, with contrasting goals contributing further to strategic disagreement. In this way, who makes decisions, and how they are made, underpins a vital feature in explaining why a TMT develops in the way that it does.

3.7 – CHAPTER SUMMARY

This chapter has sought to outline the major theoretical discussions underpinning the manner in which TMTs develop. A first key point presented was that the defining activities of TMT development should not be divorced from the development trajectory of the firm as a whole. It is for this reason that popular growth models

offer useful insight. In particular, these highlight the drivers of team development and how these may emerge through a combination of internal strategic efforts and external stimuli. However, the dominant lifecycle approach evidently faces a large body of criticism, not least its universal principles and lack of consideration of how firms interact with their context. The introduction of Dynamic States principles (Levie and Lichtenstein, 2010) underlines the notion that while TMT development may well be tied to strategic decisions, exploitation of opportunity, and firm growth in general, development trajectories need not necessarily follow a deterministic path.

The perspective encourages this study to disregard rigid biological metaphors and to conceptualise TMT development more accurately as an unfolding pattern of management reconfigurations. Under this lens, considerable more focus is placed on varied reactions to external stimuli. This underlines a view of TMT development that is more in tune with idiosyncratic and context dependent evolution (Breslin, 2008). In turn, the stance also raises a number of key discussions concerning the reconfiguration of management. The first concerned *what* constituted a reconfiguration. Here, two categories of TMT modification were outlined:

- The entry and exit of TMT members
- Significant alterations to dominant management structures

The second discussion concerned *why* reconfigurations are made. The rationale for member changes was found to lie in the accumulation of capital resources, balanced with considerations of team chemistry, trust, and network access. The rationale for structural changes lay in the effective organisation of firm activities and retention of applied knowledge, balanced with allowing flexibility for new knowledge applications and the pursuit of opportunity.

The third area of discussion concerned *how* reconfigurations are made. The political model emphasised differing goals within the team, and how varying levels of power and influence held by members support certain agendas while possibly undermining others. The cognitive model highlights the dynamics of how a team attempts to reach a resolution on strategic decisions through the gathering and processing of

information. Here, the literature emphasises the effective management of conflict as the central issue.

These discussions represent questions that are key to understanding TMT development:

- What changes occur during TMT reconfigurations?
- Why are TMT reconfigurations enacted?
- How are TMT reconfiguration decisions made?

Examining patterns of TMT reconfiguration actions, and how these underpin effective or ineffective TMT development is the central focus here. Furthermore, differing actions and development patterns can be associated with the main considerations raised in Chapter Two. This helps in examining what implications the originating state of the TMT may have for future development decisions. Ultimately, this encourages a portrayal of TMT development that is very much steeped in the selected historical and contextual environment.

4. CONTEXTUALISING TOP MANAGEMENT TEAM DEVELOPMENT

4.1 – INTRODUCTION

This study is chiefly concerned with how the phenomenon of TMT development occurs in conjunction with the wider business context in which it takes place. As such, this chapter gives consideration to historical, institutional, and spatial context of Scottish technology-based industries. Recent work in the field of entrepreneurship has underlined the need for scholars to contextualise their findings and theoretical offerings (Zahra, 2007; Welter, 2011). This school of thought essentially posits that theorisation of entrepreneurial behaviours tends to lose its relevance if it is abstracted from the attributes of the wider environments in which studies take place. Contextualisation is clearly a very important consideration for the present study. Welter (2011) offers a particularly useful framework for the examination of different contextual dimensions (See Table 4a). This serves as a basis to guide the discussion presented in this chapter.

The chapter opens with a review of the fundamental principles underpinning the identification and emergence of regional 'innovation systems' (Lundvall, 1992; Edquist, 2004) and clusters (Porter, 1990; Malmberg and Maskell, 2002). The benefits of 'thick' industrial activity, and how these may influence TMT development conditions, form the next element of the review. This opens the discussion to consider differences in regional conditions. In particular, this entails comparisons between 'core' and 'less favoured' regions (Birch, 2011; Felzensztein et al., 2013). Finally, the chapter provides an historical overview of the Scottish economy and, in particular, the Scottish innovation system (Roper et al., 2006), as the selected business context for this study. This overview addresses various contextual aspects, including historical, business, spatial, and institutional dimensions.

Table 4a: Key Dimensions of Contextualisation

Dimensions Type of Context	Omnibus	Discrete (examples)
Business	Industry; market	Stage of life-cycles of industries and markets, number and nature of competitors
Social	Networks; household and family	Structure of networks, density, frequency of network relations; composition and roles of household/family
Spatial	Geographical environments, e.g., countries, communities and neighborhoods; industrial districts and clusters	Characteristics of physical business location; business support infrastructure; characteristics of local communities and regions
Institutional	Culture and society; political and economic system	Societal attitudes and norms; legal and regulatory regulations; policy and support measures

Reproduced from Welter, F. (2011). Contextualizing Entrepreneurship— Conceptual Challenges and Ways Forward.

4.2 – EXPLORING THE BUSINESS CONTEXT

The notion that rapid and ongoing internationalisation of the world economy would eventually undermine the importance of research into distinct regional economies is one that, as yet, finds limited reflection in empirical evidence. Despite the rise of multinational corporations, and advances in communications technologies, "geographical proximity remains a critical feature of industrial development" (Raines et al., 2001: 995). The geographical concentration of industry activities within particular regions underlines the existence of distinct variances in regional and industrial economic conditions (Saxenian, 1985; Porter, 2000; Malmberg and Maskell, 2002). These sources of empirical evidence serve to refute claims behind the so-called 'death of distance' within industrial development (Cairncross, 1997).

4.2.1 – Defining the Wider Business Context

Although subject to many different interpretations and forms of discussion, the use of the 'region' concept has become fundamental to how scholars and policy makers understand economic activity (Hodson, 2008). The term 'region' is a broad one. There is no universally applied method to distinguish what exactly constitutes a region, which may be discussed in terms of a range of geographical, cultural, and political-institutional boundaries. Ultimately, this study selected Scotland as the geographical and institutional context within which the development of TMTs was

examined. As a starting point for this discussion, it is recognised that Scotland does not display homogeneous systemic conditions across its various areas. Perhaps the most obvious means of demarcation could be made between the 'Central Belt' – a label attached to the area of Scotland with the highest population density (approximately 70%), encompassing cities such as Glasgow, Edinburgh, and, in some definitions, as far as Dundee – and the range of areas that are peripheral to this. The dominance of the Central Belt, in addition to Aberdeen, as the basis of the Scottish economy is powerful. In a 2006 analysis of the Scottish Innovation System (SIS), Roper et al (2006: 9) note that certain geographical areas of Scotland, notably in the Highlands and Islands, and perhaps in the Borders and Dumfries and Galloway "are effectively excluded from the system".

For the purposes of this study, however, Scotland is taken as a single region. This choice was supported by several rationales. Firstly, Scotland possesses relatively distinct and unified set of institutional, legal, and policy guidelines not only from other countries, but also from the rest of the UK. Secondly, there are relatively short travel distances between the vast majority of populated Scottish areas, with there being no real transport or distance barriers between major cities such as Edinburgh, Glasgow, and Dundee. Sources of labour can, and do, commute between these city areas on a daily basis. Additionally, within the technology industries selected, individual Scottish areas or cities did not have distinctive sales market or supply networks in comparison to other Scottish areas or cities. Certainly, Scotland has concentrations of firms in certain areas, which have, in some quarters, been labeled as 'clusters' (for example, concentrations of biotechnology firms in Dundee or in Edinburgh and Lothian). However, these so-called clusters do not display unique local conditions that act to serve their inhabitants while exhibiting any notable barriers to technology firms in any other Scottish area (Leibovitz, 2006). Existing research indicates that the bulk of sales and supply activities conducted by Scottish technology-based firms are international in scope (Leibovitz, 2006; Birch and Cumbers, 2009; Birch, 2011), rendering any attempts to define market or supply chain variances in micro-locations somewhat pointless. In this sense, the study follows Roper et al (2006) in viewing Scotland from a 'region-state' status, where it

is possible to identify distinct geographical, institutional, and, to a some extent, sectoral boundaries that frame the innovation system.

A further definitional challenge concerns the 'business' or 'industry' dimension of context. Specifically, three high-technology industries – Life Sciences, Chemical Sciences, and Optoelectronics – were selected for this study. These industries were identified as key technology sectors by Scottish Enterprise, the primary public sector economic development agency within Scotland. However, again, industry labels highlight certain considerations. For example, industry boundaries may implicitly assume homogeneity amongst firms, where, in fact, there is likely to be considerable variance. Within Life Sciences for example, vast ranges of specialist fields, which are very much distinct in terms of approach, are evident. Most notable perhaps is the difference in typical development models between drug development firms and specialist medical device manufacturers (Leibovitz, 2004). Ultimately, this study makes no attempt to imply that the conditions in the three selected technology industries are entirely homogeneous. That said, this study follows precedents set by existing research in examining technology-based firms as a whole (see Mason and Brown, 2012). It is reasoned that the relative similarity across Scottish technology-based industries in terms of finance structures, knowledge base, labour force, and institutional support ensures that meaningful inferences can be drawn from the analysis.

To define the specific elements and actors considered to be involved in the wider business context, the study adopts an approach similar to that noted in research on Regional Innovation Systems (Doloreux, 2004; Edquist, 2004; Asheim and Coenen, 2005). The wider business environment is defined as:

"A concentration of interacting private and public interests, formal institutions, and other organizations. These include other firms, research institutes, education and training organizations, policy makers, financial organizations, regulatory authorities and intermediary organizations" (Doloreux and Dionne, 2008: 260)

In short, the wider business context encompasses the conditions created by a variety of actors and institutions. Clearly, some of these actors can, and do, operate across geographical boundaries. Yet, through their activity in Scotland, they contribute to the functioning of environmental conditions within Scotland.

4.2.2 – The Historical Emergence of Regional Industries

Doloreux and Dionne (2008: 266) reflect that "the development of innovation systems is never instantaneous, but the result of a historical process conditioned by time and space". The influence that historical economic activity can have on divergent regional and industrial development paths is a phenomenon perhaps most notably addressed by theories of path dependence (Martin, 2006; Boschma, 2007; Simmie and Martin, 2007). As with Beckman and Burton's (2008) path dependent conception of TMT development (outlined in Chapter Three), this view cites the cumulative influencing effect that early conditions and activities can have on the subsequent trajectory of economic development. This thesis proposes that an understanding of historical regional industry development is central to appreciating the conditions faced by TMTs in their wider business context.

The identification of what constitutes a distinctive industry development path is a challenge in itself. For example, what exactly distinguishes the emergence of a new industrial development path from a variation within an existing path (Deeg, 2010)? Distinctive industries tend to develop typical strategies, business models, routine operations, all of which exist within institutional arrangements, for example, industry regulations and legal systems (Sunley and Martin, 2007). However, equally, an industry development path that is not pushed towards ongoing variance by its inhabitants is likely to stagnate. Again, the degree to which this holds for different industry types varies. For example, highly traditional industries are perhaps more likely to be more rigid in terms of how historical arrangements inform subsequent development trajectories. Conversely, more rapidly evolving regional industries will be prone to increased variance, and even to the rapid creation of distinctly new industries.

The downsides of historical influence on future development are particularly apparent in old industrial regions (Hodson, 2008). Cumulative effects stemming from stagnation of innovative industry activity, and exogenous shocks such as wider economic downturns, can impose significant barriers for any attempts to turn industries and economies in a new direction (Hassink, 2005). However, while the influence of 'what came before' can be substantial, most contemporary researchers argue against the concept of definitive 'lock in' to a settled equilibrium (Meyer and Schubert, 2007). Instead, path disruption, emerging, for example, from the introduction of new technologies, or from wider economic conditions, is underlined. As such, paths do not last indefinitely, and they do not exclude the possibility of new paths emerging (Boschma, 2007). In short, previous historical development matters, but it does not fully dictate future industry development.

Ultimately, this discussion of historical influences on regional industry development helps us to understand why certain industries, and certain environmental conditions, develop in some places and not in others. Boschma (2007: 41), for example, poses the question "why did Detroit become the capital of the US car industry?". Extant research offers a myriad of possible factors to explain initial industry emergence in particular geographical areas. One relatively common explanation originating from the economic literature is that industry change events are largely serendipitous, which then go on to act as a catalyst for what eventually become the cumulative and self-reinforcing activities that define a certain regional industry (Meyer and Schubert, 2007). Such a view indicates that agents act with no explicit intention of directing industry development. In contrast, other researchers underline the purposeful strategic actions of human agents in inciting deviations in industry development. For example, Lawton Smith (1991), emphasises the role of pioneering entrepreneurs in forging the creation of a cryogenics industry in the Oxfordshire area. Similarly, work by NESTA (Athey et al., 2007) underlines the key role of 'individual change agents' in driving commercial innovation in a range of European city-regions.

Alternatively, studies have focused on how some regions hold clear advantages over others in terms of having the conditions to create and sustain certain industries (Martin and Sunley, 2006). Obvious examples of this are industries developed to exploit natural geographic resources (Felzensztein et al., 2013). Take, for example, the oil industry surrounding Aberdeen, or, for that matter, any other global oil industry. Here, intrinsic geographical characteristics clearly explain why such an industry is founded and developed in one location and not another. However, original conditions need not be so inherent, and can equally concern certain structural or institutional characteristics that are conducive to subsequent development (Simmie and Martin, 2007). In short, certain regions may possess particular basic conditions, which can act to as a 'window of opportunity' to those agents that eventually drive industry development (Scott and Storper, 1987).

Finally, existing research has also underlined the role of exogenous shocks in initiating regional industry development paths. For example, Saxenian (1994) notes how large defense sector and military contract awards were key to the early development of Silicon Valley semiconductor industries. Without such a distinctive external influence, the early development path of that region may have been significantly altered. Ultimately, however, most empirically observed examples of industry genesis appear to point to a range of these factors working in conjunction with each other. Serendipitous events tend to occur in tandem with deliberate agency (Meyer and Schubert, 2007), while, equally, internal conditions can accommodate exogenous shocks towards the emergence of new industry activity.

The necessary conditions of, and driving forces within, a particular region are likely to vary from industry to industry. However, discussions surrounding the initial development of high technology industry concentrations can often trace their roots back to an original university or research facility. This is evidenced in the fact that the vast majority of technology firm agglomerations are based around prominent research institutions (Kline and Rosenberg, 1986; Nelson, 1993; Florida et al., 2006; Rasmussen, 2008; Wright et al., 2008). Amongst the most notable examples are the cases of Stanford University and MIT, where both institutions were crucial drivers of

innovative practices and economic development in Silicon Valley and the greater Boston area (Florida et al., 2006). Similar examples are evident in the UK. The Trinity College owned Cambridge Science Park provided a hotbed of technical and industrial activity within the Cambridge region (Keeble et al., 1998). Indeed, in an early study of the so-called 'Cambridge Phenomenon', Segal Quince (1985) argues that every high technology firm represented in the sample could trace their origins back to Cambridge University (at least in some fashion). With this considered, the subsequent discussion presented in this chapter considers academic research facilities as key initial anchors of technology industry emergence.

4.2.3 – The Role of Entrepreneurs

Extant research attaches a central role in the emergence of new industries to entrepreneurial individuals. For example, Joseph Schumpeter, one of the central figures within evolutionary analyses of innovation, cited the entrepreneur as a primary catalyst underpinning variance in economic activities (Schumpeter, 1942; 1962). By introducing new goods, new services, new production processes, and new methods of organisation, the entrepreneur serves an important purpose in preventing stagnation within industries.

Studies of technology-based regional industries also place the entrepreneur at the centre of regional industrial development. Principally, this concerns how entrepreneurs drive processes of spinout. Spinout occurs when individuals leave a former place of employment to found their own firm in the same geographical area (Cooper and Folta, 2000). Typically, the new venture would be based on knowledge and resources gained from the previous place of employment, known as the incubator organisation (Cooper, 1971; Lawton Smith, 1991; Harrison et al., 2004). Incubator organisations may spawn numerous spinout firms. For example, Fairchild Semiconductor Company in Silicon Valley represented a hotbed of entrepreneurial creation by spawning over fifty new businesses in a twenty year period, including highly successful firms such as Intel (Burton et al., 2002; Sorensen and Fassiotto, 2011). A similar phenomenon has been identified in other technology-based regional economies, for example, the firm Nortel Networks in Ottawa (Harrison et al., 2004)

or Acorn Computing in Cambridge (Garnsey and Heffernan, 2005b). Such organisations can essentially act as breeding grounds for the commercial firms that go on to populate a regional industry (Feldman, 2003). Additionally, in breeding new firms, incubator organisations essentially create their own competition within a geographical areas in a process that is fundamental to the build up of industry 'thickness' (Freeman and Soete, 1997).

There is abundant evidence that spinout dynamics were central to how many prominent regional technology industries emerged (Saxenian, 1985; Feldman, 2001; Agarwal et al., 2004). This is notably relevant during what Malmberg and Maskell (2002) refer to as the pioneering stage of industry development. Within high technology industries, this pioneering role is frequently attached to the technologist-turned-entrepreneur, who spins out from a research-focused institution and applies their technical knowledge within the commercial domain (Malmberg and Maskell, 2002; Oakey, 2003; Harrison et al., 2004). Thus, universities can often act as an initial key source of incubation, in addition to the institutional support role that they frequently play in more developed technology-based economies. The following section reviews existing research on how regional industries can go on to develop from this basis by introducing the concept of the agglomeration economy.

4.2.4 – From Spinout to Agglomeration

If one of the primary byproducts of rapid entrepreneurial spinout is to build up thick pockets of associated and co-located firms, then the notion of agglomeration (Marshall, 1890; 1920) is one that conceptualises the variety of positive features that can emerge from regional industry density (Luger, 2005). Extant literature emphasises critical mass across a variety of entrepreneurial firms, high performance 'gazelles' (Colombelli et al., 2013) and large established 'anchor' firms as being central to how firm-level benefits are created (Harrison et al., 2004)

To date, the study of regional dynamics in high-technology industries has been dominated by examinations of agglomerations or clusters (for examples see Saxenian, 1994; Keeble et al., 1998; Henry and Pinch, 2000; Casper and Murray,

2005). Cluster theory represents perhaps the most popular of the recent manifestations of work that can be traced back as far as 1776, when Adam Smith noted the benefits originating from the geographical concentration of Kirkaldy nailaries (Reid and Ujjual, 2008). The notable work of economist Alfred Marshall (1890; 1920) provided the cornerstone for much of the subsequent theoretical development in this field. Marshall famously drew on his observations of the Sheffield Steel industry in first developing the notion of the 'industrial district'. For Marshall, agglomeration benefits were largely attributed to cost reductions emerging from the co-location of firms, or to the provision of shared inputs, such as specialised labour sources or raw materials. Further research in this area emphasised the notion of the 'industrial complex', which was characterised by the stable trading and supply chain relationships that emerged when closely located firms became dependent on one other (Aydalot and Keeble, 1988). Beyond this, the work of Granovetter (1985) underlined the social nature of trust and collaboration in spreading risk and innovation between networks of firms.

This long tradition of studies was one that Porter (1990; 1998) was able to resurrect and once again bring to prominence. In developing his highly influential theories of regional clustering, Porter (1990; 2000) borrowed from many Marshallian observations relating to how a critical mass of actors within a regional industry can breed cumulative benefits for inhabitant firms. Porter (2000: 15) defined clusters as "geographical concentrations of interconnected companies, specialised suppliers, service providers, firms in related industries, and associated institutions in a particular field that compete but also co- operate". In high-technology industries, clusters have been epitomised by much studied regional success stories such as Silicon Valley (see Saxenian, 1994). These have been largely held up as a reference point for the policy objectives of other economies, providing a model to follow in order that new Silicon Valleys might be created. While development and implementation of such policies has been evident across a range of worldwide regions over the last decade (Luger, 2005), Angel (2000) asserts that older industrial regions in particular have looked towards the Silicon Valley and Boston Route 128

blueprints to stave off manufacturing job losses and inject fresh impetus into the process of urban economic growth.

Significant for this study is the notable extent to which Scottish economic policies have been influenced by cluster theories (Peters et al., 2000; Reid and Ujjual, 2008). Much of this policy focus was inspired by recognition that Scotland could potentially become a 'knowledge-based economy'. Using the Porter methodology, a Scottish Enterprise 'monitor group' formed in 1993 (Peters et al., 2000) was able to identify a number of potential high growth clusters to pilot these policy measures. Amongst the identified high technology or 'new' economy clusters were biotechnology, Optoelectronics, and semiconductor industries. These, and other identified industries in the 'old' economy, were supported by government funded 'cluster teams', which sought to align the efforts of key stakeholders and sources of finance to build a critical mass of interconnected firms (Peters et al., 2000; Reid and Ujjual, 2008). As such, cluster principles represent a useful frame through which to conceptualise the wider business context faced by Scottish technology-based venture TMTs.

4.3 – AGGLOMERATION BENEFITS AND IMPLICATIONS

Once the benefits of clustering take hold, these can become "cumulative and self-reinforcing over time" (Mellander and Florida, 2007: 3). This discussion addresses the positive externalities that typically emerge from agglomeration in regional spaces. In particular, the emphasis of the discussion concerns implications for TMT development. This, in turn, frames a closing overview of Scottish high-technology industries as the selected context for this study.

4.3.1 – Collaboration, Competition, and Opportunity

As discussed in the review of extant literature conducted in Chapter Three, the development of the TMT is likely to share an intrinsic association with venture growth (or decline) as a whole. In particular, this concerns how growth events may necessitate the need for additional sources of managerial resources or for new management approaches (Forbes et al., 2006). The existence of a critical mass of relevant actors in a particular regional economic space has been associated with

inciting numerous firm level benefits, many of which relate to improved access to growth opportunities. Thus, equally, these benefits hold implications for TMT development trajectories in general.

Many of the reported benefits stemming from the co-location of related firms have been attributed to the reduced costs of exchange between actors (Malmberg and Maskell, 2002). This relates to aspects such as ease of communication or reduced costs of physical distribution. Intuitively, the co-location of related firms is readily associated with aspects of firm collaboration, for example, the emergence of complimentary supply chains or strategic partnerships. While this is certainly the case, Porter (1990; 1998) highlighted the importance of competitiveness between firms just as much, if not more so, than collaboration. This is evident within the extent that the existence of significant competition between co-located firms became a "definitional necessity for cluster existence" (Maine et al., 2010: 129). The rationale here is that highly visible competitive forces drive innovative behaviour amongst population firms. Other researchers point to the observation that dense and highly networked communities tend to provide increased access to entrepreneurial opportunities in general (Lawton Smith et al., 2005; McMullen and Shepherd, 2006). An explanation for this is that firms in economic concentrations tend to be situated in close proximity to strong local markets, thus reducing barriers to sales channels (North and Smallbone, 2000; Luger, 2005).

4.3.2 – Knowledge Flow and Spillover

Malmberg and Maskell (2002) posit that the focus of geographical proximity has much to do with community density and associated regional learning and innovation. Thickly linked networks and pockets of social capital ensure easier and more rapid transfer of knowledge (Doloreux, 2004). This has implications for TMTs in two respects. Firstly, knowledge flow is central to how TMT members build their human capital. Secondly, knowledge flow is key to the diffusion of organisational and management practices throughout inhabitant firms.

Regional knowledge flow has been discussed in numerous terms. Storper and Venables (2004) highlight the concept of regional 'buzz' in transferring knowledge between agents. An underpinning observation of this phenomenon is that knowledge appears to somehow 'rub off' on agents that are embedded within innovative and rapidly developing industry spaces. Examples of this include knowledge spillover from universities and research facilitates (Felzensztein et al., 2013). Glaeser (1999) explains this predominantly through the notion that agents tend to learn through ongoing exposure to more knowledge people. However, this does not fully explain why all areas containing knowledge experts – for example, populated cities – do not emerge as notable 'learning regions', and why some smaller or less dense population areas – such as university towns – do. Despite the continuing development of improved communications technologies, Storper and Venables (2004) point to the enduring role that personalised communication and face-to-face contact plays in promoting positive externalities through local 'buzz'. Supported by distinctive institutional arrangements (Johannisson et al., 2002), this may help to partially explain rapid flows of industry-relevant knowledge.

Alternatively, the flow of labour has been cited as a primary mechanism in moving knowledge around a region. Sorensen and Fassiotto (2011) note that the movement of individuals across firm boundaries incites the diffusion of knowledge. Firm spinout and business creation in particular are seen as crucial mechanisms through which both industry-specific and embodied managerial expertise are developed and carried from firm to firm (Keeble and Wilkinson, 1999). This discussion leads the chapter to consider the implications for labour creation in more detail. The manner particular labour types are produced and attracted within regional industry spaces represents an absolutely central consideration for how TMTs both emerge and add future members.

4.3.3 – Labour Production and Attraction

Chapter Two of this thesis emphasised how incubation experiences within career paths mold founding team condition through the prior development of important capital resources. Consideration of how this occurs in context is key, because the

structure and dynamics of a regional economy play a significant role in "shaping careers, career networks and the access of entrepreneurial firms to talented labor" (Casper and Murray, 2005: 53). As in Chapter Two, this discussion applies to the shaping of founding team member (entrepreneur) experiences, which are evidently core to any TMT development 'story'. However, the arrangements within particular labour markets also shape the emergence of other specialised labour sources and of the management-level executives that essentially represent the potential 'components' of growing TMTs. The discussion of the labour market outlined here embodies all of these key types. In essence, a TMTs access to members is largely dictated by the extent to which appropriate labour is fostered and made available within local labour markets (Audretsch and Feldman, 1996; Casper and Murray, 2005).

The labour market does not function in the same manner as a traditional commodity market. One key initial point to make is that labour power is embodied within consciously thinking and socially active individuals, who have the ability to make choices about their place of residence (Martin, 2000). Equally, however, labour is relatively immobile in comparison to other commodities (Storper and Walker, 1989; Martin, 2000; Coe et al., 2007; Mackinnon and Cumbers, 2007). This is primarily because "Unlike other commodities, labour power has to go home every night" (Harvey, 1989: 19). As such, sources of labour are typically required to stay within a reasonable proximity to their place of work. Add to this the family and social ties that individuals tend to have within particular areas, and it becomes clear why labour markets continue to be expressed regionally. Of course, regional labour markets are subject to fluctuation, for example through in-migration and out-migration. However, given the reasons outlined here, the regional or local boundaries that surround labour markets often retain a relative level of strength, without being entirely fixed (Martin, 2000).

The internal production of labour sources within a labour market is subject to the incubators and career paths that dominate a regional economy. Different regional industries are epitomised by different dominant incubation paths. For example,

Casper and Murray (2005) contrast dominant career paths for technologists within Munich technology clusters with the Silicon Valley model of rapid entrepreneurial spinout. They identify that, within the Munich region, senior scientists exhibit an apparent unwillingness towards starting up or working for small firms. Instead there is evidence of a much more traditional route from academia to one of the large pharmaceutical firms that operate in the area. The result is that there are relatively homogenous training nodes are made available to scientists, and experiences of working in industry are largely limited to traditional career ladders in highly structured environments.

In contrast, the tendency towards rapid spinout in many high-performing regional technology industries represents an alternative model through which the production of potential TMT members occurs. As an incubation path for a technology-based TMT member, this can prove very effective, particularly if the spinout originates from a prominent, high reputation firm within a relevant industry, from which numerous resource benefits can be transferred (Burton et al., 2002; Sorensen and Fassiotto, 2011). Equally, processes of habitual entrepreneurship are central to the creation of experienced labour sources. For example, Wolfe (2002) identify successful entrepreneurs that recycle their experience as mentors of new entrepreneurs as being a key labour type. This is also a central discussion in Mason and Harrison's (2006) examination of entrepreneur post-exit activity. As such, the processes that build up regional 'knowledge' go hand-in-hand with those that produce relevant and quality sources of labour.

Given that knowledge flow is frequently underpinned by labour movement, it is unsurprising that many prominent high-tech regions are seen to be characterised by aspects such as shorter periods of job tenure, routine hiring and firing, and a certain 'footlooseness' amongst skilled workers (Keeble et al., 1998; Casper and Murray, 2005). This is enabled by the thickness of employment opportunities in dense industry locales, and is exemplified by the claim that many Silicon Valley engineers could change jobs without changing car parks (Saxenian, 1994). Similarly, Henry and Pinch (2000) describe the intense periods of labour movement amongst

designers, engineers, and managers that occur within 'Motor Sport Valley'. This study is able to depict a genealogy of key commercial and managerial figures and how they have moved between firms in the region. In a process they label "churning" (p.g.198), experienced engineers, managers, and entrepreneurs are seen to rapidly build their skillsets as they move from company to company. Again, these findings underline regional incubation opportunities as being key to the development and flow of relevant expertise.

Alternative to the internal production of key labour sources, a labour market can also be supported by the attraction of externally located individuals. The 'talent attraction' literature can be traced back to early work by Jacobs (1961) and has been popularised more recently though the work of Florida (2000; 2002b) on the 'creative class'. Florida (2000; 2002b) argues that high quality labour sources are attracted to particular regions for a variety of reasons. Principally, he notes that dense industry concentrations have an advantage in this respect, because their 'thick labour markets' cut down the risks associated with relocation. Workers face a risk if something goes wrong with an initial appointment (Glaeser, 2000; Florida, 2002b), for example, an idiosyncratic downturn in company fortunes or a poor firm-worker match (Glaeser, 2000). However, if numerous employment alternatives are available, these risks are mitigated. Equally, skilled workers that are willing to relocate to an area are able to pursue a number of career options beyond any one company, which can result in rapid career progression (Florida, 2002b).

In essence, this view highlights attraction through the availability of economic opportunity. Related views concern the attraction role that particular high reputation organisations can play in drawing labour sources to an area. Numerous studies have underlined how so-called 'magnet organisations' act to pull significant sources of related labour to an industry (Keeble and Wilkinson, 1999; Harrison et al., 2004). Such firms also tend to be significant sources of incubation for spinout activities. Magnet organisations need not be commercial firms. Just as universities tend to be central to initial spinout processes, they can also function as a major attraction source. Mellander and Florida (2007) argue that the university is one of the major

factors influencing the geographical distribution of human capital to established economies. Workers tend to be drawn to reputational aspects such as the perceived "quality and intensity of the science" or the number of "star scientists" working in organisations within the region (Lawton Smith et al., 2005: 450).

Again, as with so many features of regional agglomeration, attraction of relevant and high quality labour sources appears to drive self-perpetuating benefits for inhabitant firms. Florida (2000; 2002b) argues that talented individuals will be drawn to areas where other talented individuals reside, in order that they can interact with and learn from them. In short, "knowledge resources seek locations with other knowledge resources" (Luger, 2005: 155). Ultimately, certain regions can distinguish themselves as 'the place to be' for particular industry sectors, and ensure an ongoing flow of high quality labour, both at an employee and top management level.

Finally, in an explanation that goes beyond desire for job security and economic opportunity, Florida taps into the perception of a 'new work ethic', which encompasses notions of 'lifestyle' and 'quality of life' as sources of attraction (Naisbitt, 1985; Sonnenberg, 1991). Specifically, he argues that skilled workers are attracted to regions that offer a wide range of amenities, activities, and recreational pursuits:

"Knowledge workers essentially balance economic opportunity and lifestyle in selecting a place to live and work. Thus, quality-of-place factors are as important as traditional economic factors such as jobs and career opportunity in attracting knowledge workers in high technology fields. Given that they have a wealth of job opportunities, knowledge workers have the ability to choose cities and regions that are attractive places to live as well as work" (Florida, 2000: 6)

Beyond this, Florida also highlights levels of 'openness' and 'diversity' within a region as important elements of labour attraction. He uses the term 'bohemian' to sum up regional attitudes to cultural creativity, and population diversity in race, background, and sexual orientation. The argument here is that such tolerance is reflective of low labour movement barriers, which are conducive to regional migration, rapid career progression, and knowledge development (Florida, 2002a;

Mellander and Florida, 2007). Again, universities are cited as important in acting as "Ellis Islands of the creative age, attracting students and faculty from a wide variety of racial and ethnic backgrounds, income levels, sexual orientations, and national origins" (Florida et al., 2006: 35). Completing the picture underpinning perceptions of 'place quality' is the physical attractiveness of a geographical area. For example, Hanson (2000) discusses the attraction effects of beaches and coastline in Florida, or of sunshine hours in other US cities. However, the range of 'physical attractiveness' factors discussed by the literature underlines a certain subjectivity (for example, some workers may prefer cold to hot weather conditions), which makes empirical observations difficult to adequately conceptualise. Additionally, other sources of research have underlined that 'alternative attraction factors' as a whole are very much a secondary concern to the availability of desirable economic opportunities, particularly in less exceptional economic concentrations (Athey et al., 2007; Houston et al., 2008; Harrison et al., 2010b).

4.3.4 – Framework Conditions and Infrastructure

The final implications for TMTs to be discussed concern the emergence of supportive institutional conditions and how these act to underpin the self-perpetuating benefits of regional agglomeration. The earlier discussion of path emergence outlined in section 4.2.2 emphasised existing regional conditions as possible influencing factors behind why certain industries emerge within certain localities. However, theories of agglomeration also underline how the build up of thick communities of related firms may also be conducive to driving further sources of infrastructural and institutional support. Boschma (2007: 45) assert that "as soon as a new industry emerges somewhere, new supportive institutions come into being and contribute to the increasing returns at that particular locality". Thus, in many accounts, such conditions are not present during the early stages of an industry, but instead emerge and evolve in conjunction with industry development (Feldman, 2007).

The term 'entrepreneurial framework conditions', developed initially by researchers within the Global Entrepreneurship Monitor (GEM) programme (Reynolds et al.,

2005), provides a useful means to conceptualise these institutional aspects of regional context that might influence entrepreneurial and industrial activity. Framework conditions are cited in a range of forms. For example, access to 'hard' infrastructure such as transport and communication links, or housing stocks, which, to an extent, represent the 'basics' of a regional economic concentration (Athey et al., 2007). This would include access to commercial and professional infrastructure. For example, Lawton Smith (2005) highlights the emergence of peripheral support communities by discussing how a 'merchant class' of workers may develop to provide specialist business services, such as accountancy, recruitment services, or related legal expertise. In Kenney and Patton's (2005) typology of support organisations, peripheral technical services are also highlighted. Examples of these could include design and prototyping experts, or laboratory cleaning services. Research and development transfer from, for example, public sector research institutions can also be a key feature. Alternatively, important 'soft' aspects such as government policies, government programs, or cultural and social norms may also emerge. Finally, existing research also underlines the rise of investment industries, and particularly, sources of venture capital, surrounding particular regional economic concentrations. These represent an integral feature of support for entrepreneurial growth, with investment communities often being cited as a key source of differential advantage for core technology regions (Saxenian, 1994; Felzensztein et al., 2013). Given the association that management modifications have with growth events, the availability and timing of investment tranches may account for a key factor condition affecting possible TMT development trajectories.

4.4 – CONSIDERING THE 'LESS FAVOURED' REGION

Despite the popularity of the 'Porter tradition', there is no universality in the way that regional industry systems develop and function (Feldman, 2001; Feldman and Francis, 2002; Harrison et al., 2004). This fact is underlined by evidence of uneven rates of innovation and economic development throughout various technology-based economies. This section considers underpinning explanations for uneven development between core and less favoured regions. It then outlines some of the key empirical observations made regarding conditions within such regions.

Given the association that industry density has with the development of positive externalities for inhabitant firms, it is perhaps unsurprising that population density as a whole has been cited as an influencing factor behind regional industry conditions. While innovation (and any associated commercial benefits) can arise anywhere, it tends to be populated urban regions that hold an advantage in this respect (Felzensztein et al., 2013). The seminal work of Marshall (1890; 1920) was perhaps the first to make the distinction between 'core' and 'peripheral' economies. Whether on a global scale between countries, or in terms of particular areas within a country (Johnson, 2004) – a debate epitomised by comparative studies of rural and urban areas – peripherality suggests significant distance from highly populated areas (Reynolds et al., 1994). Doloreux and Dionne (2008: 261) argue that a fascination with "highly urbanized metropolitan areas, which have attained exceptional levels of prosperity" has relegated any focus on how innovative economic systems may emerge in non-core regions. Evidence suggests that such regions face unique challenges, which are, in turn, likely to heavily influence the wider environmental conditions faced by inhabitant firms. Notably, the fact that economic regeneration policies are often based on insights gleaned from high performing core regions underlines a possible mismatch between research focus and policy need.

However, it must be noted that peripherality from populated urban areas or from global population centres does not fully explain divergences in the condition of regions. For example, numerous studies highlight economic challenges faced within areas of Northern England, which has highly urbanized areas with established basic infrastructures (Athey et al., 2007; Burke et al., 2009). Birch (2011) makes similar observations in identifying Scotland as 'less favoured region' (LFR). What emerges is that there are factors beyond the extent of peripherality that can influence the conditions of the wider business context. That said, there is significant common ground between the two literature streams, which identify particular characteristic economic conditions for technology focused regions, such as:

- Organisational ‘thinness’: the lack of relevant actors in a critical mass and in sufficient density (Todtling and Trippl, 2005; Doloreux and Dionne, 2008)

- Reduced startup and spinout activity in comparison to core regions (Johnson, 2004)

- Small domestic market sizes (North and Smallbone, 2000), less access to key supply chains (Raines et al., 2001), and lack market diversity (Athey et al., 2007)

- A disproportionate responsibility for science and technology production in favour of the public sector, especially the academic sector (Landabaso and Reid, 1999)

- Difficulties in attracting key sources of labour and investment from outwith the region (Frenkel et al., 2003)

- Difficulties in restructuring mature or embedded industries, for example traditional manufacturing, in order to accommodate new economic directions (Hodson, 2008; Birch, 2011)

Most regional scholars appear to recognise that entrepreneurial activity does not somehow simply underperform by virtue of the fact that it occurs in a non-core region. As Felzensztein et al (2013) argue, many of the challenges appear to reside with the conditions present within the wider business context.

4.5 – THE SCOTTISH CONTEXT

Scotland lies on the Northwestern periphery of Europe and is the Northern most region of the United Kingdom. The country had a population of approximately 5,313,600 people in 2012 (Ellis, 2013). Whether or not Scotland is indeed a less-favoured region is a matter for some debate. Certainly, Scottish policy makers have

Table 4b: UKCI Innovation Score and Rank by Region (UK Average = 100)

	UKCI		Rank		Average Change	
	2010	2013	2010	2013	UKCI	Rank
London	132.0	135.0	85	76	+3.0	+9
North West	91.7	92.0	253	238	+0.3	+16
West Midlands	94.2	91.9	223	240	-2.3	-17
East Midlands	94.3	92.8	221	225	-1.6	-4
East of England	100.1	98.6	157	161	-1.5	-4
Yorkshire and Humber	92.9	91.8	240	239	-1.1	0
South West	97.4	96.3	178	178	-1.1	0
Wales	87.4	86.4	300	304	-1.0	-4
Scotland	94.6	93.7	222	225	-0.9	-3
South East	105.4	104.7	111	111	-0.7	+1
North East	86.6	86.8	317	309	0.2	+8

** Reproduced from Huggins, R. and P. Thompson (2013). UK Competitiveness Index.*

cited a number of challenges concerning the development of commercial industries around an existing research and technology base (Peters et al., 2000; Leibovitz, 2004; Reid and Ujjual, 2008; Mason and Brown, 2012). Given the performance of certain cities, such as Edinburgh, Glasgow, Aberdeen, and perhaps Dundee, the 'less favoured' label (Birch, 2011) may be somewhat unfair. A useful indicator of economic performance within UK regions is the UK Competitiveness Index (UKCI) (Huggins and Thompson, 2013). This report goes beyond simplistic measures such as Gross Domestic Product (GDP) to utilise a composite analysis of competitiveness based on economic, political, social, and cultural variables. The UKCI report for 2013 calculates both regional and city-specific competitiveness rankings. Unsurprisingly, London, both as a city, and as its constituent boroughs, dominated UK regional competitiveness. While some Scottish cities, notably Aberdeen (which enjoys inherent advantages stemming from the surrounding oil and gas industry) and Edinburgh, placed highly relative to other UK cities, the regional analysis shows Scotland as being behind London, the South-East of England, and the East of England (See Table 4b). Furthermore, the report states that "localities in both Scotland and Wales failed to show any overall progress, and are actually continuing to lose ground" (Huggins and Thompson, 2013: 15). These findings run parallel to

assessments of UK regional innovativeness. For example, the European Regional Innovation Scoreboard (ERIS) suggested that Scotland displayed a comparable innovation profile to Northern English regions (see Athey et al., 2007).

While the previous discussion of LFRs may not be *entirely* applicable to the selected context for this study, Scotland does appear display enough of these characteristics that it is able act as an effective counterweight to studies of exceptionally performing core regions. The following sections overview the Scottish context in more detail. The first section provides a broad historical overview of the Scottish economy. Clearly, given the discussions outlined already in this chapter, one central rationale of this research is that an understanding of how an industry context comes into being stems largely from historical evolution, and not from a distinctive industry 'birth' or revolution. In this sense, the overview of Scottish economic history presented here serves to place any discussions of technology industry context within that wider history. The second, and final, section provides a specific overview of the Scottish innovation system as a whole.

4.5.1 – The Scottish Economy – A Short Historical Overview

It is, of course, impossible for a short overview to do justice to the complexities involved in what is a lengthy and varied economic history. There are numerous specialist texts that offer far more comprehensive analyses (Devine, 1976; Payne, 1985; Lynch, 1992; Lee, 2005; Broadie, 2012). In this overview, many key issues, such as the distinctive activities evident between rural Scottish areas and urban concentrations, have been largely relegated in favour of broadly outlining the most notable and influential periods of Scottish economic development. In this sense, rapid development in urban areas is chiefly emphasised on account of its greater impact on economic development as a whole.

The Rise of Heavy Industry

Up until the onset of the industrial revolution during the mid-eighteenth century, Scotland's economy had been based largely on agriculture. However, the rapid rise of trade links with the Americas saw the foundations being laid for industries

surrounding the production of various goods, particularly textiles such as linen, cotton, and jute (Devine, 2005). Glasgow in particular emerged as a key industrial base, which was financed heavily by tobacco plantations in Britain's Caribbean colonies and the lucrative trade associated with these (Devine, 1976). This allowed Scotland to emerge primarily as an industrial centre during the early to mid nineteenth century. Able to use the worldwide trade links of the British Empire, Scottish producers enjoyed favourable modes of distribution and access to mass markets for their goods. Associated roles in administration, shipping, and finance also rapidly emerged to support increased trade, which improved the sophistication and global influence of the Scottish banking system (Cowen and Kroszner, 1989; Lee, 2005). Scotland enjoyed some important conditions central to the support of heavy industries, chiefly in the form of cheap and abundant labour and access to natural resources such as coal and iron. The invention of the hot blast smelting iron by James Beaumont Neilson in 1828 paved the way for more cost efficient iron production, positioning Scotland as a leader in the manufacturing of ships, locomotives, and other types of heavy engineering outputs (Finley, 2001; Devine, 2005). The latter part of the nineteenth century saw iron production being largely supplanted by steel production (Lynch, 1992), which became integrated into heavy industry.

The Decline of Heavy Industry

Peden (2005) identifies the end of the First World War as the beginning of a decline in the traditional industries. While orders for ships and munitions ensured a flow of contracts for manufacturers during the war, the UK had borrowed heavily at high inflation to finance the campaign. An inability to finance redevelopment coupled with a sharp drop in both the price and demand of heavy engineering outputs saw a significant economic slump from 1920-1922. This, in turn, lead to sharp rises in unemployment rates throughout the 1930s during what was, for the most part, a period of worldwide economic depression. The build up to the Second World War saw a temporary revitalisation of heavy industry in the wake of increasing demand (Thomas, 1983). However, core industries began to become more reliant on support from macroeconomic and industrial policies designed to redress an increasing lack of

competitiveness amongst the Scottish manufacturers, who, by this time, faced higher transport and labour costs as a result of their peripheral location and rising wages (Broadberry and Crafts, 1996).

The Managed Economy

From the early 1950s to the late 1960s Scottish shipbuilders continued to struggle to maintain global competitiveness in the wake of union-negotiated employee wages. Coal industries also faced increased difficulties in accessing natural resources, as well as pressure from the increasing use of oil (Peden, 2005). Many prominent shipbuilders closed during this period. Government interventions (primarily in the form of financial support) again sought to bolster heavy industry in Scotland. A prominent example was the construction of a new steel-producing mill in Ravenscraig, Lanarkshire (Payne, 1985). The 1960s were characterised by the emergence of numerous industry and trade associations, which were designed to support existing industries. Some policies were industry specific, while others focused on general improvements such as transport links. Buxton (1985) notes that from the mid 1960s to the mid 1970s, policy measures appeared to have bolstered some relatively significant improvements in the growth of manufacturing, engineering, and food and drink industries.

It was during this period of development that Scotland emerged as what has been termed a 'branch plant' economy (Massey, 1984; Harris, 1988; Harrison and Hart, 1992). This term arose through the recognition that, on account of their externally located manufacturing branches, multi-plant firms should be treated as a distinct feature of national economic composition (Dicken, 1976). As mass-producers became ever more standardised in their operations, the UK labour force became open to deliberate "control and exploitation" (Martin, 2000: 53). One characteristic of multi-plant firms was the decentralisation and geographic dispersal of organisational functions. In her work on 'spatial divisions of labour' Massey (1984) found that specific organisational functions tended to be allocated to certain regions. The overriding tendency in the UK was for research and management functions to be located in central areas and large cities, with 'blue collar' or manual work being

moved out to peripheral areas. Specifically, while the vast majority of company headquarters were located within cities in the South, Northern English and Scottish towns and cities became dominated by production and manufacturing activities (Massey, 1984).

This developed somewhat of a historic dichotomy between the labour pools in the North of Britain (including Scotland) and those in areas of Southern England (Harrison and Hart, 1992). The separation of management functions from production functions fostered a geography of labour that displayed marked differences between core regions and lower paid, lower-skilled peripheral regions (Vaessen, 1993). Scholars have pointed to a number of issues arising from this phenomenon. Young et al (1988), for example, highlight how the loss of decision-making power created tension between organisational control and local needs. Mason and Brown (2012) argue that branch plants are poor incubators of future entrepreneurs on account of the fact that managers have very limited exposure to the market and limited purchasing power. Thus, while branch plants were certainly significant sources of employment, they were unlikely to expose the working populace to entrepreneurial opportunities or to experience of upper-level strategy, both of which underpin organic processes of spinout and indigenous growth.

Initially, during periods of industrial prosperity, relocation of branch plants allowed many regions to thrive through increased employment. There were notable successes; for example, those stemming from government support for ‘Silicon Glen’ – a name attributed to what was a broad area of technology-based industrial activity running through central Scotland – and the attraction of large electronics multinationals through incentivised programmes. Original equipment manufacturers, who produced components for global electronics brands, were particular attracted to Silicon Glen, setting up vast manufacturing plants, and employing thousands of people (Turok, 1993). At its peak, Silicon Glen produced 35% of Europe’s computers and 12% of the world's semi-conductors as well as directly employing 55,000 people (McCann, 1997).

However, in the face of global competition on labour costs, many of these multinationals eventually scaled back their Scottish operations. The consequences associated with external control were very much underlined in the wake of plant closures. In many ways, branch plant locations bear the most risk with respect to wider economic downturns. This was indeed the case in Scotland. During the early-to-mid eighties, in the wake of firm closures, Scottish economic policy was still very much focused on positioning the region as a branch plant location, primarily through the attraction of foreign direct investment (see Brand et al., 2000). However, the process of deindustrialisation would become inevitable as manufacturing and production functions increasingly came to be outsourced on a global scale to developing nations. Ultimately, it appears that the type of regional dualism evident within the UK during this period was harmful to growth in less developed and more peripheral locations (Harris, 1988).

It must be noted that the general decline of heavy industry in Scotland was also interspersed with some particularly prominent sources of economic growth. The discovery of North Sea oil and gas represented a noteworthy boost to the economy, especially in Aberdeen and the surrounding area. Aside from oil exploration itself, a vast array of peripheral requirements drove the emergence of various related technology firms and infrastructural services. However, ultimately, this period of Scotland's economic history saw a fundamental shift from its former position as an industrial powerhouse.

The Post-Industrial Economy

By the early-to-mid 1990's the Scottish economy was showing clear signs of transition into what could be described as a post-industrial economy. Two main features epitomised this. Firstly, there was increasing emphasis on the provision of services over the production of goods. Secondly, there became an increasing focus on knowledge-based activities over cost-efficient activities. It would perhaps, however, be an exaggeration to suggest that Scotland has fully transitioned from its industrial past. As Peden (2005: 263) contends, "Scotland was not a post-industrial society in 2000, but little was left of the traditional Scottish economy from 1919, or

1960". Other commentators prefer to use the term 'old industrial region' (Hassink, 2005; Hodson, 2008; Houston et al., 2008). This is a label that perhaps gives more consideration to the challenges faced by formally industrial economies during their attempts to transition.

Modern Scotland still maintains a sizable portion of activity in manufacturing and production. Much of this can be attributed to Scotland's two largest export sectors, petroleum and chemical products and food and drink. A great deal of industry activity in oil and gas and basic chemicals sectors focuses on what can be described as 'extractive industries' (The-Scottish-Government, 2013). However, the supply chain requirements surrounding extraction have encouraged the rise of dense supportive industries, notably in the Aberdeen area. The Scottish legacy of expertise in heavy engineering also remains evident through a sizable construction industry. Additionally, despite the decline of FDI in computer and optical industries, Scotland maintains a strong commercial presence in this area, with a growing number of laser-based firms being born out of the existing industries and being supported by the development of specialist university research institutions (Scottish Optoelectronics Association, 2010).

Despite these notable pockets of manufacturing activity, it is the service sector that now dominates in Scotland, accounting for 72% of output according to Scottish Government figures (Gillespie, 2014). The rise of the service sector was driven significantly by rapid growth within financial services, which was arguably a corollary of Scotland's historical position within banking circles. This has coupled naturally with other legal and professional services. A significant additional contribution to this comes from tourism and related services. The digital technologies industry, comprising software, telecoms, and IT services, is another growing contributor, straddling product and service outputs to directly employ an estimated 70,000 people (ScotlandIS, 2013).

A notable 'key sector' in modern Scotland is life sciences. Throughout its history, Scotland has habitually 'punched above its weight' in terms of achievements within

science and invention (Peters et al., 2000). Much of this can be traced back to the period known as the 'enlightenment': a cultural and scientific golden age that corresponded broadly with rapid trade expansion during the eighteenth century. Among many other contributions, this period saw the establishment of engineering and science-orientated universities, which would go on to have a great deal of influence in underpinning Scotland's educational focus and knowledge agenda in the modern era (Broadie, 2012). It is this national legacy that seemingly fuelled the early direction of numerous policy measures in the aftermath of industrial decline (Galbraith et al., 2008). Policies became notably centred around the 'science and skills' agenda in prioritising business growth, global connections, and learning through commercialisation of Scotland's high quality research base (Mackinnon and Cumbers, 2007). Transition from the industrial branch plant economy also saw an increasing shift in policy direction from a focus predominately on attraction of inward investment to one that emphasised business start-up and indigenous growth of firms (Scottish-Enterprise, 1999; Houston et al., 2008). In short, there was clear divergence from the previous focus on "low cost and high labour intensity, to one more focused on high productivity, greater innovation and enhanced competitiveness" (Reid and Ujjual, 2008: 5).

Scotland's science and skills agenda became largely unified through the development of key policy documents, notably "A Smart, Successful Scotland" and "A Science Strategy for Scotland" (Scottish-Enterprise, 1999). Much of the focus here was placed on exploiting the strong research base within the region, particularly within biotechnology and related fields. Emerging clusters of biotechnology firms now surround a number of Scottish universities, for example, in Dundee (Athey et al., 2007) and Edinburgh, in the area known as the Edinburgh Bio-Quarter (Birch and Cumbers, 2009). Biotechnology activity is also characterised by the presence of a significant number of major multinational companies with Scottish subsidiaries, particularly within pharmaceutical markets. In a broader sense, there is a range of research-based firms in Scotland residing under the 'Life Sciences' label, which contribute to many facets of the Scottish economy, including significant industries such as food and drink (McCann, 1997).

This overview was designed to provide historical context to the next section of this chapter. Section 4.5.2 presents a more in-depth discussion of the Scottish Innovation System. The aim here is to frame the empirical findings of the thesis within a clear portrayal of the wider business and institutional context in which TMT formation and development takes place.

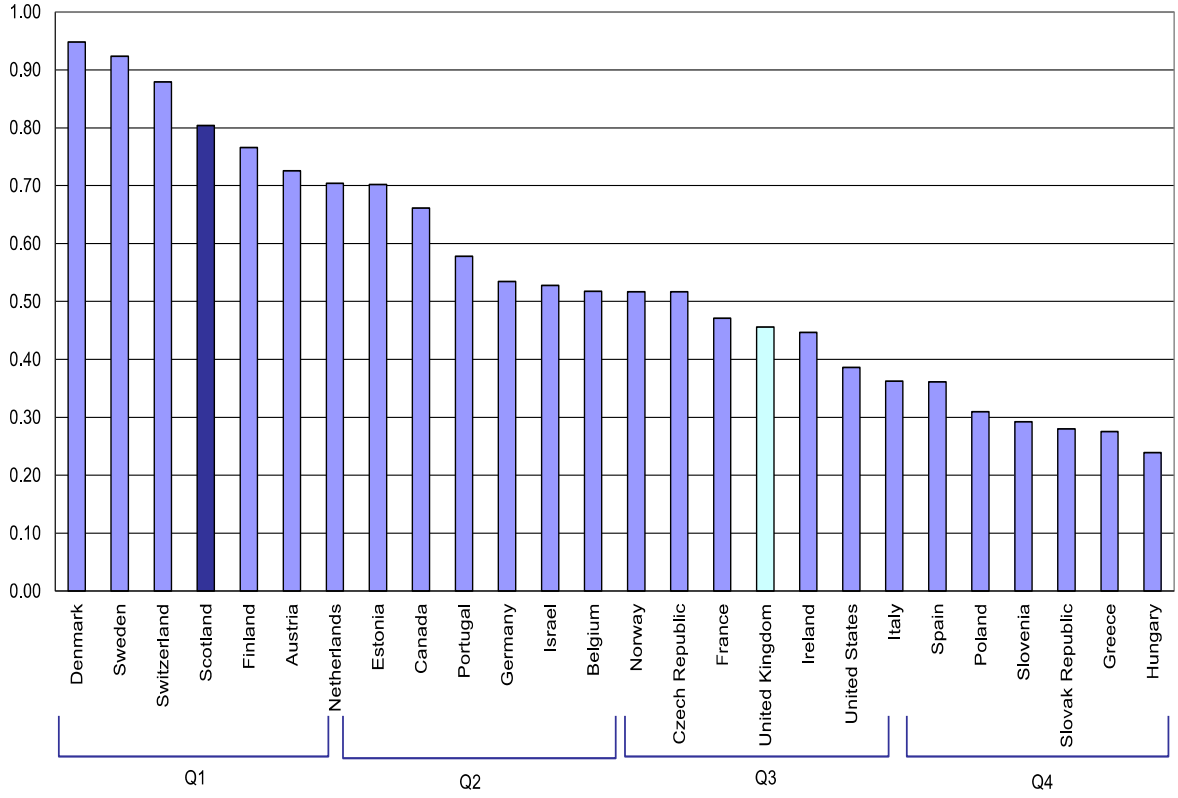
4.5.2 – The Innovation System in Modern Scotland

Evaluation of the Scottish Innovation System (SIS) is aided somewhat by what is a relatively unified policy agenda surrounding support for the development of knowledge and technology-based industries. The definition of the wider business context outlined in the early stages of this chapter sought to give consideration to the range of actors involved within the production and commercialisation of innovative activity. This definition included: private firms, formal institutions, institutes, education and training organizations, policy makers, financial organizations, regulatory authorities and intermediary organizations (Doloreux and Dionne, 2008). In their analysis of the SIS Roper et al (2006) outline dimensions of 'knowledge generation' and 'knowledge exploitation' as a means to conceptualise the regional picture of innovation, science, and technology based activity within both public and private sectors. This serves as a useful frame for the following overview:

Knowledge Generation:

The initial generation of science, technology and research-based knowledge within the Scottish Innovation System stems from a variety of sources. Following the precedent set by existing evaluations of the Scottish ecosystem (Roper et al., 2006; REAP, 2014), knowledge generation is assessed here by examining the dominant sources of R&D activity within the region. Given that quality-based assessments of generated knowledge are fraught with complexities, R&D expenditure represents perhaps the most reliable available measure of overall activity.

Figure 4a: HERD as a % of GDP in OECD Countries (2012)

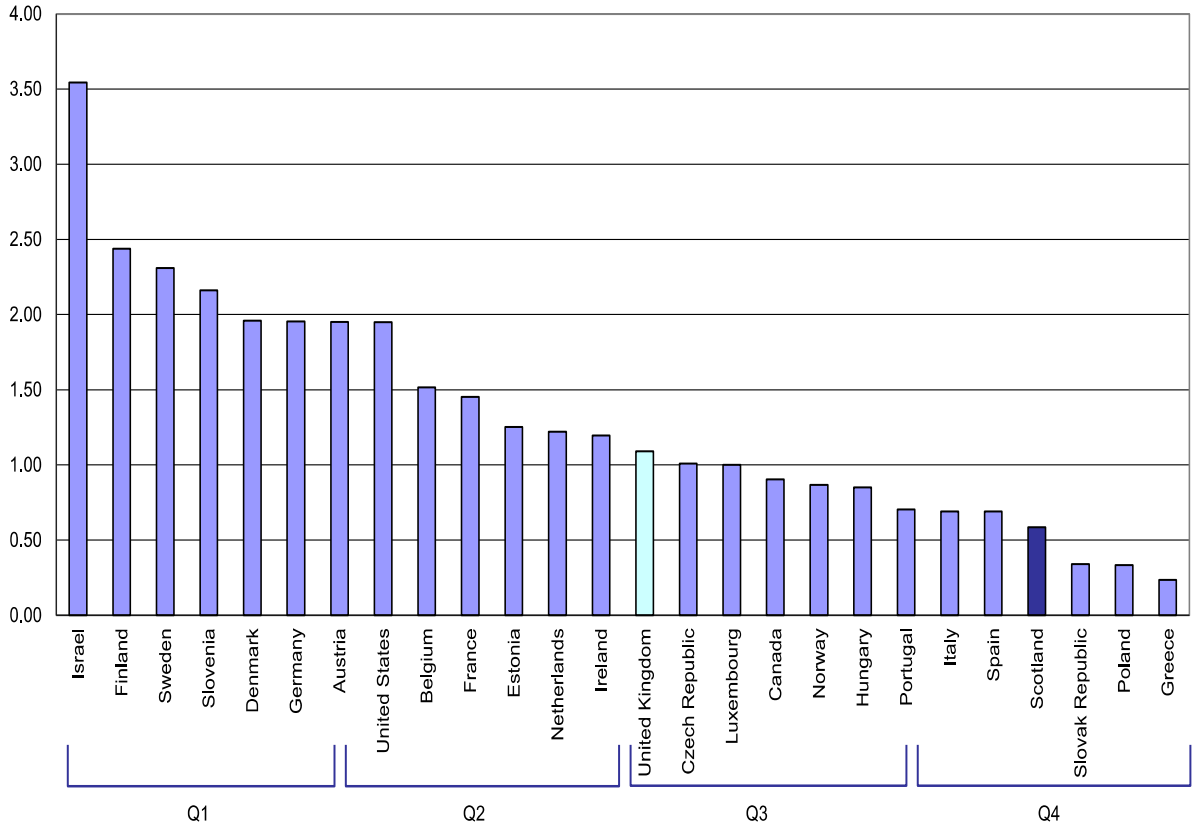


Reproduced from The Scottish Government (2014) "Gross Expenditure on Research and Development Scotland 2012"

The latest government evidence, which addresses R&D undertaken by business, higher education, government and private non-profit sectors during 2012, places Scotland's Gross Expenditure on Research and Development (GERD) at a total of £1,922 million (The Scottish Government, 2014). This total can be broken down in to the following components:

- Higher Education Expenditure on Research and Development **(HERD)**: £973 million in 2012
- Government Expenditure on Research and Development **(GoveRD)**: £233 million in 2012
- Business Expenditure on Research and Development **(BERD)**: £707 million in 2012

Figure 4b: BERD as a % of GDP in OECD Countries (2012)



Reproduced from The Scottish Government (2014) "Gross Expenditure on Research and Development Scotland 2012"

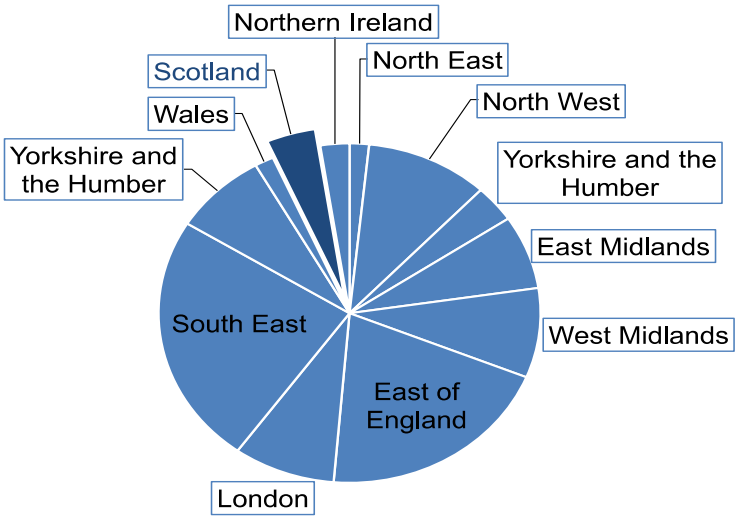
- Private Non-Profit Expenditure on Research and Development **(PNP)**: £9 million in 2012

This evidence highlights that, in Scotland, 63% of knowledge generating expenditure comes from the public sector. Within this, Scotland's nineteen higher education institutes (HEIs) account for a significant majority of that expenditure, placing them at the forefront of Scottish research generation activity. A recent report by the Regional Entrepreneurship Accelerator Programme (REAP, 2014: 17) states that, collectively, Scottish university research departments "win approximately £2 billion of public funds from UK research councils, industry, charities and the Scottish Funding Council (SFC)". Scotland's universities are often cited as a source of strength and prestige, particularly in the fields of informatics, engineering, physics and life sciences (see Birch and Cumbers, 2009). Many Scottish universities have

world leading research departments in a range of specialist fields, and existing evidence suggests that Scotland resides amongst the top countries in the world in terms of publication numbers per million head of population (SSAC, 2009; Omidvar et al., 2014). The performance of the university research sector is very much reflected by Scotland's above average HERD expenditure as a percentage of GDP, where it ranks top of all UK regions and fourth overall in an international comparison with twenty-six OECD countries (See Figure 4a).

Against this, 37% of knowledge generation expenditure is accounted for by private enterprises. In contrast to Scotland's comparative performance in public sector spending, private sector expenditure as a percentage of overall GDP is in the bottom quartile of OECD countries (see Figure 4b). Scotland also lags behind the UK in terms of BERD, with the average business R&D spend per head of population being £103 in Scotland compared to £269 per head of population in the UK (The Scottish Government, 2013). Differences in private sector knowledge generating activity are particularly notable in comparison to the South East of England (which accounts for 24% of UK expenditure) and the East of England (which accounts for 20% of UK expenditure). In terms of expenditure as a percentage of GDP, Scotland ranked eighth out of the twelve UK regions/countries in 2012 (see Figure 4c).

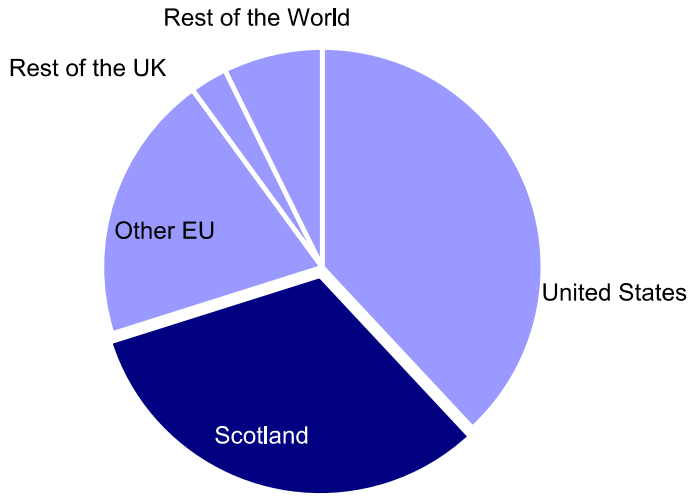
Figure 4c: BERD Expenditure by UK Region 2012



Reproduced from The Scottish Government (2013) "Business Expenditure on Research and Development Scotland 2012"

Further insights into how knowledge is initially generated within the Scottish innovation ecosystem can be gleaned from an examination of the *types* of private sector firms engaged in R&D activity. Scottish Government figures indicate that R&D expenditure is concentrated within a small number of large firms. In 2012, just five out of 2,040 R&D active firms accounted for almost a third of Scottish R&D expenditure (The Scottish Government, 2013). Large pockets of this activity were attributed to large multinational firms in the pharmaceuticals sector (17.1% of BERD) and the 'precision instruments and optical products' sector (17.4% of BERD). Furthermore, evidence suggests that the majority of research active businesses in Scotland are not Scottish-owned. Through their Scottish-based operations, companies headquartered in the USA actually account for the most significant portion of BERD (see Figure 4d). The low level of R&D in the majority of indigenously owned firms has previously been noted as a possible weakness of the Scottish Innovation System. For example, Roper et al (2006: 72) contend that this status "limits both the capacity of firms to develop their own knowledge bases… and also no doubt hinders their ability to absorb external knowledge".

Figure 4d: BERD Expenditure by Country of Ownership of Business 2012



Reproduced from The Scottish Government (2013) "Business Expenditure on Research and Development Scotland 2012"

It must be noted that BERD expenditure does not necessarily tell the whole story of business involvement in knowledge generating activities (REAP, 2014). Much of the existing literature finds that public and private sector knowledge generation often interact, predominately through knowledge spillovers from universities to private R&D (Becker, 2014). Indeed, the clustering of particular industry activities around universities suggests some sector specific diffusion to technology-based firms. That said, some clear aspects of demarcation between the two sources remain, particularly with respect to the types of research projects being pursued (cutting edge/radical against commercially viable) and to the goals for ultimate application of research outcomes (advancing knowledge against commercial application). Ultimately, evidence from Scotland certainly highlights "disconnection between what is generated from a strong public science base and what is generated and required from a weak corporate innovation base" (Gregson et al., 2013: 99). While Scotland has, in many senses, an excellent system for knowledge generation, this imbalance, particularly with respect to the lack of indigenous private sector research, arguably undermines the development of commercially focused and market driven research activity, as well as placing a particularly heavy obligation on public sources of funding.

Knowledge Transfer and Exploitation:

A key feature of any regional innovation system concerns the mechanisms through which the knowledge generated by R&D activities is ultimately exploited. Typically this entails some form of tangible or commercial application of research so that it may be released as an output to wider markets. Given the discussion outlined above, there are two important indicators of knowledge exploitation within the SIS. The first concerns the application of spillover knowledge from publicly funded research institutions. The second relates to the performance of R&D active commercial firms.

Knowledge spillover from publicly funded research facilities can occur through a wide variety of transmission channels, including spinout companies, patents and technology licensing, consultancy, and contract research (Becker, 2014; REAP, 2014). Additionally, it has been suggested that knowledge spillover from universities

can originate from education as well as research activities. The supply of high quality graduates to the private sector, notably in science and engineering disciplines, represents a somewhat indirect form of knowledge transfer and exploitation from public to commercial sectors (Becker, 2014). In 2012, Scottish businesses employed 8,343 R&D staff, 53% of whom were scientists and engineers (The Scottish Government, 2013). Research suggests that demand for science, technology, and engineering graduates is likely to grow, particularly in energy and life sciences sectors, and the Scottish Government have placed significant emphasis on supporting all levels of education to address this (SEEAG, 2012). At the time of the data collection period, Scottish universities produced a slightly higher share of graduates in comparison to the UK. However, Scottish businesses actually employed a slightly lower share (REAP, 2014).

In terms of direct knowledge exploitation from spillovers mechanisms, the evidence suggests mixed levels of performance within the Scottish Innovation System. Patent numbers from universities, for example, reflect relatively poor levels of knowledge transfer. The OECD finds that Scotland generates 68.5 patents per million head of population. This is below the UK average of 84 patents per million head, and significantly below those of international comparators such as Finland (281.5 patents per million head), Sweden (294 patents per million head), Japan (226 patents per million head), Germany (209 patents per million head), and the USA (132.5 patents per million head) (Omidvar et al., 2014). Other direct forms of exploitation occur through formal cooperative agreements with private industry, including collaborative R&D (where Scottish universities account for 15.3% of the UK HEI total), contract research (9.5% of UK universities), and consultancy (14.5% of UK universities) (See Table 4c for Scotland's comparative performance with other UK regions).

Scottish universities display a relatively positive picture in terms of knowledge exploitation through university spinout activity. According to business population estimates by the Department of Business, Innovation, and Skills (BIS, 2013) Scotland is home to 15.3% of UK businesses in the 'professional, scientific and technical activities' sector against the UK regional average of 14.3%. However,

Table 4c: Indicators of HEI Knowledge Transfer and Exploitation 2012

UK Region	Total HEI Spinout Firms	Estimated Employed by HEI Spinouts	Income from Collaborative Research (£000)	Income from Contract Research (£000)	Income from Consultancy (£000)
SCOTLAND	**186 (16.4%)**	**1726 (17.4%)**	**£145,399 (15.3%)**	**£110,283 (9.5%)**	**£58,144 (14.5%)**
ENGLAND	761 (74.1%)	7692 (77.5%)	£705,227 (74.1%)	£1,009,351 (86.5%)	£317,687 (79.3%)
WALES	90 (8.8%)	459 (4.6%)	£70,441 (7.4%)	£27,501 (2.4%)	£16,543 (4.1%)
N.I.	8 (0.8%)	50 (0.5%)	£30,082 (3.2%)	£19,682 (1.7%)	£8,029 (2.0%)
UK TOTAL	1027 (100%)	9927 (100%)	£951,149 (100%)	£1,166,817 (100%)	£400,403 (100%)

Data from the Higher Education - Business and Community Interaction Survey Report 2012-2013 (available https://http://www.hesa.ac.uk/index.php?option=com_content&view=article&id=3166&ItemId=161 - Annex.)

Scotland accounts for 16.4% of HEI-linked spinout firms, thus reflecting a comparatively above average contribution of university spinout activity to this category of firm (See Table 4c). Gregson et al (2013) note that the University of Edinburgh in particular has been highly ranked in terms of spinout and startup activity between 2000-2010. Scotland also displayed a favourable 17.4% of all employment by academic spinout firms in 2012 according to figures from the Higher Education Business and Community Interaction Survey Report 2012-2013 (HESA, 2014). Spinout firms have long been viewed as a key conduit for the commercial exploitation of university generated intellectual property (Rothaermel et al., 2007). However, as a measure of commercial knowledge exploitation, university spinout rates should be taken with a note of caution. After all, exploitation activity is indicated more by the eventual performance and reach of spinoff technology firms than simply by the numbers of firms created. In this respect, the potency of Scottish university spinoff activity as an exploitation mechanism may be called into question. For example, in their study of high-growth firms in Scotland, Mason and Brown (2010; 2012) note that university spinouts actually made a very small contribution to

high-growth activity. Instead, they cite evidence that corporate or industry spinouts perform considerably better in terms of sales growth and survival rates (Wennberg et al., 2011).

The performance of non-spinoff research or technology firms, through, for example, sales or employment growth, provides further insight into regional knowledge exploitation within Scotland. In 2012, there were an estimated 51,915 firms engaged in 'professional, scientific & technical activities' (The Scottish Government, 2013). Reflecting the Scottish economy as a whole, the vast majority of these were small, with less than forty-nine employees. In some senses, this implies an active community of innovative small businesses, which might be viewed as a promising base for the development of successful commercial technology-based industries. However, as with the performance of spinoff firms, evidence suggests that young and small technology-based firms in Scotland typically struggle to achieve large-scale growth. Contrary to the popular image of the archetypal technology 'gazelle' as a primary driver of wider economic activity, Mason and Brown (2012) found that only 12% of high-growth firms in Scotland were technology based. This was the second lowest proportion of all UK regions. Similarly, evidence suggests a paucity of AIM-listed technology companies in UK regions outside the South East of England (Amini et al, 2012), reflecting challenges faced by technology firms in reaching advanced investment stages, such as IPO.

Undoubtedly there are a number of successful high-growth and large-scale technology based firms in Scotland, and these contribute heavily to the regional exploitation of knowledge. However, again, a significant proportion of these large firms were founded or headquartered outside of Scotland. In fact, 82% of large businesses (with 250 employees of more) and 41% of medium-sized businesses (with between 50 and 249 employees) were owned and headquartered outside of Scotland (REAP, 2014). Further, Enterprises with ultimate ownership outside of Scotland (either in the rest of the UK or overseas) accounted for 35% of all employment and 58% of all revenues. This evidence reflects what is a notable gap between diverse populations of SMEs and established corporate technology sectors, with the relative

lack of widespread indigenous growth of entrepreneurial firms causing a thin 'middle ground' in many industries. The recent report on the Scottish innovation ecosystem by REAP (2014) finds that the presence of large multinational companies brings benefits associated with the transfer of knowledge, access to global markets, and supply chain development. However, it also notes that overreliance on such firms marks Scotland out as somewhat of a modern 'branch economy', as opposed to an ecosystem driven by indigenous entrepreneurship. These observations exemplify the view that Scotland's entrepreneurial or commercial exploitation capabilities are some way behind its notable innovation-generating capabilities.

Connectivity and Thickness:

The levels of connectivity and network thickness between the key actors within a region's innovation ecosystem represents an important aspect of how that ecosystem functions. Dense and active relationships between actors are features often noted in examinations of exceptionally performing technology economies, particularly with respect to discussions of firm populations, startup and spinout rates, labour market density, completeness of supply chains, and activity of investment communities (Saxenian, 1994; Angel, 2000; Cohen and Fields, 2000). In comparison to oft-studied technology clusters, evidence from Scottish technology industries points to a somewhat more fragmented picture (Roper et al., 2006; Birch, 2011; REAP, 2014). For example, the REAP report finds that some geographies or urban centres in Scotland do offer numerous opportunities for entrepreneurs and entrepreneurial teams to engage with key actors in the ecosystem such as investors, academics, and large corporate enterprises. However, it also finds that these levels of connection are likely to be concentrated in particular specialist sectors and particular locations rather than being evident across the region. The report also notes fragmentation in terms of the content of networking activity in Scotland. Typically, the Scottish ecosystem provides relatively accessible support to experts in areas such as exporting, software development, or taxation; however, support on business issues related to product development, sales, marketing, regulatory approvals, or senior human resource management tends to be "more elusive" (REAP, 2014: 28)

One particular area where issues surrounding network connectivity are frequently cited concerns the levels of collaboration between Scotland's HEIs and commercial firms (Leibovitz, 2004; Roper et al., 2006; Birch and Cumbers, 2009; Omidvar et al., 2014). In a 2006 report, Roper et al (2006) point to evidence of an almost complete mismatch between the type of knowledge being generated by universities – which is typically highly experimental – and that which is demanded by industry. Typically this limits collaborative activities with industry to the use of university analytical services or laboratory facilities (Birch and Cumbers, 2009). Additionally, much of this activity involves relationships with multinational firms, which, through contract research, are a primary source of income for Scottish HEIs. As such, there is a tendency for mutually beneficial collaboration with entrepreneurial ventures to be marginalised, as well as having possibly negative implications for the spillover of knowledge into the local context (Miller, 2014).

The primary issue here appears to concern the lack of incentives for university researchers to engage in research activities that are relevant to the needs of locally embedded private firms (Roper et al., 2006; Omidvar et al., 2014). Generally speaking, the goal of research-focused Scottish universities is to be recognised are centres of research excellence, allowing them to gather income from funding and teaching rather than through industry engagement projects. Typically, suggested solutions to these issues have pointed to changes to the current Research Excellence Framework (REF) in order to incentivise academics to collaborate with industry as part of their performance assessments (Omidvar et al., 2014). Other discussions at policy level have centred on the development of a Scotland-wide interface to provide business with a central point through which they can access academia, as well as further development of research pools, which support university collaboration with SMEs through the sharing of research resources and infrastructure (Stennett, 2012).

Finally, levels of relevant networked activity in Scottish technology industries are typically hampered by the lack of critical mass in many industry sub-sectors (Birch and Cumbers, 2009; Harrison et al., 2010; Miller, 2014). Firstly, firm populations tend to be heavily concentrated within the central lowlands sub-region, meaning that

most areas external to this have relatively sparse business populations. Secondly, and more importantly, while firms may be grouped under certain industry labels (such as Life Sciences or Chemical Sciences), these labels are broad and there is typically a high degree of specialism between particular sub industries. Thus, it is relevant density that is actually key. Despite seemingly healthy business populations categorised under public policy sector labels, Scottish technology firms are often unable to share labour and resources, meaningfully collaborate, or drive increased innovation through competition as a result of how 'thin' specialist sectors are (Leibovitz, 2004; Birch and Cumbers, 2009). Thirdly, evidence suggests that many Scottish technology and research firms tend to deprioritise local linkages in favour of connections with international firms (Birch and Cumbers, 2009). This, in part, has positive connotations, in terms of firms possessing an international outlook. However, it is also arguably a corollary of the overall business population in Scotland, where relevant linkages with indigenous firms are often unavailable.

Public Policy Support:

Scotland has an active innovation policy agenda, with an extensive range of public sector support mechanisms for high technology industries. Roper et al (2006) cite the publication of the 'Smart Successful Scotland' policy agenda (The Scottish Executive, 2001) as the foundation for modern policy direction within the SIS. Policy objectives revolve around identifying scientific and research strengths, ensuring that these are adequately funded, supporting commercial enterprises through a range of funding schemes and advisory services, improving international linkages, building sector 'brands' amongst international audiences, and encouraging a sustainable, critical mass of innovation activity in key sectors.

The delivery of Scottish research and innovation policy is facilitated by a variety of agencies. Chief amongst these are the Scottish Science Advisory Council (SSAC), the Scottish Funding Council (SFC), Scottish Enterprise (SE), and Highlands and Islands Enterprise (HIE). SSAC primarily act the advisory board for Scottish Government policy makers, drawing from a diverse group of influential stakeholders to shape overall policy direction. The Scottish Funding Council (SFC) acts as the

main funding body for Scottish universities and colleges, providing funding for teaching, research and other HEI activities. SFC funding represents a key pillar of support for Scotland's HEI knowledge generation activities.

SE (and the counterparts HIE) are chiefly responsible for 'on the ground' delivery of policy initiatives for commercial firms, often through a range of specialist offshoot initiatives. Overall activities revolve around business advice and funding support for technology-based businesses. Advisory services fall under numerous schemes, for example, the Scottish Enterprise High Growth Startup Unit is designed to give targeted business advice - raising finance, business planning and IP, company structuring and market assessments - to firms identified as having high growth potential (Scottish Enterprise, 2012). Similarly the 'Winning Through Innovation' Programme provides access to a series of events designed to aid companies in bringing their products to market. Funding provision also takes a variety of forms. For example, schemes such as SMART Scotland are designed to support project costs for technical and commercial feasibility studies, as well as providing commercial R&D grants. Between April 2008 and September 2011 approximately £16.7m in funding was issued by SE to businesses through the SMART programme (Stennett, 2012).

The Investment Market:

The provision of investment sources is often cited as a key aspect of support for developing technology-based businesses. Such firms typically require significant financial support to negotiate what can be very lengthy and expensive periods of R&D, clinical or prototype trials, regulatory approval procedures, and international expansion strategies. As a summarising position, most commentators identify Scotland as having a small risk capital market (Harrison et al., 2010; Gregson et al., 2013). For example, in their analysis, Harrison et al (2010: 235) state that "compared with other successful economies, the risk capital market remains relatively small scale and highly segmented along a number of important dimensions: by technology/ product/market/domain; by stage of development; and by capital structure preferences (debt vs. equity)". One notable feature has been the virtual withdrawal of

corporate-level investment, such as venture capital or mutual funds, from early-stage and 'new deal' markets in Scotland. Instead, evidence suggests that venture capital investment is primarily concentrated on portfolio investments, which typically fund established firms and have transactions values above £5m (Gregson et al., 2013). Sources of Foreign Direct Investment (FDI) in sectors such as machinery and equipment engineering, food and drink, and business services (Ernst and Young, 2013), also contribute larger-scale finance to the Scottish innovation ecosystem.

Despite this, there is considerable empirical evidence to suggest that early stage indigenous Scottish ventures do not face a 'funding void'. For example, funding is partially aided by abundant public policy support for early stage ventures in Scotland, where numerous schemes are in place to support initial development. However, a prominent role has also emerged for high net worth individuals-turned-investors – known as business angels – in supplying sources of early stage finance to Scottish ventures (Mason and Harrison, 2008; Gregson et al., 2013; Mason et al., 2013). The 'new deal' market in Scotland, in comparison to other EU countries (and the rest of the UK), is now disproportionately accounted for by business angel networks (EBAN, 2008; Gregson et al., 2013), who are responsible for a significant proportion of startup and first rounds investments (Harrison et al., 2010).

Again, there is evidence of significant support for early stage investment capital markets provided by public policy initiatives. For example, business angels in Scotland are afforded very highly generous tax breaks through the Seed Enterprise Investment Scheme. Additionally, the Scottish Funding Council has played an important role in formalising angel networks into syndicated groups (Hayton et al., 2008; Harris and Mason, 2012; Gregson et al., 2013). LINC Scotland, a private limited company that has been granted enterprise agency status by the UK government, also performs an important networking role in linking more informal sources of investment capital to meet the demands of early stage firms. Finally, the Scottish Co-Investment Fund has emerged as key driver in increasing the scale and impact of equity investments through its ability to match angel investment with

Table 4d: Risk Capital Investment in Scotland 2009-2011*

Investment Type	Investments between £100k - £2m in 2011		Investments over £2m in 2011	
	£m	%	£m	%
Angels	12.8	27.5	1.4	3.3
VCs	14.4	30.9	33.8	80.5
SE/Public Sector	14.4	30.9	2.8	6.7
Other	5.0	10.7	4.0	9.5

** Reproduced from Harris, J. and C. Mason (2012). The Risk Capital Market 2009-2011.*

public funds (Hayton et al., 2008). Angel investors have been key to plugging the gap resulting from the withdrawal of private institutional funds from new deal markets. The increasing formal syndication of angel networks and the opportunities to provide 'hybrid' funding with sources such as the Co-Investment Fund have encouraged sophisticated early-to-mid investment support in Scotland (Harrison, 2009). As a result, Scotland's angel investment network is amongst the most active in Europe, playing a vital role in servicing post-seed but pre-institutional investment demands, typically below transaction values of £2m (Hayton et al., 2008; Harris and Mason, 2012).

The primary investment challenge in Scotland now concerns follow on funding. Angel investment activity in Scotland drops dramatically once transaction values go beyond the £2m range (See Table 4d), highlighting the emergence of a second 'funding gap' for the provision of investments between £2m and the large-scale portfolio investments usually above £5m (Sohl, 2012; REAP, 2014). A typical funding 'pipeline' model of risk capital investment would see angel investors 'passing the baton' to the VC community (Mason et al., 2013). However, evidence indicates that the lack of VC activity in mid-stage investment transactions often causes a breakdown in follow-on funding, acting as a major barrier to the scale-up of Scottish firms (REAP, 2014). Furthermore, the attractive tax break options for

individual investors, which are so helpful to supporting early-stage investment activity, also impose restrictions that tend to disincentive a transition into VC investment. This means that the typical upper levels of angel investment amounts frequently represent the 'end of the line' for funding provision in Scotland (Mason et al., 2013). A number of commentators note that this encourages a 'build to sell' mentality amongst private investors, rather than encouraging the growth 'companies of scale' (Oakey, 2003; Mason and Brown, 2012). Trade sales, of course, can be positive in terms how they encourage the recycle of finance and entrepreneurial talent (Mason and Harrison, 2006). However, there are also challenges associated with retaining that value regionally.

Summary of the Scottish Innovation System:

As an innovation system, Scotland possesses a great many strengths. Many of these reside in what is a globally competitive public research base, which has the capacity to generate high quality knowledge. While there is no shortage of commercial offshoots from universities, evidence suggests a lack of full alignment between the agendas of public knowledge generators and the needs of associated commercial industries. The SIS displays strength in its thick system of public policy support, particularly for early stage commercialisation. But, there are seemingly difficulties in resourcing the development of indigenous commercial growth, which has had effects both in the production of 'companies of scale' and in the development of a substantial mid-corporate commercial population. At one end of the SIS resides a large body of small, but highly innovative, indigenous ventures, and, at the other, are predominately externally-owned multinational firms. This results in what is a relatively thin middle ground, which acts to undermine many of the self-perpetuating benefits noted in high-performing regional clusters. It also implies that high quality knowledge generated in Scotland may be vulnerable to exploitation elsewhere. This dispersal of firm types within industry populations is further reflected in the investment capital structure within Scotland, where institutional support appears abundant for early-stage firms and for large corporations, but not for the 'middle ground'.

4.6 – OVERVIEW OF SELECTED INDUSTRIES

Having overviewed the spatial, historical, industry, and institutional context from a largely macro perspective, this final section of Chapter Four provides a more specific discussion of the three sample industries upon which the research is based. The industry sectors in question are Life Sciences, Optoelectronics, and Chemical Sciences.

4.6.1 – Life Sciences

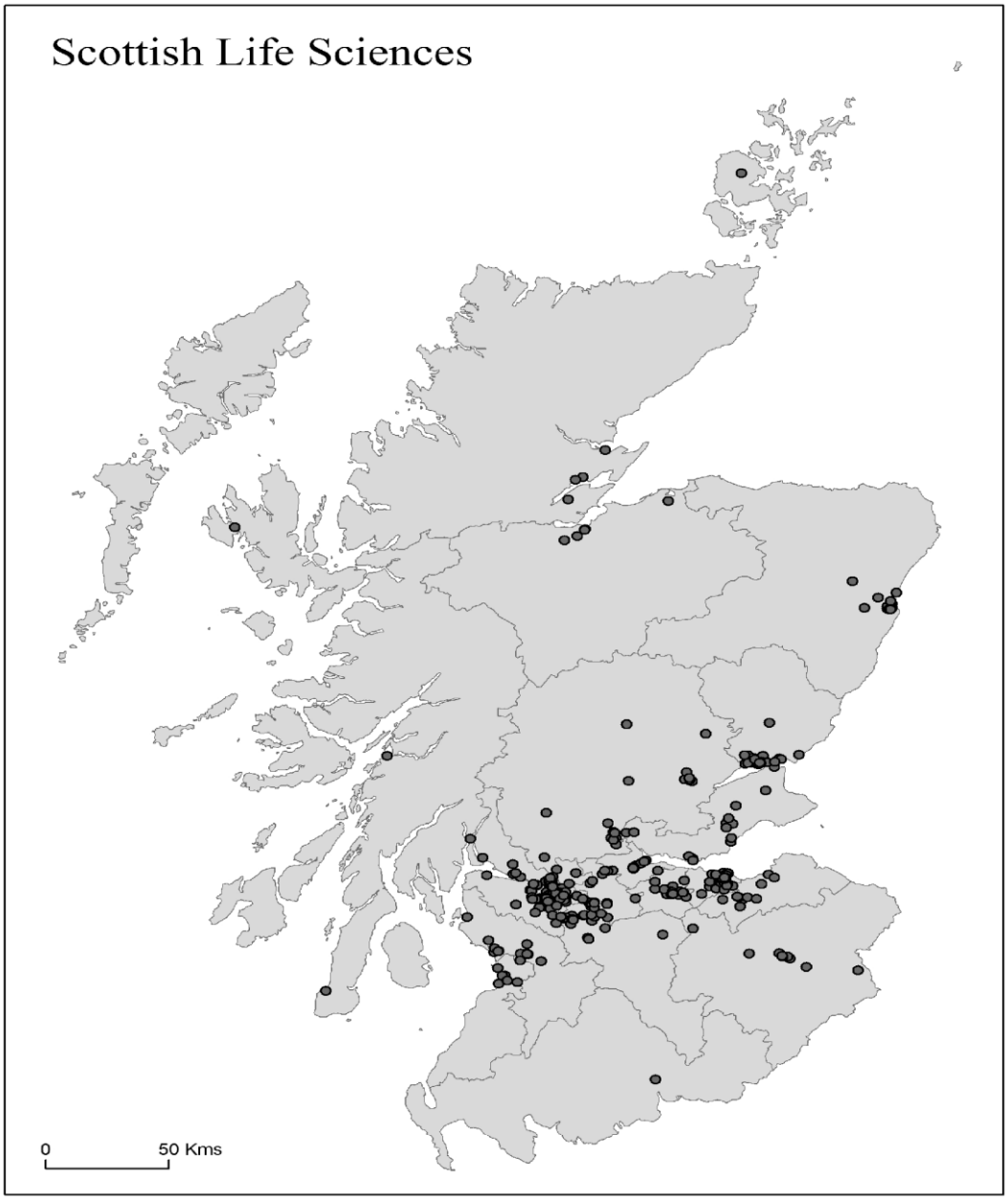
The Scottish Government identifies Life Sciences as a 'Key Sector' for the economy (Scottish Enterprise, 2012). There may be some questions asked surrounding the extent to which Life Sciences is truly an industry, or if it is, in fact, a collection of separate industries. Certainly, the label is characterised by a diversity of research and commercial activities, including:

- Drug Development/Pharmaceuticals
- Medical Devices
- Contract Research
- Diagnostics
- Experimental and Translational Medicine
- Regenerative Medicine and Stem Cells

Despite this diversity, this study follows the broad definition used by Scottish Enterprise who maintain a database for the Life Sciences identifying over 650 organisations involved in the 'cluster'. It must be noted that this definition encompasses a range of peripheral services, such as specialist legal practices, and so levels of actual technology-based activity are somewhat exaggerated by the headline figure.

As an industry, Life Sciences can trace its roots back to traditional medicine, agriculture, and food and drink sectors, where R&D emerged as an important means to improve production processes and general output (McKelvey, 1996). The development of antibiotics and their widespread use after the Second World War was

Figure 4e: Geographical Distribution of Scottish Life Sciences Firms in 2009



** Reproduced from Birch, K. and A. Cumbers (2009). Policy Report: Strengthening the Life Sciences in Scotland.*

also a major driving force behind the birth of modern drug development sectors (Leibovitz, 2004). The modern Life Sciences sector in Scotland is characterised by particularly strong, internationally recognised, and commercially active academic

research (Life-Sciences-Scotland, 2011). Other key research-focused, and largely publicly funded, bodies support this; for example, the Roslin Institute, which is based on the outskirts of Edinburgh. Furthermore, the publicly-funded National Health Service (NHS) provides a potentially important avenue for research outputs (Life-Sciences-Scotland, 2011).

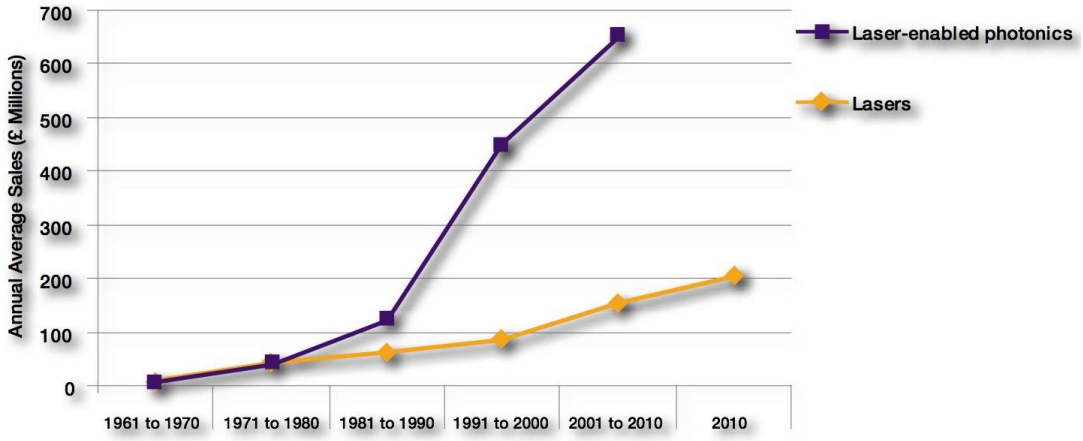
Typical of the SIS as a whole, the sector is characterised by a large number of specialist small and early stage companies (The-Scottish-Government, 2009; Birch, 2011; Life-Sciences-Scotland, 2011). There is some evidence of urban concentration, particularly around Edinburgh, Glasgow, and Dundee (See Figure 4b). This has been aided through various forms of physical infrastructure and business investment, such as the creation of 'science parks'. However, most analyses have pointed to an overall lack of critical mass in specialist sub-sectors (Leibovitz, 2004; Birch and Cumbers, 2009; Birch, 2011). Again, in reflection of the SIS as a whole, the Scottish Life Sciences are also populated by the presence of a significant number of major multinational companies, particularly within pharmaceutical markets.

4.6.2 – Optoelectronics

Optoelectronics chiefly encompasses a wide range of laser-enabled technologies used, for example, in areas such as military equipment and precision manufacturing. The growing scale of laser-enabled applications used in other technologies and processes now dwarfs direct sales of laser-based products (See Figure 4c). In this sense, photonics activities in Scotland permeate the value chains of a tremendous variety of global industries.

Scotland's laser-based industries can be traced back to two large, and indigenously grown, engineering firms that developed products to satisfy substantial military contracts during the late 1960's (Scottish-Optoelectronics-Association, 2010). Between the 1960's and 1970's, it was these two established firms that were responsible for a number of global-level innovations in the application of optics technologies. Based in the outskirts of Glasgow and of Edinburgh, the two firms became a part of the broad geographical concentration of technology firms residing

Figure 4f: Annual Average Sales Within Scottish Optoelectronics Sector



Reproduced from Scottish Optoelectronics Association (2010). 50 Years of Lasers in Scotland

in 'Silicon Glen' (Turok, 1993). Recognising the need for research and labour support, a number of Scottish universities developed specialist photonics departments to work in compliment with commercial industry partners. As laser-enabled applications grew substantially during the 1990's, numerous university spinout firms emerged to exploit specialist applications. A number of these achieved relatively substantial growth and successful exits resulted in the recycling of new firms.

Today, the Scottish Optoelectronics industry is still principally anchored by the same two established companies, which have now, through various international mergers, been absorbed by large conglomerates. These firms remain in Scotland and operate chiefly as autonomous subsidiaries. Further international acquisition activities and injections of FDI have added to this pocket of very established firms, and a small group of both indigenous large companies and multinational units now anchor the Scottish Optoelectronics industry. Complementing these are around 80 smaller laser-based photonics firms. The Scottish Optoelectronics Association (2010) estimate that the industries annual turnover in 2010 was approximately £660 million, the vast majority of which was to international export markets.

4.6.3 – Chemical Sciences

Scotland has a long history of achievement in developing innovations within chemicals-based research. Examples include the discovery of Carbon Dioxide in 1753, and the early development of X-ray Crystallography technologies (Chemical-Sciences-Scotland, 2010). Today, as with the 'Life Sciences' label, Chemical Sciences denotes a vast range of research fields and commercial sectors, which are represented predominately under the industry body, Chemical Sciences Scotland. Typically, three distinct industry strands are identified under the term 'Chemical Sciences'. These are Basic Chemicals, Fine Chemicals, and Speciality Chemicals.

Basic Chemicals are predominately represented by commodities (such as salt and fertilisers) and the 'building blocks' of other production processes (such as petrochemicals, man-made fibres, plastics, or industrial gases). They account for the bulk of global chemical sales and around 40% of revenues within Scottish chemicals industries (Chemical-Sciences-Scotland, 2012). Chemical Sciences Scotland (2010; 2012) identify seventeen manufacturers operating exclusively within the area of basic chemicals and a further six that operate across this and a range of other areas. This segment is capital intensive, with a strong focus on quality, cost-efficiency, and productivity. Thus, the primary driver for the sector is price. This means that the sector has high barriers to entry, and is not typically a market for new ventures. Instead, basic chemicals production is dominated by "well-established organisations with global parents based outside Scotland; Scottish operations are mainly manufacturing plants, part of their parents' global supply chain, with limited local autonomy over marketing and business development issues" (Chemical-Sciences-Scotland, 2010: 6).

The term 'Fine Chemicals' has a significant degree of definitional overlap with the pharmaceuticals sub-sector of the Scottish Life Sciences industry. This causes some difficulties in accurately separating activities between the two. Broadly speaking, the portion of pharmaceutical activity exclusively assigned to the 'Life Sciences' label is that which revolves around clinical trials of pharmaceutical research for medical and

healthcare markets. However, drug development activities centred around other specialist markets often intersect across Life Sciences and Chemical Sciences sectors. Examples here include areas such as agrochemicals and pesticides, which could potentially be counted under both headings. The 'Speciality Chemicals' label is more distinct. This includes chemicals or chemical processes that have been developed for a particular application. Examples include specialist paints, food additives, or water treatment chemicals for the oil and gas industry. Owing to its diversity the Speciality Chemicals sector is particularly fragmented (Chemical-Sciences-Scotland, 2010). This gives vastly increased scope for new product applications, providing niches that SMEs can more easily exploit. As such, the sub-sector is comprised of three firm types. The bulk of these are specialist SMEs. A second group concerns "Scottish Origin" firms that have been taken over by foreign-owned companies. The third comprises specialist manufacturing sites that have been set up by leading multinationals (Chemical-Sciences-Scotland, 2010). Chemical Sciences Scotland identified sixty-three dedicated Specialist Chemical manufacturers operating in Scotland in 2010.

4.6.4 – Summarising Industry Overviews

Broadly speaking, the selected industries outlined above share a number of common aspects. Firstly, technology firms in all three industries are typically R&D intensive in nature. Secondly, all industries require highly specialised technical labour sources. Thirdly, given the first and second points, all three industries are heavily reliant on linkages with Scotland's HEIs, with reference to both education and research capacities. Fourthly, their firms typically need to look beyond domestic markets for customers. And, finally, the three industries reflect the wider Scottish innovation ecosystem in that they are predominately populated by large internationally owned firms and populations of highly specialist small firms.

Clearly, however, no two industry contexts are the same. The three sectors selected here have some notable contextual differences. Of the three sectors, the Life Sciences industry is the most reliant on public sector and HEI research activities and facilities for support in generating new knowledge. As a consequence, the issue of alignment

between public and private sector is one that lies at the heart of Life Sciences industry strategy. However, the key issues for the industry do not so much concern the generation of new research, but rather the challenges surrounding how R&D is commercialised. Many Life Sciences firms are required to undergo lengthy processes of experimentation, research, clinical trials, and regulatory approval. This means that research outputs typically face a long road to market. During what can be a lengthy early development period, firms are often entirely funded by investment rather than revenues, meaning that they are highly susceptible to gaps in funding. Consequently, Life Sciences firms in Scotland (and globally) have high attrition rates (Life Sciences Scotland, 2011). As such, the key contextual challenges for Life Sciences industries are identified here as firstly relating to the availablity of long-term *investment* support, and secondly, to the *design of business models* that might mitiage the risks inherent within the sector.

In contrast, the primary contextual issues within the Scottish Optoelectronics sector are primarily *market* related. Scotland already possesses many of the manufacturing capabilities required to design and produce components and products for laser-based applications. And, while the Optoelectronics maintains strong links with HEI research departments, private firms tend to undertake much of the R&D in-house. However, with in excess of 90% of Scottish laser-based outputs being sold to export markets (Scottish Optoelectronics Association, 2010), the defining challenges for firms reside in accessing and building relationships with international supply chains. Given that laser-based applications have rapidly overtaken laser products themselves, this challenge is particularly relevant in terms of how firms access global Original Equipment Manufacturer (OEM) markets. To this end, Scottish Optoelectronics firms also face challenges surrounding the development of quality standards that are suitable for international supply chains.

Finally, Scottish Speciality Chemicals firms typically operate at the high end of the value chain and tend to be focused on market niches or on a special product class. Their specialist nature and the expertise requirements associated with this means higher barriers to entry and, consequently, typically higher margins. Many Speciality

Chemicals firms in Scotland are tied in some form to the Oil and Gas industry, meaning that Chemical Science ventures have stronger domestic sales markets than both Life Sciences and Optoelectronics industries. Given the focus on niche products, Chemical Sciences Scotland (2012) identify *innovation* as the primary issue within the sector. This emphasises the development of new products, applications, services, and processes.

4.7 – CHAPTER SUMMARY

The principal aim of this chapter was to contextualise the study of TMT formation and development within the wider Scottish Innovation System. The discussion focused on historical, spatial, institutional, and industry dimensions of context (Welter, 2011). To achieve this aim, it was firstly important to frame Scottish technology industries within a wider consideration of regional industry emergence, agglomeration, and clustering. The subsequent review of the SIS depicted some notable strengths – particularly in the initial generation of knowledge – and a number of challenges, relating principally to the alignment of public sector and commercial objectives, and to the provision of support for indigenous growth. Finally, sector specific overviews sought to further embed the research within the business contexts selected for study.

5. RESEARCH METHODOLOGY

5.1 – INTRODUCTION

This chapter discusses the research methodology utilised to examine the phenomenon of TMT formation and development. It opens by outlining the objectives of the research and reintroducing the research questions. The foundations of the methodological approach are first discussed in conjunction with the ontological and epistemological assumptions underpinning the study. Here, principles of interpretivism and of social construction are predominately emphasised. A research design comprising of multiple case studies is outlined as the primary approach utilised to collect and analyse rich, context-embedded data, towards the aim of emergent theory building. Next follows a detailed discussion of the purposeful sampling approach and the sampling criteria employed in the study. Data collection methods are then outlined, detailing semi-structured interviews and secondary analysis of both career histories and critical firm events as the primary means employed. Finally, the chapter provides a comprehensive account of the data analysis process, which presents a cross-case analysis of eighteen TMT development timelines narratives.

5.2 – REVIEWING RESEARCH OBJECTIVES

The aim of the research was to explore TMT formation and development within technology-based entrepreneurial ventures. Specifically, the study reconceptualised TMT development as a non-sequential series of reconfigurations determined by how existing teams made decisions in response to their surrounding environmental conditions. In this sense, the aim was to address ahistorical and aspatial accounts of TMT development by examining the determinants and mechanisms that underpin its "path-dependent, contextual, and idiosyncratic nature" (Breslin, 2008: 131).

The key research questions here surrounded *how* and *why* high-technology venture TMTs develop in the ways that they do (Edmondson and McManus, 2007). Specifically, these were:

1. ***How do technology-based TMTs emerge?***

2. ***How does the modification and ongoing development of technology-based TMTs occur in conjunction with the wider business context?***

Research questions were aimed at encouraging inductive theory building. Here, theory is defined as a "coherent explanation of observed or experienced phenomena" (Gioia and Pitre, 1990: 587). Thus, theory building is considered to be the process by which explanatory representations of phenomena are generated. As part of this approach, the thesis forwards a number of research propositions, which were generated from the key findings.

An exploratory approach is significant in light of a) the substantial body of critique that surrounds existing lifecycle-based theories as a realistic conception of TMT development (Beckman and Burton, 2008; Levie and Lichtenstein, 2010), and b) the existing body of literature – most notably that which discusses human capital theories – that indicates noteworthy historical and spatial influences on entrepreneur, and, by extension, the team (Burton et al., 2002; Harrison et al., 2004; Sorensen and Fassiotto, 2011). The suggestion here is that examination of the historical origin of teams, their interaction with their regional context, and any impacts on TMT development behaviours represent important elements of the empirical phenomenon; elements that are only partially addressed by the assumptions of current theory (Eisenhardt and Graebner, 2007). Research questions were approached in the following manner:

1. ***How do technology-based TMTs emerge?***

To address this question, the study examined career histories of founding and early core members within each TMT. Career history data were collected for all founders, appointed managers, and appointed board members within the eighteen TMTs examined. Collection was initially conducted through secondary sources, most notably self-reported career histories published on *Linked-In* and on company

websites. Subsequently, career history data of core members were discussed throughout the in-depth interviews with either the member in question or with an individual that was a direct colleague of that core member. Therefore the emphasis on rich and complex data collection was maintained throughout (Eisenhardt and Graebner, 2007). This data served two purposes. Firstly, it satisfied what is the established means of assessment for human and social capital levels within TMTs, namely prior career experiences. Secondly, it encouraged the study to build a picture of dominant sources of human capital incubation within the region, thus encouraging the emergence of specifically regional findings and observations from the data (Freeman, 1986; Burton et al., 2002; Cooper and Park, 2008; Sorensen and Fassiotto, 2011).

2. ***How does the modification and ongoing development of the TMT occur in conjunction with the wider business context?***

This research question is addressed through the examination of overall development narratives for each of the eighteen TMTs within the sample. Qualitative interviews and secondary sources were combined to construct a timeline of TMT development in the context of venture development in general. The analysis identified points of where TMTs were reconfigured. Ninety-seven reconfiguration events were identified throughout the sample. A cross-case analysis of all ninety-seven reconfiguration events allowed distinctive behaviours and actions to be coded. The coding process led to the development of discussion themes. These themes formed the basis of an emergent conceptualisation of TMT development.

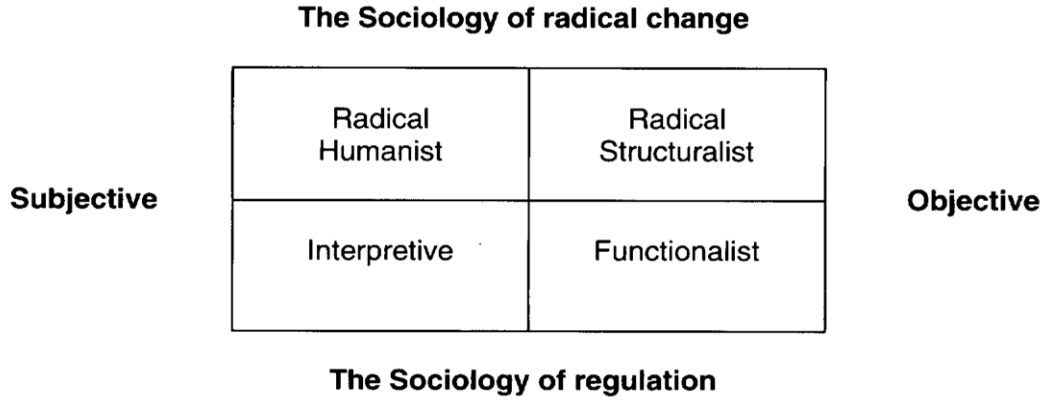
The two strands of analysis were then combined in Chapter Eight. This portrayed empirical examples of an overall emergent conceptual model in practice, and encouraged a closing discussion of how the phenomenon functions as a context-embedded process.

5.3 – UNDERPINNING PHILOSOPHICAL ASSUMPTIONS

"Either explicitly or implicitly, researchers base their work on a series of philosophical assumptions regarding ontology, epistemology, and human nature, which have methodological consequences" (Jennings et al., 2005: 145). Despite this, it has been noted that articles published in the small business and entrepreneurship field display a tendency towards omitting any discussion of the author's ontological and paradigmatic position (Grant and Perren, 2002). This section moves to discuss and overview the assumptions underpinning the approach taken by the present study. Two principal concepts are key to this discussion. The first concerns the view taken on epistemology, which addresses the nature of knowledge and what knowledge is considered to be. The second concerns the ontological stance taken, which addresses how the study views the nature of reality. Together, the position taken on these concepts reflects the guiding principles through which the research was approached (Guba and Lincoln, 1985).

The philosophical assumptions made by researchers have a great bearing on the type of knowledge that a study contributes and how theory is subsequently developed (Grant and Perren, 2002). The key here is to appropriately align the assumptions surrounding the type of knowledge that is being (or is attempted to be) developed with the assumptions of the research approach. In this sense, research approaches should be grounded in paradigmatic assumptions that are consistent with the organizational phenomena under study (Gioia and Pitre, 1990). Here, the paradigm is defined as a categorisation of an overall worldview, which reflects underpinning beliefs concerning the nature and study of phenomena. One commonly applied categorisation of underpinning paradigmatic assumptions utilised within organisational and business research is that of Burrell and Morgan (1979; 2003). Using a matrix to position categories across a spectrum of objective to subjective and 'regulation' to 'radical' – which details a range of views on society as being reflected either by social order or by inherent conflict – Burrell and Morgan (1979; 2003) were able to identify and define four dominant paradigmatic positions (See Figure 5a). This provides a basis for the discussion outlined here.

Figure 5a: Dominant Research Paradigms



Reproduced from Burrell and Morgan (2007). Sociological Paradigms and Organisational Analysis

Typically, discussions concerning the philosophical assumptions of research in the social sciences begin by referring to the differences between paradigmatic extremes. This is a logical approach, because it firstly positions what the underlying assumptions of the research approach are *not*, before opening a more detailed discussion of what they are. The first discussion concerns Burrell and Morgan's (1979; 2003) categorisation of the 'functionalist' paradigm. This stance advocates a realist view of ontology, where social reality is external to and independent of the cognitive structures of human investigators. In short, the social world is seen to exist separately from those that inhabit it, and hold its own rules, structures, and norms. The epistemological stance of the functionalist paradigm underlines knowledge as an objective and neutral representation of the empirical world. The focus here is on the creation of universal principles that can be used to extrapolate or predict findings across contexts (Benton and Craib, 2001). Crucially, the generation of new theory from a functionalist perspective is rarely practiced. Instead "theory refinement is the watchword" (Gioia and Pitre, 1990: 590). These assumptions reflect how the social sciences inherited their epistemological orientation from the scientific research methods associated with the physical sciences. Concerning the field of entrepreneurship specifically, this functionalist legacy has been carried through from the more established fields that underpin entrepreneurship research's trans-

disciplinary background, for example economics (Bygrave, 1989). These roots see the vast proportion of theory and research within the entrepreneurship field originating from functionalist assumptions (Chell, 1998; Grant and Perren, 2002; Jennings et al., 2005).

There are a number of reasons why this study is not approached from functionalist principles. In the main, these reasons concern the functionalist focus on the creation of knowledge as social 'facts' and the assumption of social stability in the application of these facts (Gioia and Pitre, 1990). The danger is that the search for taken-for-granted axioms can disproportionately influence the manner in which issues are explored and in which knowledge is created to explain these issues (Aldrich, 2000). Many complicated, socially embedded, phenomena can prove difficult to approach through the rules of what Burrell and Morgan (2003: ix) refer to as 'functionalist orthodoxy'. In particular, Gioia and Pitre (1990: 590) contend, "the study of phenomena such as sensemaking, meaning construction, power, and conflict becomes very awkward to handle using any immutable objectivist framework. What is 'out there' becomes very much related to interpretations made 'in here'".

Clearly, given this study's critique of universalistic lifecycle principles, a functionalist perspective is likely unsuitable as an underpinning rationale. Instead, the research questions and approach taken lend themselves more readily to the principles of an interpretive paradigm. The assumptions of interpretivism emphasise how individuals interpret reality from their own particular worldview (Jennings et al., 2005). The approach champions the meanings and interpretations that respondents ascribe to their actions (Benton and Craib, 2001). This is useful for gaining understanding of how research subjects interpreted external stimuli and how they made decisions – in this case, decisions to modify the TMT or not – to accommodate those stimuli.

5.3.1 – An Ontological Stance

This study emphasises social reality as being co-constructed by individuals who interact to create understanding of the world that they occupy. It is considered that

they do this primarily through agency and through the use of linguistic or symbolic tools used to make sense of the world (Berger and Luckmann, 1966). However, while social construction is emphasised as foundational rationale for the research, it is important to further specify some elements of the ontological position taken. The view taken by the study is that the social world cannot be completely reduced to an artificial state where it is constructed *entirely* by linguistic or discursive actions. It is considered that social reality is partially shaped by the mechanisms used to understand it, but that it also retains an independence from those mechanisms. This position shares its ontological principles with stances such as Critical Realism (Bhaskar, 1989) and with recent work on the use of Pragmatism and Realism within entrepreneurship research by Watson (2013). It must be noted that the term 'realism' here does not imply an objectivist position, and that both stances maintain a strong social constructionist ontology (Fleetwood, 2005; Watson, 2013). The phrase "it is no contradiction to say something is socially constructed and also real" (Fish, 1996: 23) sums up this point well. Thus, the research is approached from the assumption of a single social reality that is made up of multiple interpretations, which are in a constant state of flux (Fleetwood, 2005). Here, reality is constantly reshaped and reinterpreted (Burrell and Morgan, 1979). Moreover, it assumes that there is interplay between human agents and the contexts that they occupy. This means social reality both shapes and is shaped by its inhabitants (Ackroyd and Fleetwood, 2000).

The significance of these assumptions for the this study is that they imply a sensitivity both to a) how the members of the TMT perceive and understand their experiences, and b) how the social context in which their actions occur may affect behaviours. The fundamental rationale for the approach stemming from this stance is summed up well by Drakopoulou Dodd and Anderson (2007: 343) who state "societies neither determine entrepreneurs, nor do entrepreneurs determine society, but they may have considerable impact on each other". Ultimately, this underpinning ontological stance emphasises an ongoing interaction with surrounding context as a key feature of TMT development as a phenomenon.

5.3.2 – An Epistemological Stance

Gioia and Pitre (1990: 588) stress that the "goal of theory building in the interpretative paradigm is to generate descriptions, insights, and explanations of events so that the system of interpretations and meaning, and the structuring and organizing processes, are revealed". From an epistemological perspective, this places the knowledge creation focus upon the actors themselves (Cohen et al, 2000). Here, research aims are concerned with exploring the historically bound, and culturally contextualised, meaning of human perspectives and interactions. An interpretative epistemology sees knowledge coming in to existence through examination of how actors engage with their world, rather than through the discovery of independent truths. Here, the actors under investigation are considered to be sensemaking subjects rather than rather than independent objects of study (Elliott and Wattanasuwan, 1998). Research subjects use mechanisms such as narrative storytelling to construct and make sense of their realities, thus creating the opportunity to uncover knowledge about a phenomenon (Gioia and Chittipeddi, 1991).

Key to the extraction of knowledge under the interpretative principles adopted by this study is the preservation of these unique empirical accounts (Gioia and Pitre, 1990). However, interpretation of information and events through analysis, classification, and modification of patterns in the data also represent key elements of how knowledge is created. In this sense, researcher interpretation becomes an integral part of the knowledge extraction process. Access to, and observation, description, interpretation, and theorization of subject accounts is mediated by the conceptual resources held by the researcher (Fleetwood and Ackroyd, 2004). Thus, *a priori* knowledge can influence the inductive process of collecting respondent accounts even before these accounts are formally engaged with existing theories as part of the theory-building process.

The difficulty in capturing a range of interpretations means that knowledge of a social phenomenon is considered to be imperfect. This study originates from the stance that knowledge is in a state of flux, and that understanding and extraction of knowledge from a social phenomenon is an "iterative and ongoing" process

(Ackroyd and Fleetwood, 2000: 14). It is through the consensus of informed perspectives and of rigorous interpretations of those perspectives that the 'truth' of a phenomenon is established. As Gioia and Pitre (1990: 588) put it "it would be useful for theory building to be viewed not as a search for truth, but as more of a search for comprehensiveness stemming from different worldviews". In a similar vain, the study does not seek to establish "'correct' or essentially 'true' conceptions" but to "develop ones that are most likely to be helpful to developing knowledge about 'how the world works', which has the potential to inform human practices" (Watson, 2013: 24).

While the study predominately utilised subject narratives as a means of gathering data, it follows the direction of Eisenhardt and Graebner (2007) in avoiding the use of the term "qualitative research" as a description of the approach used to gather knowledge. This is in recognition of the fact that the term qualitative can still imply a range of epistemological assumptions. Instead, the decisions on what knowledge is considered to be is driven by the nature of the phenomenon under study and the mode of theorising, not a specific type of data. Indeed, data other than respondent narratives – for example, archival data – were used to support and create convincing knowledge claims.

5.4 – CASE STUDIES AS A RESEARCH APPROACH

The study adopts a multiple case-study approach as the primary means to contribute to knowledge. A case study is "an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident" (Yin, 2003: 13). In this sense, the approach was suitable for focus on the interaction between TMTs and their surrounding environments. The use of case studies was also greatly influenced by the pursuit of 'how' research questions (Yin, 2003) as well as by the objectives surrounding theory building. The research strategy largely followed the principles of Eisenhardt and Graebner (2007) in using case studies as a means of inductive theory generation. This meant that the study was primarily located in a 'context of discovery' rather than in a 'context of justification' (Symon and Cassell, 1998), with

the theoretical contribution emerging at the end rather than the beginning of the research (Eisenhardt, 1989).

However, importantly, unlike purportedly grounded or purely phenomenological approaches, this study does not claim to suspend theoretical or personal preconceptions (Suddaby, 2006). In the approach utilised here, conceptualisation of theory was considered to be an essential partner to empirical work. So, while the study was exploratory in nature, a priori development of constructs, which emerged through examination of extent literature, encouraged an initial structure by which to shape and make sense of the empirical descriptions of phenomena (Lopez and Willis, 2004). This aided theoretical engagement and formed the basis for an iterative 'back and forward' analysis between theoretical constructs and emergent empirical data (Guba and Lincoln, 1985; Eisenhardt, 1989).

The aim of the literature review was to raise issues and present a plausible conceptual argument surrounding how historical and spatial context is likely to influence TMT formation and development. Case studies offered a means firstly to illustrate this theoretically conceptualised phenomenon in action (Siggelkow, 2007), and secondly to sharpen existing and develop new constructs in line with empirical data (Berglund, 2007). Of course, a small number of case studies (relative, for example, to a large-scale questionnaire research strategy) cannot prove a theory in the sense that a certain phenomenon will always occur in a certain manner. Instead, the aim of the approach was to get closer to theoretical constructs as they occurred in their real life environment, thus presenting a persuasive argument concerning the phenomenon in action (Siggelkow, 2007).

Specifically, the research strategy employed multiple case studies. This allowed for description, illustration, and analysis of the TMT formation and development phenomenon across multiple settings within the given regional context. The study employed replication logic in using each case study as a means to corroborate or refute inferences made from previous ones (Eisenhardt, 1991). Notable emergent findings were assessed in terms of how they were replicated across the data

collection and analysis, as opposed to being idiosyncratic to a particular case (Eisenhardt, 1991; Yin, 2003; Eisenhardt and Graebner, 2007). In this way, multiple case studies encouraged theoretical propositions to be grounded in a variety and range of empirical evidence, making emergent findings more robust than those developed from the study of singular settings (Eisenhardt and Graebner, 2007). The difficulty here was, of course, the presentation of large amounts of descriptive empirical data and how the wide variety of notable details occurring across cases would fit in to a presentable theoretical conception of the phenomenon (Eisenhardt and Graebner, 2007; Siggelkow, 2007). To this end, the study attempted to present those observations that were most replicated across the cases. Ultimately, the findings developed from analysis of complex processes within multiple settings could not fully reflect reality, simply because the level of complexity erodes their usefulness. Instead, the research attempted to synthesise dominant and contrasting observations, attaching them to and scrutinising them against existing theory in order to present digestible and plausible conclusions.

5.5 – DEVELOPMENT OF THE SAMPLE

5.5.1 – Theoretical Sampling

The difficulties that case-study based studies face in producing generalisable findings are frequently underlined as somewhat of a criticism of the approach (Sjoberg et al., 1991). There can be a sense from some quarters that probability sampling, extracted from a randomly selected population and typically associated with statistical analysis, offers a more objective, or even more rigorous, method of gathering research subjects. Siggelkow (2007: 20) notes that this occasionally appears to put pressure on case-based researchers to "defend themselves against nonrepresentativeness", or even to "try to claim that they have a representative sample" as a means to make stronger claims to generalisability. However, as Siggelkow goes on to argue, a claim of representativeness in a sample of case studies is largely unnecessary, and only serves to signify a mismatch between method and goals. Put simply, the aim of this research approach is develop theory, not to test it with a representative sample. Instead, the knowledge created here is associated with highly contextualised accounts of TMT formation and development processes. The

fact that this approach is likely to constrain generalisability simply represents an unavoidable methodological trade-off.

Rather than claiming representativeness, the utilisation of a case study based research strategy means that any explanation of sample selection largely entails a defence of case choices. Consistent with established literature on theory building from case studies (Eisenhardt, 1989; Yin, 2003; Eisenhardt and Graebner, 2007) this study relied on theoretical sampling in order to gather its empirical subjects (See Figure 5b for a comparison of purposeful and probability sampling technique characteristics). Often used interchangeably with the term purposeful sampling, this approach principally selected cases on how they were judged to satisfy the needs of the research (Patton, 2002) and the extent to which they offered an "opportunity to learn" (Stake, 1994: 243). In particular, the theoretical sampling approach selected cases based on their relevance to the research questions (Flick, 1998; Teddlie and Yu, 2007) and for their suitability in "illuminating and extending relationships and logic among constructs" (Eisenhardt and Graebner, 2007: 27). In short, the purposeful selection of cases is view here as a positive for a theory-building approach, rather as a source of selection bias (as it would be viewed under the principles of probability sampling).

Focus was placed on case choices that would raise central issues concerning TMT formation and development. This is as opposed to a choice of cases specifically on the basis of their particular uniqueness, as is often be the rationale for selection within particularly small sample or single case-based research (Siggelkow, 2007). In this sense, theory development was encouraged through the cases as a set and how these replicated or counter-replicated key observations across that set (Yin, 2003). Central to this approach was the notion of gradual selection, where the sample evolved as data were being collected (Flick, 1998). To achieve this, snowball sampling was also utilised to forge links with other suitable cases. This encouraged an iterative, back and forward approach where theory, analysis, and sampling occurred concurrently and interactively throughout the research process (Mason, 1996).

Figure 5b: Comparison Between Purposive and Probability Sampling Techniques

Dimension of Contrast	Purposive Sampling	Probability Sampling
Other names	Purposeful sampling Nonprobability sampling Qualitative sampling	Scientific sampling Random sampling Quantitative sampling
Overall purpose of sampling	Designed to generate a sample that will address research questions	Designed to generate a sample that will address research questions
Issue of generalizability	Sometimes seeks a form of generalizability (transferability)	Seeks a form of generalizability (external validity)
Rationale for selecting cases/units	To address specific purposes related to research questions The researcher selects cases she or he can learn the most from	Representativeness The researcher selects cases that are collectively representative of the population
Sample size	Typically small (usually 30 cases or less)	Large enough to establish representativeness (usually at least 50 units)
Depth/breadth of information per case/unit	Focus on depth of information generated by the cases	Focus on breadth of information generated by the sampling units
When the sample is selected	Before the study begins, during the study, or both	Before the study begins
How selection is made	Utilizes expert judgment	Often based on application of mathematical formulas
Sampling frame	Informal sampling frame somewhat larger than sample	Formal sampling frame typically much larger than sample
Form of data generated	Focus on narrative data Numeric data can also be generated	Focus on numeric data Narrative data can also be generated

** Reproduced from Teddlie, C. and F. Yu (2007). "Mixed Methods Sampling: A Typology With Examples."*

5.5.2 – Application of Sampling Criteria

The sampling process applied various forms of inclusion criteria in order to ensure that selected cases accurately reflected the phenomenon under investigation. The study utilised a number of technology industry experts to help shape the sample (Tushman and Katz, 1980). On the recommendation of one industry expert, an initial sample of possible respondent firms was gathered through access to Scottish Enterprise 'key sector' databases. Three key high-technology industries were selected (Life Sciences, Optoelectronics, Chemical Sciences).

This yielded an initial sample of 684 possible respondent firms. Consistent with calls for researchers to state clear selection criteria for samples (Lyon and Sepulveda, 2009), possible cases were included according to the following characteristics:

Table 5a: Eligible Cases Breakdown

INDUSTRY	ELIGIBLE CASES
LIFE SCIENCES *Drug Discovery and Development* *In-Vitro Diagnostics* *Medical Devices and Specialist Manufacturing*	**74**
CHEMICAL SCIENCES *Manufacturing Processes* *Oil and Waste Treatment*	**12**
OPTOELECTRONICS *Photonics and Laser Applications* *Display Technologies*	**18**
TOTALS	**104**

- **The TMT was managing a firm that was founded and had operations within Scotland:**

In line with research aims that emphasise the interplay between TMTs and their historical and spatial context, cases were selected on the basis that they operated within the chosen context of Scotland. The primary rationale here was that focus on TMTs within a single region encouraged consistency across key labour market and environmental conditions.

- **The TMT was managing a firm that specialised in technology-based products, services, or core operations.**

The study defined a high technology venture as a firm relying on technology intensive goods or applications. Key here was a significant focus on research and development (R&D) activities. Although no quantifiable R&D-intensity measures were applied (see Almus and Nerlinger, 1999: who discuss OECD classifications),

core operations of each firm in the main sample were scrutinised, and a judgement was made on their R&D activity level. In practicality, this largely entailed the exclusion of firms that were peripheral services attached to high technology industries; for example, specialist intellectual property lawyers, consultants, or contract research organisations. A surprisingly large amount of the firms identified in the main sample proved to be peripheral or supporting services only.

- **The TMT managed a firm that had been founded for at least three years and was no older than ten years.**

The sampling frame purposefully selected TMTs within young firms. This was principally because the study was focused on TMT formation and development within entrepreneurial ventures. Practically speaking, the data required to construct a reliable TMT development timeline typically became more difficult and complex to collect for older firms. The rationale for the lower firm age threshold of three years was that TMTs in firms younger than this age were likely to lack a rich enough development story during what can often tend to be relatively inactive formative years.

- **The TMT managed a firm that was founded as an independent entrepreneurial start-up**

Only independently founded firms were included in the sample, defined here as "firms without prior structural existence or major control influence from external firms" (Almus and Nerlinger, 1999: 144). Of course, a judgement had to be made on what constituted 'major control influence'. For example, entrepreneurs could maintain strong ties with the former incubators from which they spun-off. University spinouts in particular may face influence from their host institutions, most notably over intellectual property issues. It was, of course, a primary aim of this study to investigate the influence of historical incubation. The final judgement for this criterion emphasised independence. While selected entrepreneurs and their ventures could maintain links with former incubators, they were also independently managed. On this basis, the sampling criteria excluded firms that were a branch or subsidiary of

Table 5b: Summary of Cases at Culmination of Data Collection (December 2011)

Case	Foundation Year	Primary Activities	Technology and Firm Foundation Source	Founding Team Size	TMT size (at end of collection)
LS1	2005	Medical Devices	University Spinout	2	4
LS2	2007	Drug Development	University Spinout	2	6
LS3	2007	Consumer Medical Products	Private Sector Spinout Combined with Academic Research	2	5
LS4	2006	Medical Devices/ Software	Private Sector Spinout Combined with Academic Research	3	3
LS5	2003	Medical Devices	University Spinout	1	3
LS6	2006	Drug Development	Start-up (License Purchased)	3	3
LS7	2003 (Entered Administrati on 2010)	In-vitro Diagnostics/Medica l Devices	University Spinout	1	2
LS8	2004	Drug Development	University Spinout	1	5
LS9	2002	Medical Devices	University Spinout	3	3
OE1	2004	Display Technologies	Private Sector Spinout	1	4
OE2	2007	Display Technologies	Start-up (Independent Inventor)	2	1
OE3	1994 (Acquired 2003)	Experimental Laser-based Applications	University Spinout	3	3
OE4	2006	Experimental Laser-based Applications	Private Sector Spinout	3	7
OE5	2007	Energy Production Applications	University Spinout	3	5
CH1	2005	Chemical-based Products (Paints)	Private Sector Spinout	2	2
CH2	2007	Waste Treatment Technologies	Start-up (Independent Inventor)	2	3
CH3	2004	Chemical Manufacturing Processes	University Spinout	3	4
CH4	2002	Chemical-based Products (Oil Treatment)	University Spinout	2	2

a larger international technology-based organisation. After application of the sampling parameters, the original sample of 624 possible cases was reduced to 104 possible cases. Table 5a shows the breakdown of cases by industry.

5.5.3 – Gatekeepers and Snowball Sampling

The challenge of recruiting respondents was first approached by contacting key gatekeepers, or boundary-spanning individuals (Tushman and Katz, 1980). Initially these were Scottish Enterprise account directors for each of the technology industries under investigation. These individuals had first hand experience as observers and advisors for many of the firms identified in the eligible sample. Gatekeepers were provided with an outline of the study aims and agreed to contact those firms on the sample list with whom they had a relationship. Contact with three industry experts – serial entrepreneurs, investors, and board members who were particularly active within the chosen industries - was also secured through gatekeepers. The study followed a snowball sampling approach, which is defined as "a technique for gathering research subjects through the identification of an initial subject who is used to provide the names of other actors" (Atkinson and Flint, 2004: 147). A total of twelve respondents were secured through recommendations made by the initial six boundary-spanning individuals. A further three were recruited through a general email to firms within the identified sample. Following Denzin and Lincoln (1994) each interviewee was asked to recommend another possible respondent. A final nine case respondents were recruited through recommendations made by interviewees in the main sample. This recruitment process was ongoing and overlapped with data collection and the early stages of analysis.

A preliminary telephone interview with a TMT member who held a position of strategic importance (typically a founder or chief executive officer) was conducted in order to determine alignment with selection criteria, level of access, and to make a judgement on theoretical usefulness. Thus, the approach continued with theoretical sampling principles. Respondents were also asked to identify, by name, the other members of the TMT, leading to further interviews within each case, and working in

conjunction with the collection of secondary evidence of TMT development activity. The primary challenge to the gathering of respondents proved to be in the securing of multiple interviewees within one case rather than gaining initial access to more cases. Six cases were eventually rejected. This was chiefly on the grounds that the firm lacked the data to contribute to the study aims. Ultimately, eighteen cases were constructed from a total of thirty-two interviews. A number of interviewees, particularly those who were active board members or investors were able to offer a perspective on TMT development activity in more than one firm. Sampling was conducted in order to achieve replication and comparability across observations in similar and contrasting cases (Teddlie and Yu, 2007). As such, the number of cases was decided upon the point of saturation, where no new insights were being raised from further data collection (Krueger and Casey, 2000). The final sample of cases used in the study is summarised in table 5b.

5.6 – DATA COLLECTION METHODS

Data were primarily collected through semi-structured interviews with informants that had "directly experienced the phenomenon of interest" (Patton, 1990:104). Interviews were selected as the main collection method because they represent "a highly efficient way to gather rich, empirical data, especially when the phenomenon of interest is highly episodic" (Eisenhardt and Graebner, 2007: 23). All but one case contained interviews from the perspective of more than one participant (See Table 5d). The collection of multiple perspectives was aimed at reducing overreliance on single narratives (Kumar et al., 1993). Primary data were supported and corroborated through the collection of information from secondary sources. Component elements of the data collection procedure are discussed in the following sections.

5.6.1 – Key Informant Interviews

In addition to their role in facilitating the process of snowball sampling, interviews with public sector gatekeepers also acted as general 'key informant' interviewees. These interviews provided important discussions concerning the prominent issues addressed by the study. Additionally, they acted as a form of pilot interview used to

Table 5c: Key Informants and Gatekeepers

ASSIGNED NAME	EXPERIENCE AND ROLES	DATA COLLECTED
KEY INFORMANT 1	Former Tax Consultant; Project Manager Enterprise Agency; Head of Recruitment Scottish Talent Attraction Agency	Face to Face Interview (60 Mins) Early 2010
KEY INFORMANT 2	Former Research Scientist; Enterprise Agency Life Sciences Advisory Team; Head of Int. Life and Chemical Sciences Development	Face to Face Interview (60 Mins) Early 2010 Follow up Interview on Case LS8 Mid 2011
KEY INFORMANT 3	Former Engineer; Operations Manager Specialist Manufacturing/Private Sector; Project Manager Scottish Optoelectronics Association; Advisor High Growth Advisory Team	Face to Face Interview (60 Mins) Early 2010 Follow up Interview on Case OE2 Mid 2011
KEY INFORMANT 4	Former Research Scientist; Int. Sales Manager Pharmaceutical/Private Sector; Commercial Director Pharmaceutical/Private Sector; Founder and Managing Director of Successful Life Science Venture; Life Sciences Investor and Consultant	Face to Face Interview (80 Mins) Early 2010 Follow up Interview on Cases LS5 and LS9 Mid 2011
KEY INFORMANT 5	Former Engineer; Commercial Manager Specialist Manufacturing/Private Sector; Commercial Director Manufacturing/Private Sector; Founder and Managing Director of Successful Manufacturing/Private Sector Venture; Investor and Consultant throughout Scottish High Tech Industries	Face to Face Interview (50 Mins) Mid 2010 Follow up Interview on Case OE5 Mid 2011
KEY INFORMANT 6	Former Research Scientist; Operations Manager Specialist Manufacturing/Private Sector; Operations Director Specialist Manufacturing/Private Sector; Director of Specialist Applications Specialist Manufacturing/Private Sector; Founder and Managing Director of Successful Manufacturing/Private Sector Venture; Investor and Consultant throughout Scottish High Tech Industries	Face to Face Interview (60 Mins) Late 2010 Follow up Interview on Case OE5 Mid 2011

shape the main interview guide. Similar interviews were also conducted with the second set of key informants, all of whom were active board members and former entrepreneurs within Scottish high-technology industries. These interviews proved particularly useful both in highlighting prominent issues and in shaping the main respondent interview protocol due to the fact that the informants had repeatedly undertaken, and, indeed, were currently undertaking, key roles in the phenomenon under investigation (Eisenhardt, 1989). In this sense, the second set of three key informants were able to offer accounts of TMT development issues that were, in some instances, recalled from very recently before the data collection period.

Interviews with key informants were collected in the form of a conversation rather than as a series of isolated statements (Kent, 1999), with open ended questions used to pursue emergent lines of discussion. They were between 50 and 80 minutes long and were digitally recorded. They were conducted either via telephone or face-to-face in the respondent's place of business or in a conveniently located coffee shop. Respondents were encouraged to choose a location in which they were comfortable in order to stimulate more relaxed and natural conversation. Interviews were anonymous, and respondents were informed of this during prior correspondence. Interviews commenced with an overview of the research and a discussion of general observations and issues surrounding the development of TMTs within Scottish high-tech ventures. The aim here was to ease respondents in to the content of the discussion. Next, the interview was aimed towards gathering context through discussions of the respondent's background experiences. Typically this would lead to a conversation surrounding prior experience and the types of human and social capital resources that were central to the management of a technology venture. Respondents were asked to provide specific examples of when they had been involved in the start-up up of a venture and the formation of a TMT, including focus on the formulation of the opportunity, the assembly of team members, initial management structures and roles, and the involvement of external parties. Finally, the interview would focus on the timing and execution of TMT development decisions, for example, management level recruitment or changes to management

structures, and how these were taken in conjunction with overall business decisions.

One particularly important feature emerging from key informant interviews was the range of specific examples of firm experiences discussed by respondents. In many cases, key informants had acted as board members, investors, or advisors within a number of the high technology firms that were identified in the sample. Of those firms discussed, a number were eventually recruited as cases within the main sample. In these cases, a return interview was conducted with the key informant in order to discuss TMT formation and development processes as they related to those specific examples. The purpose of these second interviews was two fold. Firstly, they served to corroborate and augment data on those cases with which they had involvement. Secondly, they offered an alternative perspective on TMT formation and development processes within those firms.

5.6.2 – Primary Interviews and Application of Critical Incident Technique

Semi-structured, in-depth interviews with key actors within cases represented the main element of data collection within the study. It was these interviews that primarily underpinned the TMT development timeline narratives on which the analyses were based. In the initial stages, collection of primary case interviews ran concurrently with that of the second set of key informant interviews. A total of twenty-six interviews of approximately sixty minutes in length were conducted with lead entrepreneur/founders, CEOs, or Commercial Directors. Again, these were held either in the respondent's location of choice or via telephone and were digitally recorded. In cases where a founder or owner was not interviewed, this was due to the fact that strategic or operational authority was in the hands of an externally recruited individual. In all cases, interviews were conducted with individuals in a position of considerable knowledge concerning the operations and strategy from the early stages of the venture (Miller and Toulouse, 1986).

These interviews followed a more directed approach than those conducted with general informant. In particular, the aim of the interviews was to link observations on TMT development to the context of surrounding events being experienced by the

managers of the firm. Extant literature strongly suggests that changes in management personnel, structure, or approach are likely to either precede, or occur in response to, periods of change, growth, or strategic upheaval (Penrose, 1959; Greiner, 1972). This was an important consideration in terms of how data was collected. In order to capture TMT development actions and behaviours, the study employed Critical Incident Technique (CIT) as a means of data collection. In its early form CIT assumed a positivist approach in attempting to objectively categorise behaviours occurring at particular events (Flanagan, 1954). However, more recently, the technique has been applied under the principles of phenomenology and social construction in attempting to capture subjective interpretations and thought processes underpinning reactions to events (Chell, 1998; Chell and Pittaway, 1998; Chell, 2014). It was this approach to CIT that the study adopted. The following definition of CIT was applied:

"…a qualitative interview procedure which facilitates the investigation of significant occurrences (events, incidents, processes or issues) identified by the respondent, the way they are managed, and the outcomes in terms of perceived effects. The objective is to gain an understanding of the incident from the perspective of the individual, taking into account cognitive, affective and behavioural elements." (Chell, 1998: 56)

After shaping the interview structure through pilot interviews, it emerged that respondents displayed an inclination towards focusing heavily on particular incidents, challenges, or particular periods of TMT change. While this was useful to the gathering of rich data concerning specific events, it tended to hamper the construction of a complete TMT development narrative. For this reason, primary case interviews were preceded by review of secondary data on the particular firm under investigation. Through evaluation of company records, company websites, and Nexis/Lexis searches, a preliminary incident timeline was constructed prior to each interview. This allowed a gauge by which to judge the pace of the discussion, as well as a means to prompt respondents on particular development milestones. Similarly, secondary data were compiled on TMT members and their backgrounds, primarily through company websites and through Linkedin (where background employment histories are self reported). This allowed the interview to directly enquire about instances of TMT recruitment, by raising particular names of reported TMT or board

members, upon which the respondent could then elaborate with a far more detailed discussion.

Interviews with primary cases respondents typically started with a story of the business and its development. This served to identify change events from the perspective of the respondent. The aim of the interview was for the respondent to recount their story and then to ask questions relative to that account (Chell and Pittaway, 1998; Chell, 2014). A pre-written interview guide developed from the literature review (See Appendix One) provided a set of important 'signposts' to stimulate conversation at change events. However, as far as was practical, the conversation was allowed to unfold naturally, and the interview style was unstructured enough to allow the researcher latitude to pursue what were perceived as significant responses (Potter, 1997). The focus was on the respondent's narrative surrounding TMT development in their firm. The aim was to uncover their interpretations of experiences and how these were formed in to meaningful episodes (Polkinghorne, 1988). Respondents were treated not as objects of study, but instead as sensemaking subjects (Elliott and Wattanasuwan, 1998). Here, their narratives simply represented their means of making sense of events (Weick, 1995).

Upon completion of an initial firm and TMT development timeline, the interview returned to examine the incident timeline in more detail. It was here where the theoretical issues detailed in the interview guidelines were more closely addressed. While the development timeline provided a context of development barriers and drivers experienced by the TMT, the re-examination element of the interview more closely examined the reactions and behaviours that defined changes in the management team. Respondents would be asked questions surrounding the rationale for team development decisions, their involvement in those decisions, the roles of others, the actions carried out, the implementation of TMT changes, and the challenges faced. Crucially, the construction of a firm development timeline also encouraged the examination of TMT non-development occurring around events. This meant that respondents could be questioned as to why critical periods of firm

Table 5d: Semi-Structured Interview Respondents Contained Within Cases

CASE	RESPONDENT 1	RESPONDENT 2	RESPONDENT 3
LS1	Mentor LS1; Face-to-face (60 mins); Late 2010	Technical Director LS1; Telephone (40 mins); Late 2011	N/A
LS2	Commercial Director LS2; Face-to-face (60 mins); Late 2010	Founder 1 LS2; Telephone (40 mins); Late 2011	N/A
LS3	Founder 1 LS3; Telephone (75 mins); Late 2010	Key Informant 5 (Board Member); Telephone (45 mins); Mid 2011	N/A
LS4	Founder 1 LS4; Face-to-face (60 mins); Late 2010	Founder 3 LS4; Telephone (30 mins); Late 2011	N/A
LS5	Founder 1 LS5; Face-to-face (75 mins); Late 2010	Key Informant 4 (Advisor); Telephone (35 mins); Mid 2011	N/A
LS6	Founder 1 LS6; Telephone (75 mins); Late 2010	Key Informant 4 (Advisor); Telephone (25 mins); Mid 2011	N/A
LS7	Founder 1 LS7; Face-to-face (75 mins); Mid 2010	Key Informant 2 (Advisor); Telephone (30 mins); Mid 2011	N/A
LS8	Founder 1 LS8; Face-to-face (55 mins); Early 2011	Key Informant 2 (Advisor); Telephone (35 mins); Mid 2011	N/A
LS9	Founder 1 LS9; Face-to-face (75 mins); Late 2010	Key Informant 4 (Advisor); Telephone (35 mins); Mid 2011	N/A
OE1	Founder 1 OE1; Face-to-face (60 mins); Early 2011	Key Informant 3 (Advisor); Telephone (45 mins); Mid 2011	N/A
OE2	Founder 1 OE2; Video Call (60 mins); Early 2011	N/A	N/A
OE3	Founder 1 OE3; Face-to-face (60 mins); Early 2011	Founder 3 OE3; Telephone (40 mins); Early 2011	General Manager (OE3 Strategic Partner); Telephone (30 mins); Mid 2011
OE4	Founder 1 OE4; Telephone (40 mins); Early 2011	Founder 2 OE4; Telephone (45 mins); Mid 2011	Commercial Director (OE4 Immediate Incubator); Telephone (30 mins); Mid 2011
OE5	Founder 1 OE5; Telephone (60 mins); Mid 2011	Key Informant 6 (Advisor); Telephone (45 mins); Mid 2011	N/A
CH1	Founder 1 CH1; Face-to-face (60 mins); Early 2011	Founder 2 CH1; Telephone (30 mins); Late 2011	N/A
CH2	Founder 1 CH2; Telephone (60 mins); Mid 2011	Sales Director CH2; Telephone (40 mins); Mid 2011	N/A
CH3	Founder 1 CH3; Telephone (60 mins); Mid 2011	Founder 2 CH3; Telephone (40 mins); Mid 2011	N/A
CH4	Founder 1 CH4; Face-to-face (60 mins); Early 2011	Founder 2 CH4; Telephone (30 mins); Late 2011	N/A

development were not matched with TMT modifications, or why intentions to modify the TMT may not have been carried out. This served to highlight difficulties and barriers faced in the construction of management teams.

The majority of the interviews offered a perspective on TMT development within a single firm. However, a number of the firms discussed were interlinked in some fashion, leading to some respondents making informed observations about other cases within the sample. This was particularly noted during the key informant interviews, where investor/board members who sat on multiple boards were able to contribute to the narrative of a number of the investigated TMTs. Additionally, in two cases (cases OE3 and OE4) single respondents, who were key figures in both firms, were able to provide a information on the development of two TMTs.

5.6.3 – Secondary Data Collection

The final step in the collection process returned to sources of secondary data to verify and augment details from respondent narratives. The focus here was firstly on corroborating incidents of both firm and TMT development identified by respondents. Also, as part of the collection of primary case interviews, the informant was asked to identify, by name, the other members of the TMT. Again, secondary data was used to confirm these members and their backgrounds. Supplementary documentation was gathered from company reports, job specifications, company websites, web searches and articles from mainstream media in order to compare, support, and substantiate interview data. Most companies maintained websites listing current TMT members, which provided a strong basis to compare responses from interviews. Again self-reported career histories of TMT members, derived from LinkedIn, offered an important source of secondary background data. This data was used to build a picture of the incubators that key labour sources were originating from, as well as portraying affiliations between TMT members (see Casper and Murray, 2005 for a example of secondary data being used to investiage career affiliations between scientists).

A total of eighty-three TMT members, both past and present, were identified throughout all eighteen cases. Career history data were collected on seventy-four individuals, and this information was aligned with data collected in the main interviews. Additionally, career history data were collected on a further sixty-two board members. Despite extensive collection of secondary data, complete career histories on all team members could not always be gathered. Often the chronology of careers was confirmed but the particular dates were uncertain. This was not a significant problem, because the study did not use objective measurements for human capital variable, such as 'number of years experience in a management function'. Instead, secondary data were used to bolster the narratives of primary respondents.

5.7 – DATA ANALYSIS

Detailing a transparent and well-defined process for the analysis of data represents a key element of demonstrating rigour, particularly within exploratory qualitative research (Leitch et al., 2010). This section outlines the analysis process undertaken by the study.

Consistent with the interpretative underpinnings of the study, the analysis does not claim perfect objectivity in its approach. Rather, it represents a systemised interpretation of the activities described by respondents in each case. The analysis was driven by pre-established study questions and was shaped through the use of pre-established measurement categorisations, all of which were developed from the review of existing literature (Miles and Huberman, 1994). In this sense, a broad deductive sequence underpinned the analysis of data. This is not an uncommon feature within exploratory research, with the inductive process frequently being "likely to entail a modicum of deduction" (Bryman and Bell, 2003: 12). However, while it attempted to remain attached to the theoretical concepts highlighted though the literature review, the approach championed an exploratory orientation and a willingness to both pursue promising observations and to abandon unhelpful lines of inquiry (Edmondson and McManus, 2007).

As an overall approach to data analysis, the study employed an iterative process that continuously shifted focus back and forward between existing theory and the data, thus encouraging emergent findings to be attached to existing theory (Yanow, 2004). The study followed Eisenhardt (1989) in firstly employing a within-case analysis of singular cases. It then used the concepts developed to corroborate, refute, and contrast observations made throughout all the cases in the sample (Eisenhardt, 1991; Eisenhardt and Graebner, 2007). This was aimed at uncovering trends and relationships between both the cases and the theoretical constructs towards the construction of a thematic discussion and the presentation of a conceptual model.

5.7.1 – Constructing TMT Formation and Development Timelines

The first stage of the analysis was to create detailed 'write ups' for each cases (Hartley, 1994). This required all interviews to be transcribed verbatim. As data collection and analysis overlapped, transcriptions were not all created during one particular time period. Instead, they were made only for those cases that were being written up at the time. Typically two or three cases were written up during any one period, during which time further data collection continued the process of gathering information for the construction of new cases. Transcribed interviews with case respondents represented the main foundation through which a TMT formation and development write up 'timeline' was created for each case. The writing up of cases continued the data triangulation principles undertaken during the collection phase, using secondary data to corroborate and augment statements made and events identified in interviews. Redundant information and irrelevant digressions were removed from transcribed interviews leaving what was considered to be essential information (Kvale, 1996). The essential data from each respondent were combined with secondary data sources to form a first draft TMT formation and development timeline for each case.

Timelines were firstly constructed as a chronology of critical events occurring within the observed lifespan each firm. Against these events, changes in TMT composition were identified as reconfiguration events. These changes were defined through pre-defined measurement constructs developed through the review of existing literature.

This encouraged consistency in the construction and presentation of case timelines. Categories of TMT modification were:

- **Changes to management personnel** - encompassing TMT member entry and exit

- **Changes in management structure** – encompassing significant changes to project management and operational systems, organisational layers, or management roles

It must be noted that the measurement categories for management formalisation were adapted from the organizational growth literature discussed in Chapter Four (Greiner, 1972; Churchill and Lewis, 1983; Vanaelst et al., 2006). While the literature review highlighted a number of criticisms associated with stage-based growth models, the study followed the reasoning of Levie and Lichtenstein (2010) in acknowledging that it is possible to use such categories to identify distinct stages in firm, or team, development; it is only the assumption of a predetermined order that is empirically invalid. In terms of the other measurement categories, member entry and exit represents perhaps the most fundamental and widely applied means of examining the changing state of a TMT (Ucbasaran et al., 2003). The same measure was applied to changes at board of director level in recognition of the fact that outside board members can become highly involved in the management of an entrepreneurial venture (Clarysse et al., 2007; Zhang and Baden-Fuller, 2008; Knockaert and Ucbasaran, 2013).

Identified reconfiguration events were presented in sequence, forming an overall TMT development pattern for each case. These patterns were mapped against the lifespan of the venture, and further details occurring at each change event were entered in to the timelines. Firstly, this included factual information, such as the career histories of existing and incoming members – which would build data on the human and social capital held by the TMT – or the mechanism for recruitment – which would support analysis of networking behaviour. Secondly, respondent

perspectives on events were entered, for example: the stated rationale for TMT change events, the perceived impact of the change, or the perceived factors that positively or negatively impacted the effectiveness of the change. Details in the timelines were combined with respondent narratives, and relevant quotes, taken from transcribed interviews, being inserted at these points of the write up in order to provide fuller illustrations of the behaviours and actions that impacted TMT development. This encouraged the emergence of a more coherent and detailed story of TMT formation and development events, experiences, and behaviours upon which the subsequent analysis was based (Edmondson and McManus, 2007).

The construction of formation and development timelines for each case served two primary purposes. The first was to amalgamate multiple sources of data in to one coherent and relevant document. This was helpful because a) unlike data taken directly from transcribed interviews (which was in the format of a conversation), it encouraged presentation of a clear order for TMT development events, b) it reduced emphasis on TMT development as an individual experience and placed focus on the team as the unit of analysis. The second purpose was to encourage data reduction. The volume of data gathered often proves to be a challenge to case study-based research. In the process of data reduction, the large amounts of data collected on each case were reshaped in to a more readily interpretable format (Miles and Huberman, 1994).

In order to improve the reliability of the data, final TMT formation and development timelines, including all details of critical events, member names, backgrounds, recruitment mechanisms, and entry/exit events were returned to original primary respondents to be reviewed and, if required, altered. Respondents from fourteen cases (78% of the sample) confirmed the accuracy of the data, with five of those cases requesting minor alterations. The final activity at this stage involved reading and re-reading of completed timelines for each case. This was to encourage familiarity with the details of the cases as standalone ‘stories’ (Senior et al., 2002). From here, reflective notes, which elaborated on important issues, were added to the timelines (Patton, 1990). This completed the case writes ups and formed the basis of

the within case analysis.

While completed timelines were suitable as a basis for the analysis, they remained particularly large and detailed for the purposes of presentation. This typified what is a common challenge to multiple case study research approaches; namely the displaying of large amounts of data in a manner that would present the story but not overwhelm the reader (Siggelkow, 2007). Thus, for the purposes of data display, condensed TMT development timelines were created. Exemplar condensed write-ups were also included in findings Chapter Eight as a means to empirically illustrate the conceptual findings emerging from Chapters Six and Seven.

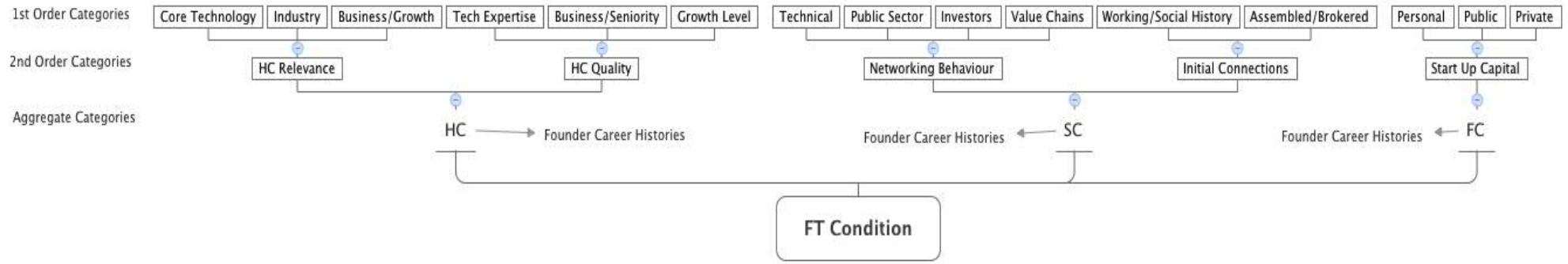
5.7.2 – Cross-Case Analysis and the Development of Themes

Individually compiled case narratives represented the within-case portion of the analysis. Next, the analysis sought to draw out thematic findings underpinning the development narratives. This aim was achieved through an initial coding process conducted on each case and then through comparison of codes across cases. The cross-case analysis process was conducted on pre-formation data – presented in Chapter Six – and post-formation data – presented in Chapter Seven. The analysis procedure was conducted as follows:

Pre-Formation Analysis:

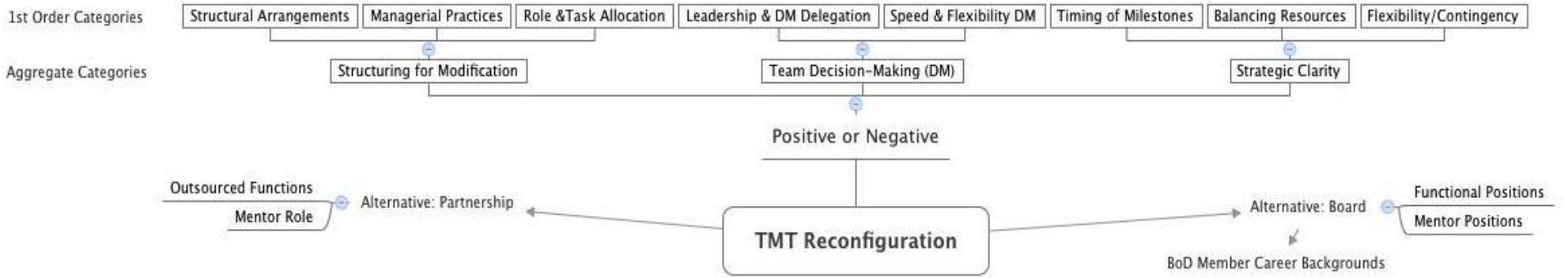
This element of the analysis sought to understand how founding teams emerged within the selected context. Specifically, findings looked to address the conditions in which TMTs initially formed. The initial analysis process was conducted on each standalone case. This sought to undercover data on the incubation sources of founding team members, identifying the types and locations of incubators evident in career histories. These discussions were then related to aspects of founding team condition. This part of the process uncovered perceptions on what constituted appropriate (or otherwise) human and social capital within a technology-based venture TMT. Perceptions were then compared across cases to create first order analysis categories (See Figure 5c for a diagrammatic representation of the analysis process). These codes were then applied to all cases in order that an assessment of

Figure 5c: Structure of Data Analysis Procedure



Pre-founding and Formation

Post-founding and Development



founding team condition could be made. This allowed a categorisation to be made for each team according to three dimensions (human capital, social capital, and financial capital).

Post-Formation Analysis:

The analysis then sought to understand the behavioural elements surrounding how TMT modification events were understood and acted upon from the perspective of the respondents (Chell, 2004; 2014). Analysis of TMT development patterns across all eighteen cases identified a total of ninety-seven critical TMT reconfiguration events. The first aim of the coding process was to identify reconfiguration events as positive or negative. Reconfigurations were deemed effective if the new influx of human resources or the new management approach adopted were supportive to the achievement of strategic direction within the venture. This is as opposed to ineffective TMT reconfigurations in which actions of modification were:

- Negative – resulting in the loss of human resources or the downsizing of operations.
- Clearly unsuccessful or quickly reversed (such as in the exit of a recently incoming new member)

In total, fifty-six reconfigurations were identified as positive and effective across the sample. The remaining forty-one reconfiguration events were identified as ineffective.

The next stage was to code actions and behaviours displayed at and around TMT modification events (See Appendix Two for coded behaviours around modification incidents with representative data). The use of a priori concepts initially acted to provide structure to the initial coding process and encouraged a systematic approach to the categorisation of empirical data. However, it must be stressed that codes were open to modification and that the coding process was an iterative one. Following Cope (2005), emergent issues were initially derived from the empirical data only,

without the explicit use of existing literature. The purpose of this was to maintain an inductive focus on theory building by allowing the data to "speak for itself" (Cope, 2003; 2005). Data were organised to correspond to the following questions at each reconfiguration event:

Reconfiguration Rationale

- What benefits were sought by the modification?
- The modification was made in anticipation of or in response to what event/scenario?

Decision Making Processes

- How did the existing team make decisions?
- What members held decision-making power?

Accommodating Reconfiguration

- How did the existing team structure itself to accommodate reconfigurations?
- What roles and task demands did new members perform

These second order categories were then compared across cases with the objective of uncovering significant patterns of similarity or difference (Eisenhardt and Graebner, 2007), with particular comparison of positive and negative events being conducted. With respect to replication and comparison, the use of critical incident technique proved effective because, while particular incidents may have been unique to each case, the categories of action taken were often common across the sample (Chell and Pittaway, 1998). This allowed the study to draw out a conceptual understanding of how existing teams make modification decisions to response to environmental stimuli.

The two analysis sections combined to underpin a final discussion of TMT formation and development as it occurs in context. Findings on formation attached this discussion primarily how regional incubators create or attract TMT labour. The

findings on reconfiguration events allowed conceptualisation of heterogeneous, context embedded narratives.

5.8 – REFLECTIONS AND LIMITATONS

As with any piece of empirical research, this study displays certain limitations. The following section addresses these limitations, the steps taken to mitigate them, and justification for methodological choices.

5.8.1 – Case Selection and the Sample

It is recognised that the nature of exploratory, interpretative research and the associated small sample size will likely inhibit the ability to generalise to some extent. This is considered to be a methodological trade-off necessary for the gathering of rich qualitative data. However, there are a number of specific features that should be addressed. Firstly, in identifying TMTs within 'Scottish high technology ventures' for the sample, some definitional clarifications must be made. The cases selected were founded and situated a variety of locations, predominately throughout the Central Belt of Scotland, and most notably in Edinburgh, Dundee, and Greater Glasgow. As such, cases were not all tied to one particular regional cluster. However, it was reasoned that the short geographical distances between firm locales, the overspill of activity between Scottish locations, and the absence of an area or cluster with particularly unique environmental conditions would allow the research to use and refer to Scotland as a single region of study. The use of Scotland as a distinct single region in comparison to other UK regions (e.g. South East England) is common throughout studies of the UK regional economy.

Similarly, the study utilised cases from three industries rather than a single sector. Thus, while the three industries selected most definitely represented the phenomenon under investigation, they a) did not represent all high technology sectors in Scotland (for example, software), and b) were likely to show at least some degree of variance in terms of the environmental and historical conditions that they imposed on cases. The three industries were chosen under the guidance of expert informant interviews in terms of how cases would reflect the R&D, knowledge, and capital intensive

nature of 'high technology' firms. It is under these terms that the label 'high tech' is used. After conducting key informant interviews it was considered that very similar descriptive themes concerning environmental conditions – such as the activity of the investment community, the thickness of labour markets, and the level of public sector support – could be seen across all three selected industries. The chief source of variance was perhaps in the business models and operations of particular firms. Most notably, drug development firms differed from other firms in their propensity to use investment rounds, rather than sales, as a primary source of income. Ultimately, this was not considered to be overly problematic because all firms still experienced clear critical events around which TMT development was conducted. Undoubtedly there was an opportunistic dimension present in the purposeful and snowball sampling methods applied. However, care was taken to ensure that cases were only selected according to the stated sample parameters.

5.8.2 – Survivor Bias in Sample Selection

The use of samples that are biased toward surviving firms is a prevalent issue within entrepreneurship research, and one that is rarely fully accounted for in research methodologies. Firms that cease to exist shortly after foundation are far less likely than firms that succeed and grow to a) be approached for information, b) provide information to researchers, and c) be included within datasets (Nightingale and Coad, 2014). However, the fact remains that early market exit is highly common amongst entrepreneurial firms, with some estimates finding that over half of new companies die within their first three years of existence (Frankish et al., 2013). The exclusive existence (Frankish et al., 2013). The exclusive reliance on surviving firms for research purposes is potentially problematic because it may distort understanding of how entrepreneurial firms function, as well as forwarding a misleadingly positive picture of their impacts on wider society (van Praag and Versloot, 2007).

Overall, the sampling frame employed within this thesis does have the disadvantage of being biased towards firms that had already survived for at least three years, and therefore had a greater than average propensity towards continued operation (Stam, 2010). This choice was driven predominately by the requirements of data collection,

which necessitated that the selected cases had a sufficient TMT development 'story' to tell. If the study had been focused (as many studies of TMTs are) on the performance implications of TMT composition, then the issue of surviving firm selection would perhaps have been more problematic. However, the focus of this thesis was instead on the origin of team members and the mechanics of team change. Both positive and negative modification incidents were identified within the analysis, meaning that positive development was not exclusively portrayed. The findings revealed the sample as containing teams both that developed into professionalised TMTs and teams that experienced highly restricted development trajectories. In short, the survival of firms did not necessarily equate with the eventual professionalisation of the team. Indeed, a number of the surviving firms examined had teams that made no sustained changes to the composition at the culmination of the analysis. Furthermore, not all of the selected cases were surviving firms. Two of the eighteen cases examined – LS7 and OE3 – had ceased to exist prior to data collection. Ultimately, however, these observations do not entirely mitigate the effects of survivor bias, and this is acknowledged as a limitation of the methodological approach.

5.8.3 – Collection of Retrospective Data

The use of semi structured interviews as a primary means of data collection for cases holds implications for the robustness of the research design. The most notable issues related to the influence of hindsight bias (Fischhoff, 1975), retrospective sensemaking (Eisenhardt, 1989), and 'image management' through self-selected reporting of data and "rationalization after the fact" (Davidsson and Honig, 2003: 311). In short, interviews were only able to report what the respondent was willing to reveal. Responses may have been subject to a deliberate or unconscious filtering process, through which informants may wish to project a certain image.

Secondly, the TMT formation and development timelines for each case relied heavily on the recalled memories of respondents. The downside here is that, in attempting to recall information, respondents may construct inaccurate, or distorted, narratives in order to make sense of the events they experienced. Formation and development

narratives collected for this study were recalled back over a number of years. For most cases, the recall period was between a maximum of four to nine years. However, one case (OE3) required respondents to recall formation events back to seventeen years prior to the conducting of the interviews. As such, this case may have been particularly susceptible to recall distortion. Nonetheless the case was retained as part of the sample for two reasons. Firstly, it provided a strong illustrative example of the findings drawn from the other cases, particularly with regards to the recycling of founding team members from a prior venture in to a new TMT (OE4). Secondly, the data collected for the case was relatively consistent across the accounts of two highly involved founders who managed the firm throughout its lifespan, as well as through supporting secondary data. For these reasons, the impact of recall bias was considered to be no more problematic as it was in other cases, or, indeed, as it is inherently to any form of retrospective narrative data collection (Cope, 2003). Furthermore, the nature of the events discussed throughout the TMT development narratives offered some form of mitigation for the effects of recall bias. By virtue of being *critical*, events were likely to be subject to more accurate recall (Chell, 2004; Chell, 2014). Significant changes to the management of the venture, and the events surrounding them, were not every day occurrences and thus were often highly memorable.

Finally, in constructing TMT development timelines for the analysis, respondents' interpretations of events had to be reinterpreted and reshaped. Thus, the main source of data underpinning the analysis was partially informed and assessed by this 'second order' interpretation (Schwandt, 1994). Smith and Osborn (2008: 53) underline the potential challenges arising from the second order analysis of recalled narratives, where "participants are trying to make sense of their world, and the researcher is trying to make sense of the participants trying to make sense of their world". This is a largely unavoidable feature of research based on the narratives of others. The study would have perhaps benefitted from the collection of some real-time TMT development data to complement retrospective interviews (Leonard-Barton, 1990). However, the collection of useful longitudinal data throughout the sample as a whole was likely to be particularly challenging. This was because TMTs could frequently

operate for long periods, sometimes years, without enacting a significant change (for example the entry of a new member). Instead, the following steps were taken to mitigate the challenges associated with the collection of retrospective data:

- All but one case (OE2) was constructed through the perspectives of different respondents. These respondents represented key organisational actors who, given that they were responsible for key strategic interests including hiring of new TMT members, were in a position to comment on the phenomenon of interest. Varied informants were unlikely to display bias in the reporting of the same events, and so this step highlighted convergence in their accounts.

- Accounts were triangulated with archival research in order to further improve their accuracy. While respondent accounts, behaviours, and interpretations took precedence, secondary data was particularly helpful in providing shape to the recall process and to the formation of the final timelines.

- Following Eisenhardt (1989) key respondents reviewed and amended draft case studies in order to improve interpretative validity

5.8.4 – Value Judgements in Analysis

A further challenge related to second order researcher analysis concerned the allocation of certain value judgements used in the categorisation of data. For example, analytical judgements were made on the following aspects:

- Whether or not a TMT modification was positive or negative
- The quality or level of human and social capital possessed by team and board members
- The levels of eventual 'professionalisation' displayed by TMT development paths

Where possible, multiple sources of evidence were used to support these judgements. For example, judgements on human capital level allocations were supported by evidence of the number of years in particular roles, and by discussions with interview

respondents. However, ultimately, these allocations were made by the researcher and not purely from the data. In an attempt to improve the validity of measurement allocations, an independent researcher was also asked to make similar judgements based on the same evidence. During this process, consensus judgements were accepted, and then discussions were held over judgement discrepancies until consensus was reached for all analysis codes.

5.9 – CHAPTER SUMMARY

The methodological approach detailed here was driven by the demands of the research aims. These aims were to build theory concerning what is a complex social phenomenon. In particular, the study aimed to capture TMT development behaviours that were embedded within their surrounding context. Consistent with the underpinning philosophical assumptions of the study, the challenge was to extract, order, and make sense of social experiences of TMT development. The use of multiple perspectives and sources of data encouraged convergence of information within each case, and acted as a step to mitigate the challenges associated with the collection of retrospective narratives. The application of critical incident technique aided both in giving order to TMT development experiences and in attaching actions and behaviours to their spatial and temporal context. Replicated and contrasted across multiple cases, the underpinning dimensions of TMT formation and development are drawn out and presented in the findings and discussion.

6. PRE-FORMATION: THE ORIGIN OF FOUNDING TEAMS

6.1 – INTRODUCTION

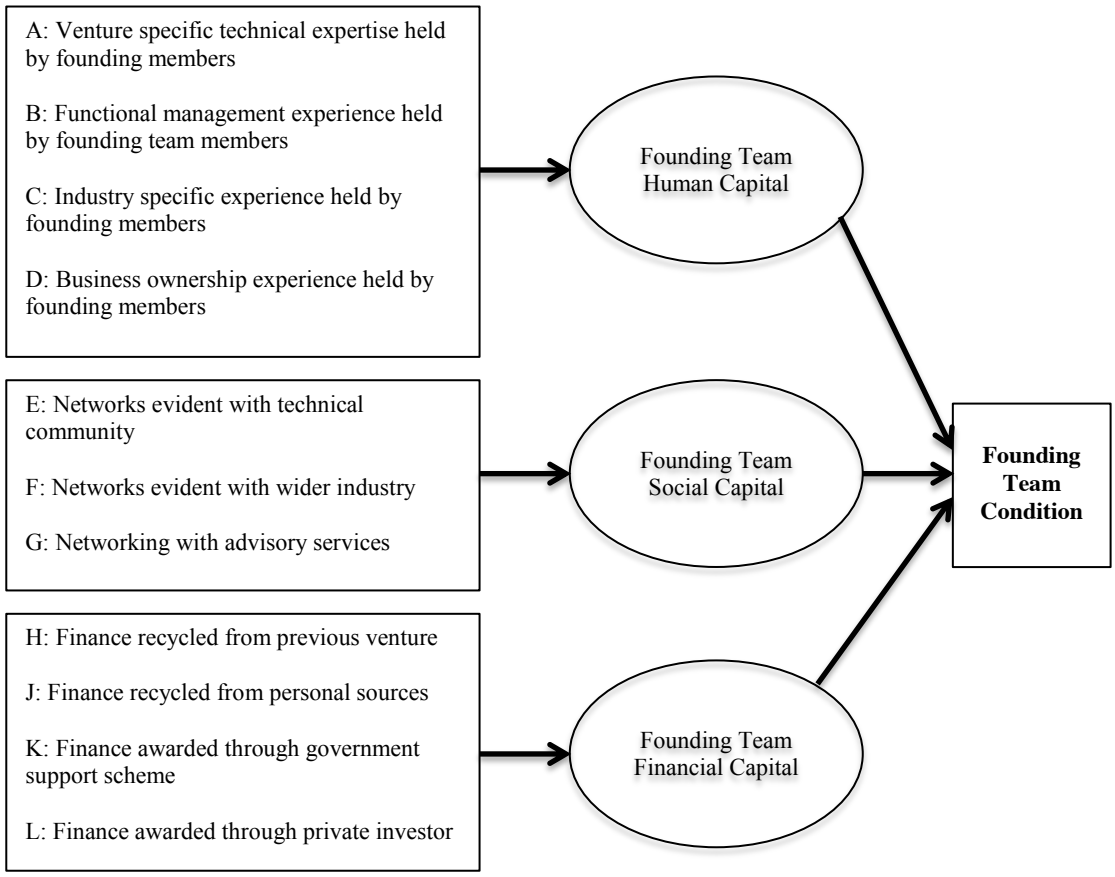
The origin of the entrepreneurial founding team represents a logical foundation from which to begin the investigation of TMT development. This study adopts the stance that the pre-founding experiences of founding team are likely to significantly influence TMT development as a whole. This rationale stems from established bodies of research on human and social capital (Mosey and Wright, 2007; Wright et al., 2007), TMT demography (Hambrick and Mason, 1984; Beckman and Burton, 2008; Eisenhardt, 2013), and regional labour incubation (Harrison et al., 2004; Lawton Smith et al., 2005).

The primary goal of this chapter is to demonstrate how TMTs originate in a wide variety of states. It is posited here that the condition of the founding team is largely dictated by the attainment (or lack of attainment) of knowledge and resources occurring during the prior career paths of founding team members (Freeman, 1986; Burton et al., 2002; Harrison et al., 2004; Sorensen and Fassiotto, 2011). Founding team condition is conceptualised according to three categories developed both in the literature review (see Aldrich and Martinez, 2001), and through the analysis of data (See Figure 6a). These categories are: *Human Capital*, *Social Capital*, and *Financial Capital*. Following an initial discussion of these dimensions, the chapter presents a descriptive overview of the sample. This serves as foundation for subsequent theory building. The second main aim of the chapter is to explore the contextual factors that influence the emergence of founding teams. This addresses how and from where Scottish high-technology founding teams emerged. To facilitate this investigation, the chapter discusses career histories of founding members, and identifies the dominant sources of incubation in evidence. In this way, the emergence of founding teams is tied to the particulars of the Scottish context.

6.2 – HUMAN CAPITAL WITHIN FOUNDING TEAMS

Two key dimensions of human capital emerged from the review of existing literature. The first of these referred to the types of human capital possessed by initial

Figure 6a: Conceptualisation of Founding Team Condition



members. This discussion highlighted specialist technical, functional management, business leadership, industry specific, and prior startup experience as prominent human capital types distinguished by existing research (Colombo and Grilli, 2005; Unger et al., 2011). The second dimension concerned the diversity and complementarity of human capital resources held within the team (Ensley and Hmieleski, 2005; Beckman et al., 2007). In particular, given the focus on technology-based ventures, this dimension referred most notably to the combination of technical and commercial skillsets. The following section addresses these dimensions of human capital as they occur within the sample. In doing so, it outlines a discussion of the particular types of human capital that are evident, and, in particular, what the notions of 'technical' and 'commercial' human capital mean in practice.

Table 6a: Overview of Founding Team Human Capital Compositions

Member Background / Founding Teams	Research/ Academic / Technical	Technical within Industry	Professional Function	Established Firm Functional or Senior Management	Commercial Experience within Entrepreneurial Venture	Variety of Commercial Experience Inputs	Total Members
Founding Teams with Exclusively Technical Human Capital							
LS1	**2**						**2**
LS2	**2**						**2**
LS5	**1**						**1**
LS7	**1**						**1**
LS8	**1**						**1**
OE1		**1**					**1**
OE2		**1**					**1**
OE3	**3**						**3**
CH4	**2**						**2**
Founding Teams with Commercial and Technical Human Capital							
LS3		**1**				**1**	**2**
LS4		**2**				**1**	**3**
LS6	**1**				**1**		**2**
LS9	**1**				**2**		**3**
OE4						**3**	**3**
OE5	**2**			**1**			**3**
CH1					**2**		**2**
CH2	**1**				**1**		**2**
CH3	**1**		**1**		**1**		**3**

6.2.1 – Overview of Founding Team Human Capital Composition

In total, the eighteen founding teams within the sample were represented by thirty-seven founders, which, in turn, represented founding teams ranging in size from one to three members. Notably, the sample contained five single founder firms, which left a remaining 72% of firms that were started by multiple member teams. These levels are consistent with of a number of previous studies within the field of technology entrepreneurship, which typically find between two-thirds and three-quarters of technology ventures being founded by teams across a range of UK and

North American regional contexts (Cooper, 1986; Oakey et al., 1990; Roberts, 1991; Cooper and Daily, 1997; Harrison et al., 2004).

The sample depicted substantial heterogeneity in the composition of human capital resources held within founding teams. Given the existing empirical evidence, it is perhaps unsurprising that the compositions of founding teams recorded here refuted any notions of the independent 'garage entrepreneur' (Beckman and Burton, 2008) or 'lone wolf' technologist (Harrison et al., 2004) as an exclusive point of genesis for technology-based venture TMTs. Indeed, only five of eighteen teams could be described as being founded by a lone technologist, and only one of these (Team OE2) invented their technology with a significant degree of independence from an incubating organisation (three of these teams – LS5, LS7, LS8 – being in university spinout firms and one being founder of an industry spinout – OE1). Notably, founding teams that were composed entirely of members who possessed no prior experience of any kind within commercial industry represented a significant portion of the sample (eight out of eighteen founding teams). Thus, multi member founding teams often contained individuals with overlapping and reinforcing experiences rather than complimentary skillsets (for example, a team of research scientists). The remaining ten founding teams displayed combinations of a wide variety of technical, managerial, industry specific, and business ownership experience inputs. Table 6a presents an initial overview of the human capital compositions of sampled teams. These inputs are discussed in more detail in the following sections.

6.2.2 – The Prominence of Relevant Technical Human Capital

Through examination of the expertise held by founding teams members, and through subsequent discussions with case study respondents, it was possible to develop a picture of those aspects of human capital that were deemed appropriate or desirable for a technology-based venture TMT. This served as a basis to assess founding team condition. Principally, the data indicated two important dimensions of human capital. The first concerned the *quality* of human capital held by members. This was related to the seniority of positions held and the reputation of the incubating organisations in which members gained experience. The second concerned the *relevance* of human

capital. This was related to how technology-specific or industry-specific founding team member human capital was. In this sense, there was little evidence of the dichotomy between technical and commercial/managerial inputs that is frequently imposed throughout extant literature (Granstrand, 1998; Oakey, 2003). Instead, this analysis indicated that the two human capital 'types' were likely to be intertwined.

For example, one immediate observation was that almost all of the founders (thirty-six of thirty-seven) within sampled founding teams held some form of technical expertise. This applied even to those founders with significant business ownership or commercial management experience prior to founding. This underlined one of the key rationales adopted by this study; namely that to understand how founding entrepreneurs emerge in the ways that they do, research must look beyond the immediately prior incubator and consider the influence that multiple career inputs have on the genesis of the TMT (Harrison et al., 2004). In utilising this rationale, it became clear that, no matter the eventual level of expertise gained by an individual, some form of technical training (particularly in skillsets that were directly related to the technology on which their venture was eventually based) was by far the most prominent foundation from which founder careers were launched (See Table 6c.1). Put another way, the vast majority of the TMT 'stories' examined here began from a foundation of technical training amongst their members.

Specifically, the development of technical expertise amongst founding members overwhelmingly occurred initially through university education of some kind. All thirty-seven founders held a university level education (all but one in a technical discipline). Twenty-three of these were at PhD level. This marked university education as the primary 'launchpad' for eventual founders. Eventual levels of technical experience evident amongst founders were by no means consistent. These varied across the sample from those starting a venture immediately after completing honours level university degrees in a technical discipline to those who progressed their career far beyond university studies and who could be considered to be technical experts or research field leaders. Many founding team members went on from an initial technical education to pursue a career exclusively in technical or

Table 6b: Detailed Backgrounds of Founding Team Members

FOUNDING TEAM	Founder 1 Background	Founder 2 Background	Founder 3 Background
LS1	PhD technical (Scotland) Extensive academic research career (Scotland)	PhD Technical (England) Moderate experience in research role within multinational (France) Extensive academic research (England/Scotland)	N/A
LS2	PhD technical (Scotland) Extensive academic research career (Scotland/US)	PhD technical (Scotland) Extensive academic research career (Scotland)	N/A
LS3	BSc technical (US). MBA (Scotland) Extensive experience in operations within multinationals (US) Extensive senior management experience in high-tech growth firm (Scotland)	PhD technical (China) Extensive academic research career (China/England/Scotland) Extensive senior research experience in high-tech growth firm (Scotland)	N/A
LS4	BSc technical (Scotland) Technical role within multinational (Scotland) Extensive senior management experience within multinational (Scotland) Extensive experience as founder of high-tech growth firm (Scotland)	PhD technical (Scotland) Technical role in high-tech growth firm (Scotland) Extensive academic research career (Scotland/US)	PhD technical (Scotland) Technical role in high-tech growth firm (Scotland) Extensive academic research career (Scotland)
LS5	BSc/MSc technical (Mexico) Extensive academic research career (Mexico) PhD technical (Scotland)	N/A	N/A
LS6	BSc technical (Scotland) Moderate experience in commercial roles in SMEs (Scotland) Public sector business advisor	MA technical (Scotland), Extensive research/medical career (Scotland/England)	N/A
LS7	PhD technical (Scotland) Moderate experience in research role with government body (England)	N/A	N/A
LS8	PhD technical (England) Extensive academic research career (England/US/Scotland)	N/A	N/A
LS9	BSc technical (Scotland) Limited academic research career (Scotland)	PhD technical (Scotland) Moderate academic research career (Scotland) Limited experience as founder of high-tech venture (Scotland)	PhD technical (Scotland) Moderate academic research career (Scotland)

			Limited experience as founder of high-tech venture (Scotland)
OE1	PhD technical (Scotland) Moderate academic research career (Scotland) Moderate experience of technical roles in high-tech growth firms (Scotland)	N/A	N/A
OE2	BSc technical (England) Extensive technical career within industry (UK/Belgium) PhD technical (Scotland)	N/A	N/A
OE3	PhD technical (Scotland) Extensive academic research career (Scotland/US)	PhD technical (Scotland) Limited academic research career (Scotland)	PhD technical (England) Limited academic research career (Scotland)
OE4	PhD technical (Scotland) Extensive experience as founder of high-tech growth firm (Scotland) Extensive senior management experience within multinational technology firm (Scotland/US)	PhD technical (England) Extensive experience as founder of high-tech growth firm (Scotland) Extensive senior management experience within multinational technology firm (Scotland/US)	PhD technical (England) Extensive experience in technical role (US, UK) Extensive experience in senior commercial roles in both multinationals & growth ventures (US/UK)
OE5	MSc technical (Scotland) Extensive consultancy experience within multinationals (Scotland)	PhD technical (Scotland) Extensive academic research career (Scotland)	PhD technical (Scotland) Extensive academic research career (Scotland)
CH1	BSc technical (Scotland) Limited academic research experience (Scotland) Limited experience as founder of high-tech venture (Scotland)	BSc technical (Scotland) Limited academic research experience (Scotland) Limited experience as founder of high-tech venture (Scotland)	N/A
CH2	BSc technical (Scotland) Moderate experience as founder of related venture (Scotland)	PhD technical (Scotland) Extensive academic research career (Scotland)	N/A
CH3	BEng Technical (Scotland) Moderate experience of related & unrelated sales and operational roles in SMEs (Scotland)	PhD technical (China) Extensive academic research career (China, US, UK)	BA Accountancy (Scotland) Extensive experience as chartered accountant (Scotland)
CH4	BSc technical (Scotland) Limited academic research experience (Scotland)	BSc technical (Scotland) Limited academic research experience (Scotland)	N/A

research roles (twenty-two of thirty-six founders). Notably, a significant portion of these exclusively technical founders had developed their expertise entirely through

positions within academic institutions (fifteen of thirty-six founders). This meant that only fourteen founders within ten founding teams subsequently left an exclusively technical orientation to gain commercial experience of at least some description.

Discussions with interview respondents revealed some insight into why at least some level of relevant technical expertise was so common amongst founding team members. Principally, the presence of defined technical expertise within the founding teams was integral to the management of technical, product development, or research aspects of the new venture. Put simply, founding teams required members that could adequately undertake purely technical dimensions. Typically, founding teams contained one or more members that acted as technical 'experts'. These members would be responsible for highly complex aspects of R&D or product development. However, it was also very much typical for other members who were not operating in a 'technical expert' role to have strong understanding of technical intricacies. This underlined that technical literacy was not exclusively associated with aspects of 'hard' product or research development. As many of the technologies upon which the ventures were based were particularly complex, respondents repeatedly emphasised that inherently commercial functions, such as the development of sales channels, were reliant upon founders who could 'talk the talk' on the technical side (See Table 6c.2). This emerged as the most consistent explanation as to why some form of relevant technical background was part of most founders' human capital.

Furthermore, for the commercially inexperienced technology entrepreneurs examined, technical experience often functioned as a platform from which subsequent commercial learning took place. Respondents indicated that commercial skills were far easier to 'graft on' to an existing technical base rather than attempting to foster complex technical understanding in an externally recruited manager. For more commercially experienced founders, a similar phenomenon was evident through examination and discussion of their career histories. These overwhelmingly displayed evidence of transitions from technical roles to roles that demanded the commercial application of technical expertise. Thus, within Scottish high technology industries at least, commercial human capital was seldom developed separately from

technical human capital. Instead, commercial or industry specific experience was likely to simply be a progression of what were initially technical careers. This is a feature reflective of entrepreneur career paths noted in a number of existing studies conducted in other technology-based regional industries (Oakey, 2003; Harrison et al., 2004; Cooper and Park, 2008).

These results underlined that, for founding teams, little importance was placed on members with defined functional management skills *on their own*. Owing to the dominance of relevant technical backgrounds, those founders that did hold prior managerial or business ownership experience were far more likely to have gained it in a relevant industry. In this sense, commercial and managerial experience held by founders overwhelmingly emphasised attachment to a relevant technology area rather than generic, functional and transferable management skillsets (Baker and Aldrich, 1996; Menz, 2012). In discussing career history data with interview respondents, a number of suggestions were made as to why this was the case. Numerous respondents indicated that understanding of the technology was likely to be related to passion and enthusiasm for the project. This was considered to be an advantageous trait in a founder, one that was less likely to be present in an externally sourced partner who held little understanding of the underpinning technicalities. Related to this was the notion that a founding team required little emphasis on defined functional management roles in the early stages. Instead, founders were more likely to engage in a variety of cross-functional leadership roles, performing 'a little bit of everything' as required by strategic or leadership demands (See Table 6c.3).

6.2.3 – Quality of Commercial Human Capital

Both career history and qualitative interview data also emphasised important considerations regarding variations in the quality of commercial human capital held by founding team members. Existing research indicates that the levels of capital resources recycled from a former position by a founder are likely to be partially dependent on the status, culture, and dominant systems of operation experienced in particular former incubators. For example, Burton et al (2002) identify incubators that spawn large numbers of spinout ventures as being 'entrepreneurial prominent',

and cite significant human and social capital advantages for those entrepreneurs emerging from such sources. The suggestion here is that the particular incubators within a founder's prior history are likely differentiate levels of human capital. This proved to be an important consideration when conceptualising the range of commercial human capital held by founding team members in this sample.

Taking, for example, founding teams LS9, CH1, and CH2 - all of which contained members with previous experience of running a technology-based entrepreneurial venture. Upon closer inspection of these experiences, respondents described their former ventures variously as 'an academic hobby firm', or 'a side project'. Thus, while they cited the practice of commercially applying their technical knowledge as a positive in terms of the human capital gained, they also underlined the limited nature of their prior business ownership experience (See Table 6c.4). In particular, these respondents emphasised how their prior entrepreneurial ventures were especially technology focused, and how limited experience of commercial growth negated the need for any significant scale of expansion or for the development of more sophisticated management structures.

This type of incubation experience contrasted sharply from other founders with business ownership experience[1] within the sample. For example, teams LS3, LS4, and OE4 contained members with either business ownership or senior project management experience within successful (and technologically-related) former technology-based ventures. The distinction here was that these incubators allowed experience both of taking a new technology application to market, and of significant organisational growth. Throughout the empirical data collected, respondents placed a great deal of emphasis on this type of human capital; namely that which had allowed founding team members to previously experience the *transition* from an early stage project to a significant commercial operation (See Table 6c.5). It was this type of

[1] Based on the definition of Gimmon and Levie (2010): "the experience of managing a total business or project: profit and loss responsibility exercised by being either CEO or self-employed or a project manager".

Table 6c: Example Data Supporting Discussion (Human Capital)

Numbered Element of Discussion and Exemplar Representative Data

1. Relevant technical expertise as the basis for subsequent commercial human capital development

"Is it easier to get the scientist or engineer skilled up or the other way around? Is it easier to try and get business types more technically geared up? I say you're best starting with the scientist. We always used to say: I'd rather have a physicist doing my accounts than an accountant doing my physics **(Founder 1, OE3)**

"All the really commercially experienced guys I know started out on the tech side before building up all the commercial stuff. That's the usual path. Very unusual to have someone running a business without understanding the technology at least a little, especially if it's complex **(Key Informant 5)**

2. Technical expertise as a key element of early commercial functions for venture founders

"*If you're trying to open up sales channels then want to speak to the inventor of the product during the first people usually few years. They want to speak to the guy that knows about it. I was never much of a salesman, but you'd have a hard time finding someone with commercial or sales experience that could talk their way around the technology in a way that I thought was acceptable"* **(Founder 1, OE1)**

"You've got to be able to talk the talk on the research side. You don't have to be the expert, but if you're going to grow a company, you're best being tech literate" **(Founder 1, LS3)**

"I wanted to get someone else in, but it comes down to: I was the best business development manager because I knew most about the device" **(Founder 1, LS9)**

"As someone who sits on multiple boards, you need to retain someone with an understanding of and a passion for the product. If they're inexperienced, you support them by all means. But I prefer to nurture a founder in the early stages rather than replace them" **(Key Informant 6)**

3. Founder as a cross-functional leadership position rather than a defined functional role

"*There's an abundance of technically competent people here. There's more than an abundance of people that can put together HR and finance and all these functional things. Growing a new company requires leadership and vision. We need people that are connected to the technology and the market and who can be strategic about tackling that market"* **(Key Informant 4)**

"Founders need to be leaders. They need to do a bit of everything in the early stages. You need someone with understanding of the product, but also with a passion to grow the business. People that have been in really defined management roles aren't always the right choice, especially if they're being recruited externally **(Founder 2, OE4)**

"In a small firm you need to be able to do everything. You need to be chief financial officer. You need to be chief technical officer. You need to be the business development person. You need to be able to do a bit of everything. As the company grows all of those elements thin off and specific individuals get specific roles" **(Key Informant 2)**

4. Low quality commercial incubation experiences

"My partners had some business experience. It was a similar operation really. But, it was an academic hobby company, nothing of any real scale" **(Founder 1, LS9)**

"We'd run a similar tech business before, and we used a lot of the same science for [company name], but it was really just us and a few other employees. We took some good experience, but it was a side project" **(Founder 2, CH1)**

5. Transitional growth experience as high quality commercial human capital incubation experiences

"*When I talk about commercial experience, I'm talking about guys that have grown their own company or have been part of a growing company. Guys that have had to structure a firm and build business models and support systems that handle big clients. Either that, or guys that have handled big product launches in large companies. I'm not talking about two or three scientists that have ran a 'mom and pop' shop"* **(Key Informant 4)**

"[incubator name] went from a very small organisation to about 40 million turnover and floated on the stock market. That's when they got acquired. That gave me the experience to then go on a build up a few opportunities, and then I've basically been involved in startup companies from there on in" **(Board Member, LS1)**

"I grew with the project from a technician to a project manager. We might have been a big company, but the challenges I faced in taking that product line from an idea to a mass-market product really prepared me for running my own business" **(Founder 1, LS4)**

"You take that culture of expectation with you. We'd been successful in the past, but once we were bought over you also see far more potential for growth. There's no way we were going to start [OE4] and not aim to grow a large company" **(Founder 1, OE4)**

6. The challenges of transferring from established firms to entrepreneurial ventures

"The risk profile is not for everyone. You have people that have been working in huge companies and are used to having two secretaries. They can struggle with the lack of resources in my experience **(Founder 1, LS5)**

"The management and leadership skills you need for a company that's just spun out are very different for what you need for a company that's got you know 30 employees, which is very different again from a company that has hundreds of employees. When you're working for say a large pharma company your job is just your job, it's not anybody else's. So someone with that skillset, and I'm not saying they can't do the job, a lot of them can, but they're used to having everything done for them" **(Key Informant 2)**

7. Experience at 'both ends of the spectrum

"There are people who are excellent big company managers and there are people that are better at growth level. Finding people to bridge the gap it's not always that easy. That's why I think that in a lot of case you'd want someone with experience of transitional management" **(Key Informant 6)**

"I think the issue for me is that it's appropriate to have experience at both ends of the spectrum. If I think about my own background, I spent many years in big corporate and then moved to small startup. I think that both have their challenges and both experiences have their real benefits that you can bring to growth businesses" **(Key Informant 4)**

human capital that respondents associated with knowledge of 'venturing in general' (Zhang and Baden-Fuller, 2008), which pertained to prior experience of navigating the challenges of growth, and, in particular, of implementing organisational and management structures capable of harnessing growth. Such experience was often contrasted with former entrepreneurs that had managed small-scale 'mom and pop' operations. The data also suggested that prior experiences of rapid growth increased growth orientation of the new venture, where teams containing formerly successful repeat entrepreneurs held greater expectations in terms of their growth prospects and their exit targets. This reflects the findings of previous research, notably DeTienne and Cardon (2010).

It was noted that those few founders with prior histories of successfully growing a previous technology-based venture had frequently also, at earlier points of their career, trained in project management or other commercial roles within established technology firms. This was a feature also evident in the career histories of many of the key informant interviewees, the majority of whom were successful portfolio entrepreneurs and prominent investors themselves. In discussing this with respondents a number of inferences could be made. Firstly, the availability of sufficiently fast-growing, or sufficiently established, technology firms capable of providing appropriate career ladders was key in allowing future founders the opportunity to broaden their experience from the technical to the commercial sphere. Secondly, as this type of former career experience was present in almost all of the previously or subsequently successful entrepreneurs examined, it appeared to be a generally effective point of departure from which to launch a related entrepreneurial venture. Thirdly, there were distinct challenges emerging from the differences between commercial experience gained within an established firm and that required in a young, entrepreneurial venture (See Table 6c.6). In particular, respondents pointed to the increased risk profile as well as the lack of resources in smaller firms as common issues influencing the effectiveness of particular types of commercial human capital. As such, the ability to straddle the two environments appeared to represent somewhat of a skill in itself. Interview responses very much championed

technology or industry relevant commercial experience gained at 'both ends of the spectrum' as a strong basis for a founding entrepreneur (See Table 6c.7)

6.3 – SOCIAL CAPITAL WITHIN FOUNDING TEAMS

The literature review discussed the social capital of a founding team as being a stock of 'goodwill' – a form of social currency - that could be used to access important resources from the wider social context (Bourdieu, 1985; Anderson et al., 2007). It was also identified that this exchange occurs through networks, which represent the means of connection between social actors. These concepts were recognised as being important to the condition of the founding team in two main respects. Firstly, differing levels of social capital were likely to influence both the types of resources accessed by founding teams, and the ease by which they were accessed. Secondly, network relationships held, and the nature of social relationships between individual founders were likely to impact on why members chose to assemble with one another as part of a team. These dimensions are discussed in detail in the following sections.

6.3.1 – Social Capital and Networking Behaviour

Examining the nature of the resources sought and exchanged - what scholars have referred to as network content (Hoang and Antoncic, 2003) - emerged as an effective way to conceptualise the use of social capital by different founding teams. Focusing on this type of networking behaviour encouraged understanding of how different founding teams attempted to utilise the varying levels of social capital that were transferred to the new venture by the initial members. Again, the results reflected vastly different networking behaviour across different founding teams. Notably, there was evidence of a strong link between the human capital held within founding teams and the types of resources sought in the early stages (see Mosey and Wright, 2007). Thus, as with human capital, prior career experiences appeared to heavily influence the team's social standing and initial resource seeking behaviours (Burton et al., 2002; Sorensen and Fassiotto, 2011).

The most notable differences in the application of social capital were evident between those founding teams with high levels of commercial industry experience

(LS3, LS4, OE4, OE5, CH3) and those with little or no commercial industry experience (LS1, LS2, LS5, LS7, LS8, LS9, OE1, OE2, CH2, CH4). Commercially inexperienced founding teams – particularly those emerging exclusively from academic institutions – were far more likely to have held high levels of social currency almost exclusively within their narrow research field. This was, of course, important in ensuring that the team held a level of technical legitimacy. Again, this form of legitimacy appeared to rely on the presence of a credible technology 'expert' within the team. While most founding teams in the sample did contain such an expert, those teams beginning without even a strong level of social standing in their particular technology field faced clear difficulties in accessing most forms of resource. Team CH4, which was started by two former students with very limited academic research experience, and which subsequently struggled to be 'taken seriously' by wider stakeholders for many years, provides a clear example of this (See Table 6d.2). In this sense, an adequate level of social standing in the relevant technical field served as somewhat of a prerequisite foundation necessary for the acquisition of further resources from the surrounding social context (See Table 6d.1).

For the vast majority of the sampled founding teams – which contained various technical and research experts – social standing within the technical field was not a problematic issue. However, as is suggested by existing research, those founding teams that were dominated by members with experience exclusively within technical pursuits were likely to have faced barriers in their initial efforts to gather resources and create networks necessary for a commercial operation (Nicolaou and Birley, 2003; Mosey and Wright, 2007). In particular, this related to difficulties in forging relationships with suppliers, manufacturers (concerning initial prototypes and production runs), initial sales channels, or, for drug development firms, regulators. This was not necessarily the case for all commercially inexperienced founding teams. Team OE3, for example, were able to utilise their narrow technical social capital to excellent commercial effect by selling experimental, bespoke, and high-value products to the wider international academic communities within reach of their existing networks. However, for the majority of teams, which were attempting to take their product or research to commercial markets, this was not an option.

The different ways in which founding teams initially applied their social capital were evident through their networking behaviour. Those founding teams without significant levels of prior commercial experience showed far more propensity towards forging initial connections with a variety of advisory services – such as university technology transfer offices (TTOs) or enterprise support agencies – rather than with what might be thought of as commercial stakeholders; for example, investors, suppliers, customers (See Table 6d.3). The extensive range of public sector support available to high technology ventures in Scotland is a feature that was underlined in the literature review (Birch and Cumbers, 2009). And, indeed, the results indicated that involvement with such services was frequently a first 'port of call' for many newly formed high-tech venture teams. In the absence of social standing with wider commercial circles, interaction with advisory services appeared to represent an attempt to accumulate broader legitimacy. For example, one respondent (Founder 1, LS8) identified being involved with the Scottish Enterprise high-growth team as an important factor in increasing 'street cred'.

However, this type of engagement did not always prove to be beneficial. Many of the teams emphasised a range of problems associated with engaging with advisory services. Firstly, a number questioned advisor quality, and how this related to their abilities in facilitating access to other important resources. Secondly, another respondent (Founder 1, OE2) emphasised difficulties faced in being 'locked out of the system' when he failed to gain significant support from advisory agencies. Thirdly, a number of academic research spinout teams expressed difficulties in negotiating intellectual property (IP) rights with university TTOs. Both Team LS5 and CH4, for example, engaged in particularly costly and lengthy legal disputes with their host universities in this regard (See Table 6d.4).

In stark contrast, founding teams containing members with higher levels of commercial human capital (particularly LS3, LS4, and OE4) largely disregarded interaction with advisory services (See Table 6d.5). Instead, their superior social

Table 6d: Example Data Supporting Discussion (Social Capital)

Numbered Element of Discussion and Exemplar Representative Data

1. The requirement for social capital in the technology field (a technical expert)

"We were both pretty well known researchers in our respective you need to have the right background to have any kind of credibility" **(Founder 1, LS1)**

"I had a PhD and spent many years researching this area. I suppose I would be an expert. You wouldn't get very far starting a technology company if you didn't have at least one person on your team that was an expert " **(Founder 1, LS5)**

2. Difficulties emerging from poor technical legitimacy

"We were research assistants on the project. Both of us hadn't long graduated from under-grad. We didn't have PhDs or big research careers. It took a while for people to take us seriously" **(Founder 1, CH4)**

"I didn't have the skills or the credibility to be the main techie on the project, so I got it touch with an academic who was a specialist. We teamed up and started the company together" **(Founder1, CH2)**

3. Commercially inexperienced teams using TTOs and advisory services as a means of building social capital

"*I got support from the Scottish Enterprise high growth unit, which was really good. They put me in touch with IP specialists to explain the agreement to me. It turns out that basically the agreement was that I give everything away. And I wasn't allowed to work on that piece of work ever again. So it's good that I didn't sign it!"* **(Founder 1, LS5)**

"I went to Scottish Enterprise to build up some contacts. I didn't know anyone in that world" **(Founder 1, LS7)**

"Scottish Enterprise was the first place I went. I had no real clue who I was going to sell the product to. It was trial and error and I used them for advice and suggestions as to what to do with the technology" **(Founder 1, OE2)**

4. Difficulties faced in interacting with TTOs and advisory services

"There was a sense that you're just supposed to take what you're given in terms advisors. There are only small pools of highly experienced people that are willing to help new technology firms out. On the other hand, there are plenty of pretty useless business advisors out there. Some of the advice is really general. It's difficult to get paired up with someone that really knows your industry" **(Founder 1, LS7)**

"My experience of dealing with the commercialisation people at [university TTO] was not the best. They gave me a document to sign, which I couldn't understand a word of. I was thinking 'I won't sign something I don't understand'. So they said I was to 'just go and look for your

own advice'. They decided to patent the technology without having me to sign the document. So they had a patent in which they didn't have the results. It was a big mess" **(Founder 1 LS5).**

"There were a few guys I met through the Life Sciences advisory board who I thought was hopeless. They either weren't really interested in committing the time, or they didn't have much direct experience of the type of early stage medical devices we were trying to develop. I had one advisor in particular that was excellent, a real value creator. But it's difficult to keep someone with a good level of experience involved. These schemes seem to offer you part-time advice, and what you need is full commitment" **(Founder 1, LS9)**

"The quality of advice from SE can be really hit or miss. It's not particularly industry specific. Plus, it's not as if they act as real members of your team. You still do most of it yourself and hope you can develop 'on the job'" **(Founder 1, OE2)**

"We ended up with huge problems with the university who had 1/3 equity stake in the company. We had no idea about company legals whatsoever. When we signed up basically stated that 100% of the shareholders had to approve everything. So the university basically had a veto on everything. So we had some really good investment offers this first 2 years off 3i, off SEP. But all of them failed because the university refused to negotiate" **(Founder 1, CH4)**

5. Commercially experienced teams disregarding advisory services and transferring their own social capital resources

"We had the loosest of relationships with Scottish Enterprise. There wasn't much input really. I mean to be honest I knew more than them. You know I've got a fairly strong business background in the right sort of market place. There were more important people to deal with" **(Founder 1, LS4)**

"*We already had relationships with customers. The first thing was to lock contracts down. The suppliers knew us and wanted to work with us. These were the priorities"* **(Founder 1, OE4)**

6. Levels of human capital and impacts on co-founder choice from the immediate, trusted network (narrow technical networks)

"*You want to start up your company with people you trust. The people I trusted were the guys I'd done the research with. They went the most experienced guys in terms of the business side, but you can't start something like this with someone you don't know"* **(Founder 1, LS9)**

"Of course you start the firm with your research team. They know the technology. We knew nothing about the commercial side of things, but we were willing to learn. We had advisors, but I found no one suitable that could just come in and take over the reins" **(Founder 1, OE3)**

"The original team was me and [Founder 2]. We'd done the work on the research side. I looked for help and advice on the regulatory and commercial stuff, but that takes time. You don't start a team with someone you don't know" **(Founder 1, LS2)**

7. **Levels of human capital and impacts on co-founder choice from the immediate, trusted network (industry networks)**

"Me and [Founder 2] had worked together at [former incubator]. He was a brilliant scientist and I'd handled operations, manufacturing and distribution, all that. We had a good working relationship and, between us, we had a real wealth of the right experience" **(Founder 1, LS3)**

"Our original team was basically half of the senior team from [former incubator]. We were all pretty experienced. Over time we took more of the top guys from them. All people that we knew and that had the right expertise in all the areas we needed. Our team was very much ready-made" **(Founder 1, OE4).**

capital was exhibited by networking behaviour that focused on gaining access to finance, supply, and sales channels. In many ways, their early networking behaviour relied on simply recycling strong relationships from former incubators. Team OE4, for example, explicitly planned their spinout from an existing industry leader, and, over an extended period of time, deliberately cultivated key relationships that would be beneficial to them in the new venture. This underlines one of the fundamental differences – and advantages – associated with industry spinout as a point of origin for a founding team. While less direct in recycling specific relationships, Team LS3 and LS4 were able to leverage social capital held with particular gatekeeper individuals with whom they were connected in order to quickly build new supplier and sales relationships. Ultimately, the prior relationships held by these teams had the effect of making sure that they were 'up and running' commercially at a significantly faster rate.

6.3.2 – Connections Between Founding Team Members

Prior research predominately finds that, despite the perceived benefits of member diversity within TMTs, entrepreneurial teams are likely to be formed by individuals with shared backgrounds (Neiswander et al., 1987; Ruef et al., 2003; Williamson and Cable, 2003). The empirical data presented here largely supports this notion. Of the thirteen multi-member founding team identified in the sample, ten were entirely composed of individuals that were former colleagues. Two more were partially composed of former colleagues. In most cases, colleagues had worked together in the incubator immediately prior to the founding of the new venture. Particularly dominant were research teams spinning off from academic institutions (six teams - LS1, LS2, LS9, OE3, OE5, CH4 - See Table 6d.6). Table 6e displays an overview of the connections between founding members.

The rationale given by respondents for forming the founding team with known collaborators was also consistent with much of the existing literature: founders preferred to work with those whom they possessed strong ties and a shared history.

Table 6e: Initial Connections Within Founding Teams

FOUNDING TEAM	Connection between FT Members
LS1	Colleagues within Scottish academic research institution
LS2	Colleagues within Scottish academic research institution
LS3	Colleagues within Scottish high-tech growth firm
LS4	Founder 1 actively seeks a research team to support a new venture Founders 2 and 3 are colleagues within Scottish research institution
LS5	Single founder (academic)
LS6	Founders had collaborated during their early careers and were friends
LS7	Single founder (academic)
LS8	Single founder (academic)
LS9	Colleagues within Scottish academic research institution
OE1	Single founder (industry/technical)
OE2	Single founder (industry/technical)
OE3	Colleagues within Scottish academic research institution (supervising professor and 2 former PhD students)
OE4	Founders 1&2 had collaborated on their PhD research to launch a successful high tech venture, which was acquired by a US-based multinational. They worked as joint MD of the newly acquired firm where founder 3 was a senior commercial manager
OE5	Founders 2 and 3 were colleagues within Scottish research institution Founder 1 was a business advisor attached to the University.
CH1	Colleagues within Scottish academic research institution. Joint founders of previous small technology venture
CH2	Founder 1 lacked technical expertise and 'spun in' to a university to collaborate with founder 2
CH3	Founders 1&3 were friends and were connected to founder 2 through Scottish Enterprise
CH4	Colleagues within Scottish academic research institution

For exclusively academic teams, which had often worked on lengthy specialist projects together prior to firm formation, this largely had the effect of narrowing member selection options (see Ensley and Hmieleski, 2005; Wright et al., 2007). However, trust as a motivation for member assembly was equally in evidence in the founding teams that had a greater range and mix of technical and commercial skills (for example Firms LS3, LS6, OE4). In short, there was a degree of socio-

psychological emphasis, in terms of the seeking of cultural or social fit, displayed in the member selection behaviour of all the teams examined here.

This was not to say that founding teams were not also driven to select members through rational assessment of human capital requirements and how these related to the needs of the venture. However, the primary difference was that more experienced founders, who had been through prior technical to commercial career paths, were able to select members for *both* rational and socio-psychological reasons. This was simply because their immediate trusted network, having been steeped in both a technical and commercial environment, was far more likely to offer access to a wider range of appropriate skillsets. Evidence of such selection behaviour supports the findings of Mosey and Wright (2007) who identify how the experience of habitual entrepreneurs can lead to increased access to sources of experienced human capital for recruitment into teams. From the analysis conducted here, there was not so much support for the assertion that commercially experienced individuals have a *greater* networking propensity, and that they are able to make 'weak ties' (Granovetter, 1973) with a wider variety of human capital sources when building their founding team. Rather, the commercial experience of such individuals simply allowed inherent selection advantages in terms of the experience of potential co-founders that they had 'strong ties' with. In short, for experienced technology entrepreneurs looking to form a team, potential fellow founders were not only familiar and trustworthy, but they were also more likely hold high quality and complimentary human capital as well (for example, the founding team of firm OE4). Essentially, the extent of prior experience held by founding members tended to influence the quality of people within the immediate trusted pool (See Table 6d.7).

While former colleagues formed most founding teams, three teams exhibited deliberate attempts to combine previously unknown founders. Prospective entrepreneurs who sought to join together with particular technical experts in order to augment specialist technical human capital within the team represented two of these cases. In both cases the technical specialists eventually identified as team members were academic experts working at a local university. In the final case, it was the

academic inventor that sought a surrogate entrepreneur (Franklin et al., 2001) to take over commercial responsibilities. In this case, the initial connection between the two was brokered by a government business support agency. There was no evidence of unrelated individuals being deliberately selected and combined together as part of a team by an outside agent, for example, an investor. This suggests that, in Scotland at least, outside investors played little role in the initial formation of management teams.

6.4 – FINANCIAL CAPITAL WITHIN FOUNDING TEAMS

Finally, it was considered that the incubation sources of founding members held possible implications for the levels of startup capital initially possessed by founding teams. The literature review emphasised development advantages associated with higher initial endowments of financial capital (Colombo and Grilli, 2005). In particular, there was discussion of how prior career experiences could either relate to, a) the levels of financial capital recycled personally by founders, or b) founders' association with external sources of startup capital.

For all of the eighteen founding teams examined, personal finance held by one or more of the founders represented at least an element of the startup capital used for the venture. However, these amounts (proportional to the total startup capital raised) varied significantly. Only in four of the eighteen teams examined was personal capital the most significant source of financial investment. Team OE4, for example, was founded by repeat entrepreneurs who were able to use the £3 million proceeds from the sale of a former venture as seed capital (See Table 6f.2). Other founders (in Teams CH2 and OE2) sold personal property, such as their homes, in order to fund early venture development (See Table 6f.3).

However, by far the most prominent sources of seed capital evident throughout the sample came from public sector finance award schemes (See Table 6f.1). In particular, the Scottish Enterprise 'Smart Award' and 'Proof of Concept' schemes emerged as vital sources of practical backing for the early technical and commercial development work carried out by founding teams. Smart Awards were typically

Table 6f: Example Data Supporting Discussion (Financial Capital)

Numbered Element of Discussion and Exemplar Representative Data

1. Public sector awards as the dominant source of startup capital

"Proof of Concept funding was what really supported the start of the project as a business. We were still doing research work at that point while looking for someone to take over the commercial side" **(Founder 1, LS1)**

"We went through what is a typical route for a new tech business to fund itself: Proof of Concept and a SMART award. Personally I went on the Enterprise Fellowship programme, which helped a little financially. From there it's all about proving feasibility and getting some real investment" **(Founder 1, LS2)**

"I did the initial work on the prototype after we got a £90,000 SMART Award. That was really what I used to start the business up" **(Founder 1, LS7)**

"*We won a SMART Award, which basically gave…well if we hadn't won the SMART Award we wouldn't be here today. That gave a 12 month window of funding to work out what it was we were doing"* **(Founder 1, OE1)**

"The SMART Award for £90k is what started us off" **(Founder 1, CH3)**

2. Startup capital recycled from prior ventures

"I had money leftover from the sale of my stake in [Founder former venture] I knew this would be a good team to recycle that with" **(Founder 1, LS4)**

"We sold [Founder 1 and 2 former venture] for £3m a few years back. After a few years working for the company that acquired us, we knew we'd go out on our own again. It's a definite advantage. For a start, we held all the equity and didn't need to give it away to investors" **(Founder 1, OE4)**

3. Startup capital predominately from personal sources

"*[Founder 2] and I developed the whole thought process. Then we had to trial it. I ploughed a whole load of my own personal money into this. We're talking six figures. We designed the ATS, which stands for advanced treatment station"* **(Founder 1, CH2)**

"*It was funded by myself. Basically I sold my house to provide the seed capital. I applied for a SMART Award, but Scottish Enterprise managed to really screw that up. I'm not going to bitch about it, but it was quite incompetent"* **(Founder 1, OE2)**

4. Startup capital predominately from sources of risk capital

"*We had some initial funding from an Angel group here in Aberdeen. Roughly £300,000. We used this for initial commercial assessment, but really the plan had to aim towards gaining further funding"* **(Founder 1, LS6)**

"The programme at the university had been funded by [industry investor]. Once the results came out and looked promising, they funded us with £350,000. I was business advisor on the project and part of the deal was that I'd join the team full time" **(Founder 1, OE5)**

within the region of £50,000-£90,000, with Proof of Concept Awards being generally higher at a typical amount of £150,000. In total, sixteen of the eighteen founding teams utilized such an award. For twelve teams, the award was identified as the largest single source of startup capital. Typically, public sector awards were matched with other sources, for example, some personal funds, a university grant, or a debt finance facility from a bank. Teams LS9 and OE3 epitomised this typical approach to startup financing in high-tech ventures:

"We all put some of our own money in. In 2005, the Bank of Scotland finally supported us. Then we matched 25k with 25k from the Business Growth fund. So we started the company with 90k" (Founder 1, LS9)

"We first got money from the Glasgow Development Agency. The university put some money in. And we put some money in. Well I put some money in! The other guys put in a little! Maybe £100,000 in total" (Founder 1, OE3)

These levels of startup finance were perhaps surprisingly modest. Certainly, there was little evidence of large risk capital investment at, or around, initial founding. Exceptions to this were Teams LS6 and OE5. Team LS6 were able to secure £300,000 in seed capital from a local business angel syndicate. An industry sponsor funded team OE5 in collaboration with a university incubator scheme to the tune of £350,000 (See Table 6f.4). Therefore, the data reflected the lack of involvement from venture capitalists in early-stage Scottish firms that has been identified in other studies, notably Harrison et al (2010a).

Those teams that were able to recycle significant amounts of personal wealth (LS4 and OE4) displayed clear advantages in early development. However, in the absence of this, the typical route for a Scottish technology-based firm was to use public sector finance awards in order to pursue further, larger, funding rounds. In this sense, there was often little change in the composition of founding teams during the early stages, as financial resources were typically directed towards vital technical and commercial development work. Many early teams recognised that they lacked important elements of human capital, however were unable to allocate resources towards full-time recruitment. In this sense, any self-assessment of the team human resources and subsequent ideas of member addition were typically held in check by the

Table 6g: Use of Public Sector Support Services

FOUNDING TEAM	Public Sector Funding Received	Public Sector Advisory Utilised
LS1	Proof of Concept	Minimal contact with SE advisory teams. Observation only.
LS2	SMART Proof of Concept Enterprise Fellowship	Minimal contact with SE advisory teams. Observation only.
LS3	SMART Proof of Concept	Minimal contact with SE advisory teams. Observation only.
LS4	SMART	Minimal contact with SE advisory teams. Observation only.
LS5	SMART Enterprise Fellowship	Legal advice Intellectual property advice Strategic advice
LS6	SMART	Minimal contact with SE advisory teams. Observation only.
LS7	SMART	Intellectual property advice Strategic advice
LS8	SMART Proof of Concept	Intellectual property advice Strategic advice
LS9	SMART Enterprise Fellowship	Legal advice Intellectual property advice Strategic advice
OE1	SMART	Strategic advice
OE2	SMART	Strategic advice
OE3	N/A	Minimal contact with SE advisory teams. Observation only.
OE4	N/A	No contact
OE5	SMART	Minimal contact with SE advisory teams. Observation only.
CH1	SMART	Minimal contact with SE advisory teams. Observation only.
CH2	SMART	Strategic advice
CH3	SMART	Minimal contact with SE advisory teams. Observation only.
CH4	SMART	Strategic advice

practicalities of resource availability. Significant changes to the TMT were typically enacted if the team were able to secure larger second and third rounds of finance. Again, for these rounds, public sector support proved vital, with the Scottish Enterprise Co-Investment Fund representing a key source of support in matching investments made by private investors.

6.5 – EARLY IMPLICATIONS OF FOUNDING TEAM CONDITION

The contrasting levels of human, social, and financial capital possessed by the different founding teams manifested themselves in the form of distinctive early behaviours. In particular, the data indicated how founding team condition had strong implications for the speed of early commercial development within ventures. In turn, the achievement of development milestones was strongly associated with how TMTs subsequently changed over time. This section presents an overview of the initial condition of founding teams emerging from the sample (See Table 6h). The most notable feature of those teams that contained founding members with significant industry experience was that both the underpinning technology and the commercial case built around the technology tended to be relatively advanced at the time of founding. In this sense, the entrepreneurial opportunity that the team was seeking to exploit was somewhat more 'ready made'. Teams LS3 and OE4, for example, were able to reapply development work that had been undertaken in former incubators as a basis for initial product lines. One major advantage of this was that the prior incubator had already borne many of the early development costs. Therefore, the proposed commercial case for the technology application was significantly de-risked. The effect of this was that early strategic milestones could be approached with improved clarity and achieved at a faster rate. This also helped the venture in creating sources of revenue and investment. Both of these aspects were key to how to definitive and effective subsequent recruitment decisions, and other major modifications to the TMT, were made (See Table 6i.1). This observation proved to be one of the key explanations of subsequent TMT development behaviour discussed in Chapter Seven of this thesis.

By contrast, teams such as LS5, LS7, OE2, CH2 and CH4, all of which exclusively contained members with limited prior commercial experience, exhibited significant difficulties in their initial development. For example, in the absence of high levels of recycled capital resources, a number of inexperienced founding teams appeared somewhat reluctant to pursue the growth of a commercial venture. Those entrepreneurs spinning off from academic institutions often expressed a desire to take a 'backseat' and relinquish strategic control of the venture to an external

Table 6h: Overview of Founding Team Conditions

FOUNDING TEAM	Human Capital	Social Capital	Financial Capital
HIGHLY DEVELOPED FOUNDING TEAMS			
OE4	High Technical HC High Commercial HC	High Technical SC High Commercial SC Strong Immediate Network of Co-founders	High Financial Resources Recycled Low Startup Investment Received
LS3	High Technical HC High Commercial HC	High Technical SC High Commercial SC Strong Immediate Network of Co-founders	Limited Financial Resources Recycled Moderate Startup Investment Received
OE5	High Technical HC High Commercial HC	High Technical SC Moderate Commercial SC Strong Immediate Network of Co-founders	Limited Financial Resources Recycled High Startup Investment Received
LS4	High Technical HC High Commercial HC	High Technical SC Moderate Commercial SC Moderate Immediate Network of Co-founders	Moderate Financial Resources Recycled Moderate Startup Investment Received
MODERATELY DEVELOPED FOUNDING TEAMS			
CH3	High Technical HC Moderate Commercial HC	High Technical SC Moderate Commercial SC Moderate Immediate Network of Co-founders	Limited Financial Resources Recycled Moderate Startup Investment Received
LS6	High Technical HC Moderate Commercial HC	High Technical SC Moderate Commercial SC Moderate Immediate Network of Co-founders	Limited Financial Resources Recycled High Startup Investment Received
LIMITED DEVELOPMENT FOUNDING TEAMS			
CH1	Moderate Technical HC Moderate Commercial HC	Moderate Technical SC Limited Commercial SC Limited Immediate Network of Co-founders	Limited Financial Resources Recycled Limited Startup Investment Received
LS9	Moderate Technical HC Moderate Commercial HC	Moderate Technical SC Limited Commercial SC Limited Immediate Network of Co-founders	Limited Financial Resources Recycled Limited Startup Investment Received
CH2	Moderate Technical HC Moderate Commercial HC	Moderate Technical SC Limited Commercial SC Limited Immediate Network of Co-founders	Moderate Financial Resources Recycled Limited Startup Investment Received
OE1	High Technical HC Limited Commercial HC	High Technical SC Limited Commercial SC Limited Immediate Network of Co-founders	Limited Financial Resources Recycled Limited Startup Investment Received
LS1	High Technical HC Limited Commercial HC	High Technical SC Limited Commercial SC Limited Immediate Network of Co-founders	Limited Financial Resources Recycled Moderate Startup Investment Received

LS2	High Technical HC Limited Commercial HC	High Technical SC Limited Commercial SC Limited Immediate Network of Co-founders	Limited Financial Resources Recycled Moderate Startup Investment Received
OE3	High Technical HC Limited Commercial HC	High Technical SC Limited Commercial SC Limited Immediate Network of Co-founders	Limited Financial Resources Recycled Limited Startup Investment Received
LS8	High Technical HC Limited Commercial HC	High Technical SC Limited Commercial SC Limited Immediate Network of Co-founders	Limited Financial Resources Recycled Limited Startup Investment Received
LS5	Moderate Technical HC Limited Commercial HC	Moderate Technical SC Limited Commercial SC Limited Immediate Network of Co-founders	Limited Financial Resources Recycled Limited Startup Investment Received
LS7	Moderate Technical HC Limited Commercial HC	Moderate Technical SC Limited Commercial SC Limited Immediate Network of Co-founders	Limited Financial Resources Recycled Limited Startup Investment Received
OE2	Moderate Technical HC Limited Commercial HC	Moderate Technical SC Limited Commercial SC Limited Immediate Network of Co-founders	Limited Financial Resources Recycled Limited Startup Investment Received
CH4	Limited Technical HC Limited Commercial HC	Limited Technical SC Limited Commercial SC Limited Immediate Network of Co-founders	Limited Financial Resources Recycled Limited Startup Investment Received

individual (See Table 6i.2). One explanation for this was that entrepreneurial spinout predominately occurred at the natural culmination of an academic research project, for example the completion of a PhD (LS5, LS7, OE3) or the end of a funding period (LS1, LS2, LS8, LS9, OE5, CH3, CH4). Thus, the initial decision to form a commercial venture was one that often conflicted with returning to a 'day job' within a university. These observations have clear implications for how spinoff, or incubation, sources might inform the initial entrepreneurial intentions of founding teams. Existing literature identifies entrepreneurial, goal, and growth intentions as important in driving strategic behaviours and organisational performance as a whole (Carland et al., 2003; Wiklund and Shepherd, 2003a). However, it appears that the types of specialist research focused activities involved in academic research projects may diminish the exposure that founding team members have to the very idea of pursuing substantial commercial growth.

Table 6i: Example Data Supporting Discussion (Initial Development within Founding Teams)

Numbered Element of Discussion and Exemplar Representative Data

1. Initial development in founding teams with strong sources of recycled capital

"The research behind it was something that we had worked on in the past in [incubator name]. They just had so many applications for it that they couldn't all be taken on. This one went to the backburner. But, we resurrected it, bought a license and started a new company. Lots of the development work had been done and I had a good notion of how to get it to market. That helps you drive things forward early on. I had a good idea of what we needed as a company, what resources. I got myself some great support from [appointed board member] who really helped direct things as we grew" **(Founder 1, LS3)**

"The first business we ever started, we were coming straight out of academia. You wouldn't believe how much time you can waste tinkering with the tech and focusing on the wrong stuff. Fast-forward ten years and we'd sold out and been running the new subsidiary. By the time we were ready to start up [Firm OE4] we'd had such good experience of running product lines. We knew the applications we wanted to go after. It was all a clear strategy. We knew what we needed, what to go for, and who to get in so that we could go after that strategy" **(Founder 1, OE4)**

2. Reluctant entrepreneurs in founding teams with limited sources of recycled capital

"From day one I said 'I know nothing about running a business, so there's no point in me trying to do this. 'I need to find someone'. But, as it happened I end up doing it all myself" **(Founder 1, LS7)**

"The two people that founded [Firm LS1] recognised that they didn't have the business skills, and also they themselves were not overly keen to move into the company full time. So they knew they had to bring in someone" **(Appointed CEO, LS1)**

"At the start I didn't really want to get too involved. I had this notion that there would entrepreneurs out there who would come and take my idea, make a business out of it and run with it and I would just advise on the technology. We rapidly discovered that these guys just don't really exist" **(Founder 1, OE3)**

"There was an opportunity after the PhD and if I went and got a proper job then I was never going to give up a nice salary to go and start a business. I thought 'at least this way I can give being my own boss a go then, if it all goes wrong, I'll go back to academia'" **(Founder 1, LS7)**

3. Initial development in founding teams with limited sources of recycled capital

"To be honest, whatever we had in the patent was pretty useless because what we realised is that what people wanted was something portable. What we had was never portable. I don't even know why we were allowed to patent it. I spent a great deal of time and a lot of my startup money redesigning and re-patenting a new design. I was new to it all and didn't have much in the way of direction. There was very little progress made" **(Founder 1, LS5)**

"While we say we started the company in 2002, that was October 2002, and essentially, nothing really happened in 2002. Lots of talking, but no money, so no real work. But 2003 was a SMART grant and spending that. We were still just testing the technology then. I spent 2 years messing round with it all, and having the occasional meeting with the high growth team. I'd spent most of the money by that point. There wasn't much of what you'd call strategy. Just a lot of fiddling with the technology." **(Founder 1, LS7)**

Additionally, while most technology-based firms are built on lengthy periods of initial R&D, some commercially inexperienced teams were particularly slow in reaching a stage where commercial strategy could be enforced. In a number of cases, companies were clearly launched before the technology was ready, and firms faced lengthy periods of 'limbo', absorbing costs while grappling with patenting, product design, and other technical issues. Often early sources of funding were almost entirely swallowed up by extended technology development periods, resulting in difficulties with the planning of venture development objectives (See Table 6i.3). Again, the impact that such situations had on the clarity of strategic development and the creation of revenue had real implications for subsequent TMT development. In short, the incubation sources of founding teams were critical in setting the initial trajectory or development 'path' of the TMT. Chapter Seven discusses these subsequent development paths in detail and aims to conceptualise the behaviours that are key in encouraging effective modifications within a management team.

6.6 – DISCUSSION: SOURCES OF FOUNDING TEAM INCUBATION

Having examined the nature and provided an overview of the capital resources held by the founding teams within the sample, the final discussion of this chapter focuses on the Scottish context and why this environment produces the founding teams that it does. The discussion centres on the question 'where do founding team members originate from?'. By analysing the career histories of founding team members, this section uncovers the dominant sources of founding team incubation in evidence.

Prior to formation, all but one of the thirty-seven founding team members examined had previously been working within daily commuting distance of where the new venture was initially located. Therefore, there is very little evidence of prospective entrepreneurs moving to Scotland with the explicit intention of starting a firm (or for the purposes of this study, forming a team). However, this in itself does not prove that the incubation of future founding team members occurs within Scottish organisations. As Harrison et al (2004) identify, entrepreneurs may gain much of their pre-founding experience within incubators that are external to the particular

Table 6j: Attraction of Externally Based Founders

FOUNDING TEAM MEMBER	Attracted From:	Organisation Entered within Scottish Region:
LS1 Founder 2	Originally English, worked in England and France prior to Scottish relocation	Took a senior academic research position within a Scottish University
LS3 Founder 1	Originally American, worked in US prior to Scottish relocation	Took a position as head of operations within a successful Scottish high tech firm
LS3 Founder 2	Originally Chinese, worked in China prior to Scottish relocation	Came to undertake PhD within Scottish University
LS5 Founder 1	Originally Mexican, worked in Mexico prior to Scottish relocation	Came to undertake PhD within Scottish University
LS8 Founder 1	Originally English, worked in England and US prior to Scottish relocation	Took a senior academic research position within a Scottish University
OE2 Founder 1	Originally English, worked in England and Belgium prior to Scottish relocation	Came to undertake PhD within Scottish University
OE3 Founder 3	Originally English, studied in England prior to Scottish relocation	Took an academic research position within a Scottish University
OE4 Founder 3	Originally English, worked in England, US, Scotland, US before returning back to Scotland	Took a position as head of sales within a successful Scottish high tech firm
OE4 Founder 2	Originally English, studied in England prior to Scottish relocation	Took an academic research position within a Scottish University
CH3 Founder 2	Originally Chinese, worked in China and England prior to Scottish relocation	Took a senior academic research position within a Scottish University
CH4 Founder 2	Originally Dutch, studied in the Netherlands prior to Scottish relocation	Came on an exchange programme to complete bachelors degree studies within a Scottish University

locale under investigation only to be attracted to that region prior to formation. However, where Harrison et al (2004) found that entrepreneurs tended to be attracted to Ottawa from external locations by job opportunities available in high profile 'magnet firms', the sample collected here that founder incubation in Scotland was largely a local phenomenon. Twenty-two of thirty-seven founders were born,

educated, and experienced their careers exclusively in Scotland. In short, founding teams were predominately produced locally.

All twenty-two indigenous founders had attended a Scottish university and completed a minimum of an undergraduate degree before embarking on a career. Subsequent career paths within specialist academic research were evidenced most frequently. A similar local orientation was displayed by four additional founders, who had been born and educated to university level in Scotland and had subsequently gained career experiences abroad before returning to a position in Scotland prior to foundation of the team/venture. Again, all four of these founders left for, and returned for, a senior academic position. No originally Scottish founder in this sample left Scotland and returned at a later date to undertake a career opportunity within commercial industry. This reinforces some key points regarding how team members were incubated prior to team formation:

1) University education was the dominant foundation for career paths that eventually lead to the formation of a technology-based venture management team. Indeed, this appeared to be the only credible foundation from which a specialist technical career could be launched in Scotland.

2) Academic institutions offered the most viable opportunities for career progression for those individuals that would eventually form teams (See Table 6k.1).

These observations were supported by the career histories of those eleven founders born outwith Scotland. All of these individuals had gained university level education, this time within their respective countries of origin. Tellingly, nine of the eleven were attracted to Scotland by a role within an academic institution (four to undertake further education, for example, a PhD, and five to take an academic position - See Table 6k.2). Only two founders had relocated to Scotland for a commercial position within a related industry (See Table 6j for an overview of externally attracted founders).

In some ways these observations are consistent with a number of studies that address regional high-technology industries. HEIs are frequently identified not only as a key 'first line' in developing potential technology venture founders and TMT members, but also are central in acting as important 'talent magnets' to such individuals (Harrison et al., 2004; Berry and Glaeser, 2005; Florida et al., 2006; Mellander and Florida, 2007; Cooper and Park, 2008). However, the role that they play in producing founding teams within Scotland appeared to be particularly extreme. Some form of direct career engagement with a Scottish university was evident in the overwhelming majority of founder backgrounds. Scottish universities represented the dominant initial foundation from which founder careers were launched, the dominant type of subsequent career path taken, and the dominant source of attraction for previously externally located founders. In short, academic research institutions were ultimately the main producers of technology venture founding teams in Scotland.

Career history data were supported by a number of narratives emerging from the qualitative interviews (See Table 6k for exemplar quotes). These largely centred on the types of high-technology firms, and the density of high-technology industries, in Scotland and how this created difficulties in the production and attraction of experienced founding team members (See Table 6k.4). For example, a number of respondents identified Scotland as somewhat of a high-risk relocation option for commercially experienced technologists. In contrast to the opportunities available within academic research, significantly less dense commercial industries reduced the opportunities for job swapping and promotion that are often identified in thick labour markets (see Henry and Pinch, 2000 for an example). Many responses pointed to the lack of large, established firms in a number of technology fields and how this could be associated with effects on training opportunities. This point was partially supported by the absence of any distinctive and commonly identified incubator firms noted across the career histories of all thirty-seven founders.

Table 6k: Example Data Supporting Discussion (Dominant Incubation Sources)

Numbered Element of Discussion and Exemplar Representative Data

1. Academic institutions as a prominent source of career opportunity for those with a technical education

"The academic career was the safe choice. I was actually a lecturer was 18 months or so. I would have had lots of opportunities in Scotland. But, my old PhD supervisor had been working on these display screens and started a company. I took a risk and went to work for him **(Founder 1, OE1)**

"When you've went to PhD level you tend to work in a research field. Most of the opportunities are in universities" **(Founder 1, LS7)**

"There are lots of jobs in academia when you've got a research background. Also you're more likely to get to work on what you're interested in. Starting a small company or working for one is risky" **(Founder 1, LS5)**

"Most of my peers, other PhDs, worked in some sort of research institute after graduating" **(Founder 1, LS1)**

2. Academic institutions as attractors to external labour

"*Scotland has great universities doing research in my field. There are a number of universities in Scotland to collaborate with. Many of the programmes here have a worldwide reputation. It was a good place for me to come and work and further my career"* **(Founder LS8).**

"I'd already had a good early career in Mexico, but wanted to get a PhD so that I could advance things. I considered a few places, but Scotland had excellent universities and it was cheaper than other places" **(Founder LS8).**

3. Attraction to non-academic magnets

"I didn't come for the job really. I mean, there were many more job opportunities back home. I came for a girl. A wee Scottish lassie! As I say, there wasn't too much going, but I had experience and I found something eventually" **(Founder 1, LS3).**

"Once [incubator name] had acquired us they set up here in Scotland. It acted to attract lots of good, experienced people here. We took some of the more experienced guys with whom we had good relationships and made them past of our team at [Firm OE4)" **(Founder 1, OE4).**

4. Thickness of technology-based industries and impacts on labour movement and promotional ladders

"To attract the right people to Scotland, you need to be able to show them that there's a critical mass of companies. So that if they come up and the company that they work for doesn't work out they haven't moved their family up here and then have to move them back

somewhere else. There would be somewhere else for them to go to in Scotland. And so until we get that critical mass of companies it's always going to be difficult to get the management and the real entrepreneurs and the real serial entrepreneurs that will come up and start companies" **(Key Informant 1).**

"There's not all that many firms in Scotland, which are producing new disruptive technologies, that also have large senior management teams. If someone experienced leaves then you're usually losing a big chunk of your team. And there's not so many places for them to go. So you just don't see that much labour movement at senior level in Scotland" **(Key Informant 2).**

"Even if you're a company with 10 people the chances are that with illness or maternity leave you've probably got 5 or 10% of your workforce out at any given time. Then you put another person or 2 on top of that and you're eating into 15% of your workforce. When you get into double figures you've got a problem. If we had more businesses that had 50 plus people in them then yes there would be movement of labour. But the way we are at the moment, no." **(Key Informant 4).**

5. Lack of training grounds for experienced commercial labour

"It's about growth businesses, and that's the chicken and egg situation. You've got to have growth in businesses in order to give people the opportunity to develop their careers. There has been a few home-grown Life Science businesses that have got big, but not many. That's where experienced people come out from" **(Key Informant 4).**

"What is also lacking in Scotland are big companies or lots of firms that are growing fast, to give people management training and backgrounds. There's good people and I think that those people can grow and develop, but its tough to do that here when you don't have a wealth of HQ companies that have got the experience of training. If you're thinking about a career, you're really quite limited in the number of companies you've got. Look at the firms in Life Sciences in Scotland and tell me how many have got more than 50 people. There's not many" **(Key Informant 4).**

"When you've got exit from trade sales then there is a natural finite size for an organisation to go to before it moves to that level. It tends to stop people from gaining experience at a really high level of growth" **(Board Member, LS1).**

"When a company grows to be big you get experienced people breaking off and doing their own thing. I can think of a few good examples of this. But, we don't have too many huge companies that were genuine startups here in Scotland. Lots of them get bought out. You need people to recycle that money and that experience" **(Key Informant 6).**

Another prominent narrative identified the lack of indigenously grown gazelle firms as an issue impacting the production of experienced repeat entrepreneurs. In particular, many interviewees contended that the tendency towards trade sale as an exit strategy for investors in technology-based firms served to truncate the experiences of technology entrepreneurs even in successful ventures. In essence, these narratives reflected somewhat of a 'Catch-22', where experienced commercial leaders were key to the growth of successful ventures, yet, at the same time, successful ventures were central to the creation and attraction of such experienced individuals in the first place (See Table 6k.5). Consequently, this underlined how the types of expertise, social connections, and financial resources recycled by founders appeared to be closely associated with the thickness and prominence of particular incubators within the region.

6.7 – CHAPTER SUMMARY

The purpose of this chapter was to contextualise TMT development by focusing on its antecedents. The results highlight how the prior career histories of founders are fundamental to our understanding of how teams emerge. The states in which founding teams emerged were highly heterogeneous. Levels of human, social, and financial capital held were dependent on the prior incubation experiences of founding team members and how these were subsequently recycled and reapplied in new teams. Reflecting the empirical findings of the chapter, it is proposed that the particular features of the less favoured regional context have important implications for the conditions in which founding teams emerge. A particular feature in this sample of Scottish firms concerned the disproportionate reliance on public sector organisations, particularly universities, as both producers of technology output and as training grounds for future technology entrepreneurs. In light of this evidence, the following research propositions are forwarded:

Proposition 1a: In less favoured regions, founding teams of technology-based ventures are more likely to emerge containing members with backgrounds exclusively in a related technology or research area

Proposition 1b: In less favoured regions, founding teams of technology-based ventures are more likely to emerge containing members with no prior business management or entrepreneurial experience

Proposition 1c: In less favoured regions, founding teams of technology-based ventures are less likely to emerge with network connections amongst key actors within a relevant private sector industry

These propositions have potentially important implications for subsequent TMT development. The results emphasised notable advantages in those teams that held both expert level technical human capital and industry relevant commercial experience, particularly if that experience was in an entrepreneurial context. These advantages appeared to influence the speed of early opportunity development and the early decisions made by the founding team. As such, the empirical findings outlined in the chapter shed light on how context can regulate the initial establishment of TMT development 'paths' (Beckman and Burton, 2008; Schjoedt et al., 2013).

7. POST-FORMATION: MANAGEMENT TEAM RECONFIGURATION

7.1 – INTRODUCTION

This chapter is the first of two that places focus on the post-formation development of TMTs. Consistent with existing research on TMT demography, a 'developed' TMT is one that becomes broadly experienced across key management functions and that displays sophisticated structures and systems of management (Smith et al., 1994; Beckman et al., 2007; Eisenhardt, 2013). Therefore, 'development' is represented by the ongoing acquisition of managerial resources and the effective organisation of those resources.

The review of existing literature conducted in Chapter Three underlined how the development of a venture as a whole is typically characterised by reconfigurations to the dominant management approach (Greiner, 1972; Eggers et al., 1994). Whereas lifecycle approaches depict set orders of development stages, empirical evidence has underlined that TMT development can actually be represented by any number of stages occurring in any order (Dodds and Hamilton, 2007; Levie and Lichtenstein, 2010; Mason and Brown, 2010). This view allows for the possibility of periods of non-development, or instances of managerial downsizing and member exit. Applying this rationale, TMT development in this study is conceptualised simply as a series of reconfigurations occurring to the dominant management logic. Displayed together in sequence, these depict the unique development trajectory of a management team. The primary focus of this chapter is to examine the events surrounding TMT reconfigurations. Principally it asks: *What actions and behaviours characterise successful or unsuccessful reconfiguration within TMTs?* By examining the actions displayed during and around reconfiguration events, a cross-case analysis of the sample builds toward a conceptual understanding of what could essentially be considered the fundamental building blocks of a TMT development pattern.

7.2 – TMT RECONFIGUARATIONS: AN OVERVIEW

7.2.1 – Drivers and Timing of TMT Reconfigurations

The critique of lifecycle principles presented in Chapter Three established that both the sequential growth of the firm and any associated development of the TMT are by no means guaranteed. Furthermore, the results presented in Chapter Six provide additional evidence to refute the notion that all TMTs begin their development path in the same 'primitive state' (Van de Ven and Poole, 1995). However, the data collected and analysed on the subsequent development of TMTs did support two of the more fundamental principles of an archetypal lifecycle approach. First, the data indicated that it was possible to conceptualise the development of a TMT by identifying distinct instances of modification to the management of the venture. Second, these modifications were likely to happen in tandem with periods of strategic upheaval. Analysis of TMT development patterns across all eighteen cases identified a total of ninety-seven critical TMT reconfiguration events (See Table 7a for example reconfiguration events). The vast majority of these (eighty-nine events) were taken either in response to or in anticipation of a major change to strategic or operational approach. Thus, the overall development of the venture, and, in particular, how ventures negotiated opportunities and threats emerging from the external environment, had strong implications for how and when modifications to the TMT took place.

Resource-seeking explanations and those approaches rooted in the Upper Echelons perspective (Hambrick and Mason, 1984) principally outline TMT development as a deliberate and rational process of human and social capital accumulation. The rationale here is that improved managerial resources will lead to improved organisational performance. In many ways, this view of development is somewhat simplistic. A purely resource-seeking perspective may be likened to 'fantasy football', where new members are assessed, recruited, and assembled in order to achieve clear strategic objectives. Examples of such behaviour have indeed emerged from some sources of extant research; notably through the actions of outside investors in replacing original founders with handpicked, functionally-balanced

professional management teams (Roure and Keeley, 1990; Cyr et al., 2000). However, the analysis presented here provided little evidence of this type of wholesale creation of a management 'dream team'. Rather, TMT development was characterised by a far more emergent and uncertain process. This was the case for two key (and practical) reasons:

Firstly, the development trajectory of a venture proved to be a difficult phenomenon for existing TMTs to accurately anticipate. Critical periods of venture development and any associated new managerial demands were not certain and defined. Instead, these *emerged* as the existing entrepreneurial team engaged with the wider environment. Therefore, TMT modifications had to be matched to these uncertain and emergent events as and when they arose. It was the anticipation of a period of new opportunity or strategic upheaval that would typically signal the need to modify the existing management. This meant that, like venture development in general, TMT development was also largely an emergent process (See Table 7b.2). In many ways, this approach to TMT development reflected effectual logic (Sarasvathy, 2001). Rather than pre-assembling the component parts of the TMT in a bid to achieve a defined goal – as in a process underpinned by the logic of causation – existing teams were far more likely to attempt to build on and around the resources that they already possessed, only enacting modifications if a seemingly appropriate opportunity or challenge arose. Of course, opportunities were not always properly identified, nor were appropriate modifications always enacted. However, it was ultimately the effective recognition of and reaction to emergent challenges that predominantly underpinned how TMTs developed.

Secondly, TMT reconfigurations were also typically constrained by the availability of resources (notably finance). In the entrepreneurial ventures examined, many of which were founded on modest investment sums, financial resources were allocated predominately towards core product development and operational concerns. This meant, first of all, that significant outlay on new management resources was particularly rare during the early stages. Beyond this, the recruitment of a new TMT

Table 7a: Reconfiguration Actions and Behaviours – Exemplar Critical Events

Key Actions and Behaviours	Exemplar Events
RECONFIGURATION EVENT	**OE3: Event 53 – Effective**
Reconfiguration Action	Delegating management of international sales and support to a new strategic partner
Context/Event Driver	Signing of exclusive sales agreement with an international partner
Reconfiguration Rationale	Existing management lacked the expertise and infrastructure to support the size of sales contract that they were awarded
Decision Making Process	All TMT members involved in decision-making process. Members held equal ownership and strategic control of venture
Accommodating Reconfiguration	Existing team relinquished much of the responsibility for quality control and commercial support processes. Management was restructured to focus on core technology development activities. Existing management now liaised with a board representative from the new strategic partner who coordinated sales and support activity
RECONFIGURATION EVENT	**LS3: Event 17 – Ineffective (Member Exit)**
Reconfiguration Action	Exit of initial founder
Context/Event Driver	Investment award withdrawn during final stages of negotiation
Reconfiguration Rationale	Exit of founder enforced by lack of available financial resources to support full time position
Decision Making Process	Decision made by exiting member, who would return to a full-time academic role
Accommodating Reconfiguration	Exiting member takes a part-time scientific advisory role on the board in order to support existing team in pitching first product line to potential customers

RECONFIGURATION EVENT	**LS5: Event 26 – Ineffective (New member Exits within 6 months)**
Reconfiguration Action	Appointment of a Sales Director
Context/Event Driver	Investment tranche of £200,000 awarded
Reconfiguration Rationale	To increase sales revenue of first product in line with investor targets
Decision Making Process	Decision making process driven by primary founder
Accommodating Reconfiguration	New member given open role specification. Role overlapped with existing main founder. New member to develop systems for coordination of activities

RECONFIGURATION EVENT	**OE4: Event 70 – Effective**
Reconfiguration Action	Appointment of Sales and Marketing Director (Europe)
Context/Event Driver	Creation of California-based subsidiary
Reconfiguration Rationale	Division of European and US sales responsibilities requires exclusive European Sales Director
Decision Making Process	Formal decision-making process involving all five existing TMT members
Accommodating Reconfiguration	Clear role specification and formalised support systems in place

member frequently represented a significant cost. Thus, outlay on externally recruited management – particularly highly experienced individuals – represented somewhat of a risk for most developing TMTs. Typically such appointments were only made when it was clear that further investment or revenues were going to be accessed. The arrival at certain strategic milestones could act to release those resources. But, equally, failure or delay in reaching milestones could act to inhibit potentially necessary, or at least beneficial, modifications to the TMT. This need to secure the release to further resources ensured that the development of the team tended to take place in a 'piecemeal' fashion, as and when resources were released (See Table 7b.1).

In essence, TMT modifications resembled somewhat of a balancing act, where the expansion of TMTs was timed in conjunction with the emerging strategic needs of a venture and the release of further financial resources to support that modification. Under a human capital, or upper echelons, perspective it is the internal agency of management that is depicted as a primary factor in influencing both firm and team growth. However, this analysis demonstrated that TMT development not only drove strategic progression, but was also predominately driven by it. It is primarily for these reasons that the vast majority of reconfiguration events observed surrounded major events in the life of the venture. Mostly such events were represented by awards of large sales contracts, or the receipt of finance rounds from external investors (See Table 7b.2). Specific events, and their impacts, depended on the business model and the resource needs of a particular venture. For instance, drug development firms (LS2, LS3, LS6, LS8) were required to conduct lengthy trialing, regulatory, and licensing processes before they were able to draw in revenues. Such firms were typically awarded far larger investment sums, which were released at key stages of regulatory development. As such, funding cycles became particularly key to their strategic progression. Ultimately, it emerged that the development of TMTs as a whole could not, and should not, be separated from these critical events.

7.2.2 – Identifying Actions Surrounding TMT Reconfigurations

In establishing that TMT reconfigurations were predominantly actions taken in conjunction with periods of change or opportunity, it became important to address how those actions were taken. In order to examine actions and behaviours surrounding modifications to TMTs focus was placed on the existing management and how decisions were made. Key questions addressed at each reconfiguration event were:

Reconfiguration Rationale

- What benefits were sought by the modification?
- The modification was made in anticipation of or in response to what event/scenario?

Decision Making Processes

- How did the existing team make decisions?
- What members held decision-making power?

Accommodating Reconfiguration

- How did the existing team structure itself to accommodate reconfigurations?
- What roles and task demands did new members perform?

In line with the critical incident approach taken by the study, this analysis process was conducted at each identified reconfiguration event. This allowed a detailed picture the actions that occurred during the events in which an existing management configuration was changed to new one. As identified in the literature review, reconfigurations were observed either as changes to management personnel, or as major changes to management structures (for example, changing member roles or changing levels of management hierarchy). This approach formed the basis of the discussion outlined in the remainder of this chapter.

7.3 – CHARACTERISING TMT RECONFIGUARATION BEHAVIOURS

A number of key behaviours characterised what were identified as being effective reconfigurations to TMTs. Reconfigurations were deemed effective if the new influx of human resources or the new management approach adopted were supportive to the achievement of strategic direction within the venture. This is as opposed to ineffective TMT reconfigurations in which actions of modification were:

- Negative – resulting in the loss of human resources or the downsizing of operations.
- Clearly unsuccessful, poorly implemented, or quickly reversed (such as in the exit of a recently incoming new member)

In total, fifty-six reconfigurations were identified as positive and effective across the sample. The remaining forty-one reconfiguration events were identified as ineffective. The following sections discuss prominent themes of behaviour surrounding critical instances of TMT modification.

7.3.1 – Strategic Planning and Strategic Alternatives

Clearly some of the major challenges to TMT development concerned the identification and accommodation of appropriate modifications in line with uncertain emerging strategic needs. In those TMT reconfigurations that were identified as effective, the uncertainty of development appeared to be mitigated to some extent by increased levels of clarity and planning surrounding the strategic milestones of the venture. There is a broad body of research that suggests that innovation strategies, such as those frequently undertaken by high-tech ventures, require increased levels of long-term planning and coordination of strategic activities (Markides and Williamson, 1996; Wolff and Pett, 2006; Kraus et al., 2008; Barbero et al., 2011). While it was impossible for existing TMTs to know the timing and nature of upcoming developments, it was those teams that were able to both anticipate growth milestones and plan for unexpected scenarios that typically enacted successful management modifications.

Particularly helpful to the planning of development strategy was the presence of an active member with prior business ownership experience (especially if that member had previously experienced relatively high levels of growth within the former venture). Clearly the growth trajectories of different ventures are heterogeneous; however, the presence of prior business ownership experience appeared to equip some TMTs with an understanding of 'venturing in general' (Zhang, 2011). This was particularly helpful if knowledge of those steps was also related to specific and appropriate industry sectors or business models (for example, knowledge of drug development regulatory procedures, or of product development and manufacturing processes). In essence, such knowledge encouraged clarity on the general order of venture growth, allowing more appreciation of likely development milestones and challenges. This, in turn, appeared to act as a useful lens through which emergent management needs could be viewed (See Table 7b.3).

Importantly, however, the levels of strategic planning in evidence were not typified by explicitly detailed and rigid approaches, as in what might be expected in, for example, a business plan. Indeed, numerous strands of existing research have cast doubts on the significance of detailed planning to organisational growth (e.g. Fletcher and Harris, 2002; Alpkan et al., 2007). Instead, strategic plans were typically discussed in terms of being 'headline' approaches. Thus, flexible decision-making, designed to help navigate the uncertainty of venture growth, was typically held within well-articulated, but loosely detailed, objectives.

Strategic planning approaches were also characterised by aspects such as contingency plans and various other measures designed to mitigate risks associated with failures or delays in achieving objectives. Again, these were likely to be general 'headline' strategies rather than detailed documents. This is an important feature of effective TMT strategy formation noted in a recent study by Eisenhardt (2013), who posits that high performing management teams typically thrive when members are able to juggle several strategic alternatives simultaneously rather than relying on a single strategy. Thus, while most of the successfully developing teams examined in this sample did display a strong main development strategy, they also typically

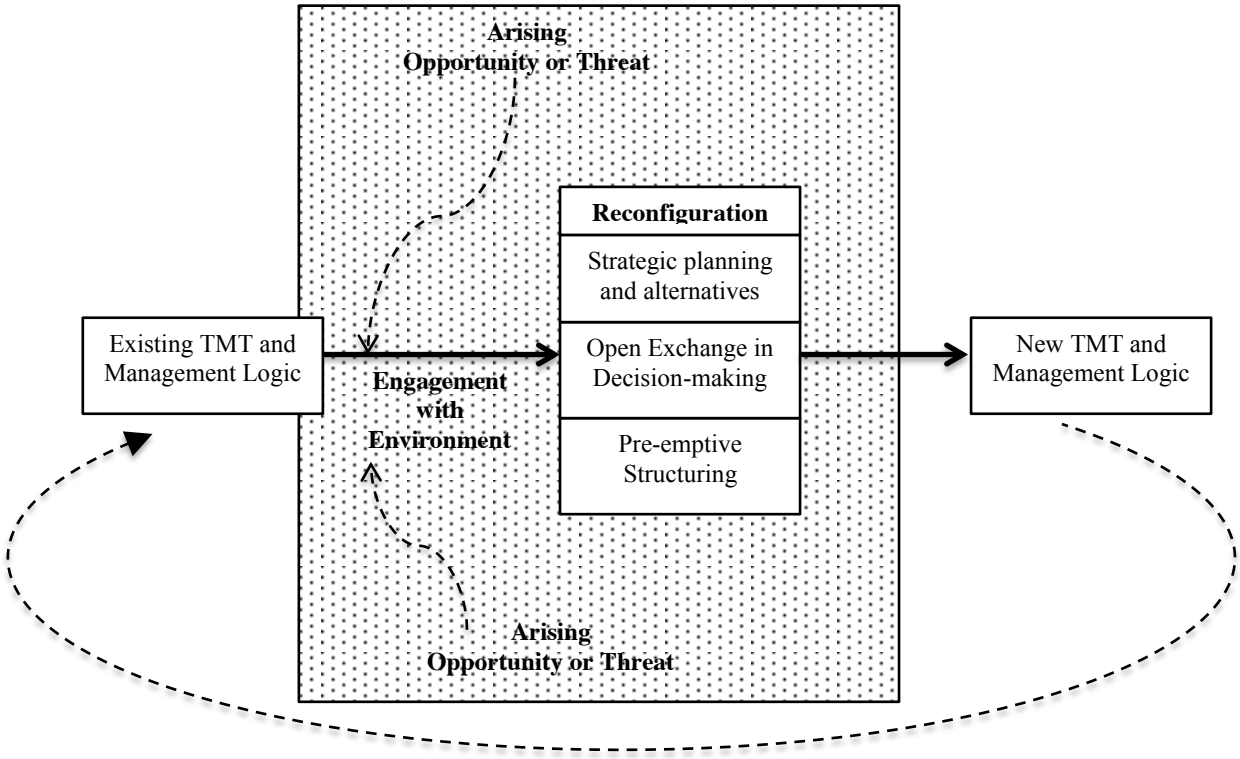
discussed alternative approaches such scaled-down versions and complementary business models (See Table 7b.3).

The use of simultaneous, but complementary, business models by some TMTs in the sample represented a strong portrayal of how existing teams could mitigate the risk of recruitment cost. The vast majority of high-tech ventures examined here were primarily characterised by 'hard' business models related to the development and distribution of a physical output. However, part of the risk with such models was that maintenance of cash flow could prove difficult, with firms often becoming reliant on a certain large contract or a certain large finance award. Successfully developing TMTs were often able to moderate this risk by employing a hybrid 'soft', or service-orientated, business model, frequently in the form of a consultancy service. In this way, existing TMTs could maintain cash flow and thus avoid the risk of a dry up of resources between development stages. This, in turn, allowed existing teams to more accurately time managerial modifications. This observation was reflective of the work of Connell and Probert (2010) who identified 'soft' approaches as a key means by which high-tech economies can alleviate pressures stemming from challenges of securing investment.

These findings place those TMT members in a leadership position very much at the heart of how TMT reconfigurations are incited by venture development (Lockett et al., 2013). In short, it is the existing team that largely drives the events that lead to its own modification. This analysis suggests that well articulated strategies, and strategic alternatives, are key to how adequately timed and resourced TMT modifications are. However, clearly, these simply act as guidelines for the speedy and flexible decisions that must be made in response to arising opportunities or threats (Eisenhardt, 2013).

By contrast, it was the relative lack of strategic clarity that characterised both those identified instances of ineffective TMT reconfiguration and those periods where TMTs were unable to implement TMT modifications at all. This was epitomised by a

Figure 7a: Archetypal Effective TMT Reconfiguration



range of actions and behaviours (See Table 7b.4). A number of TMTs displayed difficulty in managing the order of key commercialisation milestones. For example, Teams LS5 and LS7 placed a great deal of focus on prototype development *before* an initial market assessment, which resulted in the need for costly product re-designs and caused significant hindrance to progress. In these cases, strategic decisions were largely reactive, formulated after arrival at a particular critical juncture as opposed to preemptively. This type of behaviour was noted particularly in first-time technology entrepreneurs. Existing research suggests that the majority of SMEs do not engage in strategic planning (Beaver and Prince, 2004; Gilman et al., 2012). However, while the appears to be little requirement for detailed projections, a degree of proactive planning and broad levels of articulation appear to be key to giving shape to flexible strategic decision making within teams.

Table 7b: Example Data Supporting Discussion (Reconfiguration Behaviours)

Numbered Element of Discussion and Exemplar Representative Data

1. The need to balance TMT modifications with the release of financial resources

"You didn't have the money to go out and recruit four or five people in one go, because you'd run out of money. Building a management team is cash flow driven, I don't know if you'll be talking to many, or any, people that have been VC backed and start off with a few million and can go out and recruit whoever the hell they want. That was not how we had to do it because we were not funded by a lot of money. That's not the experience for the vast majority of firms in Scotland" **(Founder 1, LS3)**

"We've only recruited at management level as we can afford and as it was required. And that's really how we've built it up. I mean, you don't have that model like you'd imagine in Silicon Valley where you would get two guys coming out of a university and going along to investors and getting five million pounds on day one, and then they'd build a team of top executives. It doesn't happen like that. It has to be organic build up" **(Founder 1, OE1)**

"We didn't have a huge amount of funding. We recruited opportunistically. So if you go and raise millions and millions, then maybe you go and build a full team with some top guys. But, with only £700k? Well, that needs to be spent on technology development" **(Founder 1, CH3)**

2. Drivers of emergent TMT reconfigurations

"Changes at management level will depend on how quickly sales traction comes through. In terms of growing the top team, we'd look to bring in an operations manager at some point and some additional commercial people, probably a product line manager. But again a lot of that will be driven by sales traction" **(Founder 1, LS1)**

"We got a new Sales Director, an experienced guy, when we were offered our first major sales contract. That was the moment where I knew there was work there for someone to do. You've got to balance your team against how the company grows" **(Founder 1, LS3)**

"*Well growth is obviously one thing. But, then you're back to the issue of funding because it's difficult to grow the business without some investment, or some sort of revenue. So, growth is the fundamental driver, but that's related to funding for many tech businesses"* ***(Key Informant 4)***

"Drug development is purely spending for most of the early and even middle stages. It's a really odd business. It makes it difficult to drive plans forward sometimes because you're dependent on finance awards in order move things. So, for us, there'll be no big changes at management level until milestones are met and funding rounds are secured" **(Founder 1, LS6)**

3. Effective strategic planning and approaches

"I'd say it's really important to have some intuative idea of how to grow a business in general. I had good experience on the operations and logisitics side, and I had [board member name] who

had grown a dozen sucessful businesses. You can broadly plan for big periods of growth, partly because you've been there and done it, and partly because, with the backing of the right people, you can be more confident that you'll get the finance or the right deal when you need it. Building a team to support this is all a bit of a balancing act, especially in the periods leading up to your first big deal. We always had a clear strategy for growth, with contingency plans and all the rest. When things went well, we knew who to get in" **(Founder 1, LS3)**

"Experience helps enormously. I had learned so much from building [former company name] in the past and from my time at [former incubator name]. I was so much clearer on the growth strategy this time. We'd been through a number of global product launches. You know what expertise you need to get in" **(Founder 1, OE4)**

"We did a bunch of consultancy to keep ourselves going. We couldn't have run things on the level of funding that was available here. But, this takes away from you making the real money out of the science. On the other hand, how could we have got anyone good onto the board unless you were taking in revenues? At [Firm Name] we counted ourselves lucky that we could afford to pay a heavy hitting Chairman early on. Most Life Sciences firms in Scotland just spend, spend, spend in the hope of being bought out. That's why historically the successful businesses in Scotland in the Life Sciences have been service businesses. They generate cash early" **(Key Informant 4)**

"Even if you've got a products business and you want to be a products business, its not the wrong thing to go and get yourself some real, paid work. You can't drive the development of a firm or get the people you need if you aren't taking in cash, either from revenues or investment. In our case, we had real expertise to sell, so we sold it through consultancy. A lot of firms that have to wait long periods before they even get a product out, and that don't have an early revenue stream can really stagnate. You end up so dependent on investment, which isn't always forthcoming, or can be delayed." **(Founder 1, OE4)**

4. Lack of strategic clarity, mistimed TMT appointments, and management of financial resources

"After maybe eighteen months of working on the product design I was thinking to myself 'I know nothing about running a business, I'll to get someone experienced in to sell it'. I hired the [new member name] when I had it ready because I wanted to offload commercial responsibilities. But, after engaing with customers we had to redesign the tech. I guess I should've really planned those steps logically before expanding the mangement. I was left wondering what [CEO name] was actually doing for us" **(Founder 1, LS7)**

"We really lacked any form of strategy in terms of hitting certain markets. I think the hardest thing for us is that we didn't know how to sell and we didn't know who to sell to. So we spoke to a lot of people and we got a load of people excited, but we didn't get big returns on that. It was all pretty 'off the cuff' rather than focused on particular target markets" **(Founder 1, CH4)**

"You really need to have a clear strategy in place for growth. What happens with a lot of biotech companies is that founders don't have the experience of what it's like to grow a commercial firm. If they don't have someone to guide them then the money tends to get spent, targets aren't reached, the funding rounds become harder to come by, and you end up with a 'mom and pop' shop. It'll be one, two, maybe three guys running it, but they won't really expand, and they won't really get to a stage where the can justify having proper management functions" **(Key Informant 4)**

5. Open discussion and delegation of decision-making

"All of our management level guys are very experienced, so they all have an input to strategy and to the big decisions. Recruitment decisions at that level would be something the whole team would discuss. You can't run the whole thing yourself" **(Founder 2, OE4)**

"I'm CEO, but I don't make all the major decisions. We have an accomplished senior management team and some very experienced board members who all have input **(Founder 1, LS3)**

6. Personality-led decision-making/ retention of power

"I wanted to be my own boss, so I make the major decisions. I've had various CEO-types and advisors in my time, but it's never worked out. I run everything now" **(Founder 1, OE2)**

"*I think it can be dangerous when you start getting investors too involved, and board members, and big business guys. We run this company and I think that we know it best. I think that we can handle it with just us two at the helm"* **(Founder 1, CH1)**

"From a personal perspective, I'll say that it's really hard to recruit your own boss. You have to get someone in that's going to tell you what to do. And that just goes against the grain" **(Founder 1, OE1)**

"I wholeheartedly agree that management teams are too technically focused in many cases. You can see why: the control of the company is usually invested in the hands of the inventor. There's sometimes a control freak mentality" **(Key Informant 4)**

"It can be a thing with newer technology entrepreneurs where they form teams that have been so focused on the technology that they think they can do it all on their own and don't want to let go. That's a problem because as soon as someone else comes in to manage the company I think they feel as if they are letting go of their technology, which is their baby" **(Key Informant 1)**

7. Pre-emptive implementation of organisational structures in effective reconfigurations

"Yes, things get more complicated when you grow. There are more things to do and you need to have certain working practices, systems for communication between your top guys, procedures. That's a fact of life in business. But, you don't just put these things in place after you've say, won a big contract. You have systems in place before these things happen. If you don't, you'll soon find that growing your team is a problem" **(Founder 1, OE4)**

"I've always had organisational procedures formal. I think if you try and change things as you grow, it's not a good idea I'm not saying you need to be Draconian, but you should have certain rules and regs. It's very difficult to introduce these things two or three years down the track. A completely personal management style where things can be changed on a whim isn't really conducive to managing a bigger company. It's best you sort things like this out early" **(Founder 1, LS4).**

"*If you want to grow, sooner or later a growth business has to transition itself into a much more structured business. This means formal communication and formal project management. The foundations should be laid early on if you want to be able to cope with growth. If you want to look for an exit from the business, there's got to be, those corporate governance structures, those explicit procedures for working need to be in place"* **(Key Informant 4)**

"Setting up these standardized forms and spreadsheets and ways of doing things that had been crafted over the years at these corporations made a big difference to us" **(Founder 1, LS3)**

8. Strong definition of new member roles

"We had a very clear idea of what roles we'd need to fill and who we needed to fill them for that matter. The management structure was really based on our experiences at [former incubator]" ***(Founder 1, OE4)***

"Part of the challenge is knowing what you need. It's knowing what direction you want to take things in and being able to identify those strengths in someone. These are difficult things to pinpoint. It helps if you've worked together in the past, or if someone you trust can recommend them" ***(Founder 1, OE5)***

"I was strong on the operations side. I knew what type of expertise we needed on that front. When manufacturing was starting to expand I was pretty sure what we needed in a product line manager" ***(Founder 1, LS3)***

9. Informal structure leading to 'wheel spinning'

"*We had to let the sales manager go. It just wasn't working. He was good at his job, but we found it hard to get enough work for him. It was difficult to organise things so that he could work effectively. It was frustrating because I knew we needed to expand the sales side of the management team, but we didn't really have the infrastructure to make it work. We were a bit 'one step forward, one step back' in terms of the building a proper management team"* **(Founder 1, CH2)**

"I wanted a Sales Director, but I'm just not so sure I knew what I expected him to do. I just wanted more sales to be honest. We decided not to replace him once he left. How do you justify a guy walking round knocking on doors who's not bringing much money in? Things just weren't set up in a way that allowed him to work effectively" **(Founder 1, LS7)**

10. Poor definition of new member roles

"We would try and write a spec or a description and send it to a recruitment agency. This is much harder than it sounds. If you're writing a spec: what do you actually want? Probably that's quite difficult to do if you don't know. If I'm looking for someone to work in the lab, I'm a lab person, I understand what I want them to do and I can write that in great detail. I'm looking for someone to do business development because I don't know how to do it myself. So how the hell do I write a spec, you know?" ***(Founder 1, LS7).***

It cost us 100,000 to recruit him, and we had to fire him. Looking back this was a mistake because we were a bit naïve when we set up the profile for the job. I'd see we were looking for a pretty scientific person, but the investors said 'no, we need a more commercial person'. But when we gave the commercial person the opportunity they didn't know anything about the market. He couldn't sell anything, he started getting too stressed, and started lying. So we found out that after a few months nothing was coming in, no sales. **(Founder 1, LS5).**

"I sometimes wish I could clone myself, but obviously I can't. Another one of me just doing all the tasks I do would be great! I've tried recruiting in the past, but it's been hard to divide up responsibilities in a way that works" **(Founder 1, LS5).**

"With 20/20 hindsight, he was the wrong person in the wrong role. He wanted to be a Chairman. What I was looking for was a CEO and not a Chairman. I didn't really have the experience to know this at the time. He never embraced the role and left after 6 months" **(Founder 1, LS7).**

"There's only so much you can do yourself. You need to simplify the process so that other people can come in and support things. But when you've been going your own little way for all these years it can be quite difficult to split it all up **(Founder 1, LS9).**

Lack of effective contingency planning was also characteristic of difficulties faced in the management of cash flow. When financial resources dried up, TMTs were forced to 'firefight' immediate strategic crises, making any management-level modifications unlikely. Lack of strategic clarity was also associated with mistimed or unnecessary TMT appointments. Typically, when the roles and task demands allocated to a new manager were not closely attached to the current strategic needs of the venture, recruitment proved to be ineffective.

7.3.2 – Decision-Making and Power Delegation

The decision to modify the composition or structure of the TMT represented a major strategic choice in itself. The manner in which TMTs arrived at such decisions is the next element of effective reconfiguration to be discussed. An important first step here was to identify those existing team members who were involved in the decision making process. During the formative stages of those teams founded by a single entrepreneur only there were clearly periods where one individual was the sole driver of TMT reconfiguration decisions. However, when TMTs contained or grew to contain multiple members they typically faced more complex decision-making processes. Examining the roles played by those members during TMT reconfigurations afforded some important insights.

Intuitively it might be expected that effective decision-making would be hampered by the input of multiple team members, which would act to slow down the process of reaching a resolution. This, in turn, would imply that those TMTs that were dominated by a clear leader would be more effective in driving management-level modifications. However, the analysis conducted here largely implied the opposite. Overwhelmingly, effective reconfigurations to the TMT were characterised by decision-making processes that involved input from all, or at least most, of the existing team members (See Table 7b.5). Therefore, effectively reconfiguring teams tended to have members that all held a significant degree of influence on venture direction. While most TMTs typically contained a lead member, who operated in a general, strategic CEO-type role (often a founder), it was also evident that, in most effective TMT reconfigurations, these lead members tended to cede a significant

degree of strategic–level control to other members, including new appointments. The result was that effective reconfigurations were often characterised by periods of intense discussion and analysis – even conflict – between TMT members. Such discussions would typically extend to include key members of the board of directors. Respondents emphasised a clear focus on the objective assessment of multiple ideas and the open exchange of ideas from possibly contrasting perspectives. This is a feature of team decision-making noted in other studies (for example, Ensley et al., 2002) and resembles what Eisenhardt (2013: 809) refers to as the "winning 'trifecta' of speed, conflict, and harmony".

It proved to be somewhat paradoxical that conflict between members was characteristic of effective reconfiguration decisions. After all, conflict could just as easily prove to be a source of animosity amongst the individuals in the TMT, which had negative implications for development. For example, poor decision-making interactions between members could undermine the effectiveness of what might have been, on paper, a positive modification to the team (for instance, recruitment of a new member). Ultimately, unhealthy levels of conflict frequently resulted in the departure of one of the disaffected parties. Personality clashes and disagreements over the direction of the venture are perhaps inevitable in team-managed ventures. However, it was clear that effective modifications to a TMT were typically epitomised by open discussion and reduced personalised debate. In short, the challenge lay in the harnessing of conflict between members.

It is important to acknowledge that the open exchange of ideas in TMT modifications was not always practical during the earlier stages of development. During these early stages, the emphasis on strong individual leadership was typically more pronounced. However, it was the ability of existing team leaders to delegate strategic power to new members that largely epitomised strong TMT development beyond the formative stages. One common trait of those TMTs that failed to enact effective modifications was that decision-making power continued to reside with an individual leader for an extended period of time (See Table 7b.6). In these cases, decision-making power was often highly centralised and personality-driven (see Eisenhardt

and Bourgeois, 1988).

In these cases, newly recruited members were treated more as 'employee-managers' rather than important components of the top-level strategic decision-making process. As such, TMT recruitment was focused largely on the alleviation of functional task demands on existing leaders. These observations were noted particularly in those TMTs that were dominated by first time technology entrepreneurs, who appeared more reluctant to give up power of control over their ideas. A key narrative here was that inexperienced entrepreneurs felt more at risk of losing control when recruiting more experienced members to fill human capital deficiencies (See Table 7b.6). One respondent referred to this difficulty as effectively 'hiring your own boss'. This desire to retain decision-making power within a single individual or dominant coalition for an extended period was one that frequently either undermined the effectiveness of potentially beneficial TMT modifications, or prevented them from occurring in the first place. Paradoxically, despite their apparent greater need to acquire managerial resources, it was less experienced teams that tended towards retention of decision-making power for extended periods. Similar behaviour was also occasionally evidenced though existing teams that displayed reluctance in engaging with investors for fear that strategic control would be lost. Thus, the inability to manage power dynamics could also have additional – and very practical - implications for how important resources were acquired by TMTs.

7.3.3 – The Creation of Organisational Structures

The formalised coordination of management activities represents a final key feature of how TMTs reconfigured. Evidence of two key elements of organisational structure emerged from the analysis of reconfiguration events. The first concerned the presence of formalised support systems, such as explicit policies, or sets of procedures, routines, and rules. Examples of these included defined procedures for management communication or explicit project management systems. The second concerned levels of 'functional structure' (Beckman and Burton, 2008: 4) in the TMT, which pertains to how clearly member roles and responsibilities were allocated to defined management positions. Together these features emerged as key both to

how management activities were directed and to how new members were assimilated into the TMT.

It is important to acknowledge that almost all active ventures experience at least some form of growth from their initial founding state. While varying significantly from firm to firm, this was the case for all eighteen ventures examined in this sample. Much of the existing literature contends that the organisation of venture activities is likely to become more formalised and structured as that venture grows (Wiklund and Shepherd, 2003a; McKelvie and Wiklund, 2010). In the strictest sense, this study finds support for this principle. In the TMTs examined here, evidence suggested that increasing formality in management approach was largely driven and facilitated by venture growth. That said, it would be misleading to suggest that the increased formality of organisational structures occurred naturally as a by-product of venture growth. On the contrary, the implementation of formal organisational structures was typically a deliberate action, taken in a pre-emptive manner prior to major growth events. In this sense, increases in organisational formality were, for the most part, a necessary pre-cursor to growth. If suitable forms of structure were imposed then the facilitation of venture development was accommodated more effectively. On the other hand, the lack of suitable structural foundations acted as a significant barrier to growth.

In the same way, it was this pre-emptive implementation of formalised organisational and management approaches that characterised most successful TMT reconfigurations. Principally this appeared to help with the assimilation of new members. The data indicated that member additions were more likely to be integrated effectively if appropriate organisational structures were already in place to support the new management role (See Table 7b.7). Respondents discussing effective additions to the management team frequently highlighted how aspects such as formal objectives and targets or explicit project management procedures were key to the integration of incoming human capital, and to the coordination of management activities as a whole. One particularly important element of this concerned the identification and articulation of definitive member roles and responsibilities. Most

existing TMTs were able to identify generic functional positions, such as a Sales Manager. However, successful instances of member entry were epitomised by more specific identification of management requirements and how these matched with both new entrant abilities and the strategic needs of the venture (See Table 7b.8).

Conversely, difficulties faced in these respects acted either to undermine the performance of newly entering members, or to prevent member addition happening at in the first place. Even the addition of a high quality new member, who, on paper, carried beneficial human and social capital into a TMT, could be undermined if the firm was not organised in such a way that it could effectively leverage the influx of new resources. Examination of the forty-one identified ineffective reconfiguration incidents highlighted numerous examples where experienced new entrants were unable to contribute effectively and exited the team shortly after joining (See Table 7b.9). One principal issue here was that the lack of appropriate structures and systems would act to impair the coordination of management activities – what Eisenhardt's (2013: 814) refers to as 'wheel-spinning' – often leading to poor performance, conflict, and ultimately, to member exit.

A prominent narrative emerging from the data was that the experience of the existing team was key to the creation and articulation of effective new management roles. For the lifelong scientist turned entrepreneur, technical positions were easy to create. However, while functional business titles may have been familiar in name, the identification of detailed management roles frequently proved difficult to pinpoint in practice (See Table 7b.10). Furthermore, the influence of prior experience on the creation of new management roles appeared to be relatively specific to particular functions. For example, Founder 1 of Team LS3 (an experienced operations director) expressed confidence in the delegation of roles relating to his venture's growing manufacturing and logistics needs. However, he underlined challenges in recruiting members to grow and manage an international sales infrastructure. It was only after building a relationship with an active board member, who held vast experience in this area, that appropriate TMT positions were created and filled for this management need.

Part of the difficulty for inexperienced existing teams was that certain common behaviours tended to have a cumulatively negative effect on the appropriate creation of new managerial responsibilities. For example, poorly articulated commercialisation and growth strategies made the accurate identification of task demands more challenging. Similarly, centralised decision-making tended to pose hurdles to the effective delegation of responsibilities. For example, when multiple key tasks were so intrinsically tied to a particular venture leader, it could prove difficult for them to abruptly organise the venture in such a way that others could take on management tasks. However, if the firm was growing in complexity, the members of those existing teams who were unable to create new management positions were likely to experience task overload. This was most notable in those teams where a single lead member, or a small dominant coalition, operated a 'jack of all trades' approach to the coordination of management tasks. Once this system became established, it became increasingly difficulty to change in the future. A number of respondents that had operated in this way commented on how much easier managing the growth of the venture would be if they were able to 'clone' or 'duplicate' themselves. Such comments provide a potent expression of the challenges related to task overload and role delegation (See Table 7b.10).

Notably, changes to organisational and management structure were not easy to enforce in the same immediate manner as personnel changes. In fact, the implementation of formal organisational structures was a feature that most successfully developing TMTs implemented from a relatively early stage (See Table 7b.7). During the formative years of a TMT, such measures may have been largely unnecessary, given the typically reduced organisational complexity present in an early entrepreneurial venture. However, in the effective reconfiguration events examined here, the pre-emptive formalisation of organisational structures appeared to represent a form of 'good practice'. Thus, actions might not necessarily have been fully implemented during earlier development stages, but nonetheless signaled certain intentions with regards to the manner in which the TMT may progress (See Table 7b.7). The implication here was that pre-emptive implementation of formal

systems encouraged an easier transition to the increasing demands on management that would be likely to arise from any significant future growth of the venture. This mitigated against what is a key challenge for many entrepreneurial ventures (Nadin and Cassell, 2007) A number of respondents pointed out how the early implementation of organisational structures and the organic development of these over time was key in instilling a professionalised management culture within the TMT. The key message here was that, once initially established, this culture was easier to maintain. However, if the foundations were not in place it would likely prove difficult to implement a complete overhaul later in the lifespan of a TMT. For these reasons, the early structural 'blueprint' (Baron et al., 1999) on which the management of the venture was based proved to be particularly important. Those teams containing founding, or early, members with relevant prior business ownership experience, who were able to transfer management approaches from former incubators, often enjoyed a distinct advantage in this respect.

The obvious tension arising in this theme of the discussion concerned the trade-off between less structure – associated with flexibility on one hand, but inefficiency on the other – and more structure – associated with efficient execution of tasks, but rigidity in the pursuit of opportunities (see Davis et al., 2009). Ultimately, the analysis conducted here underlined that successful modification of the TMT was more readily associated with increased levels of structure. This issue also raises an important point with regards to the assimilation of new TMT members and to TMT modification as a whole. The resource-seeking perspective of TMT development works largely on the assumption that appropriate new member additions will see the human and social capital 'stock' of a team increasing. However, Forbes et al (2006: 234) highlight that this view considers the benefits of member addition up to the 'point of entry' only, thus largely ignoring how a member is assimilated. Yet, it is evident that even the addition of highly experienced new members – who, in theory, should add new managerial resources – did not always prove to be beneficial to TMTs if they were not supported and leveraged effectively. In short, any hypothetical advantages to be gained from TMT recruitment were mediated to some degree by the organisation and structure of that TMT.

7.4 – ALTERNATIVE MEANS OF DEVELOPING TMT RESOURCES

The above discussion depicts TMT development as a series of distinctive modifications, such as personnel changes. While this proved to be an effective means of examining development, it emerged that this was not the only way that TMTs accumulated managerial resources. The data also provided evidence of a number of alternative means of development, which typically occurred in parallel to distinctive modification events.

Two observations were key here. Firstly, the human capital contained by TMTs was not necessarily represented by an amalgamation of its full-time members. Instead, a central element of how a TMT functioned concerned surrounding sources of support, most notably the board of directors (Knockaert and Ucbasaran, 2013) and closely associated strategic partners (Gulati and Higgins, 2003; Hayton and Zahra, 2005). For example, effective leveraging of a knowledgeable board of directors could allow existing TMTs to access strong sources of human and social capital without over-committing and overspending on full-time management appointments. Similar resource acquisition advantages were noted through venture interaction with industry partners (see the work Wright et al., 2004b on joint venture spinoff [JVSO] technology firms). Typically, the levels of capital resources accessed from such sources were beyond that which was held by the current team, or that which could be practically gained by full-time recruitment.

Secondly, the human and social capital of the existing TMT was not static. As such, the growth of managerial resources within the TMT occurred through ongoing learning of existing members as well as through overt modifications. Again, surrounding sources of support emerged as key to this process in that they acted as mentors and role models to existing teams. Use of alterative methods of development allowed some teams to augment and stretch existing human and social capital resources, meaning that they were important considerations for how TMT development was understood as a whole. The data indicated that such behaviour was often a necessary compliment to the development of the core TMT. In many cases,

the board of directors became intertwined with the TMT, making it difficult, at times, to separate the two entities (Vanaelst et al., 2006; Gabrielsson, 2007; White et al., 2007; Knockaert and Ucbasaran, 2013). Thus, the study of TMT development was rendered somewhat ineffective if not discussed in conjunction with the activities these supportive sources. Two key roles of non-core sources of TMT support are discussed here. The first concerns their use as a means to alleviate task demands on existing TMTs. The second concerns what was often a vital mentoring role played by board members or strategic partners and how this could occasionally become extended to have a transformative influence on TMT development as a whole.

7.4.1 – Filling Managerial Functions

The recruitment of a new TMT member represented an attempt to either alleviate task demands or to augment a perceived human or social capital deficiency in the existing team. However, the full-time recruitment of a TMT member was frequently a costly expenditure relative to the resources that were available to many developing ventures. This was particularly true for potential full-time recruits who held significant levels of prior experience, and who typically commanded higher levels of remuneration. In this sense, making full-time TMT appointments carried somewhat of a risk, and existing TMTs had to be guarded against making poor recruitment decisions (Buchholtz et al., 2003), which could potentially damage the development of the venture (See Table 7d.1).

The utilisation of non-core sources of TMT support represented a hybrid form of recruitment, where teams could access the expertise of highly experienced individuals without incurring unreasonable expense (See Table 7d.2). For example, a number of TMTs were able to outsource management functions to non-executive board members who were financial specialists (in teams LS2, LS3, and CH2), legal specialists (in OE5), or technical/operations experts (in LS2, LS5, LS6, LS8, OE1). As many directors came from a background of significant experience, this was often a highly suitable arrangement, as most did not wish to enter a relatively new (and potentially risky) venture on a full time basis, preferring instead to maintain a lower commitment position. Similar behaviour was reflected in TMTs that were able to

forge strong strategic partnerships (See Table 7d.3). Team OE3, for example, avoided the need to manage their growing international sales channels by signing an exclusive agreement with an international partner. By inheriting an international sales and support network they were able to address expertise deficiencies in the existing team in order to accommodate strategic developments. In this way, effectively leveraged sources of peripheral support represented a means by which TMTs could manage the challenges of growth without having to make changes to core personnel.

7.4.2 – Mentoring and Leveraging of Social Position

The ongoing development of human and social capital in existing TMT members was a phenomenon that occurred naturally through the team's exposure to the business environment. In searching for opportunities, acquiring new information, and accessing new resources, existing members were typically able to 'learn from experience' (Nicholls-Nixon et al., 2000) to varying degrees. While this remains an important consideration for how human resources are developed within TMTs, measuring the extent of learning experienced by all TMT members on an ongoing basis was a task that lay outwith the scope of this study. Nonetheless, the role played by surrounding sources of TMT support – again in the form of the board of directors and strategic partnerships – in facilitating learning within the TMT was, in some cases, so fundamental to how TMTs developed that it represents a vital strand of discussion to be reviewed here.

Various studies have underlined evidence of an important coaching or mentoring role that can be played by the board of directors (Cyr et al., 2000; Hellmann and Puri, 2002; Wright et al., 2003; Knockaert and Ucbasaran, 2013). External directors may act to support the TMT in a number of ways, including strategic formation, resource acquisition, and general reputational advantages (Deakins et al., 2000; Lynall et al., 2003). Other researchers highlight similar learning and resource-acquisition advantages gained through close interaction, alliances, and joint ventures with other, typically more established firms (e.g. Narula and Hagedoorn, 1999; Wiklund and Shepherd, 2003b; Lu and Beamish, 2006). Beyond any specific resource benefits,

Blackburn et al (2013: 16) note that young ventures are likely to benefit simply through the "sharing of good business practice than older business owners"

Whereas lifecycle explanations of TMT development emphasise the replacement of founders as a cornerstone of team professionalisation, many of the teams examined in this sample displayed a model of development in which founders attempted to grow their own experience through use of these supportive sources (See Table 7d.4). It was difficult to identify precisely why this was the case. However, a variety of explanations were offered by respondents, including:

- The desire of initial founders to continue as self-employed entrepreneurs and to maintain some level of control over the direction of the venture
- The often prohibitive cost of hiring a new full-time member with attractive experience to act as a replacement CEO
- The difficulty involved in identifying and attracting a suitably experienced replacement CEO to manage a developing entrepreneurial venture

Regardless of the particular reasons, the utilisation of these peripheral resources, designed to support the ongoing improvement of the existing team, represented a central feature of TMT development. This often occurred in tandem with the more prominent model of TMT development in which human resources were acquired predominately through member addition. The fact that the majority of TMTs examined here retained the presence of initial founding members throughout their recorded development lifecycles provides some support for how prominent internal learning was as a part of overall TMT development patterns.

Essentially, the experiences gained by existing team members during the life of the venture represented the real-time incubation of human and social capital. For first-time technology entrepreneurs, the learning curve could be particularly steep, which signified another significant challenge to the management of the venture over and above those faced by more experienced counterparts. Mentorship represented a means by which to overcome this challenge. Over the lifecycle of the sampled teams,

a number of inexperienced technology entrepreneurs displayed notable transitions in their levels of expertise (See Table 7d.5). Such transitions almost always occurred through at least partial engagement with an experienced and committed mentor. The data identified evidence of a number of founders citing their evolution from, as one respondent put it, "boffin to businessman" through the experiences that they gained.

The role of board members often went beyond the advisory capacity. First and foremost, access to an experienced and committed board member could represent a transfer of particularly high-level human capital to the TMT. This could allow the existing team to "in effect acquire years of experience at a single stroke" (Zhang and Baden-Fuller, 2008: 22). Secondly, experienced board members were often able to utilise their superior position in the wider social structure in order to allow the venture greater access to resources (See Table 7d.6). Thirdly, the introduction of an active mentor during the formative stages of a venture often acted as a catalyst for the implementation of increased formality in management approach (See Table 7d.7). This is observation is similar to one made by Beckman and Burton (2008) with regards to how VC involvement tends to formalise functional structures within a TMT. These factors combined to have obvious implications for the development of the venture and thus for the completion of TMT-shaping strategic milestones. In some initially slowly growing ventures, the introduction an experienced and active board member had a transformative effect on development trajectory (See Figure 7b). Zhang and Baden-Fuller (2008) use the term 'entrepreneurial brokers' to describe mentor-type individuals that utilise their experience and networks to leverage opportunities and facilitate processes of firm development. Here, they distinguish entrepreneurial brokers from the 'functional' brokers that have specialist knowledge about one particular element of a venture's operation. Instead, entrepreneurial brokers, while often holding functional or firm-specific knowledge, are portrayed more as general venture 'champions':

"Entrepreneurial brokers typically know about venturing in general, have experience and knowledge across venture development stages, and have prior experience of setting up and growing a business. Entrepreneurial brokers are valued not so much for what they know, but more because they have a sense of what types of

FIGURE 7b: CASE STUDY EXCERPT:
TRANSFORMATIVE MENTOR IN TEAM LS8

The involvement of Mentor LS8 represents a clear point of change in the TMT and firm development trajectory in Firm LS8. This mentor is one of a very small group of individuals recorded in the sample with particularly relevant and high quality capital resources, who were also willing to commit themselves to an inexperienced existing team. Mentor LS8 had a career history that involved technical education and technical working experience that branched in to commercial management and executive level roles, and finally in to a series of highly successful entrepreneurial roles. From here, he recycled capital resources from the sale of his firms.

The introduction of Mentor LS8 not only drove firm growth and associated TMT development. The following case study excerpt details the beneficial use of prior experience in guiding strategic direction as well as how social position increased access to finance and recruitment networks:

"People ask me 'what do I look for in a CEO?' I look for determination and passion. Give me those two and most of the rest is common sense because you can guide them. Taking [LS8] as an example if we may: here was a young lady [Founder 1, LS8] who had an idea of producing a systemic fungicide. It was a very good idea. She didn't get the proof of concept that she wanted because it was deemed to be too advanced, which I thought was totally wrong. So I was asked to go and see if I could sort her out.

I found someone that had something unusual with academics, common sense. Most of them are beyond common sense. If you're a VC putting an academic in charge of your company then you've lost your investment. It's just a rule of thumb. But, here was one that actually had the making. So I refocused the research, she did the lab work, and eventually we went out for funding. The answer was 'it's too early, it's too late', the usual. So I conned one or two of my pals into coming up with cash. One of them even came in for a million. But that was basically for no more reason than their faith in my judgment. And off we went.

Now because she lacked any management skills I produced a board that consisted of the head of corporate from Shepherd and Wetherburn, the Chairman of the Anglo-Irish Bank, an ex-FD from BP, and a couple of others. So she had all of that guidance. I said to all of them 'talk to me if you have any issues'. One thing I've noticed about CEOs is that they close up as they get out of their comfort zone. So what I do, and I've got eight companies at the moment, all of them know that they can ring me at any time of any day and I will always come back to them within the hour. I can oversee problems strategically and give advice on how it should be solved" (Mentor, LS8).

knowledge are required at different points of time in the new venture creation process" (Zhang and Baden-Fuller, 2008: 9).

Analyses of data on career backgrounds indicated that active mentors typically possessed a vast range of experience in business ownership, specialist technical roles, and senior commercial positions (See Table 7c). Transformative mentors were

Table 7c: Transformative Mentors Identified in Sample

TMT	Mentor Background	Nature of Mentor Support	Nature of Mentor Recruitment
LS1	PhD technical (Scotland) Technical role within multinational (Scotland) Extensive senior management and sales experience within multinational (Scotland) Extensive experience as senior manager of high-tech growth firm (Scotland)	Full takeover of commercial and managerial operations for the firm	Mentor identified after attempts to pitch for investment
LS2	PhD technical (Scotland) Technical role within research institute (Scotland) Extensive senior management experience within research institute (Scotland) Extensive experience of commercial spinout management and finance management from research institute (Scotland) Moderate experience as founder of high-tech growth firm (Scotland)	Coaching on regulatory procedures and licensing processes Use of networks to access finance and regulatory communities	Mentor was director at the same immediately previous incubator organisation
LS3	PhD technical (Scotland) Technical role within multinational (England) Extensive senior management and sales experience within multinational (England) Extensive experience as senior manager and founder of numerous high-tech growth firms (Scotland/England) Investor and board member for multiple high-tech firms (Scotland and England)	Coaching on regulatory procedures and licensing processes Use of networks to access finance and regulatory communities Use of networks to access international sales opportunities	Mentor identified after attempts to pitch for investment
LS8	PhD technical (England) Technical role within multinational (England) Extensive senior management and sales experience within multinational (Scotland) Extensive experience as senior manager and founder of numerous high-tech growth firms (Scotland) Investor and board member for multiple high-tech firms (Scotland and England)	Coaching on regulatory procedures and licensing processes Use of networks to access finance and regulatory communities	Mentor identified after attempts to pitch for investment

often pioneering figures, who by growing successful companies in the past, were involved in early trailblazing activities in particular industry sectors (see Lawton Smith et al., 2005). References were made to mentors being 'grandfathers' (LS3

mentor), or as being part of 'early big success stories' (LS1 mentor) within certain commercial technology fields. As such, the notion of resource and experience recycling from prior experiences – so key to the prior analysis of founding team condition conducted in Chapter Six – also emerged as being central to the production of key peripheral sources of TMT support.

Important to note, however, is that board members with especially high levels of relevant commercial experience in a particular technology industry could provide support, resources, and networks to *all* varieties of TMT, not just inexperienced or early TMTs. For example, Founder 1 of Team LS3 began from a position of relative proficiency through time spent working at management level with a relevant technology industry. However by working with a highly experienced board-level mentor, this team member gained significant advantages in the acquisition of resources. Therefore, even for those TMTs that contained members with significant experience, the concept of 'surrounding yourself with good people' was one that maintained its importance. Consequently, ongoing learning within the TMT and the utilisation of the board of directors remained central elements to most portrayals of effective TMT development.

Ultimately, all TMTs examined here developed a board of directors. However, relatively few were able to have a transformative effect on development trajectories. Certainly, the findings presented here mirrored the 'pronounced diversity' (Demb and Neubauer, 1992) that had been identified by previous research in terms of involvement levels of outside directors. Of the sixty-two board level appointments identified throughout the sample, respondents identified forty-one of these as largely passive in terms of their input to strategic development (See Table 7d.9). Many of these appointments were investor-representatives, who often played a monitoring rather than a value-adding role (See Table 7d.10).

The disparity in director effectiveness appeared to be due to a number of factors. One of these concerned the compatibility of director experience. For example, a number of respondents highlighted how highly experienced directors coming from corporate

Table 7d: Example Data Supporting Discussion (Alternative forms of TMT development)

Numbered Element of Discussion and Exemplar Representative Data

1. Cost associations with full-time recruitment

"When you've only got half a million worth of investment and you've got to employ a sales director on eighty grand, that's a lot of money. It's very scary to do that. It's a huge risk" **(Key Informant 6)**

"It's a double-edged sword. I think there's reluctance in part because we're dealing with such small pots of money that to bring in somebody on a global salary is difficult. I've tried to encourage the board of a company to recruit somebody that's global. Now this guy wants to get two hundred and fifty thousand dollars a year, plus a bonus programme, plus options, plus housing, plus school education, et cetera. If you're only raising a million then that's half of that gone in a year. And if the person doesn't contribute in that year then you're up shit creek" **(Key Informant 4)**

"He was good. It's nothing to do with that. But he was earning too much money and he didn't want to get his fee reduced, because as a consultant we were basically paying him a hundred and twenty thousand a year. And the level of sales that he was bringing into the business was not enough to justify his role. So actually we offered to keep him here and to perhaps give him some equity and a drop in salary but he said no. And that was that. I thought: if that's what it costs to pay a business development manager, I'd be better handling the sales myself" **(Founder 1, LS5)**

2. Utilising the board of directors to fill management roles

"We have a financial director, but he is basically a consultant who we meet a few times a month and who we keep in the loop. He deals with the financial models because to be honest I couldn't cope anymore" **(Founder 1, LS5)**

"I outsourced all of the finance part of it to a director that came recommended to me. If I hadn't have done this I would never have been able to take things forward. I was just drowning in cash flow management" **(Founder 1, OE1)**

3. Utilising the strategic partnerships to fill management roles

"We had the choice to either create our own sales and support infrastructure or to enter an alliance with a firm that already had that infrastructure. So, we got in touch with [strategic partner]. We were actually hurting them from a business perspective. So we said 'can we do a deal here?' I guess that by making the alliance with [strategic partner] we were able to tap into their marketing expertise and resources. You could say that we copped out by not doing the marketing. Or you could say that we recognised that the sales and marketing expertise did not exist in the team. So, we tapped into the marketing skills of a global player" (Founder 1, OE3)

"As a technology person speaking to marketing people, there was a bit of a gap. And in retrospect I'm actually embarrassed with some of things I've done like going into Fosters and showing them really bad demonstrations. So what we've done now is we've actually got one of our manufacturing partners, they're selling directly for us to the people that make the bar fonts and they sell on to the various brands. So we just handed that over, because it wasn't worth, well it was too hard for us to do" **(Founder 1, OE1).**

"I kept the management as simple as I could. We have to manufacture our main product line, but I don't have an operations director. We have a partner that manages that side of things. It was something that was beyond my expertise, so we outsourced it all" **(Founder 1, LS5)**

4. Ongoing learning as a model of development (utilisation of non-core support e.g. board of directors)

"When you're looking at firms coming out of university they aren't typically able to afford to buy in management with a lot of experience. The salaries are too high. They need someone that can support them by sitting on the board. You'd expect an initial team with some guidance and support rather than through recruitment" **(Key Informant 2)**

"The role of the board is fundamental. There has to be solid structure to the board, particularly at non-exec level. If you're sitting on a good board, with good people, with good experience then you're going to live and learn" **(Key Informant 4)**

5. Real-time incubation of founder expertise (predominately through mentorship)

"The vast majority of people I can think of are scientists that have grown to be MDs or VPs. A lot of learning is through some sort of mentoring. In a lot of cases it's about the chairman of the company. With the right Chairman mentoring the Chief Executive, a lot can be said for that" **(Key Informant 1)**

"I could never have made the transition from scientist to CEO without the help I had from [mentor name]. He had been involved with a few spinouts from Moredun and had been very successful. He knew the ropes and saved us a lot of costly mistakes. It was like an apprenticeship. I learned my trade under him. And now I'm CEO of a successful technology firm" **(Founder 1, LS2)**

"I set the company up, meaning to be the Chief Scientific Officer but ended up being the CEO as well. I started out as a boffin and ended up as a businessman" **(Founder 1, LS2)**

"In the beginning I was just another scientist with a good idea. Now people in the business world know me. We created something of real value. I've been given great help along the way. Having worked with [mentor] was a real leg up, but five years on I'm running the company myself and we're doing well" **(Founder 1, LS8)**

6. Mentor roles (leveraging of social position)

"[Mentor name] is a bit of a god (laughter). If you've heard of Genzyme, he grew that chunky company, which is now one of the grandfathers for biotech. So he's definitely well linked, well respected, he's into pretty much everything. He's linked in with a number of partners as well

helping fund some of our low points. He gave us all sorts of links to sales channels, and jumped all sorts of barriers on the regulation side. He just knows everyone" **(Founder 1, LS3)**

"People grow off your reputation. [Founder 1] at [LS8] now has a phenomenal reputation. I mean, four years ago we were getting the run around from the VCs, being told to bog off. And now recently a person in the same company has approached us saying 'I'm now doing x, y, and z, would you like to do contracts for the company?'" **(Mentor, LS8)**

7. Mentor roles (development of organisational structures)

"When you have investors they expect the management to run in a professional way. Most investors will put someone experienced on the board to help with this" **(Founder 1, LS4)**

"The business was basically a research project before I arrived. The two founders wanted out. I joined the board and made things more professional, so that investors would actually look at us" **(CEO, LS1)**

"*You cannot manage fifty people on an ad hoc basis. Our feeling is now; because we now run a venture fund, we only invest in firms that have an appropriate board structure from day one and where we feel comfortable that the appropriate executive and non-executive positions are taken care of. We don't want to see anything that's science driven. We want something that's driven from a business point of view with appropriate consideration of the science"* **(Key Informant 4)**

8. Experience recycling and mentor production

"There are a lot of [prior successful incubator name] people that have gone on to do stuff at other companies. Quite a few of my colleagues have now gone on to start spinouts or mentor new spinout companies. I think that one of the key themes here is that, once you've worked for a startup company, a lot of people then go on to work with other startup companies. These guys have good experience and have a great advantage over inexperienced entrepreneurs" **(Mentor, LS1)**

"I hope that there have been enough young people that have been through the cycle of company growth and that will be available to act as mentors, practical mentors. We should be tapping into this expertise. I could probably name three or four or five that have been through and got that experience and could pass that on to others" **(Founder 1, OE3)**

"When we sold up, most of our top management went on to get involved in other tech firms. We could bring a wealth of experience to them. It's important to recycle that experience, and even recycle the money. I sit on a number of boards now and so do my former colleagues" **(Key Informant 4)**

9. Passive roles played by board members

"The problem is that it's easy to find non-execs. It's not very easy to find good non-execs. We had a chairman who was a former Shell man, who was a perfectly fine Chairman. He was gray-

haired. He didn't have any ambition. He was retired. He was one of these very sensible and experienced people. He was never gonna kick down doors for us" ***(Founder 1, CH4)***

"It's all very well getting an experienced board member, but you've got to be careful. You've got to make sure that you're getting some value out of the relationship. Many of these guys sit on loads of boards. You might see them two or three times a year. It's no use just having the name. You've got to make them work for you" **(Founder 1, LS1)**

"I guess really his role was overall strategy. For us, there was a huge focus on finance and investment. But none of our non-execs would be particularly hands-on. When you're involved in chemical industries in Scotland there can be a tendency for retired ex-BP guys to join boards. They look great on paper, but not always in practice" **(Founder 1, CH3)**

"It's easy to get a non exec and make your team look great 'on paper', but not all these guys know what it takes to grow a company, or they don't want to work too hard" **(Founder 1, LS3)**

10. Monitoring roles played by board members

"So our new Chairman was brought in by the investors to work out…well we had a fall out with the investors over changing technology. They felt that had been cheated in some way. So a new Chairman came in simply to investigate on behalf of the investors. It doesn't make for a comfortable working environment" **(Founder 1, LS7)**

"Q: What sort of role do the investor representatives have? Is it hands on at all? A: Not terribly. It's more to do with watching what's going on. I guess you need to understand the mentality of corporate investors. They call themselves venture capitalists, but they're not really. They help at some times, but at other times you can just feel like part of their portfolio to be watched like a hawk" **(Founder 1, CH3)**

"They appointed a non-executive advisor to the board, as they had the right to do. I kid you not she used to turn up at our board meetings on a broomstick (laughter). You know, she was not there to add value. She was there to police us" **(Founder 1, LS6)**

backgrounds, while appearing attractive 'on paper', faced difficulties offering effective support to a growing firm. Another factor concerned the commitment levels of non-executive directors. In the absence of full-time salaries, it often proved difficult for teams to maintain the involvement levels of experienced board members. Frequently, such individuals sat on multiple boards, which could impact upon the time and effort that they could commit to the director/TMT relationship. A number of directors appeared to use their board role as a form of semi-retirement, a means by which to remain loosely connected to their industry without becoming too involved in the difficult process of new venture growth. Evidently it was not so difficult to build a board of directors *per se*. However, the challenge clearly lay in gaining the commitment, leveraging the experience, and encouraging the activity of the board.

7.5 – CHAPTER SUMMARY

In light of criticisms associated with predictive models of TMT development, the findings outlined in this chapter conceptualised the phenomenon instead as a set of non-deterministic reconfigurations to the existing team. Echoing existing research on entrepreneurial team member entry and exit (e.g. Ucbasaran et al, 2003), reconfigurations to the TMT were predominately enacted as an attempt to accumulate further managerial resources. However, the rational desire to accumulate human resources did not adequately explain the practicalities surrounding the nature, timing, and effectiveness of TMT modifications. The evidence presented here indicated that the development of the TMT was instead inherently embedded within the context of wider firm development. This raised two important observations. Firstly, the ability to modify the team appeared to be heavily dependent upon the release of financial resources; an observation that was exemplified by the typically 'piecemeal' nature of new member additions. Secondly, the effectiveness of modification appeared to be dependent upon how existing teams interpreted their managerial needs in line with emergent events, thus placing a strong focus on the formulation of strategy.

Much of the existing literature on TMT member addition focuses on predicative associations between the composition of the existing team and subsequently developed levels of heterogeneity or professionalisation (see Klotz et al., 2014). However, by characterising TMT development as decisions made at and around critical events, the empirical findings presented in this chapter move towards an explanation of the decision-making mechanics involved in the modification of the TMT. Examining and thematically analysing the reconfiguration actions of existing teams affords some insight as to why some TMTs modified themselves effectively while others did not. Reflecting the empirical analysis conducted in this chapter, the following research propositions are presented:

Proposition 2a: The effectiveness of modification actions within technology venture TMTs is associated with the extent to which the existing team formulates and articulates clear strategic objectives and milestones amongst its members

Proposition 2b: The effectiveness of modification actions within technology venture TMTs is associated with the extent to which the existing team articulates role responsibilities and performance targets to incoming new members

Proposition 2c: The effectiveness of modification actions within technology venture TMTs is associated with the extent to which strategic decision-making authority is decentralised amongst existing and incoming members

Proposition 2d: The effectiveness of modification actions within technology venture TMTs is associated with the extent to which formal organisational and managerial structures and procedures are implemented prior to modification

It is proposed here that the prior experience held within the existing team, and how this is related to the reconfiguration actions taken, was the principal influencing factor impacting these behaviours. Those teams containing members with industry-relevant business management experience were often better equipped to negotiate the uncertainties of TMT reconfiguration. In particular, prior experience of growing an

entrepreneurial venture appeared to help existing teams envisage their managerial needs in line with emerging development events. Exploration of these behaviours sheds further light on why previous studies have noted path dependent associations between the composition of the existing team and subsequent TMT development (Beckman and Burton, 2008). Put simply, the decisions that existing teams make appeared to have a cumulative effect on overall development. Where the decisions of experienced teams more typically accommodated future managerial modifications, those of inexperienced early teams appeared to be far more experimental in nature, often acting to impede progress, occasionally to the point where teams stopped developing at all.

Importantly, however, the findings also indicated that the accumulation of managerial resources was not exclusively reliant upon full-time recruitment of new members. There was, in fact, very little evidence of the wholesale replacement of original teams as a means to drive management professionalisation. More prominent was a model where founders attempted to learn 'on the job', often in conjunction with more explicit modifications. This approach appeared to be more appropriate given the financial practicalities of recruiting highly experienced TMT members on a full-time basis, particularly during earlier development stages. Again, this underlined the influence of wider contextual conditions, particularly resource availability, on modification decision-making. It also reflected the frequently competing tensions between the desire to develop experiential heterogeneity and attempts to maintain team cohesion. As Clarysse and Moray (2004: 57) point out, if the gathering of experience can only be "accomplished by hiring external business people, it can become a disadvantage". Ultimately, evidence of the learning model of TMT development thrust the spotlight on vital sources of peripheral support, notably the board of directors, the investment community, and industry partners, as a means to guide the decisions of existing TMTs. As such, these findings developed potentially important insights into how formal mentors and partnerships impact the composition of management teams over time. This leads to a final proposition:

Proposition 2e: Technology venture TMTs are more likely to enact effective modification actions if they leverage human and social capital from more experienced stakeholders e.g. the board of directors or strategic partners.

8. TMT DEVELOPMENT IN CONTEXT

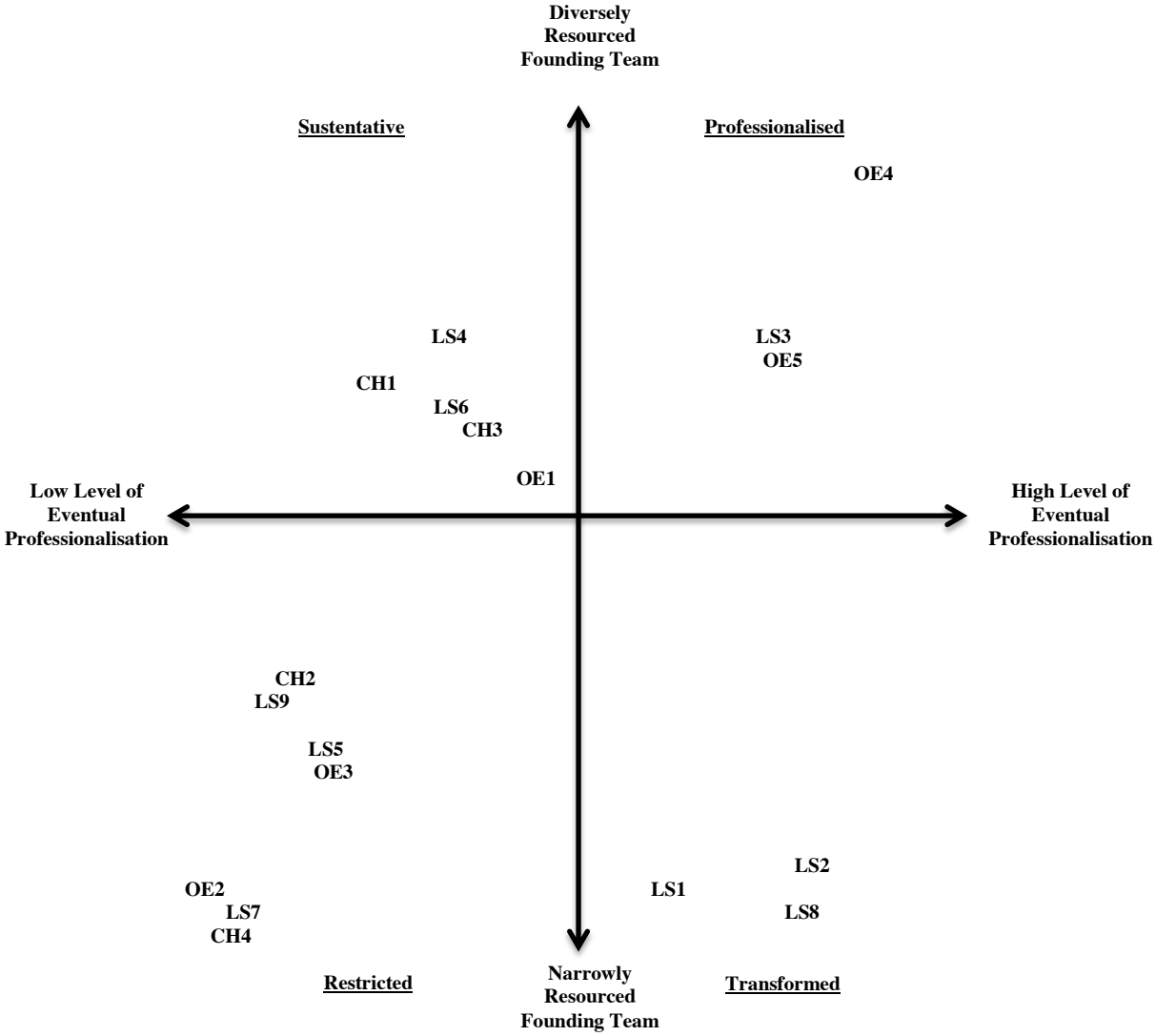
8.1 – INTRODUCTION

Building on the discussions outlined in Chapter Six – which demonstrated how founding teams originate in a variety of states – and Chapter Seven – which demonstrated the impacts of actions surrounding reconfigurations to TMTs – this chapter presents overall development narratives of sampled TMTs. The narratives and subsequent discussions serve two main purposes in demonstrating how TMT development occurs as a contextually embedded phenomenon. Firstly, they offer a dynamic portrayal of how TMTs negotiated external opportunities and challenges, and how they enacted modifications in conjunction with these. Secondly, they position the preceding findings within the context of the wider Scottish 'ecosystem'.

8.2 – PRESENTING TMT DEVELOPMENT NARRATIVES

One major challenge within a multi-case research design is that the presentation of relatively complete and un-broken narratives of all cases is often impractical (Eisenhardt and Graebner, 2007). This is particularly true of a study with eighteen cases. As such, four exemplar narratives, each depicting a distinctive thematic category of TMT development trajectory, are presented here. The exemplars are representative of the eighteen cases examined within this sample, and not of TMT development patterns as a whole. This study does not attempt to theorise about overall development patterns. Rather, the empirical portrayals presented serve to illustrate the prominent issues emerging within the final discussion. Two criteria were selected to depict thematic development categories. First, founding team conditions from the findings of Chapter Six were plotted. Second, the eventual levels of professionalisation (encompassing levels/diversity of expertise, and extent of management formality) were plotted. It must be noted that this second criteria was not static, and thus the assessment was made at culmination of data collection. Figure 8a depicts the four thematic categories and where the cases reside within these categories. In the following sections, exemplar narratives are presented as a series of reconfiguration events occurring within the wider context of venture development.

Figure 8a: Representation of Sampled TMT Development Narratives



8.3 – NARRATIVE ONE: PROFESSIONALISED TMT

Three firms most closely depicted a process of TMT professionalisation in their development patterns. These were team OE4, OE5, and LS3. Notably, none of these teams - in terms of their initial expertise and management structures - originated in a 'primitive state'. Instead, all three teams were founded by groups of

Table 8a: TMT Development Narratives and Exemplar Cases

Narrative Category	Exemplar Case(s)	Category Features	Other Cases
Professionalised TMT	**OE4**	• Founding team with industry relevant experience • Early professionalisation of management approach • Strong pool of immediate recruitment resources available • Cumulative development benefits realised • Category most representative of progressive professionalisation	OE5, LS3
Restricted Development TMT	**LS7**	• Limited-to-moderate industry experience in founding team • Efforts initially aimed towards building professionalised TMT • Challenges faced in reaching development milestones and managing resources • Initial founders experience task overload • Growth and management professionalisation targets are revised • Founders adopt a 'Jack-of-all-trades' approach to management	LS5, LS9, OE2, OE3, CH2, CH4
Transformed Development TMT	**LS2**	• Founding team commercially inexperienced • Slow initial development of both venture and management approach • Services of transformative mentor secured during early stages • Significant learning experienced by founder(s) with transition to commercial roles • Development towards professionalised TMT	LS1, LS8
Sustentative Development TMT	**LS6**	• Existing TMT seeks to restrict addition of outside members • Emphasis placed on keeping a 'lean' existing TMT • Growth ambitions either kept deliberately modest or are not reached	LS4, OE1, CH1, CH3

individuals with both significant technical expertise and industry-relevant business management experience. Consistent with the expectations of a path-dependent view

(Beckman and Burton, 2008), this initial experience appeared to have a positive cumulative effect on overall development. These teams contained members that were able to recycle knowledge and resources from former incubators, which was advantageous in facilitating TMT professionalisation in line with overall venture development. The case study narrative presented here is that of Team OE4:

Team Formation:

Team OE4 manages an Optoelectronics company that creates and produces a wide range of applications for experimental laser-based products. Founded in 2006, the underpinning technology can be traced back over seventeen years to a Scottish university research department. From 1994 to 2001, two of the OE4 founding members (Founder 1 and Founder 2) had previously been lead entrepreneurs and technologists within a university spinout venture based on earlier applications of the underpinning technology. An American-based industry partner then acquired the venture in 2001 for approximately £3m, establishing subsidiary operations in Scotland, and installing the Founder 1 and Founder 2 as Joint Managing Directors. After overseeing rapid growth in international sales during the next five years, Founder 1 and Founder 2 formed Team OE4 in mid-2006.

Founders 1 and 2 were able to use financial capital recycled from the sale of their previous venture in order to fund premises for manufacturing and support the initial development of product lines. Since having their former venture acquired in 2001, Founder 1 and Founder 2 always intended to return to running their own firm again at some point in the future. In their roles as Managing Directors within the subsidiary firm, tensions had been growing amongst senior management concerning differing opinions on strategic direction between the Scottish-based unit and head operations, based in California. The subsidiary unit had enjoyed a significant degree of autonomy over its four-year lifespan, and had grown rapidly under the management of Founder 1 and Founder 2. The decision to spinout was made in 2006.

Founder 1 and Founder 2 formed their initial team with the Sales and Marketing Director of the host subsidiary unit, who was also a highly experienced technologist-

turned-senior commercial manager. The rationale here was that Founder 1 and Founder 2 would be required to oversee technical, design, and manufacturing demands, while Founder 3 exploited an existing bank of sales contacts. Thus, systems of operation, management procedures, and customer networks were largely transferred from the prior incubator:

We were at such an advantage when we started up [Firm OE4]. We had great relationships with customers already, and we knew the products they were looking for. Lots of the development groundwork had been done already. We were doing really similar management roles that we'd been doing for years. Only now we were the bosses (Founder 1, OE4).

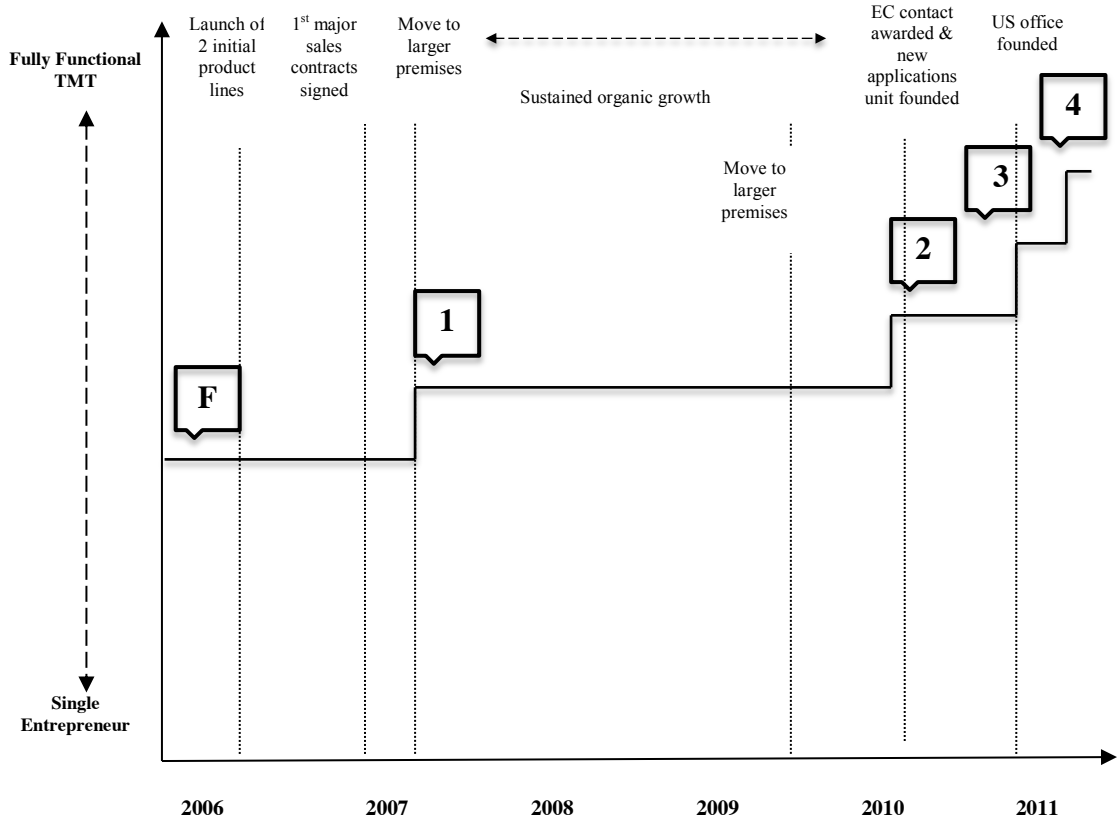
Reconfiguration Event 1:

By 2007, two initial product lines achieved first sales revenues, primarily through international buyers. With revenues streams secured, the existing TMT were able to fund the creation of new product applications. The first catalyst for TMT reconfiguration came when the firm relocated to larger premises capable of in-house R&D. With Founder 2 specialising in the R&D behind new product applications, a new Business Development Director was appointed to oversee the exploitation of new sales markets for the resultant products. The new member (Member 4) had previously been a Sales and Marketing Manager within the subsidiary unit from which firm OE4 had spun-out. All three existing founders had shared a close previous working relationship with the new entrant. Member 4 undertook a broadly similar role to that which he had already been doing in his previous firm.

Reconfiguration Event 2:

Throughout 2008 and 2009 rapid organic growth was achieved, which necessitated another change of premises. In 2010, a significant contract was awarded the European Commission to pursue experimental applications for healthcare markets. A new member (Member 5) was appointed to lead a new R&D unit. Member 5 was recruited from a leading specialist research unit within a Scottish university, and had a specialist technical background.

Figure 8b: Team OE4 Development Trajectory



I kept strong ties with [University Name] and they had a strong research department there. We were able to entice [Member 5] out with a salary hike. We needed a really high level of technical expertise for what we were trying to do. Lots of these products were very experimental (Founder 1, OE4).

Reconfiguration Event 3:

Growing sales within US markets saw the establishment of a new business unit in San Jose, California during early 2011. The firm conducted a great deal of their business with Silicon Valley-based firms and sought an increased presence in the region. This caused a change to the role of Founder 3, who relocated to become exclusive Business Development Director for US markets. As a result, a new Sales Director (Member 6) was appointed to fulfill sales and support duties for European and Asian markets.

Table 8b: TMT Development Time Line – OE4

Critical Events	TMT Changes	TMT State
2006		
Firm founded (laser-based products) Product lines spun-off from Scottish subsidiary of related US based multinational Firm locates in local technology park Production processes set up to deal with 2 main product lines		Founder 1: Operations and Business development Founder 2: New product applications and business development Founder 3: International sales and support Formal project management systems Formal management communication No separate board of directors Founders retain full ownership HR and finance functions outsourced
2007		
A number of sales contracts signed with international clients Firm relocates to larger premises to accommodate increased production	Appointment of New Business Development Director	Founder 1: Operations and overall strategy Founder 2: New product applications and overall strategy Founder 3: International sales and support Member 4: Business development (new applications) Formal project management systems Formal management communication No separate board of directors Founders retain full ownership HR and finance functions outsourced
2008		
All 3 product lines fully functioning and being sold to international markets Sales grow organically by apprx 100%	No changes	
2009		
Firm relocates to larger premises to accommodate increased production Engineering staff doubled Sales grow organically by apprx 100%	No changes	
2010		
Firm is awarded funding and contract by European Commission to develop applications for healthcare markets	Appointment of experimental application development Director	Founder1: CEO/Operations/Overall strategy Founder 2: CEO/Overall strategy Founder 3: International sales and support Member 4: Product line director Member 5: Technical development of experimental applications Formal project management systems Formal management communication No separate board of directors Founders retain full ownership

2011

Firm creates a US subsidiary based in San Jose, California to service the US market	Appointment of Sales and Marketing Director (Europe)	Founder1:CEO/Operations/Overall strategy Founder 2: CEO/Overall strategy Founder 3: Sales and support for US Member 4: Sales & support of new applications
Significant increases in revenues resulting from US expansion	Appointment of Chairman/ Regulatory Director	Member 5: Technical development of experimental applications Member 6: Sales & support for Europe Member 7: US Regulatory Director Formal project management systems Formal management communication Chairman on the board of directors Founders retain full ownership HR and finance functions outsourced

Again, the new member had previously been a Business Development Manager within the subsidiary unit from which firm OE4 had spun-out.

We had a goldmine of top guys to pick from, really experienced people who'd been working in those markets. The management at [incubator name] was our old team. They knew us and trusted us. They knew we were going to be doing exciting things. And we knew who was good and who would fit in to our team. It took a few years to get the sales in, and then we pretty much nicked our team from them. Now we're in direct competition (Founder 1, OE4).

Reconfiguration Event 4:

Existing management faced challenges in gaining access to healthcare markets for their nanotechnology products. This saw the appointment of an internationally recognised chairman (Member 7), aimed at "being a figurehead" and "boosting reputation" in US markets. However, the new entrant undertook a significant role in negotiating a variety of regulatory challenges associated with entry into US healthcare markets. Member 7 was a leading figure within a prominent US regulatory body and had previously dealt with a number of the existing TMT within OE4. Team OE4 indicated that they intend to continue expanding markets and product lines. This is likely to require further modifications to the TMT in the future.

We've grown organically through sales so we've never really needed investment. We want to grow in to a large company, and I think we're on the way to doing this. This might require investment in the future, but I think we're in good shape internationally to attract that, especially with our footprint in Silicon Valley. We have a great director level management team here now, which I think will be the core for a while, but obviously as we expand we may need more input and there may be some changes on that front (Founder 1, OE4).

8.4 – NARRATIVE TWO: RESTRICTED DEVELOPMENT TMT

One of the most obvious empirical observations to stand contrary to the lifecycle depiction of progressive development is that, put simply, not all TMTs easily professionalise and grow. In fact, the majority of TMTs examined in this study displayed a lack of significant cumulative growth (at least in terms of member numbers). Twelve of the eighteen TMTs developed to contain three or less members

at the culmination of data collection, with eight of this twelve ultimately reporting two or less core team members. In short, many of the TMTs within the sample did not increase membership to a degree that saw management level appointments in most of the management functions expected within a technology-based firm.

This narrative category depicts those TMTs that were unable to develop professionalised and divesely skilled TMTs. Example cases were teams LS5, LS7, LS9, OE1, OE2, CH2, and CH3. All of these teams contained limited to moderate levels of commercial experience at founding. Notably, all cases in this category indicated an initial, and ongoing, desire to increase the expertise and professionalisation levels within their TMT. For the most part, initial founders recognised human and social capital deficiencies in commercial and industry-specific spheres, and aimed to augment their management resources through member addition. Thus, as Beckman and Burton (2008: 18) observe, it did not "seem to be the case that narrowly experienced founders simply failed to recognize the importance of other types of functional expertise". Instead, the development of these TMTs appeared to be constrained by actions or pressures that made them unable to act on, or unable to sustain, modification intentions.

Cases in this category were characterised by initially positive growth intentions. In particular, those that had received investment from external financiers during their early stages discussed rapid growth ambitions. This is consistent with extant literature, which suggests that venture capital-backed firms have an increased inclination towards the pursuit of more aggressive growth strategies (Gompers and Lerner, 2001; Hellmann and Puri, 2002). The rationale for this has been explained both through the notion that investors are likely to back more promising ventures, and that VCs are likely to provide a number of added human and social capital benefits to the ventures that they support.

However, for cases in this category, initial growth orientations became markedly less ambitious after they experienced difficulties in achieving strategic milestones. If firms failed to achieve these milestones, or even faced delays in achieving them, then

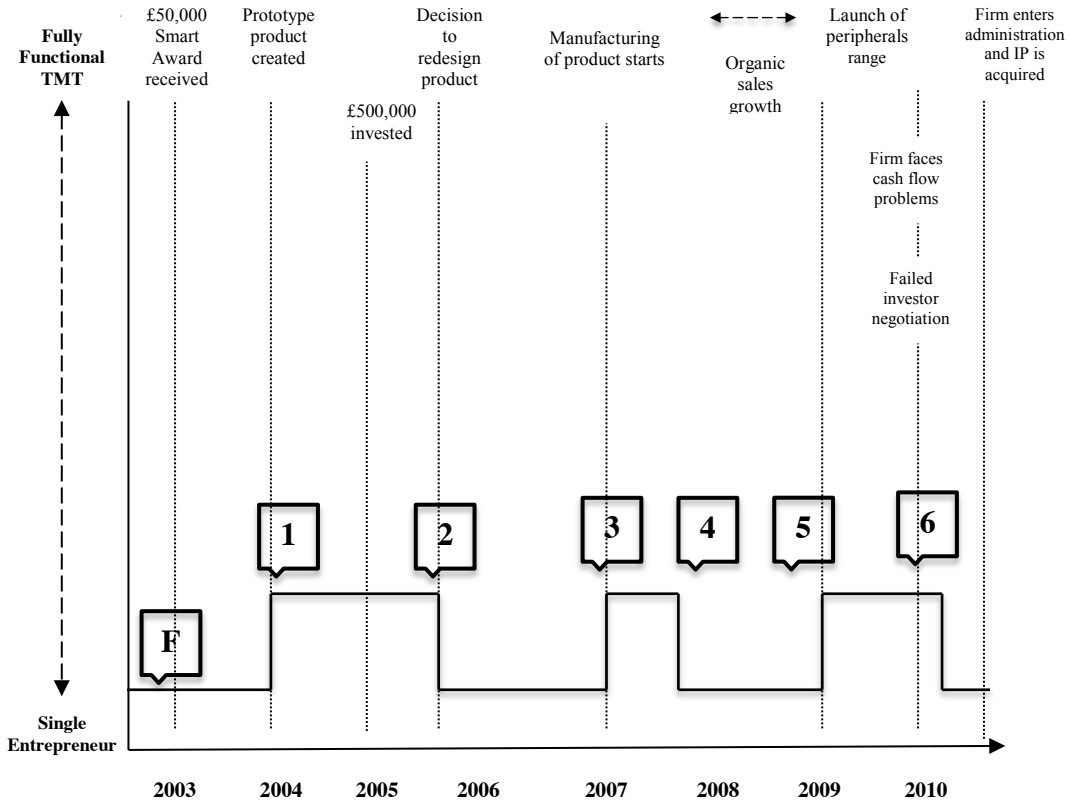
resources for the expansion of the TMT could become limited. This would place extra demands on existing management (in some cases a sole founder). Existing management would likely become stretched, and business development would likely suffer. Eventually, the firm would typically limit its growth orientation and be characterised by a small, founder-managed firm, in which multiple management tasks would be undertaken on a 'jack of all trades' basis.

Resource-seeking perspectives on TMT development suggest that negative issues with the strategic progression of a venture would encourage an existing team to examine its human capital weaknesses and requirements, thus *inciting* member addition and other TMT modifications (Sandberg, 1992; Kamm and Nurick, 1993). However, for the poorly developing TMTs examined in this category, it had just the opposite effect. Lack of strategic progression, in fact, led to the need for teams to tighten their grip on managerial resources. This behaviour appeared necessary in order to control costs. However, equally, such behaviour would also act to limit any addition of human capital, which, in turn, had implications for how adequately management would be equipped to encourage further growth. It was exactly this type of self-informing process that characterised the TMT development behaviour within those firms that a number of respondents labeled 'mom and pop' businesses. The case study narrative presented for this category is that of Team LS7:

Team Formation:

Team LS7 managed a Life Science company that created an in vitro diagnostic medical device to test for particular bacteria strains in water supplies. Founded in 2003, the underpinning technology was developed through PhD research conducted in a Scottish University by the firm's founder (Founder 1). Founder 1 was the only initial member of the team, and was a career researcher who had no prior experience of business ownership or of commercial roles. Initial strategic efforts were focused around creation of a prototype, which was funded by a £50,000 award from a government scheme. Founder 1 relied on general business support from the Scottish Enterprise high-growth team during initial commercialisation activities.

Figure 8c: Team LS7 Development Trajectory



Reconfiguration Event 1:

Recognising human and social capital deficiencies very soon after the initial formation event, Founder 1 sought to recruit a replacement CEO (Member 2) to manage the early commercialisation process. The appointment of Member 2 was arranged in late 2003 by the Scottish Enterprise high growth support team. Member 2 was returning to Scotland after having been an Operations Director in a US-based technology multinational. It was proposed that Founder 1 would control all technical development and the new CEO would control business functions.

"It was just me in the very early stages and I worked with the Scottish Enterprise High Growth Start-Up Unit. They introduced a guy called [Member 2] to the company during 2004. So he came on as Chairman and CEO, so as to drive the commercial side of things and leave me to play in my sand box, as he would put it" (Founder 1, LS7).

Reconfiguration Event 2:

After creating an initial prototype in 2004, the firm received £500,000 investment from a venture capital fund in early 2005. However, after re-engaging with potential sales markets, Founder 1 decided that the prototype required a redesign:

We started off with one technology and then after spending an inordinate amount of money and a huge amount of time on it, we decided that a second technology that we'd been developing in the background was actually a better way of doing it and it would be cheaper for the end customer, simpler to use. It ticked a whole load of boxes that ours didn't, and actually it was going to provide the same sensitivity in terms of what the product was supposed to do. So we kind of had a technology switch in May 2005 (Founder 1, LS7).

The decision incited conflict with investors, who were unhappy at the rate of development displayed by the firm. During this period of upheaval, the investors appointed a Chairman to the board and the CEO left the TMT. Founder 1 indicated that this was due to differing expectations regarding the CEO's business development role, as well as to pressure from investors:

We had a fall out with the investors over changing technology. They felt that had been cheated in some way. So a new Chairman came in simply to investigate on behalf of the investors. His recommendation was that [Member 2] wasn't right for the company, and it was suggested that I should be the CEO (Founder 1, LS7).

[Member 2] didn't really go and do a lot of selling. That wasn't how he saw his role. He saw his role as to shape the business rather than go out and sell. It was more the structure of the business. But, I wanted someone to grow the sales side (Founder 1, LS7).

Founder 1 took on responsibility for technical and commercial functions. The newly appointed chairman played little active role in strategy development, primarily fulfilling a monitoring function.

Reconfiguration Event 3:

In early 2007, the firm signed a manufacturing deal and launched the product. At this point, the management team still consisted of only the original founder, who undertook all management functions. In order to allow the founder to start work on

Table 8c: TMT Development Time Line – LS7

Critical Events	TMT Changes	TMT State
2003		
Firm founded (medical product) £50,000 Smart Award received		Founder 1: All technical and commercial roles Minimal formality of management processes No separate board of directors
2004		
Initial prototype created	Appointment of CEO	Founder 1: All technical roles Member 2: Production management Minimal formality of management processes No separate board of directors
2005		
£500,000 investment received from VC fund in conjunction with SE co-investment fund	Investor representative appointed	Founder 1: All technical and commercial roles Minimal formality of management processes Investors and Founder hold ownership Investor rep on board
Complete re-design of product in line with market assessment	Exit of CEO (disagreement over role)	
2006		
Conflict with investors over product redesign	Founder takes CEO role	
2007		
Manufacturing deal signed to produce final design	Appointment of Sales Director	Founder 1: All technical and commercial roles Minimal formality of management processes Investors and Founder hold ownership Investor rep on board
Development work on peripheral product range commences	Exit of Sales Director (unable to justify salary)	
2008		
Sales of main product increase Sales of peripherals range commences	Appointment of Sales Director	Founder 1: Technical and strategic roles Member 3: Sales and support of Existing Markets Minimal formality of management processes Investors and Founder hold ownership Investor rep on board
2009		
Loss of key contracts	No changes	
2010		
Firm experiences cash flow problems Failed investor negotiations Firm goes in to liquidation during late 2010. IP is sold to a competing firm	Exit of Sales Director (unable to pay wages)	Founder 1: All technical and commercial roles Minimal formality of management processes Investors and Founder hold ownership Investor rep on board

the development of a pipeline of peripheral add-on products, a Sales Director (Member 3) was appointed to support and grow sales for the initial product line. This appointment was made through a traditional advertising and interview process. Member 3 had a strong background as a mid-level sales manager within a local branch of a pharmaceutical multinational.

Reconfiguration Event 4:

Within six months, the sales director had exited the TMT and it returned to the Founder operating in a multi-function capacity. The Founder cited a number of reasons for the departure:

We brought on board a sales guy in 2007 at some point for about three months. He quit before I fired him (laughs). We just didn't see eye to eye in terms of what we were trying to achieve. We decided not to replace him. One of the problems he had was that he didn't understand the product. We didn't really have a structure that could support him. I felt like I was answering all his questions for him while he was just knocking doors. He left and then sales kind of fell back to me or other techie people that we employed (Founder 1, LS7).

Reconfiguration Event 5:

Sales of the initial product increased from 2008 to 2009. By late 2008, a range of peripheral add-on products was launched. This saw the appointment of another Sales Director (Member 4) who was to support the development of these new markets. Member 4 was appointed through a traditional advertising and interview process.

Reconfiguration Event 6:

By 2010, Founder 1 was facing significant difficulties in supporting the existing customer base through the current sales and support infrastructure. This resulted in the loss of some key contracts. The firm experienced cash flow problems and had to seek further investment. Unable to secure this, the lack of finance led to the exit of the new Sales Director, returning the TMT to a single member. With management resources stretched the Founder was unable to expand sales of peripheral products:

We were reliant on sales of things like reusable nozzles to bring in important cash flow, but I was so stretched supporting our customers on the main device. It's not as if the product wasn't well received. We just ran out of cash after all the road bumps we'd had since starting. I don't know what I spent that half million on to be honest. We just needed a bit more support to get through things. It was criminal really…how we were struggling. It was a really good and really useful product. It was just cash flow (Founder 1, LS7)

The firm entered administration during late 2010, with only one member occupying the management team. Administrators then sold the intellectual property rights for the device to a Scottish-based technology venture and Founder 1 subsequently took a role as product line manager within that firm.

8.5 – NARRATIVE THREE: TRANSFORMED DEVELOPMENT TMT

One of the most prominent features of how TMTs in this sample developed concerned the clear influence that the experience of early 'lead' members can have on subsequent professionalisation of venture management. However, while it appears evident that less well-endowed founding teams are placed at a disadvantage, their lack of experience did not necessarily preclude them from developing a strong and professional TMT. A number of teams that were formed by founders with very limited commercial or industry relevant experience were able to break out of their development path, primarily through interaction with a committed and experienced mentor. Typical of this narrative category were founding teams containing a technical inventor (or inventors) who were able to leverage more experienced board members in order to improve their own human and social capital. The case study narrative presented for this category is that of Team LS2:

Team Formation:

Team LS2 manages a drug development company that created a novel means of administering a range of vaccines and treatments. Founded in 2007, the underpinning technology was developed through a long-term research project conducted in a prominent Scottish academic research institution. The team founders (Founder 1 and Founder 2) were career researchers, who had been lead scientists on the project. After negotiating joint ownership of the intellectual property rights with the

incubating organisation, the founders spun-off to create a commercial enterprise, using the Scottish Enterprise 'Proof of Concept' Scheme as an initial source of finance.

The firm aimed to trial, regulate, and license a pipeline of vaccine applications to international distributors. In order to present a business case needed to raise the required finance, clinical trials had to be conducted on an initial application. In terms of experience and access to facilities, the existing TMT were well equipped to conduct these trials, which took place within the incubating research institute. However, it was recognised that at least one founder would also be required to undertake the management of commercial duties associated with development of the business. Acknowledging a lack of commercial experience, Founder 1 undertook training through Royal Society Enterprise Fellowship scheme, which was designed to develop commercial skills in first-time technology entrepreneurs, while also providing a basic living wage for the first year of the venture:

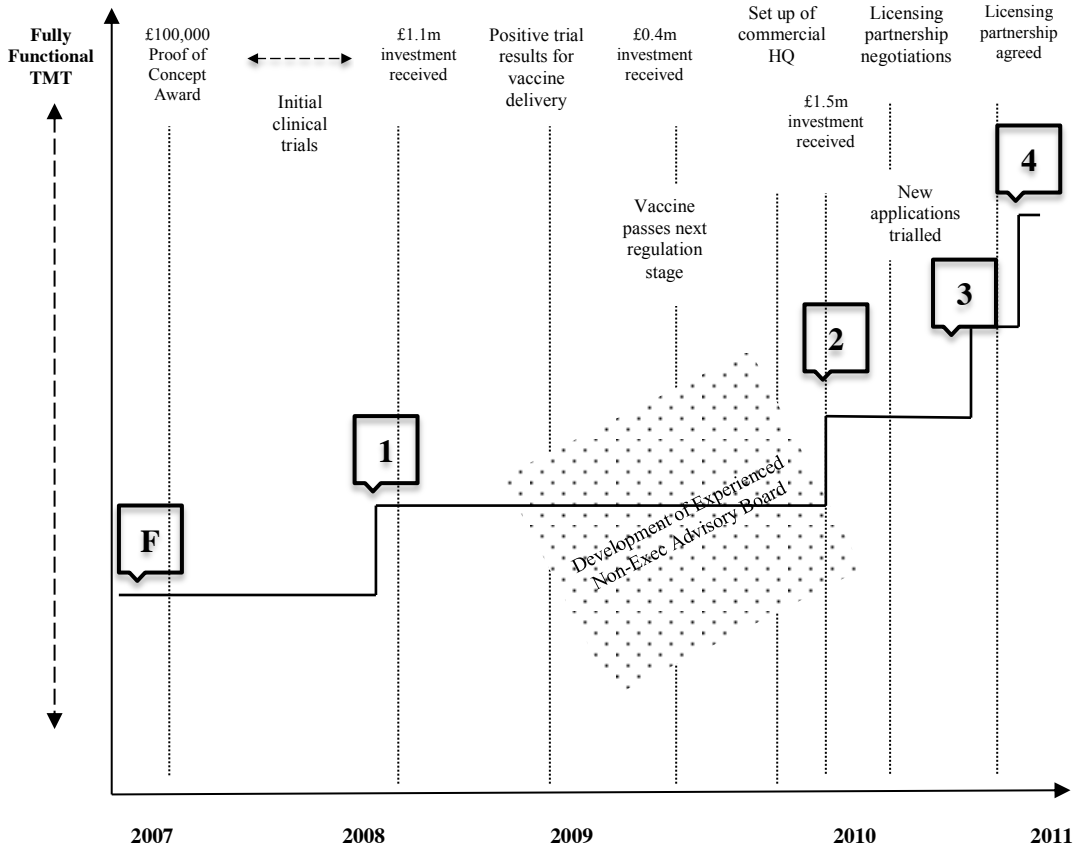
"The Enterprise Fellowship was a sort of well-meaning programme designed to change scientists in to business people. Whether or not it worked on me, I wouldn't be too sure. But, it gave some time for breathing room at the start (Founder 1, LS2)

As a result, Founder 1 found himself undertaking most of the duties associated with shaping the business case, raising finance, and negotiating regulatory approval in addition to technical duties. Founder 2 maintained a purely technical role.

Reconfiguration Event 1:

The main activities of the venture during its first eighteen months of operation were related to ongoing scientific trials. More robust test results were required to begin the process of early regulatory approval. As a result, most of the early resources were allocated to this. The founders recognised their lack of experience in putting together a business and regulatory case, and decided to recruit a Chairman to advise in these respects. The founding team used their direct connection with the commercial director of their research institute and appointed him as Chairman of the board (Member 3):

Figure 8d: Team LS2 Development Trajectory



[Founder 1] lent very heavily in terms of advice on an ex-colleague of his who was on the board. [Mentor name] was a director level scientist, but he'd worked very closely with many commercial operations. He knew how to guide the company. He was able to guide [Founder 1] very well, and [Founder 1] was very willing to learn and listen. [Founder 1] always seemed to have a knack for that natural progression from scientist to commercial, but equally he also always knew to surround himself with more experienced people so that he had a chance to gain experience (Commercial Director, LS2).

Having had previous experience in the commercial development of a number of research-based spinouts, Member 3 became heavily involved in management and strategic functions and was able to act as a mentor to Founder 1, who emerged as the CEO. Founder 2 officially took the title of Technical Director and maintained his purely technical responsibilities.

Successful initial trials saw the firm being awarded a funding round of £1.1m from a Scottish business angel syndicate. This investment was provided in order to conduct full-scale trials aimed at gaining regulatory approval for a first vaccine application. Management communication up until this stage was largely conducted on an informal basis, but the introduction of investors encouraged more formal communication procedures, which matched the already formalised project management and quality control systems that the TMT had implemented.

"With that amount of money coming in, things obviously had to get more serious in terms of how it was run. We'd been fortunate enough to be running quite a strict style of project management from the early days. This was really a legacy of our scientific and lab backgrounds. It was something the investors liked. But, now it was all formal board meetings and the like. It's a natural thing when you grow (Founder 1, LS2).

Trials for vaccine delivery proved successful and the existing team sought to build a strong non-executive advisory board to aid ongoing efforts to commercialise. Two new non-executive directors were appointed between 2009 and 2010. Both of these were experienced former technology entrepreneurs in related industries that had previously sold their firms and maintained a presence in the industry. In both cases, it was Member 3 who made the initial connection, having known the individuals through previous interaction in his capacity as a research unit director and former technology entrepreneur. Aside from an advisory role, respondents indicated that board members were appointed in order to add 'clout' to the team, but were not involved in day-to day management activities. Member 3 now officially occupied a full-time role within the TMT, overseeing a complex regulatory approval process. The firm received a further £400,000 investment from the existing investors, allowing the creation of a specialist commercial unit within their existing research premises. In late 2009, successful trials of the first vaccine application were completed.

Reconfiguration Event 2:

In 2010, the firm received investment of £1.5m from an international consortium of investors (including finance from the Scottish Enterprise co-investment fund). This

Table 8d: TMT Development Time Line – LS2

Critical Events	TMT Changes	TMT State
2007		
Firm founded (drug development) Spinout from academic research Awarded £100,000 finance under "Proof of Concept" Scheme Clinical trials continue as part of original research project		Founder 1: Commercial and R&D roles Founder 2: Research and development role Formal project management systems Informal management communication processes Ownership held between founders, and university
2008		
£1.1m investment received from angel group Clinical trials for vaccine delivery yield positive results	Appointment of Chairman (Chairman takes full-time role in TMT)	Founder 1: CEO Founder 2: CTO Member 3: General strategy & regulatory Formal project management systems Informal management communication processes Majority ownership held by founders Minority holding retained by investors/university
2009		
£400,000 investment received from angel group Specialist commercial unit formed in old research premises in order to develop vaccine	Appointment of Non-Exec Director (serial entrepreneur in same tech field) Appointment of Non-Exec Director (serial entrepreneur in same tech field)	Founder 1: CEO Founder 2: CTO Member 3: General strategy & regulatory Formal project management systems Formal management communication process Majority ownership held by founders Minority holding retained by investors/university Formal non-executive advisory board
2010		
£1.5m investment received from an international consortium (based in London, Hong Kong, and the Caymen Islands). Supported by Scottish Enterprise Co-Investment New vaccine applications trialed Business case for initial vaccine presented to potential partners Research staff numbers expanded significantly	Appointment of Commercial Director Appointment of Finance Director	Founder 1: CEO Founder 2: CTO Member 3: General strategy & regulatory Member 4: Commercial licensing Member 5: Finance Manager Formal project management systems Formal management communication processes Large ownership stakes held by founders & new investors Formal non-executive advisory board
2011		
1st licensing partnership is signed	Appointment of Product Line Director	Founder 1: CEO Founder 2: CTO Member 3: General strategy & regulatory Member 4: Commercial licensing Member 5: Finance Manager Member 6: Product Line Manager Formal project management systems Formal management communication processes Large ownership stakes held by founders & new investors

saw the appointment of an investor representative to the board. It also saw the appointment of a Commercial Director (Member 4), recruited from a Scottish-based Life Sciences firm, who would oversee commercial terms on licensing agreements. Member 4 had been a former scientist turned mid-level commercial manager within a technologically related, Scottish-based medium-sized firm. The connection to Member 4 was made through a prior working relationship with LS2 CEO, Member 1.

I knew [Founder 1] for some years. It was an ex-colleague of mine that had been speaking with [Founder 1], and mentioned to me that they were looking for a commercial director. So, that was word of mouth (Commercial Director, LS2).

By this stage, employ numbers had risen to fifteen, the majority of which were scientists. Administrative, human resource, and finance functions were outsourced.

I set the company up, meaning to be the Chief Scientific Officer but ended up being the CEO. I started out as a boffin and ended up as a businessman (Founder 1, LS2).

During 2010, management actively pursued licensing deals with multinational partners. Investment also allowed commencement of trials for new applications of the underpinning science.

Reconfiguration Event 3:

Late 2010 saw the appointment of a full-time Finance Director (Member 5), recruited on recommendation of the primary investors. This appointment was made in order to oversee the financial complexities involved in licensing partnerships as well as day-to-day finance related duties.

Reconfiguration Event 4:

The firm secured a first licensing deal for distribution of the initial (and most rigorously tested) application of the technology. A full-time Project Director (Member 6) was also appointed in 2011 in order to oversee operations for further

applications. Member 6 was recommended by one of the non-executive board members, who had worked with him in the past.

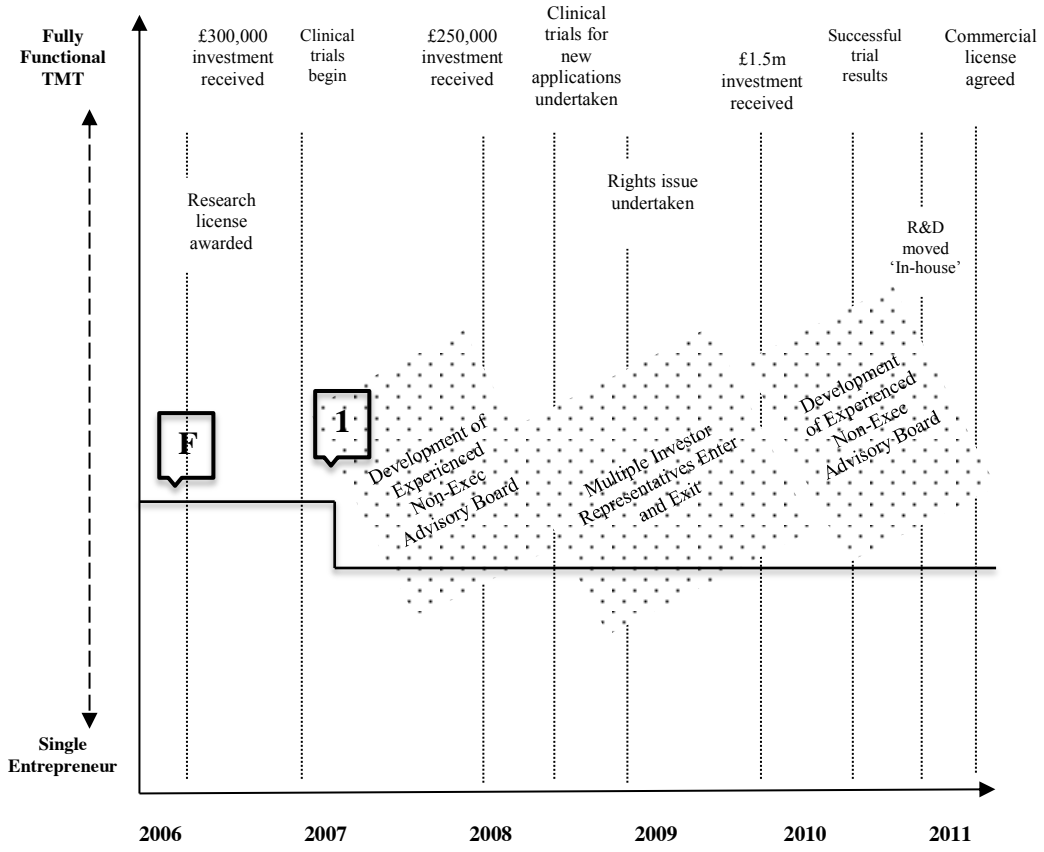
With the TMT now containing six members, respondents indicated no intention to expand in the near future. The strategy of the firm continues to be based around the development of a pipeline of applications to be de-risked and licensed to international distributors. Respondents stated that they would require significant investment in order to develop later-stage applications or to set up their own distribution network. Instead, senior figures within the team recognised that investors would most likely pursue an exit via trade sale:

Essentially we're interested in out-licensing areas that are not strategically important to the company. Emerging diseases, emerging vaccines for example. We'd be looking for partners with expertise in that area so that we could take it to market and see some licensing income. We don't intend to grow the company into a huge company. Our investors are looking for an exit. We'd hope that we could exit by trade sale (Commercial Director, LS2).

8.6 – NARRATIVE FOUR: SUSTENTATIVE DEVELOPMENT TMT

The final narrative category to be discussed offers somewhat of a challenge to the assumption that TMTs will seek to actively modify their core personnel. Indeed, a number of the teams examined here expressly indicated approach designed largely to sustain the shape of existing management, or, at least, to encourage conservative modification only. Within this category there were two overlapping groups. Firstly, there were those teams for which the level of TMT development appeared to largely be a function of overall venture development. Put simply, ventures that did not experience much in the way of growth were not required to modify their management. Such firms typically did not discuss objectives around large-scale growth. Instead, the emphasis was placed on sustaining growth levels within the means of the current management. This approach was typified by emphasis on the reduction of risk-taking activities and the efficient use of current resources. TMTs operating under such a outlook manifested themselves as being controlled by one or two lead management team members, who would act as CEO(s). In these teams,

Figure 8e: Team LS6 Development Trajectory



appointment of employees tended to be the primary method utilised in order to alleviate task pressures on existing management. Example cases here were teams OE2, CH1, and CH4.

A second group displayed similar efforts towards maintaining management control amongst founding members. However, these teams either achieved significant growth or displayed actions associated with higher growth orientation, for example pursuit of risk capital. This group of cases were characterised by the utilisation of non-core sources of management support, for example large non-executive boards (LS6), or heavily involved strategic partnerships (OE3). A typical goal for this group was to keep core management 'lean'. Example cases here were teams LS4, LS6, and OE3. The case study narrative presented for this category is that of Team LS6:

Team Formation:

Team LS6 manages a biotechnology firm, which develops an antibody that can be used in the treatment of various surface cell cancers. Founded in 2006, the underpinning research can be traced back to a large-scale clinical project based at a prestigious English-based university. Founder 2 of LS6 had been head of clinical trials at a Scottish research university that had been conducting an evaluation of particular applications of the work carried out at [English University]. Founder 1 had a long-standing relationship with Founder 2, chiefly through his role as a business advisor for a Scottish business and enterprise development agency. When strong initial results for the antibody were realised, a number of firms sought to buy licenses for various applications. Through his experience of clinical trials, Founder 2 was able to recognise the potential in a bladder cancer application. He approached Founder 1 for advice and then purchased the license:

The results were just unbelievable. So, as a result of that, one of the major multinationals, [firm name], took the license for cervical cancer and I started to get really interested in what [Founder 2] was doing. So [Founder 2] being a clinician recognised that this technology could potentially be used for other types of surface cell cancers. Bladder cancer, the one that we're most involved in is the 7th most common cancer in women, and the 4th most common in men globally. So he bought the license from Cancer Research Technology. That was pivotal (Founder 1, LS6).

Founder 1 and Founder 2 decided to form a venture to commercialise the research. Founder 1 decided that further expertise in the licensing of technology was required within the founding team, and used a personal relationship with a third member, Founder 3, to recruit him as part of the team:

[Founder 3] had advised a lot of the oil technology and software firms in Aberdeen on things like licensing agreements or acquisitions. He had helped firms grow and realise value. I thought it would be good to get someone like that involved. We got him involved right from the start. That type of practical knowledge about the structure of licensing deals is vital to research heavy technology firms (Founder 1, LS6)

Table 8e: TMT Development Time Line – LS6

Critical Events	TMT Changes	TMT State
2006		
Firm founded (drug development) License secured to research diagnostic antibody process for cancer Based on long-running research in Cambridge £300,000 investment secured through Angel syndicate		Founder 1: Business Development Founder 2: All research functions Founder 3: Licensing/Corporate Structure Formal project management systems Formal management communication process Majority ownership held by founders/Minority by investors
2007		
Contract signed with Scottish University to run clinical trials Clinical trials commence Clinical trials relocated to English University after problems £250,000 investment secured through Angel syndicate (to fund new trials) Founders lose significant equity to new investors who set new management targets Conflict with investor over targets and valuations of the firm	Exit of Founder 3 (reverts to part-time board role) Scientific Advisor appointed to board Angel syndicate 1 appoint investor representative Angel syndicate 2 appoint investor representative	Founder 1: All commercial functions Founder 2: All research functions Formal project management systems Formal management communication process Ownership divided between founders and investors Part-time non-execs and investor reps on board
2008		
Clinical trials commence for new applications of antibodies Rights Issue undertaken and all existing shareholders reinvest		Founder 1: All commercial functions Founder 2: All research functions Formal project management systems Formal management communication process Ownership divided between founders and investors Part-time non-execs and investor reps on board
2009		
£1.5m investment from local investor (supported by SE Co-investment fund)	Exit of all current investor representatives Local investor takes board position	Founder 1: All commercial functions Founder 2: All research functions Formal project management systems Formal management communication process Investor holds majority ownership Founders 1 and 2 hold significant stakes Part-time non-execs and investor reps on board
2010		
Bladder cancer trials completed and prove highly encouraging Research contract awarded to firm by new board member Research work moved to an in-house lab	Appointment of non-exec board member (experienced biotechnology entrepreneur)	Founder 1: All commercial functions Founder 2: All research functions Formal project management systems Formal management communication process Investor holds majority ownership Founders 1 and 2 hold significant stakes Part-time non-execs/investor reps on board
2011	No changes	First partnership/licensing agreement

Initial founder roles saw Founder 1 chiefly responsible for forming the initial business case and raising finance, Founder 2 responsible for clinical trials, and Founder 3 investigating the structure of potential licensing deals. Initial strategic aims were dependent on achieving statistically significant results on clinical trials. Team LS6 were able to secure £300,000 in funding from a local business angel syndicate in order to fund these trials, which were based at a local university:

We had some initial funding from an Angel group here in Aberdeen. Roughly £300,000. We used this for initial commercial assessment, but really the plan had to aim towards gaining further funding (Founder 1, LS6)

Reconfiguration Event 1:

Clinical trials were conducted within a local research university and began in late 2006. By early 2007 it became clear that the trialing process would be significantly lengthier than expected. With the research being at a far too embryonic stage for licensing discussions, Founder 3 found that he had little to contribute to the team on a day-to-day basis. Founder 3 subsequently exited his role and took a part-time non-executive position on the board.

The firm faced a number of challenges, which continued to lengthen the initial clinical trialing period. In particular, respondents from Team LS6 highlighted problems with the technical work that was subcontracted to an academic research unit:

We had a real issue with one of our academics….a rogue academic in [Scottish University] doing part of our clinical work. It really affected our ability to raise further equity. He had basically written a report saying that our technology was a turkey. So that put us to the bottom of the pile with a lot of venture capitalists (Founder 1, LS6).

In order to provide support for the challenges being faced by Founder 2 in managing clinical trials, Team LS6 turned to further non-executive board member appointments, rather than full-time appointments to the TMT:

We appointed a very high level, world-class scientific advisor to the new board. Now that's been fantastic, and it's given us a lot of credibility (Founder 1, LS6).

The link to the new appointment was made through existing networks that Founder 2 held within the medical research community – primarily through prior work undertaken on initial research into uses of the technology on cervical cancer. The purpose of the board level appointments was to improve the clinical trialing process and to add scientific 'clout' to the venture. Board member roles were part-time. Respondents from Team LS6 indicated that they were unable to afford the full-time recruitment of such senior figures:

[Board member name] is by no means full-time. It's important to have that type of support structure there, but management teams tend to be lean. This is really to do with cost. I'd love to have had someone like [board member name] on board full time, but who would pay his wages? This is a top-level guy we're talking about here. You get these people on board in an advisory capacity, and you pay them non-exec fees. That's how it works (Founder 1, LS6)

Clinical trials were subsequently moved to a new university facility after perceived problems with the old set up:

We knew how many patients we needed to recruit to get a statistically valid test. But [Scottish University] failed to perform, so we terminated their contract. We went back into the lab, did some more science, and then we transferred everything down to [English University].

The extended nature of the clinical trials placed added pressure to secure further investment. In early 2008, a local business angel group invested a further £250,000. However, given that robust results were not already achieved, the investors enforced strict development milestones on the existing management and took a significant portion of equity in the firm:

Well, we brought in a business angel group. And, being frank about it, although 20 million pounds has been spent on this core technology down in [English University] - the biggest single investment that the Medical Research Council and Cancer Research have made at any one site - they valued us at diddly squat. So, we had to negotiate some quite interesting management ratchets to get our shareholding back.

And they really screwed us into the ground, so there wasn't a great atmosphere to start off with (Founder 1, LS6).

Investor representatives were appointed for both business angel groups were appointed to the LS6 board of directors. LS6 respondents indicated that these individuals largely fulfilled a monitoring role. Founder 1 pointed to significant conflict between the TMT and the board:

They appointed a non-executive advisor to the board, as they had the right to do. And they appointed somebody that I'd clashed swords with in the past. I kid you not she used to turn up at our board meetings on a broomstick (laughs). You know, she was not there to add value, she was there to police (Founder 1, LS6).

I couldn't exactly tell the investors what to do in terms of board level recruitment but it was obvious that we couldn't find harmony with her on the board as a representative. We had such a big board by this point (Founder 1, LS6)

Mid-2008 saw an expansion of clinical trials to focus on applications of the technology to prostrate cancer. This clinical contract was awarded to a research team based in [English University].

By 2008, Team LS6 and their board of directors sought to raise further finance to push through progress of the clinical trials in order to pursue licensing deals with multinational biotechnology firms. A rights issue was attempted in late 2008, with existing management having to inject further personal finance in to the venture in order to maintain their shareholding. However, much of the value was lost in the wake of the credit crunch:

We decided that we were falling behind on some of our technical milestones. So we did a rights issue and I had to find a significant amount of money to maintain my shareholding. So we did our rights issue in august 2008. What happened in September 2008? The credit crisis. So all that value just disappeared through the floor (Founder 1, LS6).

The team required further sources of finance to complete vital technical milestones. By 2009, the board of directors had been significantly streamlined, with only one investor representative being retained:

It eventually worked out that they shifted a few people around, and we got a new investor representative. We were still being policed, and being made to stick to strict, and at some times, impossible-to-hit targets. But, things did run smoother (Founder 1, LS6)

Late 2009 saw a significant investment made by a local private investor, who bought out much of the holdings of the existing investors. Together with a £500,000 contribution from the Scottish Enterprise Co-investment Fund, a total of £1.5m was invested in the firm.

In the wake of the rights issue not going as planned I had to seek other investment. The operation was promising and we had some world-class people associated with the board, so I was able to convince a local entrepreneur turned investor to support us to the tune of £1.5m (Founder 1, LS6).

By mid 2010, the clinical trials for the bladder cancer application were completed and displayed highly encouraging results.

"The results were very impressive. So that has given us the confidence to go and talk to commercial companies" (Founder 1, LS6)

The success of the trials attracted a new board member to the team. A Scottish-based biotechnology entrepreneur who had previously sold a former venture for a significant sum, this individual provided LS6 with key contracts to carry out a number of peripheral trials:

We brought [board member name] into the team. He was a former client and had sold his business for 25 million to [company name]. He gave us a significant contract to do some science. That then made us appreciate that we were beginning to become a proper little biotechnology business. We then recruited 3 scientists so that we could do most of the important functions ourselves in-house (Founder 1, LS6)

With this important source of revenue secured, Team LS6 were able to pursue partners to license the technology. LS6 identified their value proposition as de-risking the various applications for the antibody before passing the license on to

larger pharmaceutical firms, who would develop products for market. The first commercial revenues for such a license were realised by 2011.

So we see our role as being a small, and I make no apologies for that word, translational medicine company. We find technology in the laboratory, take it into to the clinic, and show that it can be made to work. So we've done that for bladder cancer. We've validated it. We've significantly de-risked it. And that's just the conversation that I've had with a potential partner (Founder 1, LS6)

Team LS6 cited no plans to expand the TMT with full-time recruitment in the short-term. They intend to operate the existing business model with the current two founders and the support they received from the board of directors:

No, we're lean and mean. Although I'm getting to the point where I'm not functioning properly I have to say. But I can't afford to take anybody else on in a senior position because we're still paying ourselves deflated salaries and if I take on a scientific director or another medical director it'll cost me £120,000 (Founder 1, LS6)

8.7 – SUMMARISING KEY FEATURES OF TMT DEVELOPMENT

The narratives presented in this chapter provide an empirical depiction of how TMT development is inherently attached to particular milestone events and how resources are reorganised to accommodate those events. According to the findings of this study, it is the strategic progression of the firm that typically encourages, or allows, TMT modifications to occur. However, equally, it is the dominant logic of the existing management – and, in particular, the strategic decisions made by members – that drives that progression in the first instance.

Effective TMT development is characterised by a significant degree of co-ordination, often between multiple actors within the existing TMT and the board of directors. During the entry of a new member, for example, existing teams must adequately address and negotiate a number of complex tasks, such as:

- Identifying and communicating a strategic approach (or several strategic approaches) for the venture to follow
- Identifying the management activities required to carry out strategic approaches
- Identifying the managerial resources required to carry out those activities
- Balancing firm resources so as to be able accommodate TMT modification
- Timing modifications in order that they match to upcoming managerial task requirements
- Designing management structures and practices in such a way that new members can function effectively

It becomes easy to see why the effective development of managerial resources represents such a challenge for many existing TMTs. Certainly, the complexity of factors underpinning modifications to management goes far beyond the 'jigsaw' metaphor (Quinn, 1980) of TMT development, where existing teams simply identify their human capital deficiencies and then recruit to fill them. In practice, existing teams do not always have full clarity both on strategic direction or on the managerial resource needs associated with that direction. They do not always possess the necessary financial resources to obtain new management inputs. There are also a number of factors relevant beyond the actual point of recruitment (Forbes et al., 2006), for example, how a new member is subsequently integrated by the team or how the team manages conflict. These factors mediate how beneficial an instance of modification is. Furthermore, internal considerations all reside within the context of uncertain external events, meaning that complex and challenging decision-making processes occur within dynamic circumstances.

The findings presented by this study underline how the condition of the existing team can have a significant bearing on how these challenges are negotiated. In particular, existing teams appear to rely on the experience (human capital) possessed by members to act as a 'cognitive frame' for effective decision-making (Talke et al.,

2010). Equally, an existing 'bank' of resources – social and financial – can help implement those decisions more effectively. In short, existing teams with relevant experience and resources hold distinct advantages in terms of being able to build a TMT. Inexperienced existing teams, on the other hand, must learn 'on the job' through what is likely to be a steep learning curve. This underlines an integral role for peripheral sources of managerial support from board members and partner organisations that can act as mentors.

The primary challenge for inexperienced existing teams appeared to be that instances of inefficient resource use, or failures to achieve strategic milestones, tended to impose a cumulative effect, making any future modifications to the TMT increasingly difficult to achieve. Technology-based ventures appeared particularly susceptible to these challenges given how dependent funding rounds typically are on the achievement of milestones (Oakey and Mukhtar, 1999; Xia and Roper, 2009). Strategic milestones frequently represented periods of particular financial stress, and the inability to secure funding sources at these times evidently had significant implications for how TMTs were able to develop. As such, these findings give an explanation as to why some technology-based venture TMTs develop to be small and relatively unsophisticated, rather than professionalised.

8.8 – FEATURES OF THE SCOTTISH 'ECOSYSTEM'

The presentation of development narratives provides a portrayal of how TMT formation and development occurs within the wider context of the Scottish 'ecosystem'. This allows a final discussion of the wider implications for TMT formation and development as it occurs within a particular regional context. Two prominent issues emerged here. The first concerned resource availability within the region and the implications that this had for constraining TMT development. The second concerned the issue of resource recycling and how this informed the ongoing construction of wider contextual conditions.

8.8.1 – The Influence of Context

Existing research indicates that business context influences the availability of opportunities in general (McMullen and Shepherd, 2006). Given that TMT development is so closely associated with strategic decision-making and the exploitation of value-creating opportunities, this is clearly an important consideration for the phenomenon. In the sample examined here, one consistently cited influence in this respect concerned the size of local markets and the relative paucity of established local firms that could act as an entry point in to lucrative value chains. This reflected certain challenges for the development of TMTs.

Analyses of the stated strategic intentions of TMTs indicated that the creation of local value chain linkages was difficult because technologies were often too specialist for ventures to create meaningful synergies with others firms in the same geographical space. This comment from one owner-manager was typical:

We might all get lumped together under a banner like life sciences. But that can mean such a wide range of things. There was no one really doing anything like we were doing. Most of the production work was outsourced to India. I dealt with the Water Boards in England as customers, but I didn't have close strategic relationships. I just sold the testing devices to them (Founder 1, LS7).

This meant that the majority of sales or licensing relationships had to be international in nature. However, again, a number of respondents underlined difficulties in forging strong relationships with the gatekeepers to international value chains:

Getting access to the global supply chains…well, doing that from Scotland is difficult. It's really helpful if big players are headquartered or have major operations on your doorstep. But, here, you're not next to those big international players. You don't share links with them. I know it's a globalised world now and all that, but it makes a difference (CEO, LS1).

This was a notable issue for Scottish ventures that were attempting to enter international OEM markets. One of the primary challenges revolved around the level of organisational formalisation in smaller companies. A respondent from Team OE3 typified the challenges faced:

We couldn't really expand because we couldn't get into OEM markets. Its one thing for major global players to do this but quite another to do it with a small company in Glasgow. You need to be closely involved with someone big to give you access to these markets. The limitation of our early approach would come in trying to access the OEM market place. You need the product to have consistency. You need all the sales and support systems in place before an established player would even think about incorporating your product into their product. Building that expertise is a big challenge (Founder 1, OE3).

Ultimately, there was relatively limited evidence of genuine partnership between early-stage technology ventures and the primary actors within global value chains. This appeared to hamper TMT development in two main of respects. Firstly, it cut down on a key means of customer access for new ventures, thus impacting on growth progression and the changes in surrounding management that this could incite. Secondly, the lack of meaningful local collaboration with larger 'role model' firms negatively influenced what is a primary means by which smaller ventures could acquire managerial inputs and other forms of knowledge from their surrounding environment (Lawton Smith, 1991).

An additional constraining feature concerned the strength and activities of the Scottish investment community. It is difficult to escape the extent to which business context regulates the availability of resources in general (Levie and Autio, 2008). The availability of investment emerged as a consistent theme amongst respondents, as these Key Informant comments summarise:

The vast majority of our businesses here in Scotland are starting with very, very small amounts of money relatively speaking. For people to turn round and say 'we don't have the management', well I'm sorry we can have the management if we've got the money. On average an American Life Sciences business will start with ten times more money than a Scottish one. A company in Cambridge or Oxford will start with somewhere from six to eight times more money. It's easy to be an aggressive internationally orientated manager and to build a management dream team if you have bags of cash. But, most Scottish firms don't (Key Informant 4).

If there's poor investment, as most Life Sciences firms have in the early stages, then there's often poor growth. Then management teams and structures don't need to evolve. Things become stuck with the CEO or founder doing everything (Key Informant 6).

While this evidence is anecdotal, it does, again, reinforce how TMT development is often intrinsically attached to investment provision. It underlines that, while being a key input for firm growth, TMT quality cannot be divorced from the other key inputs that are evident within the wider business context. It appears that lack of investment not only constrains progression towards TMT modification events, but it also accentuates the risk of recruitment in tightly resourced firms, as well as reducing the margin for any errors resulting from modification decisions.

A related discussion concerned investor exit targets. Existing research suggests that Scottish technology ventures are likely to pursue exit – typically a trade sale - rather than large-scale growth strategies (Oakey, 2003; Mason and Brown, 2012). Certainly, this is a view supported by respondent statements on firm growth ambitions (See Table 8b). By way of comparison, it is interesting to note the title of Beckman and Burton's (2008) Silicon Valley-based study of TMT development, "*Founding the Future: Path Dependence in the Evolution of Top Management Teams from Founding to IPO*", and the assumption that going public is a viable, or even expected, option for high-tech ventures. In contrast, not one of the firms examined in this sample reached the stage of stock market flotation. In fact, only firms LS3 and OE4 consistently expressed aims to grow a company of scale.

Again, the implications for TMT development are clear. In the absence of significant scale up of operations there is simply less need to pursue the development of highly sophisticated management structures. This tends to place a natural cap on the level of TMT professionalisation required. Additionally, as many respondents were fully aware of their exit targets, they recognised that particularly large and complex systems of management could be unattractive to potential buyers. This incited a number of TMTs to remain relatively 'lean'.

8.8.2 – The Ongoing Construction of Context

Through examination of career histories this research was able to present a historical portrayal of how resources – both human and financial – were recycled and

Table 8f: Growth and Exit Targets of Case Study Firms

TEAM	COMMENT ON GROWTH INTENTIONS
LS1	*Well I'd love to be a global player, but the pragmatics here are that, if you're an investment-backed company, they need an exit. Your exits are either trade sale, or IPO. There's not that many big company spinouts. It's harder and harder to get to the IPO level. I think more and more trade sales will become the norm* (Mentor, LS1)
LS2	*We don't intend to grow the company into a huge company. We'd hope that we could exit by trade sale* (Commercial Director, LS2)
LS4	*We're lean and mean in terms of management. That's the way we'd want to keep it. I see us as being a small translational drug development company that de-risks propositions for larger international firms. We want to get licenses and create value for our investors so that they can get an exit* (Founder 1, LS4)
LS5	*I think that the view of the investors was to prepare the company for sale in the next 3 years. So I don't think that there's too much point to have a lot of management. What I need to do at the moment is to develop the structure to prove that the company is not a one-product company, that there are many markets, to give good value for the IP. Basically to prepare it for sale* (Founder 1, LS5).
OE1	*Again from our investor's point of view, they're looking for an exit. So what's a good exit for them? A good exit is a trade sale. Probably not an AIM flotation or something like that* (Founder 1, OE1).
OE5	*Our majority investor is heavily involved and is in the process of selling their stake to an investment group. It's up to us to take it as far as we can, but I'd imagine the firm will be acquired somewhere down the line* (Founder 1, OE5)
CH2	*"Yes. I'm 55 years old now. I'm not in the prime of youth anymore, I've tried to build up as much as I can do to get to the point where I can turn around and say 'right, it's good enough to sell'. That's where the trade sale would come in. We'd look at a partner or a company that's already involved in that market space who had the resources to take things much further afield"* (Founder 1, CH2).
CH4	*"We own the majority share between the two of us. We have very little investment, so there's no real pressure on that front. I don't think we want to*

	grow a huge company. I want to keep it manageable and just keeping securing some high margin contracts" (Founder 1, CH4).
KEY INFORMANT 5	*Most life sciences firms in Scotland just spend, spend, spend in the hope of being bought out* (Key Informant 5).

transferred from prior incubators into new ventures. The study did not follow the subsequent career activities of sampled members beyond their activities within the case study TMTs (for example those that had exited), and so definitive observations could not be made on how this contributed to the ongoing recycling process. Nonetheless, the subject of eventual firm exit was a prominent strand of discussion, and it was clear that the reapplication of resources beyond this would contribute to the ongoing construction of the wider business context. In this sense, the acquisition of Scottish firms was not necessarily a negative feature for Scottish firms. Firm exits simply represented the culmination of another incubation experience for TMT members. And, as it was relatively successful firms that were typically acquired, the resources attached to the exiting TMT were likely to be potentially beneficial both to future technology-based ventures and to the condition of the wider environment. However, as a recycling mechanism, the overwhelming dominance of trade sale exits implied a number of challenges in terms of the extent of beneficial resource transfer back into the Scottish business environment.

The principal challenge here appeared to concern the retention of human and financial resources within Scotland. For example, Mason and Harrison (2006) found that large foreign-based companies were primarily responsible for acquisitions of Scottish technology firms. The chief issue is that beneficial assets, and any resulting value, may be transferred out of, rather than being recycled back into, the Scottish Innovation System (Mason and Harrison, 2006; Harrison et al, 2010a). This was a challenge raised by a number of respondents:

We're running with that danger that we spend all our money on research and development, get to the end of our runway, somebody picks us up for nothing, invariably an American company or a large European multinational. Someone we've been dealing with already (Founder 1, LS6).

Having our companies acquired is not something that we should be averse to, as long as we can embed some activity of the company in Scotland. For example, a couple of years ago my company, [Scottish firm name], were bought out by [US Multinational]. But, they were keen to stay in Scotland. So they stayed up in Aberdeen. So, having [Scottish firm name] being bought by an American company, we now have [US Multinational] having activity in Scotland. It acts as a great training ground for our workforce. That's no bad thing, unless [US Multinational] decide to leave (Key Informant 4).

The second challenge concerned the scale of Scottish technology ventures at the point of exit and the impacts that this could have on the extent of resource recycling. For example, through examination of Scottish acquisitions data, Mason et al (2013) contend that the market is dominated by relatively small exits, which give a good return to investors and team members, but do not necessarily leave individuals with large levels of surplus finance that they would be willing to reinvest in technology sectors. The exit of successful companies represents one of the primary ways through which high-net worth individuals (with an interest in certain technology sectors) are created. However, once all investors have taken their share, it takes a particularly significant windfall to encourage individuals to re-enter an industry in an active capacity:

The problem that we have now in life sciences is that we don't have very many serial entrepreneurs. We just don't. We've now sold our stake in three businesses. Two we sold out completely and the other we just had a small stake and we sold it back to them. So we are recycling money, but there's not many people doing that. What we need is ten people that have been there, done it and made money and are now reinvesting that money (Key Informant 4).

There's a huge thing in Scotland about how you do business, especially if you're a spinout company: you spin out, you raise money, you get a bunch grey-haired people on the board, because you're not allowed to touch the money, they then build it up, you probably have one or two more rounds of investment, and then you sell it to mister 'exit America'. Then you take a few board positions and maybe if you're lucky you find a good company and you can become Chairman. You keep your cash flow of

150-250k a year going, and you drive your Porsche around. It's good for you, but it's quite short-term for the industry as a whole (Founder 1, CH1).

Beyond recycling of finance, the scale of Scottish firms at the point of exit also has implications for the levels of human capital that TMT members gain during their time within the venture. Much of the emphasis in this study has been placed on those entrepreneurs and managers that had experienced the *transition* of growth between a new venture and a large firm. However, if the growth of indigenous ventures is truncated by early exit then so too are the entrepreneurial experiences gained. In short, the typical exit mechanisms for successful Scottish technology firms act to constrict the creation of labour sources with experience of growing companies of scale:

There aren't many people that have been through the entire life cycle. You know, there's a lot of people that are involved at early stages of commercial development, but there's not many that have taken their products all the way through and become a really big firm. So, we have strong expertise at the early stages, but not for the later stages. It's difficult to find people that have been through all the stages of growth (Commercial Director, LS2).

We aim for less growth because we have to. Our business owners don't gain experience of transitional growth. They are the ones advising future companies. And these companies themselves also face resourcing issues. You end up with a situation where few people have any real experience of growth and genuine structure. You need commercial success to breed commercial experience. It's a bit of a vicious cycle (Key Informant 4).

The incubation of experienced founding entrepreneurs – typically serial entrepreneurs – represents perhaps the most obvious and important aspect of labour creation for TMT development. It was these very processes that underpinned the discussion of founding team emergence outlined in Chapter Six of this thesis. However, the production of board members to act as potential mentors is subject to the same mechanisms, and the same constraints. In conducting a career history analysis of all sixty-two board members identified by case study respondents and secondary data, this study highlights a number of features concerning the incubation

of potential mentors. Firstly, the twenty-three investor appointed board members identified within the sample overwhelmingly originated from a professional finance, accountancy, or legal background (twenty of twenty-three board members). One respondent, a very experienced serial technology entrepreneur who acted as a key entrepreneurial broker within Team LS8, reiterated that the dominance of such backgrounds in investor representatives was not only common, but potentially problematic:

Everybody knows how to run a small company until they actually have to do it. You get so called 'experts' in, particularly accountants, and they supposedly know their stuff, but most of the time they don't know the sector, and don't know how to help grow a company. Funds very often insist on putting somebody in as an observer, who is usually to the company what I am to ballet. They don't understand what it's like to grow a business, and that it's not all plain sailing and hitting targets. They've been dealing with numbers on a page all their life, mostly in large companies. They can be a real hindrance (Mentor, LS8).

The suggestion here is that there may be a lack of compatibility between what are very defined functional skillsets and the requirement for guidance through the challenges of entrepreneurial growth. In essence, it could be argued that large portions of the Scottish investment community have backgrounds that are *more suited* to general monitoring or functional activities rather than general leadership and strategic support.

Similar issues surrounding the compatibility of mentor backgrounds were raised through the career history analysis of the remaining thirty-nine team-appointed board members, who were typically non-executive directors. Highly active, transformative mentors were very likely to have been previously successful entrepreneurs in a related industry. However, relatively few board members possessed such a background. The majority displayed career histories in large corporate organisations only. Again, there were a number of questions raised regarding the suitability of corporate-only backgrounds in conjunction with effective mentoring within rapidly changing, and often tightly resourced, ventures:

There's plenty of grey haired guys that have spend their life in Glaxo that will be glad to sit on your board of 15k a year, but there's not many guys around in Scotland that have experienced what it's like to grow a successful company (Founder 1, LS3).

He was from Sun Microsystems and had been a vice president at Sun. He'd worked with the infrastructure of a multi-billion dollar company behind him. If something was running late, he'd just put more money in it, you know? It's not such an easy decision when the money's running out. I get the impression that during all his time working there, he'd lost any connection of what it's actually like to manage a resource strapped business (Founder 1, LS7).

Some big pharma companies are letting go of some of their top people. Could we get one of them and put them in to manage one of these small companies? Well in some cases this may be good, but the problem is that in some cases the skillset that they have in big pharma is very different from what you need in a small firm. In a small firm you need to be able to do a bit of everything. When you're working for Glaxo or Pfizer your job is just your job, it's not anybody else's. You're not caretaker, cleaner, janitor, or whatever else. And so someone with a skillset from say Glaxo, and I'm not saying they can't do the job, a lot of them can, but they're used to having everything done for them (Key Informant 1).

Even if you've been a manager in a big corporate there's still some issues. It doesn't mean you can work in a growth situation. When I worked in Russia I had two secretaries. I didn't need to think or do anything for myself. That can be detrimental because you get a big shock if you come back to run a Scottish firm, which, let's face it, will probably be tightly resourced (Key Informant 4).

Anecdotally, it could be argued that the production of board members was reflective of the gap between typically Scottish owned early-stage or small firms, and typically foreign-owned established firms. Given the relative paucity of indigenously grown technology firms, and the associated incubation experiences that these encouraged, it was those with experience at the relatively well-represented corporate-level that typically took up mentoring duties.

Furthermore, it was clear that the attraction of experienced individuals to undertake senior commercial or active board roles in Scotland remained a difficulty, which placed further pressure on indigenous creation and recycling of high quality human resources. A number of respondents emphasised the lack of opportunities in Scotland for very experienced, but externally based, board members:

It's tough to get really experienced people to come and work here. There's not too many of them about, and most of them want to stay where there's a variety of big jobs. Uprooting to come to Scotland often means that you're uprooting for one single opportunity. You've got to have a lot of faith in the firm to do that. Many of the heavy hitting guys just don't see enough big opportunities in Scottish industries (Key Informant 4).

Getting a heavyweight chairman or advisory panel from Scotland is challenging. I don't necessarily think that it can't be done. I just think that it's more challenging to be done from here (Mentor, LS1).

Interestingly, these findings echo those of a number of other Scottish-based studies by highlighting migrant Scots who return to their homeland at a later date as a more realistic source of high-level human capital (Houston et al., 2008; Birch and Cumbers, 2009; Harrison et al., 2010b). While the majority of experienced individuals identified in this sample were Scottish born, Scottish educated, and began their career in Scotland, a number of them gained experience outwith Scotland. So, where there may be limited opportunities for indigenous development of 'full cycle' technical to commercial experience within Scotland, returnee Scots that developed human capital in another geographical environment frequently offered a means to augment sources of expertise if they returned to the Scottish labour market:

I had good experience already and I was working with a university spinout from University College Dublin in Ireland. I worked for them four days a week. But I consciously kept one day back a week to do my own consultancy work because I was always looking to pick up a startup back in Scotland (Mentor, LS1).

I gained great experience in Switzerland and used that to start back up in Aberdeen. Of all the places in the world to start up in, Aberdeen probably wasn't the absolute best to do so, but that's where my roots were. So it's not always a bad thing for people to gain experience abroad because I'd say more often than not they come back home at some point (Key Informant 4).

Individuals such as this, that had reached mentor-level expertise, appeared to build their human capital to a stage where they are could return to Scotland and still remain sufficiently confident that they would be able to either access an appropriate level of employment, mentor an appropriately promising new venture, or succeed in starting their own successful venture. Thus, where experienced individuals with a Scottish

affiliation are concerned, the thickness and quality of economic opportunities became less of an all-pervading influence on regional attraction (in contrast to the assertions of Florida, 2002a; 2002b). In essence, the level of expertise and experience gained by such individuals largely served to supersede issues surrounding labour market 'thickness', which are so dominant in dictating regional attractiveness for many other labour types. As a result, highly experienced mentor figures had more freedom to indulge alternative attraction factors, for example, family, friends, and national affiliation. Additionally, this also highlights the argument that the export of labour is not necessarily a negative for the Scottish economy. Much is made of graduate retention and the prevention of 'brain drain' (Houston et al., 2008). However, if technically proficient individuals that hope to make the transition to a commercial career are able to access rich incubation opportunities in other geographical locations, then this can work as an advantage if, as is often the case, they return to their homeland at a later date.

8.9 – CHAPTER SUMMARY

This chapter has sought to present empirical portrayals of the main findings of this study. Four TMT development narrative categories were presented. These depicted the ongoing interdependency between strategic decisions, TMT modification actions, and the wider business context. It also highlighted a number of Scotland-specific features concerning how TMT formation and development occurs as part of a wider contextual 'ecosystem'. The evidence indicated that regionally specific resource constraints – relating chiefly to investment access – greatly impacted TMT development trajectories. Furthermore, the ongoing performance of ventures in key technology sectors appeared to hold significant implications for how key resources – finance, entrepreneurial labour, and mentor communities – were recycled back into the environment. As such, TMTs also actively shaped the context from which new TMTs will emerge and develop.

In short, the wider business context matters (Welter, 2011). It ensures that TMTs are likely to face discrepancies across a number of factors critical to their development,

such as access to managerial labour (Florida, 2002b; Florida, 2002a), access to a supportive investment community (Harrison et al., 2010a), or access to growth opportunities in general (Lawton Smith et al., 2005; McMullen and Shepherd, 2006). These features cannot be divorced from those decisions that dictate how a TMT is modified over time. Perhaps even more damaging than the relegation of context from the debate (Zahra, 2007; Welter, 2011) is the tacit assumption that certain regional conditions are the norm. For example, the technology entrepreneurship literature has traditionally displayed a particularly strong tendency towards focusing on exceptionally performing regional clusters (Head et al., 1996; Mytelka and Farinelli, 2000). Most notable is the proliferation of studies that examine highly successful high-tech regions such as Silicon Valley or Boston's Route 128 area, which enjoy uniquely 'thick' labour markets (Angel, 1991; Saxenian, 1994; Florida, 2002b) and highly supportive regional conditions (Saxenian, 1985; Saxenian, 1994; Bernasconi et al., 2006). The empirical findings drawn from the chapter encourage this study to forward the following research propositions:

Proposition 3a: In less favoured regions, the reduced availability of key resources (particularly financial capital) is associated with the lower likelihood that technology venture entrepreneurial teams will add new members

Proposition 3b: In less favoured regions, the reduced availability of key resources (particularly financial capital) is associated with lower growth aspirations within technology venture entrepreneurial teams thereby moderating the development of professionalised TMTs

Proposition 3c: In less favoured regions, technology venture entrepreneurial teams are less likely to gain access to relevant and qualified mentors thereby reducing the chances that professionalised TMTs will be developed

9. CONCLUSIONS AND CONTRIBUTIONS

9.1 – INTRODUCTION

This chapter presents the concluding discussion of the study. Beginning by revisiting the study aims, it then outlines the key empirical findings arising from the research questions. Reflecting the inductive and explorative nature of the study, these empirical findings are formalised as three sets of research propositions. The propositions highlight three primary dimensions of TMT formation and development. First, they emphasise contextual influences on the emergence of founding teams. Second, they emphasise how TMT modifications take place in conjunction with the wider environment. This forwards a conceptualisation of TMT development that focuses on individual reconfiguration incidents, and thus is more in tune with the empirical realities of development pattern heterogeneity. Third, they emphasise how TMT development patterns develop within and help to construct their wider business 'ecosystem'. The chapter raises a number of implications for TMTs themselves, as well as discussing issues surrounding training and professional development. Consideration is also given to how the findings of the research fit with wider government policy. Finally, the chapter closes by reflecting on the nature of the knowledge claims made.

9.2 – REVISITING THE RESEARCH QUESTIONS

The study was initially driven to examine TMT formation and development by the numerous observations concerning managerial deficiencies in Scottish technology-based ventures (Leibovitz, 2006; Houston et al., 2008; Harrison et al., 2010b; Mason and Brown, 2012). It was considered that this would likely have significant negative implications for the growth and prosperity of the high-technology sectors that are often cited as being central to economic improvement in the region. Thus, an overriding aim was to explore the nature of these claims.

In reviewing existing literature, a number of research gaps were also identified. This provided further focus for the study aims. Research gaps predominantly related to a perceived dominance of ahistorical and aspatial theoretical explanations of how TMTs develop. Following the principles of human and social capital perspectives (Burton et al., 2002; Colombo and Grilli, 2005; Mosey and Wright, 2007; Sorensen and Fassiotto, 2011), it was identified that the pre-founding experiences of founders were likely to have a significant bearing on how TMTs came into being. Thus, an initial aim of the study was to demonstrate how TMTs emerged within the selected business context under study.

Next, the study sought to build a conceptualisation of TMT development that a) was sympathetic to heterogeneity in TMT development patterns, and b) attached TMT development patterns to the wider business context in which they occurred. This aim was formulated in response to the large body of critique surrounding the use of deterministic and universal models as explanatory frameworks for both firm growth (Levie and Lichtenstein, 2010; Blackburn et al., 2013) and TMT professionalisation (Beckman and Burton, 2008). It was also underpinned by evolutionary (Aldrich and Martinez, 2001; Breslin, 2008) and strategy-based views (St-Jean et al., 2008; Blackburn et al., 2013), which characterise development as an ongoing process in which an existing TMT adapts in response to wider contextual conditions.

Finally, the study aimed to further highlight contextual influences on TMT development by presenting a study based in a peripheral (Leibovitz, 2006), or 'less favoured' (Birch, 2011), region. This aim was constructed in response to the view that an overwhelming research focus on exceptionally performing regional technology clusters – such as Silicon Valley – may have had a damaging influence on the creation of explanatory frameworks (Mytelka and Farinelli, 2000; Nightingale and Coad, 2014).

The research sought to achieve these aims by compiling and analysing eighteen qualitative case studies. An inductive approach was utilised towards the aim of

theory building. Theory generation primarily took the form of research propositions, which were developed from the key empirical findings. These are represented in Figure 9a. Research inquiries were driven by two research questions:

9.2.1 – Research Question One

How do technology-based TMTs emerge?

By conceptually tying the foundation of TMTs to theories of human and social capital, the findings indicate that TMTs emerge with vastly heterogeneous ranges of resources at their disposal, depending on where and how founding members are incubated. It is the dominant incubating (and attracting) organisations occupying a particular regional space that predominately influence the types of teams that are created. Essentially, the surrounding business context represents the 'gene pool' in which the creation (and attraction) of potential entrepreneurs, managers, and board members occurs. The observation that incubator firms influence entrepreneurial spinoff is well established (Cooper, 1971; 1973). However, the integration of this concept into how TMTs develop underlines the importance of 'pre-founding' influences on subsequent development patterns, as well as helping to embed the emergence of teams within a particular regional context.

During the pilot stage of data collection, the initial focus of this study had been placed on how the availability of external managers within the regional labour market. The rationale for this early focus was that TMT development would be epitomised predominately by the recruitment of external managers, as is the case in a 'professionalisation' hypothesis (Charan et al., 1980; Flamholtz and Randle, 2000; Wasserman, 2003). However, early data analysis instead emphasised that firm founders frequently maintained an ongoing leadership role in the management of the venture, regardless of how 'professionalised' that TMT eventually became. The analysis provided no support for the proposition that 'founder-managed' TMTs necessarily developed to become any less professional than so-called 'professionally-managed' TMTs, where founders had been replaced by incoming executives (see

Pollock et al., 2009; Mason and Brown, 2012). In short, the early development of TMTs was tied heavily to the incubation of initial entrepreneurial leaders (Hmieleski and Ensley, 2007; Lockett et al., 2013). It was these individuals that were most often (although not always) a main driving force behind overall venture and TMT development. Thus, the importance of integrating founding team emergence into TMT development was further underlined.

In Scotland, founding member career histories were overwhelmingly steeped in a related technical discipline. Two broad pre-founding career paths were evident from this foundation: a purely technical route and a commercial/managerial route. Business management experience tended to emerge as a continuation of an initial technical career, with more commercially experienced founders typically emerging from existing companies in a related industry. Consistent with existing research on technology entrepreneur career movements (Harrison et al., 2004; Casper and Murray, 2005; Cooper and Park, 2008), this emphasised the importance of career paths that provided career progression, through which technologists could broaden their experience into the commercial sphere.

Commercially experienced founding entrepreneurs held clear early advantages in leadership and strategic abilities. However, the managerial resources possessed by an existing team were not static, and could be subject to ongoing learning. For first-time entrepreneurs, or those without a commercial background, the learning curve was likely to be steep. This also underlined a vital role for sources of external support – board members and strategic partners – to act as mentors or as social conduits for the access of further opportunities and resources. Those individuals that played an active mentoring role recycled resources from typically high-quality prior incubation experiences, such as prior ownership or senior management experience within a high-performing relevant firm. Active mentors represented another key labour type; one that was frequently integral to how lead entrepreneurs accessed expertise, resources, and opportunities. Thus, the incubation of the team was ongoing.

In the Scottish example, there were a number of prominent issues that clearly had an effect on the emergence of these key labour sources. Firstly, particularly 'thick' academic research sectors tended to produce founders with little exposure to the commercial environment. Secondly, the relative dearth of indigenous high-growth technology ventures adversely affected development opportunities for commercial technologists to broaden their experience within a growth environment. Thirdly, the types of firm exits evident for even successful Scottish ventures typically occurred prior to large scale growth (such as IPO), thus the levels of resources (human and financial) recycled back into the economy were often truncated (Mason and Harrison, 2006; Mason and Brown, 2012).

The findings shed some light on the nature of the Scottish-specific 'managerial deficiencies' debate. The study posits that in citing TMT quality as a cause of poor performance within technology-based ventures, commentators merely succeed in 'blaming the victim' (Massey, 1984). Simply put, management level labour quality is as much a *symptom* of wider industry performance and environmental conditions as it is a cause. A comment from one of the 'Key Informant' interviews – a highly experienced portfolio entrepreneur and investor in Scottish Life Sciences industries – provides an insightful reflection on how wider context can shape the production of entrepreneurial and managerial labour sources:

Let's deal with the broad question at first: is there a lack of management talent in Scotland? Well, everywhere I travel in the world from Life Sciences to big pharma, I meet guys from Scotland that are right at the top of the tree. So, I'd have to say to that is 'no'. What is lacking in Scotland are the opportunities to give people management training and backgrounds. There are good people and I think that those people can grow and develop, but its tough to do that here when you don't have a wealth of HQ companies that have got the experience of training. Simply to say that there aren't good managers in Scotland, I think, is wrong. I actually believe that we have better managers here, because we're used to doing more with less resources (Key Informant 4).

As Aldrich and Martinez (2001: 42) reflect, "agency, process, and context interact in a recursive continuous process". Just as the wider environment impacts the types of TMTs that are created, so too does the performance of those TMTs act in turn to

shape the wider environment. Thus, current TMTs, at least partially, influence how future TMTs emerge. In essence, labour production and TMT development occur within the same self-reinforcing processes that help define how particular regional innovation systems function. This underlines a particularly important role for those ventures that outperform the constraints of the wider environment. It is outperforming firms that help kickstart self-perpetuating benefits when they recycle financial and high-quality human resources back into emerging new teams and into the wider environment in general. In short, ventures may be embedded within a particular context, but are not completely constrained by it (Schienstock, 2007). For policy makers, a key challenge here clearly lies in ensuring that benefits are appropriately retained and recycled.

9.2.2 – Research Question Two

How does the modification and ongoing development of technology-based TMTs occur in conjunction with the wider business context?

First and foremost, the findings of the thesis support what most empirical examinations of both firm and team development contend; namely that universal and deterministic models represent poor explanatory frameworks for what is a heterogeneous and context-dependent phenomenon (Beckman and Burton, 2008; Levie and Lichtenstein, 2010). This study downgrades emphasis on the prediction of overall development patterns and, instead, focuses on the actions and behaviours that define instances of modification (St-Jean et al., 2008; Blackburn et al., 2013). This places the *existing team* and the decisions they make at the heart of TMT development. It advances a view of TMT development that shares conceptual roots with contemporary stances on firm growth (Levie and Lichtenstein, 2010; McKelvie and Wiklund, 2010; Blackburn et al., 2013). Central to this is how the strategic decisions – and, in particular, the TMT modification decisions – made by the existing team occur in conjunction with the wider environment. In essence, understanding of how a TMT develops is ultimately founded within how existing TMTs accommodate and react to environmental stimuli.

The findings demonstrate that the modification and ongoing development of the TMT is poorly explained by a 'jigsaw' metaphor (Quinn, 1980), in which different management inputs are simply assembled as a causal 'shopping list' designed to improve firm performance. There are a number of reasons why this view is impractical. Firstly, it does not take into account the wider context of possible resource deficiencies. In the findings presented here, TMT modifications decisions were heavily dependent on the availability of resources – particularly financial resources – and how these allowed or constrained actions of change. This was reflected by the observation that most existing TMTs enacted a 'piecemeal' recruitment strategy contingent upon how financial resources were managed and released. For Scottish firms, it was primarily the availability of financial investment that appeared to constrain modification activity (for example, the inability to afford the wages of an experienced recruit).

Secondly, it assumes that the existing TMT holds a degree of certainty over its human resource requirements and how these relate to firm development. However, the evidence presented here indicates that an understanding of managerial resource requirements typically depended on uncertain and emergent events. Effectively modifying existing TMTs did not simply assemble complimentary sources of human and social capital in order to pursue strategy, but, instead, had to balance their modification choices with the demands of emerging stimuli. Clarity on broad 'headline' strategic plans proved helpful in terms of how existing TMTs timed and resourced appropriate modifications. However, plans acted simply as guidelines to frame what were flexible approaches. Alternatively, the ineffective reconfigurations in evidence demonstrated that the addition of what were often hypothetically beneficial human resources could be seriously undermined if not timed well. In short, effective TMT development was not just about assembling human resources, but also about successfully matching and timing human resource influx with emergent strategic needs.

Thirdly, the assumption that recruitment of an appropriately experienced new member will always result in an increase to the human capital 'stock' of a management team represents a weakness in our understanding of how new knowledge is added to a TMT (Clarysse and Moray, 2004; Forbes et al., 2006). The study demonstrated that hypothetically beneficial recruitment actions could also be undermined if the existing team were not structured or configured in such a way as to support and utilise a new influx of experience. These factors mitigated the effectiveness of member addition actions beyond the "point of entry" (Forbes et al., 2006: 234). This was noted, for example, when new TMT recruits did not have clearly articulated role demands. Again, the assembly of human resources was not enough for effective TMT development. The *co-ordination* of those resources was also highly important.

Ultimately, it was how existing TMTs accommodated these challenges through the decisions they made that underpinned how TMT development occurred. The effectiveness of reconfiguration actions appeared to be impacted heavily by the resources held by the existing TMT. The analysis highlighted advantages held by more experienced management teams in terms of:

- The use of existing experience as a 'frame', key to appropriate strategic decision making, through which the uncertainty of venture growth and associated emergent management needs could be negotiated (Talke et al., 2010). This was particularly relevant if prior experience related to 'venturing in general' (Zhang and Baden-Fuller, 2008).

- The use of 'organisational blueprints' from former workplaces as a foundation for the ongoing development of appropriate management structures in the new venture (Baron et al., 1999). In particular, this related to the appropriate delegation of strategic responsibilities and TMT role demands.

- The use of social and financial resources recycled by TMT members. For example, access to a strong pool of experienced and trusted potential recruitment sources.

As TMT modifications were largely built upon the actions of the existing team, more experienced teams tended to gain cumulative advantages from the choices they made, which allowed them to continuously improve. Conversely, with every ineffective strategic decision made, less experienced teams narrowed the window of opportunity for future modifications. A typical end point here for Scottish technology-based ventures was a 'Mom and Pop', or 'Science Project' type business, where large-scale growth was unlikely. These observations offer an underpinning explanation as to why some researchers identify a strong path dependent influence on how TMTs develop (Beckman and Burton, 2008). They also serve to tie Research Question One and Research Question Two together as part of an overall explanation of the TMT development phenomenon.

9.3 – OVERVIEWING RESEARCH PROPOSITIONS

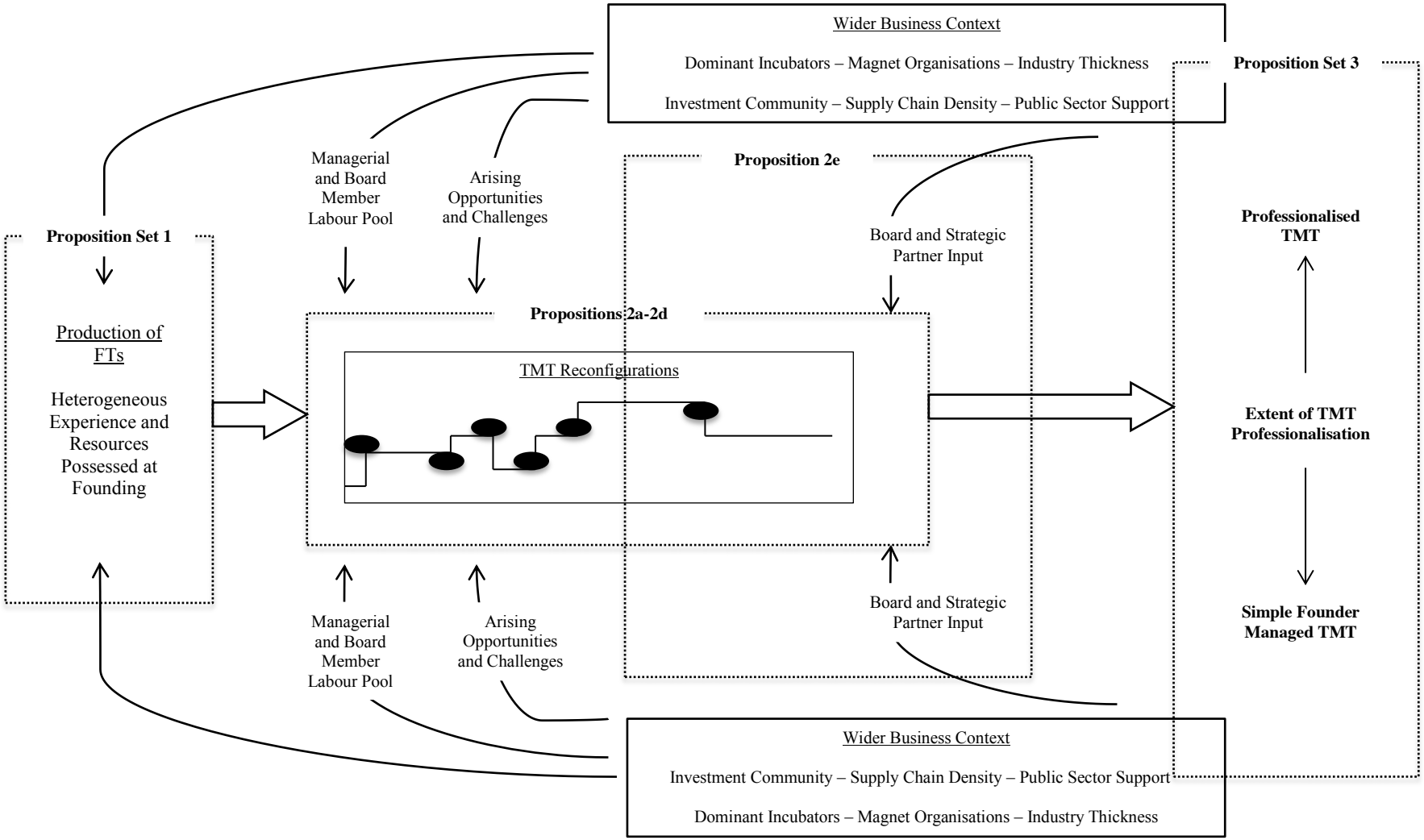
The key findings of this exploratory research are reflected by three sets of research propositions. Together, these depict a conceptualisation of TMT formation and development in the less favoured regional context. This conceptualisation is outlined in Figure 9a. The research propositions are used here to frame the theoretical contributions of the study. The propositions were as follows:

Proposition Set One

Proposition 1a: In less favoured regions, founding teams of technology-based ventures are more likely to emerge containing members with backgrounds exclusively in a relevant technology or research area

Proposition 1b: In less favoured regions, founding teams of technology-based ventures are more likely to emerge containing members with no prior business management or entrepreneurial experience

Figure 9a: Research Propositions Reflecting TMT Formation and Development in the Less Favoured Region



Proposition 1c: In less favoured regions, founding teams of technology-based ventures are less likely to emerge with network connections amongst key actors within a relevant private sector industry

Proposition Set Two

Proposition 2a: The effectiveness of modification actions within technology venture TMTs is associated with the extent to which the existing team formulates and articulates clear strategic objectives and milestones amongst its members

Proposition 2b: The effectiveness of modification actions within technology venture TMTs is associated with the extent to which the existing team articulates role responsibilities and performance targets to incoming new members

Proposition 2c: The effectiveness of modification actions within technology venture TMTs is associated with the extent to which strategic decision-making authority is decentralised amongst existing and incoming members

Proposition 2d: The effectiveness of modification actions within technology venture TMTs is associated with the extent to which formal organisational and managerial structures and procedures are implemented prior to modification.

Proposition 2e: Technology venture TMTs are more likely to enact effective modification actions if they leverage human and social capital from more experienced stakeholders e.g. the board of directors or strategic partners.

Proposition Set Three

Proposition 3a: In less favoured regions, the reduced availability of key resources (particularly financial capital) is associated with the lower likelihood that technology venture entrepreneurial teams will add new members

Proposition 3b: In less favoured regions, the reduced availability of key resources (particularly financial capital) is associated with lower growth aspirations within technology venture entrepreneurial teams thereby moderating the development of professionalised TMTs

Proposition 3c: In less favoured regions, technology venture entrepreneurial teams are less likely to gain access to relevant and qualified mentors thereby reducing the chances that professionalised TMTs will be developed

Three prominent narratives currently dominate scholarly literature on entrepreneurial and top management teams. The first of these concerns what might broadly be defined as 'demographic' research, which primarily attempts to link aspects of team member composition (for example, human capital) to organisational performance outcomes, such as growth (See Klotz et al., 2014 for a comprehensive overview of this literature). The second concerns work that attempts to uncover predictive patterns of team development, either through variations on a lifecycle approach, or through correlations between existing team composition and subsequent development patterns, for example, in Beckman and Burton's (2008) path dependency hypothesis. The third focuses on the function and impact of conflict dynamics between team members (Ensley et al., 2002; Vanaelst et al., 2006). However, in exploring these phenomena, very few studies have attempted to integrate, or even highlight, regional or industry context as principal considerations. Addressing this, the propositions raised by this study attempt to embed the TMT formation and development phenomenon within its wider environment, thereby raising some potentially important implications for research.

The findings developed in chapter six incorporated existing literature on regional economic agglomeration as a means to explore the antecedents of TMT formation. The discussion positioned the emergence of founding teams within concepts that are key to economic agglomeration in general, such as entrepreneurial incubation, spinoff, and recycling, or talent retention and attraction. This led to the development

of proposition set one. These propositions offer a novel contribution to research firstly by embedding the initial creation of TMT development 'paths' within a regional ecosystem, and secondly by driving inquiries specifically towards consideration of the less favoured regional context. While comparisons of uneven development between centrally located core regions and peripherally located areas have been examined in the literature (Saxenian, 2006; Mueller et al., 2008; Van Stel and Suddle, 2008), non exceptional or developing regional economic concentrations remain significantly underexplored (Felzensztein et al., 2013). Further, these studies tend to focus specifically on firm formation rather than team member incubation (and subsequent links to team formation). Proposition set one directs future research toward opportunities for comparative analyses of team formation between exceptional and less favoured contexts. Potential insights are likely to revolve around differences in dominant career paths or in initial team formation choices.

Proposition set three drives similar lines of research inquiry. These attempt to connect the uneven distribution of key resources and actors across regional spaces to impacts on observed levels of TMT professionalisation. In particular, the strength of the investment community emerged as an important influence. This highlights research opportunities to investigate how particular aspects of investment behaviour – investment amounts, investment timing, exit targets, or investor involvement in strategic activities – may impact particular aspects of TMT professionalisation – the types of members added, the timing of member additions, the development of formalised managerial practices, or team orientations towards professionalisation. Again, comparative analyses of these aspects between regions with highly active investment communities and those without may potentially be informative.

Propositions 2a-2d move to direct scholarly study towards a more fine-grained understanding of the specific actions that underpin TMT development. This represents a departure from the dominant existing entrepreneurial and top management team literature because it encourages exploration of the mechanics of individual TMT modifications rather than of overall development patterns. The

propositions look towards conceptualisation of the *building blocks* of TMT development, by integrating modification decisions into wider strategic and resource coordination actions. The direction suggested by propositions 2a-2d addresses recent discussions in the management team literature. For example, referring to research on team demography, Klotz et al (2014: 248) argue that "studies have often failed to directly investigate the actual cognitions, motivations and processes through which teams influence firm performance". The same could be said of the processes through which TMTs make modifications. Indeed, the action of modifying the TMT could easily be framed as a major strategic decision itself. As such, it may potentially be beneficial to approach entrepreneurial team modification from the perspective of literature on entrepreneurial leadership, entrepreneurial cognition, strategy development, and firm growth (see Lockett et al., 2013). Lines of inquiry might question, for example, how do the existing members of a team use their 'mental modes' to make assessments about their future managerial resource needs? How do they reconcile perceived managerial needs in conjunction with their strategic vision? Or, how are multiple cognitive perspectives reconciled so that modification decisions can be made? These questions may shed further light on the role that existing team experience has on the development of professionalised management teams.

Additionally, the qualitative nature of this study provided some important insight by contextualising accounts of TMT modification as they occurred in conjunction with the firm development (Hindle, 2004). However, future studies might explore key behaviours more deeply by capturing micro incidents, actions, and interactions occurring before, during, and immediately after particular TMT modification events. This would require longitudinal data to be collected perhaps over a period of several weeks surrounding a modification incident.

Finally, the empirical findings of this study suggested that developing TMTs used methods other than full-time recruitment in order to accumulate managerial resources. These alterative methods typically involved interaction with more experienced stakeholders, such as board members or strategic partners. This had two primary

impacts on the TMT. Firstly, it supported the learning and development of existing members through mentorship. Secondly, it allowed teams lower commitment access to individuals with typically high quality expertise and levels of social influence. There is an existing literature on the use of boards of directors (e.g. Clarysse et al., 2007, Knockaert and Ucbasaran, 2013) and strategic partners (e.g. Lu and Beamish, 2006) by entrepreneurial firms (and teams). However, these studies primarily focus on resource acquisition and firm performance. The findings of this study, and specifically proposition 2e, build towards an understanding of how such interactions impact the development of management structures and personnel, both through strategic mentoring and through direct intervention in recruitment processes. Future studies may explore the ways in which teams interact with mentors when framing decisions to modify the TMT. Additionally, proposition 4e also refers to the use of the board and strategic partners to fill specific functional positions. Existing research does explore the leveraging of complimentary human capital from boards of directors (Clarysse et al., 2007, Knockaert and Ucbasaran, 2013). However, there is clearly scope for integrating this, and other forms of 'managerial bootstrapping', into conceptualisations of how TMTs develop.

9.4 – IMPLICATIONS FOR PRACTICE AND REFLECTIONS ON POLICY

The findings of this study have relevance for audiences beyond the research community. The following sections outline potentially important implications raised concerning the training and professional development of TMT members, as well as for entrepreneurial teams that are seeking to add new members. The section concludes by offering some reflection on the research in relation to wider public policy issues.

9.4.1 – Implications for Training and Professional Development

A primary theme of this research concerned the availability of commercial management expertise within technology industries. The study explored this issue by examining the historical production of expertise through analysis of team and board member career histories. Other elements of the discussion emphasised ongoing

learning amongst TMT members, which typically occurred in tandem with new member addition as a further key element of how TMTs developed. Taken together, these discussions raised a number of potentially important implications for the training and professional development of relevant commercial management expertise.

As a starting point, the findings underlined a highly limited role for undergraduate business and management education in the eventual professional development of commercial managers and entrepreneurs in technology-based TMTs. Aside from those individuals with definitive professional backgrounds in areas such as law or finance, TMT members with managerial experience overwhelmingly emerged from an initially technical background. This appeared to be symptomatic of the high level of technical understanding required to manage firms within the three selected high technology industries examined in this study. It also strongly suggests that relevant learning typically occurs when commercial training and development experiences are applied to particular technology, product, or industry contexts. As such, this study encourages a strong focus on professional development mechanisms that support context embedded learning.

There is clearly an important role to be played by private sector technology firms in providing career ladders, training courses, and managerial practices that support the transition of individuals from purely technical roles to applied commercial roles. However, equally clear is that this form of professional development is reliant on there being sufficient numbers of relevant technology firms that are large enough to offer appropriate career progression. Given the relatively small populations of medium and large sized firms identified in the review of selected industries outlined in Chapter Four of this thesis, there may be some challenges for Scotland in this respect. Moreover, there must be a note of caution regarding the possible overreliance on these forms of career ladder, particularly with respect to the transferability of applied commercial expertise from established firms to entrepreneurial contexts. This highlights the importance of training and professional

development mechanisms within both environments.

Reflecting the strong focus of wider UK enterprise policy on *de novo* start-ups (Brown et al, 2014), much of the formal entrepreneurial training and support provision discussed in this study appeared to be centred on early commercialisation and startup challenges faced by novice technology entrepreneurs. Support initiatives were primarily operated by public sector enterprise agencies and associated partner organisations. Despite what is evidently a strong support environment, deficiencies in 'startup skills' - those related to taking a technology application to market - were noted in a number of novice entrepreneurial teams. Other skills development challenges identified in the study surrounded growth or 'scale up' capabilities, particularly with regards to accessing and servicing large international sales markets and to building complex organisational and logistics infrastructures.

The findings of this study imply that training and development for both startup and growth capabilities is most likely to be effective when it is attached to and addresses specific business challenges faced by TMT members. The knowledge and skills required to manage an entrepreneurial firm are highly complex and it appears evident that these are unlikely to be addressed by generic or out-of-context support offerings alone. Instead, training mechanisms should ideally be integrated to work in conjunction with 'on the job' learning. This would necessitate a shift from reactive, time-bound training assistance towards more temporal, flexible and proactive support mechanisms (Brown et al, 2014). In turn, this implies an important role for 'hands-on' relational forms of training, such as mentorship (OECD, 2013; Roper and Hart, 2013), which provide entrepreneurs with tailored strategic guidance and a 'sounding board' for specific business issues. Public sector services, such as high growth advisory units and specialist account managers, provide some support of this nature. However, the evidence from this study indicates that most highly experienced mentors, such as those with successful entrepreneurial track records, are likely to take positions as board members. This type of ongoing relational training should be supported by the provision of executive education developed form industry best practice. In particular, this study echoes the findings of the REAP (2014) report in

recommending the use of 'just in time' online training sources as a means to cater to specific arising business challenges.

Of course, there are likely challenges surrounding how suitable advisors and mentors are sourced. Relational training is reliant on there being enough individuals who have 'been there and done it' and are willing to contribute their expertise to other entrepreneurial teams. Public policy focus should be placed on systematically identifying suitably experienced individuals and encouraging their involvement in mentoring activities. A systemised approach towards tracking and cataloguing successful entrepreneurs might be useful in building a mentor database. A similar approach may be applied in identifying experienced individuals amongst internationally located Scottish diaspora. Specifically, REAP (2014) identify the possibility of an Industrial Fellowship scheme, which would be designed to attract experienced migrant Scots back to the Scottish innovation ecosystem.

9.4.2 – Implications for Entrepreneurial Teams

A number of practical implications for entrepreneurs and entrepreneurial teams are raised by this research. These have perhaps most relevance for novice and early-stage entrepreneurial teams, or those originating from specialist technical backgrounds, such as university spinout teams, for whom the effective accumulation of managerial expertise is typically a key consideration. The study identified a number of challenges faced by existing teams when they were attempting to develop their managerial expertise and resources (primarily through new member addition). Firstly, it often proved difficult for teams to effectively identify their specific managerial requirements in line with their understanding of emerging external developments. Secondly, managerial changes had to be timed effectively so as to be suited to emerging strategic needs and resource availability. Thirdly, organisational and managerial practices had to be designed to accommodate TMT changes. An additional key issue concerns group dynamics and elements such as cognitive and affective conflict, which could impact the effectiveness of TMT changes. While these issues formed part of the discussion, they were not, however, the primary focus

of the study. The following practical recommendations for entrepreneurial teams are forwarded:

Firstly, engagement in strategic planning appears to be highly important for effective TMT development. Therefore, this study encourages entrepreneurial teams seeking to add new members to, at the very least, have a well-articulated vision of their key development milestones and objectives. It is recommended that this be formalised in some form of strategic document, such as a project or business plan, and that it be shared with all TMT members and board members. While such a document is likely to be 'ideal' in nature, it is nonetheless also likely to provide improved clarity on the knowledge and experiential inputs that might be required from a potential new member. The benefits of strategic clarity for effective member addition do not necessarily only apply to periods of explicit search. TMT member addition is often opportunistic in nature, becoming viable when a particular individual leaves a former role, or when a firm experiences a release of financial resources. Thus, a clear strategic vision is likely to improve how an existing team 'scans' the environment for potential members on an ongoing basis. Importantly, appreciation of strategic vision should not be taken as synonymous with static or rigid planning. Instead, this study encourages entrepreneurial teams to regularly update development plans as events unfold and as new information becomes available. This also places a strong emphasis on formal and regular communication of strategy between members.

Secondly, entrepreneurs should be aware of the importance of role clarity when adding new members to the TMT. A number of the ineffective TMT modifications identified in this study could be attributed to a mismatch in role expectations between the existing team and an incoming new member. This appeared to be primarily because new positions were offered in broad functional areas rather than being matched to firm-specific requirements. It also appeared to be the result of relatively ad-hoc recruitment processes. To combat this, developing entrepreneurial teams are encouraged to place particular focus on drawing up firm-relevant job specifications when adding a new member. These should include explicit task responsibilities, as

well as defined objectives and targets. By employing such a practice, alignment in role expectations between both parties is more likely.

Thirdly, in recognition of the challenges associated with resourcing the recruitment of highly experienced new members, this study encourages entrepreneurial teams to make extensive use of alternative expertise sources, such as non-executive board members and strategic partners, as a means to augment managerial capabilities. Effective leveraging of such sources can allow existing teams to access high-level expertise, which would typically be cost prohibitive as a full-time appointment. The findings of this study encourage entrepreneurial teams to consider using non-executive board members as a means to address particular specialist functional management needs, such as financial or regulatory expertise. Teams can also use board appointments in order to conduct longer-term assessments of member 'fit' prior to making full-time appointments. Entrepreneurial teams should also actively assess supply chain partners for possible functional synergies, for example, by 'piggy backing' on the management strengths of larger partners. These examples offer a practical approach to addressing financial challenges around member addition.

9.4.3 – Reflections on Policy

Given the strong focus on regional context applied in this study, the findings evidently share a great deal of overlap with a number of wider policy considerations. However, with respect to the comparably small sample utilised by the research, there is a limited evidence base from which to make definitive policy recommendations. Nonetheless, some reflection on relevant Scottish innovation policy issues is likely to provide further insight into the findings. Notably, the reflections outlined here are not strictly 'management-specific' in nature. This underlines the extent to which policy considerations within the wider Scottish innovation ecosystem are heavily intertwined with issues relating to TMT formation and development.

A key feature of the Scottish innovation ecosystem relevant to this study concerned the dominant role of public sector bodies, particularly universities, in initially

producing innovative research and technologies. A great deal of public policy intervention in Scotland is targeted towards supporting innovation at the R&D stage, particularly in key sectors such as Life Sciences and Energy (Mason and Brown, 2012). This contextual feature had strong implications for the production of founding teams and other sources of TMT labour. Academic research institutions act as an important foundation for the production of the technical skillsets that are often vital elements of TMT member human capital. However, a central issue for TMT labour production clearly concerns how those skillsets are transitioned into applied commercial contexts. The issue of transition and connection between innovation generating technical activities and innovation exploiting commercial activities is one that is reflected throughout Scottish policy discussions. Extant policy-focused literature has identified the strengthening of network ties between universities and other key stakeholders as a priority for the Scottish ecosystem (REAP, 2014), particularly with reference to aligning goals between public and private sectors (Roper et al., 2006; Omidvar et al., 2014). Reflecting on this issue, it is contended here that such efforts are also likely to impact the production of commercially experienced technology entrepreneurs and TMT members, particularly with respect to how improved network connections might help kickstart more commercial career transitions.

The other dominant policy issue emerging from the findings concerned the availability and provision of investment for Scottish technology-based ventures. This is a topic that permeates almost all policy discussions surrounding the Scottish innovation system (for example, Levie, 2014; REAP, 2014). Support for innovation investment in Scotland is a highly active policy area, with numerous public sector avenues open for startup finance, and highly sophisticated policy mechanisms designed to bolster and stimulate private investment, most notably through the Scottish Investment Bank. According to the Global Entrepreneurship Monitor Scotland Report (Levie, 2014), the Scottish Investment Bank helped 460 Scottish companies raise funding in 2012/2013, investing £32.4 million and leveraging a further £60.4 million in private sector investment. However, notable gaps in the

provision of scale up finance still exist, and it is difficult to escape the effect that this has on firm growth, and subsequently on the development of TMTs.

Finance provision impacts not only the ability of the existing team to resource changes at managerial level, but also, through moderation of firm growth, the need to enact those changes. This is perhaps most notable with reference to how early investor exit targets act to truncate the development of highly sophisticated managerial structures. The lack of growth capital also has other implications for TMT development, for example, how it influences the training of individuals with growth capabilities and high growth aspirations, or how it impacts the recycling of human capital back into new founding teams. In short, entrepreneurial or managerial labour production and TMT development are very much intertwined with investment policy. Focus is increasingly being placed on finding new sources of growth-focused investment capital provision. For example, the Scottish Enterprise 2013 to 2016 business plan outlined aims to work with banks, business angels, and international funds in order to streamline the risk capital market, and unlock larger scale investment (Scottish Enterprise, 2013). Taken in the context of the findings of this study, such measures, if successfully realised, are likely to exert strong influences on the types of TMTs being created in Scottish technology-based sectors.

9.5 – LIMITATIONS AND REFLECTIONS

As with all studies, the knowledge claims made here are constrained by certain limitations, principally concerning methodological choices, and research design as a whole. This section reflects on the challenges faced by the study, and attempts to both justify the steps taken to mitigate limitations and caveat overall knowledge claims.

First and foremost, the inductive approach taken by this study towards the aim of building emergent theory means that the knowledge claims made are not definitive but, instead, part of an ongoing process of theory development. Theory is, by its very nature, an abstraction and simplification of what are typically highly complex social

realities. The challenge here lay in rising above the intricate details of what were complicated and dense empirical descriptions in order that effective explanatory guidelines could be presented (Siggelkow, 2007). The framework suggested is not a causal model but an abstracted explanation of complex empirical data, the principles of which may be useful to explain TMT development in other contexts. It is considered that the knowledge claims presented here are open to ongoing critique and iteration. Thus findings serve largely as a basis for further inquiry.

Secondly, the prominent use of retrospective interview data characterises a clear methodological weakness. Essentially, the reported nature of the data creates a degree of distance from phenomenon under examination. As Davidsson and Honig (2003: 311) contend, "retrospective approaches are likely to be flawed by memory decay, hindsight bias and rationalization after the fact". This raises concerns about the accuracy of development narratives. To accommodate this, cases were constructed through interviews with more than one respondent. They were also supplemented and corroborated through secondary sources. Finally, they were made available for respondents to assess the accuracy of narratives. That said, gaining access to more individuals within each TMT proved to be particularly challenging. TMTs and their boards were often close-knit groups, and were aware that other colleagues had participated in the study. Thus, some potential respondents expressed reluctance to repeat the development narrative already provided. Access to data sources to strengthen the validity of data was perhaps the biggest single methodological challenge faced in this study.

Thirdly, it is recognised that a longitudinal study would have been more effective in capturing the ongoing development of TMTs as it happened. The decision not to undertake a longitudinal approach was driven by considerations of practicality and scale. TMTs could frequently operate for long periods, sometimes years, without enacting a significant change (for example, the entry of a new member) meaning longitudinal data would have to be collected over many years for it to have any real meaning. This was not only outwith the scope of the data collection period available

to this study, but would also require particularly high levels of cooperation from participants. It was considered that by virtue of being *critical*, modification events were likely to be subject to more accurate recall (Chell, 2004; Chell, 2014).

Finally, there are certain flaws present in the collection of career history data. For example, in career data recorded from secondary sources only, experience was taken as factual. This means that, for instance, three years experience as a commercial director was taken as a positive human capital input. However, this would not account for a situation where those three years had been particularly unsuccessful. This was particularly problematic in assessing the career data of more peripheral TMT members, or board members, where experience and status were not corroborated by additional data sources. However, the vast majority of core members had their secondary data career histories discussed as part of the qualitative interviews. Interview respondents were able to make comments on the experience levels held by core member, who were identified by name. Ultimately, judgement was made on member experience levels (in the categories extensive, moderate, and limited). However, an independent researcher also made analysis judgements, with any discrepancies between the two allocations being resolved through a subsequent discussion.

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APPENDIX ONE – PRIMARY INTERVIEW GUIDE

	Areas of Focus
Firm Development Story	
- Please provide an overview of how the firm has developed, focusing on major milestones, - and associated drivers/barriers	Initial construction of events timeline
The Origin of the Firm and the Team	
- How and where was underpinning technology developed? - Who and what drove the creation of the firm? - Where did the initial funding for the venture come from?	Venture incubators; Discovery of opportunity; Recycling of resources/experience
- Who were the main founding members? - What experience did the founding members hold prior to starting the venture? - What were the advantages/disadvantages of that prior experience?	Prior experience and links to human capital, social capital, and other resources
- How did the members of the founding team get together?	Prior affiliations; network brokers
- What roles did the initial team members play? What tasks did they perform? - How would you describe the main operations for the venture in the early stages? - How would you describe the system of management in the early stages of the venture?	Extent of functional specialism; Identification of leadership roles; Extent of management formality; Leadership style
- What were the initial aims and objectives of the venture?	Growth orientation; Strategic aims and direction
- Detail any involvement of outside parties in the strategic direction of the venture	Advisors; surrogate entrepreneurs; investor influence

At Each Identified Reconfiguration Event

	Areas of Focus
- Nature of incident; events leading up to incident; strategic decisions taken?	Development drivers and barriers; reactive or proactive strategic decisions
- Were any significant changes to the management of the venture taken in response to the incident? - If not, why not?	Reactive or proactive TMT change decisions; barriers to TMT change
Describe the changes to the management of the venture:	
Organisational Changes:	
- Were there significant changes in the operations of the venture? - Were there any changes in TMT member roles? - Were there significant changes in formality of processes/procedures (management structures, communication procedures, formal rules)? - What were the outcomes and challenges associated with the changes?	Identification of management task demands; changing TMT roles; extent of role definition; extent of management formality
Personnel Changes:	
- Were any new TMT members recruited? - Why was the decision to recruit made?	Recruitment rationale
- Who was brought in and for what role?	Perceived managerial task demands; Division of management labour; TMT Diversity; Prior experience and links to human capital, social capital, and other resources; Career histories and Incubators associated with labour creation

- In what way did they contribute to the team?
- What was their background and for what attributes/skills/resources were they hired?

- Describe the process of recruitment
- Where did the new member come from?
- How was a connection made with the new member?

- What was the outcome of the recruitment?
- Did you formally appraise the outcome of the recruitment?

- How was the new member assimilated in to the team?
- What measures for communication were there between team members?

Member Exit:

- Which member left?
- Where did they go?
- Why did they leave?

- What challenges, if any, were associated with recruitment of a new member?

Changes at Board Level:

- What drove changes at board level?

Areas of Focus
Recruitment networks; Recruitment brokers; Labour availability; Labour attraction
Management culture; Mechanisms for knowledge sharing; Common language
Thickness of alternative opportunities; Sources of conflict
Investment/ownership; Power/leadership
Prior experience and links to human capital, social capital, and other resources

- What roles did your board members undertake?
- How would you describe the influence of board members?

- What were their backgrounds?

- What skills/attributes/resources did they bring to the team?

- How was the relationship established with the board member?

- How were board member knowledge and resources utilised by the team?

The Individual

- What do you consider to be key attributes for the management of a high tech venture?

- What have been your biggest learning experiences over your career (in particular since becoming involved with the venture)?

- Has your role/tasks changed over time? In what way?

The Region

What do you perceive to be the advantages and disadvantages of starting and managing a high tech venture in Scotland? Focus on:

- The production of technologies
- The investment community

Areas of Focus
Recruitment networks; Recruitment brokers; Labour availability; Labour attraction
Communication; Conflict; Levels of Involvement
Learning events; Perceptions of human capital
Human capital development

APPENDIX TWO – CODING SCHEME WITH EXEMPLAR DATA

TMT RECONFIGURATION BEHAVIOURS AND ACTIONS		
Aggregate Dimensions	**1st Order Categories**	**Representative Data**
Strategic Clarity	**Timing Milestones**	*"I spent a lot of time communicating with the various people that were important to us in terms of getting the product to market. It's important to have a good idea of the timelines involved. What we needed to do was bring in a sales and marketing director. The plan was to,, just as soon as the product was approved, bring in someone in. Once it all started, I couldn't handle those responsibilities for long, but, equally, you can't bring someone in before you need them. We had the interviews lined up, but by the time he could actually join it was June of this year"* **(CEO, LS1)** *The problem you always have with a sales and marketing director coming in is that you ideally want them in much earlier but there's not enough for them to do full time at the early stages* **(CEO, LS1)** *"Drug development is very much milestone dependent. Our founding team was strong on the technical side of that, clinical trials and the like. Our Chairman knew all about regulatory, licensing, and investment timelines. This is how we were able to bring the right people in at the right time"* **(Founder 1, LS2)** *"I'd say it's really important to have some intuative idea of how to grow a business in general. I had good experience on the operations and logisitics side, and I had [board member name] who had grown a dozen sucessful businesses. You can broadly plan for big periods of growth, partly because you've been there and done it, and partly because, with the backing of the right people, you can be more confident that you'll get the finance or the right deal when you need it. Building a team to support this is all a bit of a balancing act, especially in the periods leading up to your first big deal. We always had a clear strategy for growth, with contingency plans and all the rest. When things went well, we knew who to get in"* **(Founder 1, LS3)** *"We got a new Sales Director, an experienced guy, when we were offered our first major sales contract. That was the moment where I knew there was work there for someone to do. You've got to balance your team against how the company grows"* **(Founder 1, LS3)** *"If things really expand, and we can see that the development team is able to handle increasing customer demands then we'd need a sales manager to handle the sales team, but right now that's all comfortably within my remit. There's no point in building a team without matching recruitment to your needs. Once we get a clearer picture of where we're going to go with that product then we might take on someone to sell that product"* **(Founder 1, LS4)** *"I work with the board on growth targets and we revise these on an ongoing basis. It's obvious we'll need more management-level expertise with*

		the way we're growing. We try to pinpoint exactly what it is we need in terms of experience according to the goals we have" **(Founder 1, LS8)** *Strategy is a big thing. It's very easy to get stuck in the day-to-day, the small scale, but seeing the big picture, the longer, what you're actually trying to do. You work out what you're actually trying to do, everything that you need to do falls from that. I'm bad, really bad for not being able to do that. You need somebody that has that 'bigger picture' vision* **(Founder 1, OE1)** *"Experience helps enormously. I had learned so much from building [former company name] in the past and from my time at [former incubator name]. I was so much clearer on the growth strategy this time. We'd been through a number of global product launches. You know what expertise you need to get in"* **(Founder 1, OE4)** *"Our initial route to market was really a set of interlinked projects. Project management was one of my strengths. Your management and employment requirements should ideally be balanced against your main project milestones. It's about knowing these and adjusting accordingly"* **(Founder 1, OE5)** *"You really need to have a clear strategy in place for growth. What happens with a lot of biotech companies is that founders don't have the experience of what it's like to grow a commercial firm. If they don't have someone to guide them then the money tends to get spent, targets aren't reached, the funding rounds become harder to come by, and you end up with a 'mom and pop' shop. It'll be one, two, maybe three guys running it, but they won't really expand, and they won't really get to a stage where the can justify having proper management functions"* **(Key Informant 4)** *"After maybe eighteen months of working on the product design I was thinking to myself 'I know nothing about running a business, I'll to get someone experienced in to sell it'. I hired the [new member name] when I had it ready because I wanted to offload commercial responsibilities. But, after engaging with customers we had to redesign the tech. I guess I should've really planned those steps logically before expanding the mangement. I was left wondering what [CEO name] was actually doing for us"* **(Founder 1, LS7)** "My mindset was 'we need more sales, we'll get a sales manager'. It doesn't really work like that. You need the compnay to be ready in terms of how close it is to market, all that stuff. Otherwise there's no point in recruiting" **(Founder 1, LS9)** I got a lady on board who was really experiencd commercially. She never did take on much of an invovled role and she left after what you'd maybe call a trial period. The company just wasn't at that stage yet. It was all a bit premature. I had what turned out to be years of tech work to do. I'm still doing it in fact" **(Founder 1, OE2)** "We just kept growing until we couldn't really handle things between our original team. We never did plan to bring anyone else on board. It was partnering up with [strategic partner] that really solved all those management problems for us. Otherwise we'd have probably kept going the way we did, and we'd have struggled to grow" **(Founder 1, OE3)** *"I very wary of recruiting at management level. We were recommended this 'business guru' type by Scottish Enterprise when we first started, but he absolutely was right for the job. The company wasn't developed enough to need his input. Recruitment needs to be matched to the strategy of the company, not the other way around"* **(Founder 1, CH2)** *"We really lacked any form of strategy in terms of hitting certain markets. I think the hardest thing for us is that we didn't know how to sell and we didn't know who to sell to. So we spoke to a lot of people and we got a load of people excited, but we didn't get big returns on that. It was all pretty*

		'off the cuff' rather than focused on particular target markets" **(Founder 1, CH4)**
	Balancing Resources	*"Changes at management level will depend on how quickly sales traction comes through. In terms of growing the top team, we'd look to bring in an operations manager at some point and some additional commercial people, probably a product line manager. But again a lot of that will be driven by sales traction"* **(Founder 1, LS1)** *"You didn't have the money to go out and recruit four or five people in one go, because you'd run out of money. Building a management team is cash flow driven, I don't know if you'll be talking to many, or any, people that have been VC backed and start off with a few million and can go out and recruit whoever the hell they want. That was not how we had to do it because we were not funded by a lot of money. That's not the experience for the vast majority of firms in Scotland"* **(Founder 1, LS3)** *"I'll handle sales and business development until we're bringing in so much that we need to recruit a sales director. What I won't do is spend money we don't really have on bringing someone in. Cash flow is key as far as I'm concerned"* **(Founder 1, LS4)** *"Drug development is purely spending for most of the early and even middle stages. It's a really odd business. It makes it difficult to drive plans forward sometimes because you're dependent on finance awards in order move things. So, for us, there'll be no big changes at management level until milestones are met and funding rounds are secured"* **(Founder 1, LS6)** *"The fact that we have clear investment tranches and some stable revenue streams means that we have a good idea of what we have available for recruitment* **(Founder 1, LS8)** *"We've only recruited at management level as we can afford and as it was required. And that's really how we've built it up. I mean, you don't have that model like you'd imagine in Silicon Valley where you would get two guys coming out of a university and going along to investors and getting five million pounds on day one, and then they'd build a team of top executives. It doesn't happen like that. It has to be organic build up"* **(Founder 1, OE1)** *"We had sales revenue from very early on. It meant we could afford to build the team that matched out strategy* **(Founder 1, OE4)** *"Even if you've got a products business and you want to be a products business, its not the wrong thing to go and get yourself some real, paid work. You can't drive the development of a firm or get the people you need if you aren't taking in cash, either from revenues or investment. In our case, we had real expertise to sell, so we sold it through consultancy. A lot of firms that have to wait long periods before they even get a product out, and that don't have an early revenue stream can really stagnate. You end up so dependent on investment, which isn't always forthcoming, or can be delayed."* **(Founder 1, OE5)** *"Revenue from our consultancy activities has been the thing that has allowed us to recruit the people we want. Without that it would have been difficult"* **(Founder 1, OE5)** *"By the time we got approval for the 2nd phase of funding we were 2 months behind. So instead of launching the product at the end of 2009 it took us until the end of February 2010. And obviously we had run out of cash because it was very tight. So by 2010 they had to do another investment. And*

		they weren't very happy when I said 'well you delayed the first one' (laughs). **(Founder 1, LS5)** *We had been involved with a recruitment agency, and they had searched the whole UK and we found this guy from Manchester. It cost us 100,000 to recruit him for the year. This was probably far more than we could afford"* **(Founder 1, LS5)** *"He was good. It's nothing to do with that. But he was earning too much money and he didn't want to get his fee reduced, because as a consultant we were basically paying him a hundred and twenty thousand a year. And the level of sales that he was bringing into the business was not enough to justify his role. So actually we offered to keep him here and to perhaps give him some equity and a drop in salary but he said no. And that was that. I thought: if that's what it costs to pay a business development manager, I'd be better handling the sales myself"* **(Founder 1, LS5)** *"If you spend all your money developing the technology, then you won't be recruiting anyone with big experience. That's why the commercial side was left to me in the end. We didn't have the cashflow to get someone in* **(Founder 1, LS7)** **LS9** *"So that was the whole issue behind that. We were then going to gear external funding. This chap was then meant to come in a write a business plan for us. Our accountant at that time basically was saying that we were a very investible company and we had huge opportunities in front of us. This guy came in and started building a huge around the development of this. He brought in all external personnel. He brought in a whole range of consultants and PR people, etc, etc. And quite honestly we didn't have the income at that point in time to withstand that level of expenditure"* **(Founder 1, CH2)** "*We didn't have a huge amount of funding. We recruited opportunistically. So if you go and raise millions and millions, then maybe you go and build a full team with some top guys. But, with only £700k? Well, that needs to be spent on technology development"* **(Founder 1, CH3)** *"We'd worked hard to arrange that investment, and it was a blow when it fell through. It wasn't dead as such, but there was a delay. We needed this investment to get some real revenues in because the feasibility studies weren't cutting it. There was no need to build the management team at this point. We weren't moving forward, and recruitment wasn't justifiable. The whole thing probably set us back about a year"* **(Founder 1, CH3)** *"It's a double-edged sword. I think there's reluctance in part because we're dealing with such small pots of money that to bring in somebody on a global salary is difficult. I've tried to encourage the board of a company to recruit somebody that's global. Now this guy wants to get two hundred and fifty thousand dollars a year, plus a bonus programme, plus options, plus housing, plus school education, et cetera. If you're only raising a million then that's half of that gone in a year. And if the person doesn't contribute in that year then you're up shit creek"* **(Key Informant 4)** "*Well growth is obviously one thing. But, then you're back to the issue of funding because it's difficult to grow the business without some investment, or some sort of revenue. So, growth is the fundamental driver, but that's related to funding for many tech businesses"* ***(Key Informant 4)*** *"We did a bunch of consultancy to keep ourselves going. We couldn't have run things on the level of funding that was available here. But, this takes away from you making the real money out of the science. On the other hand, how could we have got anyone good onto the board unless you were taking in revenues? At [Firm Name] we counted ourselves lucky that we could afford to pay a heavy hitting Chairman early on. Most Life Sciences firms in Scotland just spend, spend, spend in the hope of being bought out. That's why historically the successful businesses in Scotland in the Life Sciences have been service businesses. They generate cash early"* **(Key Informant 4)**

		"When you've only got half a million worth of investment and you've got to employ a sales director on eighty grand, that's a lot of money. It's very scary to do that. It's a huge risk" **(Key Informant 6)**
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Team Decision-Making	**Leadership and Decision-Making Delegation**	*"At the moment I'm doing a lot of strategic work with the CEO looking at the overall strategies of the company. I handle commercial development, so I have input into the big decisions. All the senior directors do"* **(Commercial Director, LS2).** *"I'm CEO, but I don't make all the major decisions. We have an accomplished senior management team and some very experienced board members who all have input"* **(Founder 1, LS3)** *"We have an executive board who meet to make all the big decisions. Recruitment of a senior member would definitely fall under that category"* **(Founder 1, LS8)** *Q: The investors: are they driving any recruitment or making any noises about future additions to the management team or at board level?* *A: To be honest, there's a lot going on but it really gets driven by myself and the other executive directors. So we put forward proposals and we debate what's best"* **(Founder 1, OE5)** *"I wish I had full control over decisions like that. Investors always want to see a team with a sales director, a financial guy, all this management. But in my experience many of these people like to tell you what to do without being the first to do it themselves. You get people coming in from big corporations into startup and they can't always do it"* **(Founder 1, LS5)** *"I'm really the only full-time active member of the team now. I make the decisions on things like recruitment. It's not something I see us wanting to do again for a while though"* **(Founder 1, LS9)** *"From a personal perspective, I'll say that it's really hard to recruit your own boss. You have to get someone in that's going to tell you what to do. And that just goes against the grain"* **(Founder 1, OE1)** *"I wanted to be my own boss, so I make the major decisions. I've had various CEO-types and advisors in my time, but it's never worked out. I run everything now"* **(Founder 1, OE2)** *"All of our management level guys are very experienced, so they all have an input to strategy and to the big decisions. Recruitment decisions at that level would be something the whole team would discuss. You can't run the whole thing yourself"* **(Founder 2, OE4)** "*I think it can be dangerous when you start getting investors too involved, and board members, and big business guys. We run this company and I think that we know it best. I think that we can handle it with just us two at the helm"* **(Founder 1, CH1)** *"It can be a thing with newer technology entrepreneurs where they form teams that have been so focused on the technology that they think they can do it all on their own and don't want to let go. That's a problem because as soon as someone else comes in to manage the company I think they feel as if they are letting go of their technology, which is their baby"* **(Key Informant 1)** *"I wholeheartedly agree that management teams are too technically focused in many cases. You can see why: the control of the company is usually invested in the hands of the inventor. There's sometimes a control freak mentality"* **(Key Informant 4)**

	Speed and Flexibility of Decision Making	*"Making the right decisions is really about being aware of what is going on around you. Internally you need to communicate with your team. Externally you need to look for the right opportunities. We're a close team and we're constantly talking about the right way forward"* **(Founder 1, LS2)** *"Our team is filled with guys that have been around board rooms for years. We can discuss strategic decisions without getting into fights about it. That's key to making the right decisions"* **(Founder 1, LS3)** *"Decision making was one of our strengths. We didn't have the big business experience, but we seemed to have an intuitive feel for what our customers wanted. We were able to respond really quickly to things. We never really got to grips with a big level strategy, but we did very well by being flexible"* **(Founder 1, OE3)** *Our team know each other from way back and all have big experience. We know each other's style and it helps is to get things done quickly within the overall strategy we have"* **(Founder 1, OE4)** *"We've had some interesting, shall we say, 'debates' between what I'd call the 'core' team and the investors. There has been some bad blood over past decisions. We're working ok now, but coming to a resolution can be painfully slow sometimes"* **(Founder 1, LS6)** *"I was always fighting with [Member Two]. He had the big business experience, but I didn't think he understood the technology. We were always having the high-growth team in to sort of mediate. Making big decisions was always a bit of a palaver"* **(Founder 1, LS7)** *"There's very little in the way of conflict [Founder 2] and I are friends. We think the same way on things"***(Founder 1, CH4)**

Structuring for Modification	**Structural Arrangements/ Managerial/ Organisational Practices**	*"Setting up these standardized forms and spreadsheets and ways of doing things that had been crafted over the years at these corporations made a big difference to us"* **(Founder 1, LS3)** *"I've always had organisational procedures formal. I think if you try and change things as you grow, it's not a good idea I'm not saying you need to be Draconian, but you should have certain rules and regs. It's very difficult to introduce these things two or three years down the track. A completely personal management style where things can be changed on a whim isn't really conducive to managing a bigger company. It's best you sort things like this out early"* **(Founder 1, LS4).** *"Yes, things get more complicated when you grow. There are more things to do and you need to have certain working practices, systems for communication between your top guys, procedures. That's a fact of life in business. But, you don't just put these things in place after you've say, won a big contract. You have systems in place before these things happen. If you don't, you'll soon find that growing your team is a problem"* **(Founder 1, OE4)** "*If you want to grow, sooner or later a growth business has to transition itself into a much more structured business. This means formal communication and formal project management. The foundations should be laid early on if you want to be able to cope with growth. If you want to look for an exit from the business, there's got to be, those corporate governance structures, those explicit procedures for working need to be in place"* **(Key Informant 4)** *"I wanted a Sales Director, but I'm just not so sure I knew what I expected him to do. I just wanted more sales to be honest. We decided not to replace him once he left. How do you justify a guy walking round knocking on doors who's not bringing much money in? Things just weren't set up in a way that allowed him to work effectively" (***Founder 1, LS7)** "*We had to let the sales manager go. It just wasn't working. He was good at his job, but we found it hard to get enough work for him. It was difficult to organise things so that he could work effectively. It was frustrating because I knew we needed to expand the sales side of the management team, but we didn't really have the infrastructure to make it work. We were a bit 'one step forward, one step back' in terms of the building a proper management team"* **(Founder 1, CH2)** *"One was a sales director who had more of a big firm background. He knew his chemistry, but he'd worked his way up to become a commercial guy. He'd been all over the world, but was now getting involved with smaller growth companies. I sometimes think he struggled with the lack of procedures"* **(Founder 1, CH3)** "*You cannot manage fifty people on an ad hoc basis. Our feeling is now; because we now run a venture fund, we only invest in firms that have an appropriate board structure from day one and where we feel comfortable that the appropriate executive and non-executive positions are taken care of. We don't want to see anything that's science driven. We want something that's driven from a business point of view with appropriate consideration of the science"* **(Key Informant 4)**

	Role & Task Allocation	*"Clarity on you strategic needs helps with clarity on your management needs. You've got to be clear on expectations for the position and what they'll expected to contribute….to what level* **(Founder 1, LS1).** *"I was strong on the operations side. I knew what type of expertise we needed on that front. When manufacturing was starting to expand I was pretty sure what we needed in a product line manager"* **(Founder 1, LS3)** *"Roles obviously overlap at a strategy level, but the team all have different specialist areas. In the past, I really didn't know too much about how a commercial development role worked, for example, but I know now that a huge part of it is knowing the regulatory side of it inside out. Once you realise what's really involved in your business model it becomes easier to allocate the responsibilities"* **(Founder 1, LS8)** *"We had a very clear idea of what roles we'd need to fill and who we needed to fill them for that matter. The management structure was really based on our experiences at [former incubator]"* ***(Founder 1, OE4)*** *"Part of the challenge is knowing what you need. It's knowing what direction you want to take things in and being able to identify those strengths in someone. These are difficult things to pinpoint. It helps if you've worked together in the past, or if someone you trust can recommend them"* ***(Founder 1, OE5)*** *"It cost us 100,000 to recruit him, and we had to fire him. Looking back this was a mistake because we were a bit naïve when we set up the profile for the job. I'd see we were looking for a pretty scientific person, but the investors said 'no, we need a more commercial person'. But when we gave the commercial person the opportunity they didn't know anything about the market. He couldn't sell anything, he started getting too stressed, and started lying. So we found out that after a few months nothing was coming in, no sales"* **(Founder 1, LS5).** *"I sometimes wish I could clone myself, but obviously I can't. Another one of me just doing all the tasks I do would be great! I've tried recruiting in the past, but it's been hard to divide up responsibilities in a way that works"* **(Founder 1, LS5).** *"We would try and write a spec or a description and send it to a recruitment agency. This is much harder than it sounds. If you're writing a spec: what do you actually want? Probably that's quite difficult to do if you don't know. If I'm looking for someone to work in the lab, I'm a lab person, I understand what I want them to do and I can write that in great detail. I'm looking for someone to do business development because I don't know how to do it myself. So how the hell do I write a spec, you know?"* ***(Founder 1, LS7).*** *"With 20/20 hindsight, he was the wrong person in the wrong role. He wanted to be a Chairman. What I was looking for was a CEO and not a Chairman. I didn't really have the experience to know this at the time. He never embraced the role and left after 6 months"* **(Founder 1, LS7).** *"There's only so much you can do yourself. You need to simplify the process so that other people can come in and support things. But when you've been going your own little way for all these years it can be quite difficult to split it all up* **(Founder 1, LS9)** **"***We weren't ready for a full time sales guy. We didn't have enough to sell or to push for. I was being stretched because I was doing everything, and we thought it'd be good to get someone in to drive commercial development, but management level recruits are costly for a business at our stage*

		and so we had to cut things back until we could be sure that our revenues could support our resources" **(Founder 1, CH2)** *"We had to let the sales manager go. It just wasn't working. He was good at his job, but we found it hard to get enough work for him. He decided to move on to other opportunities. It was frustrating because I knew we needed to expand the sales side of the management team, but this has to match the development of the firm and the resources it has available. We were a bit 'one step forward, one step back' in terms of the management structure behind the operation"* **(Founder 1, CH3).**
Alternative: Using the Board of Directors	**Functional Positions**	*"Non-execs can be a great way to fill your experience gaps. I was looking for a non-exec that came from a health care background. I've been in lots and lots of industries but this is the first time that I've done a health care or a medical product. So again I was looking at where the gaps in my skills base were. I wanted someone that had fund raising experience and to supplement what I had done in the past as well. So someone that had a network into the VCs. Someone that had worked globally in big multinational companies, but who also had startup experience as well"* **(Founder 1, LS1)** *"We've been able to operate with the small team we have because I've had a part-time board member handling the finance side of thing. He adds clout and he takes some of my workload off. It wouldn't make sense to have a full-time Finance Director at this stage though"* **(Founder 1, LS4)** *"We have a financial director, but he is basically a consultant who we meet a few times a month and who we keep in the loop. He deals with the financial models because to be honest I couldn't cope anymore"* **(Founder 1, LS5)** *We haven't built a large management team. It's actually been the same since the start in terms of the two core people. We have had lots of board members. Some have been helpful and some have been a complete hindrance. The good ones give guidance, but the also take some of the management duties from me. It helps when you're running a tight team"* **(Founder 1, LS6)** *"I outsourced all of the finance part of it to a director that came recommended to me. If I hadn't have done this I would never have been able to take things forward. I was just drowning in cash flow management"* **(Founder 1, OE1)** *"This was a bit of a lower level recruitment. It wasn't a big full-time guy on big wages. [Member 4] had been with the firm for a while, and I just got him involved a management level to operate all those sales aspects that I wanted to shift from my own"* **(Founder 1, CH3)**
	Mentoring Activities	*"The business was basically a research project before I arrived. The two founders wanted out. I joined the board and made things more professional, so that investors would actually look at us"* **(CEO, LS1)** *"I set the company up, meaning to be the Chief Scientific Officer but ended up being the CEO as well. I started out as a boffin and ended up as a businessman"* **(Founder 1, LS2)** *"I could never have made the transition from scientist to CEO without the help I had from [mentor name]. He had been involved with a few spinouts from Moredun and had been very successful. He knew the ropes and saved us a lot of costly mistakes. It was like an apprenticeship. I learned my trade under him. And now I'm CEO of a successful technology firm"* **(Founder 1, LS2)**

		"[Founder 1] lent very heavily in terms of advice on an ex-colleague of his who was on the board. [Chairman] was a director level scientist, but he'd worked very closely with so many commercial operations. He was able to guide [Founder 1] very well, and John was very willing to learn and listen" **(Commercial Director, LS2)** *"[Mentor name] is a bit of a god (laughter). If you've heard of Genzyme, he grew that chunky company, which is now one of the grandfathers for biotech. So he's definitely well linked, well respected, he's into pretty much everything. He's linked in with a number of partners as well helping fund some of our low points. He gave us all sorts of links to sales channels, and jumped all sorts of barriers on the regulation side. He just knows everyone"* **(Founder 1, LS3)** *"In the beginning I was just another scientist with a good idea. Now people in the business world know me. We created something of real value. I've been given great help along the way. Having worked with [mentor] was a real leg up, but five years on I'm running the company myself and we're doing well"* **(Founder 1, LS8)** *"People grow off your reputation. [Founder 1] at [LS8] now has a phenomenal reputation. I mean, four years ago we were getting the run around from the VCs, being told to bog off. And now recently a person in the same company has approached us saying 'I'm now doing x, y, and z, would you like to do contracts for the company?'"* **(Mentor, LS8)** *"The vast majority of people I can think of are scientists that have grown to be MDs or VPs. A lot of learning is through some sort of mentoring. In a lot of cases it's about the chairman of the company. With the right Chairman mentoring the Chief Executive, a lot can be said for that"* **(Key Informant 1)** *"When you're looking at firms coming out of university they aren't typically able to afford to buy in management with a lot of experience. The salaries are too high. They need someone that can support them by sitting on the board. You'd expect an initial team with some guidance and support rather than through recruitment"* **(Key Informant 2)** *"The role of the board is fundamental. There has to be solid structure to the board, particularly at non-exec level. If you're sitting on a good board, with good people, with good experience then you're going to live and learn"* **(Key Informant 4)**
Alternative: Using Partnerships	**Outsourcing Management Functions**	*"I kept the management as simple as I could. We have to manufacture our main product line, but I don't have an operations director. We have a partner that manages that side of things. It was something that was beyond my expertise, so we outsourced it all"* **(Founder 1, LS5)** *"As a technology person speaking to marketing people, there was a bit of a gap. And in retrospect I'm actually embarrassed with some of things I've done like going into Fosters and showing them really bad demonstrations. So what we've done now is we've actually got one of our manufacturing partners, they're selling directly for us to the people that make the bar fonts and they sell on to the various brands. So we just handed that over, because it wasn't worth, well it was too hard for us to do"* **(Founder 1, OE1).** *" For me, having to do all the sales and support functions was just becoming more and more difficult to do from base in Scotland without having a global infrastructure. Just in terms of servicing stuff. Someone has a problem in Japan; one of your senior engineers has to go out to Japan. That's why we needed a partner. We could manage the scale of it"* **(Founder 1, OE3)**

		"We had the choice to either create our own sales and support infrastructure or to enter an alliance with a firm that already had that infrastructure. So, we got in touch with [strategic partner]. We were actually hurting them from a business perspective. So we said 'can we do a deal here?' I guess that by making the alliance with [strategic partner] we were able to tap into their marketing expertise and resources. You could say that we copped out by not doing the marketing. Or you could say that we recognised that the sales and marketing expertise did not exist in the team. So, we tapped into the marketing skills of a global player" **(Founder 1, OE3)** *"We couldn't really service our markets in America well from over here. For a while we had an office in Texas, but it wasn't worth it. The decision was: expand the management team to have a full-time Sales Director, pull out of the market, or find another way. We have a partner over there now. The margins aren't as good and we can't have the same focus on business development, but it's a headache that's gone and it means we keep keep control of the whole thing"* **(Founder 1, CH4)**
	Role Model Function	*"The manufacturing side of it was a mystery to me. We wasted a lot of money getting components made through outsourcing. It was so bespoke, that the product was very difficult to make. Working with [manufacturing partner] has been so important to me. I would never have been able to get a full-time production director in, but [partner name] really helped me out and, in fact, ended up investing a bit in the company* **(Founder 1, LS5)** *"[Large OEM partner] have a whole process of mentoring companies to work with them. They understand not just from language or geographic barriers, but the fact that a big company dealing with a small company can be really hard. So they've got a process in place, and we've come across that in few companies. They do it in slightly different ways. Some invest. Some do development projects. So at a corporate central there's a division that will proactively try and force other divisions to work with small companies. That's the sort of thing we want to get more and more involved in. It's the best way to boost the expertise you have"* **(Founder 1, OE1)** *"A huge part of how I learned how to structure an international sales and support infrastructure was simply watching what [Partner Name] did with us. All those systems and practices are things we've taken on"* **(Founder 1, OE4)**