The University of Strathclyde

Department of Computer and Information Sciences

The Information Audit: Theory Versus Practice

Volume One

Steven Buchanan

PhD

2008

Acknowledgements

I would like to acknowledge and thank my supervisor, Forbes Gibb, for his ongoing support and advice, and patience.

Abstract

The information audit (IA) provides a method to identify, evaluate, and manage an organisation's information resources. With such a central information management role, it might be reasonable to assume that the IA would be an accepted element of information management best practice, particularly given the growth of information based services, and growing recognition of information as a primary resource and tradable commodity. However, there is evidence that the IA is neither accepted nor commonly practiced, primarily due to methodological problems, most notably the lack of a standard approach, limited empirical evidence, and an ambiguous sense of purpose.

The objectives of this research were to firstly, identify and/or develop a generic and universally applicable information audit framework; and secondly, to test the usability of the framework. A qualitative approach supported by case studies was adopted. IA methodologies were critically reviewed to identify an appropriate method to select as the basis for a generic and universal approach. The selected methodology was Buchanan & Gibb (1998), which was found to provide a complete methodology and comprehensive toolset. The methodology was tested in two stages: firstly, two case studies were conducted by the author to pilot and test completeness of design; and secondly, three usability trials were conducted by independent auditors under the observation of the author. In the stage one tests, the methodology was successfully trialled, proving to be both complete and usable and a suitable basis for a generic and universally applicable framework; however the usability trials, while also successfully completed, identified that the methodology requires some further instructional depth and tools/templates to be suitable for universal adoption, most notably for conducting interviews, process modelling, and qualitative data analysis. Recommendations are made accordingly for the refinement of the methodology.

This research also developed and successfully trialled a scope matrix for identifying and managing IA scope, and mapped a direct methodological relationship from the information audit to information systems architecture development, potentially redefining and extending the value of the IA by demonstrating that IA output provides direct input to related information system development frameworks and processes. Further notable output includes the development of two templates for capturing process data and information resource data respectively.

Table of Contents

Volume One

Section One: research rationale and approach

1. Introduction 1

1.1. The Research Rationale 2

1.1.1. The Information Audit: complexity, scope, and value 3

1.1.2. Information Management: theory versus practice 6

1.2. Research Aims & Objectives 9

1.3. Methodological Approach 11

1.4. Research Origins 12

1.5. Dissertation Structure 14

2. Research Methodology 16

2.1 The Nature of Research: conceptual considerations 17

2.1.1. Research philosophy 18

2.1.2. Research approaches 19

2.1.3. Research strategies 20

2.1.4. Time horizons 21

2.1.5. Data collection methods 22

2.1.6. Theory versus practice 23

2.2. The Research Process 25

2.2.1. Topic and research problem 26

2.2.2. Research design 27

2.2.3. Data collection and measurement 27

2.2.4. Data analysis and interpretation 38

2.2.5. Presentation of the findings and report 41

2.3. Reliability, Validity, and Causality 42

2.4. Risks 45

2.5. Limitations 47

2.6. Summary 49

Section Two: key concepts, relationships, and methods

3. The Management of Information: key concepts 53

3.1. Data, Information, and Knowledge 54

3.1.1. Data 54

3.1.2. Information 57

3.1.3. Knowledge 59

3.2. Information Management 63

3.2.1. The Information Challenge 65

3.2.2. The Information Resource 68
3.2.3. The Information Audit 69
3.3. Information Strategy 74
3.3.1. Strategy Components 74
3.3.2. Information Strategy Models 75
3.3.3. The Relationship between Information Strategy and Business Strategy 82
3.4. Information System Architecture 84
3.4.1. Systems Thinking 85
3.4.2. Information System Architectural Frameworks 88
3.4.3. Information Systems Architecture and the Information Audit 99
3.5. The scope of the Information Audit 102
3.5.1. The Strategic Perspective 105
3.5.2. The Process Perspective 107
3.5.3. The Resource Perspective 111
3.6. Summary 113

4. Information Audit Methods 116
4.1. Background 117
4.2. Methodological Origins 118
4.3. Burk & Horton 123
4.3.1. Methodology 123
4.3.2. Critique 133
4.4. Orna 137
4.4.1. Methodology 137
4.4.2. Critique 143
4.5. Buchanan & Gibb 145
4.5.1. Methodology 145
4.5.2. Critique 155
4.6. Henczel 157
4.6.1. Methodology 157
4.6.2. Critique 165
4.7. Comparison of IA Methods 168
4.7.1. Comprehensiveness 168
4.7.2. Applicability 177
4.7.3. Usability 181
4.8. Summary 195

Section Three: case studies

5. Case study one 200
5.1. Overview, client brief, and methodological scope 200
5.1.1. Organisational overview 200
5.1.2. IA brief 202

5.1.3. The IA Methodology 204

5.2. DMEM IA 205
5.2.1. Promote 205
5.2.2. Identify 206
5.2.3. Analyse 220
5.2.4. Account 228
5.2.5. Synthesise 228
5.3. Observations and reflection 230

6. Case study two
6.1. Overview, client brief, and methodological scope 233
6.1.1. Organisational overview 233
6.1.2. IA brief 233
6.1.3. The IA Methodology 235
6.2. SAC IA 236
6.2.1. Promote 236
6.2.2. Identify 238
6.2.3. Analyse 254
6.2.4. Account 259
6.2.5. Synthesise 259
6.3. Observations and reflection 261

7. Interim Findings and considerations for usability trials 265
7.1. Scope Setting 265
7.2. The Buchanan & Gibb (1998) methodology 266
7.2.1. Promote 266
7.2.2. Identify 267
7.2.3. Analyse 271
7.2.4. Account 273
7.2.5. Synthesise 273
7.3. Summary 274

8. Usability Trials 275
8.1. Usability Trial One 276
8.1.1. IA brief and methodological overview 276
8.1.2. Post audit interview 287
8.2. Usability Trial Two 289
8.2.1. IA brief and methodological overview 290
8.2.2. Post audit interview 297
8.3. Usability Trial Three 300
8.3.1. IA brief and methodological overview 300
8.3.2. Post audit interview 308
8.4. Summary 311

Section Four: discussion and conclusion

9. Discussion 314

9.1. Research objective one: to identify and/or develop a generic and universally applicable information audit framework 315

9.1.1. What is the purpose and scope of the information audit? 315

9.1.2. What should be the core methodological components/elements of a generic, and universally applicable information audit? 316

9.2. Research objective two: to identify and explicitly map key relationships to information system development processes, in order to identify and demonstrate the potential extended value of the information audit. 320

9.2.1. What is the relationship of the information audit to evolving information systems development processes, including information systems architecture? 320

9.3. Research objective three: to test the usability of the information audit framework. 322

9.3.1. How should the information audit be tailored to individual organisational circumstances and goals? 322

9.3.2. How should information audit scope be managed? 325

9.3.3. How usable is the information audit framework? 327

9.4. Summary 333

10. Conclusion 334

10.1. Contribution to the field 335

10.1.1. A revised IA definition 335

10.1.2. An IA scope matrix 335

10.1.3. IA integration with information systems architecture 336

10.1.4. An IA methodological baseline 337

10.1.5. A process-based approach to the modelling information flow 338

10.1.6. A basis for a generic and universal information audit framework 339

10.2. Research limitations 341

10.3. Recommendations 343

10.3.1. A revised Buchanan & Gibb methodology 343

10.3.2. IA instruction 347

10.3.3. Further research 348

10.3. Reflection 351

References 352

Volume Two

Appendix One: Buchanan & Gibb (1998) 367

Appendix Two: Case study one workshop instructions and minutes 369

Appendix Three: Case study one information survey briefing paper 405

Appendix Four: Case study one information resource inventory sheet 419

Appendix Five: Case study two interview notes 420

Appendix Six: Case study two information use survey 448

List of Illustrations

Figures

Figure 1.1	Information Audit Methods	6
Figure 2.1	Research Model (Saunders et al, 2003)	17
Figure 2.2	The Research Process (Ghauri & Gronhaug, 2005)	25
Figure 3.1	The Information Spectrum	54
Figure 3.2	The information Age (Earl, 2000)	58
Figure 3.3	A typology of knowledge (Boisot, 1987)	59
Figure 3.4	Information Management	64
Figure 3.5	Typology of Audits (Buchanan & Gibb, 1998)	73
Figure 3.6	Information Strategy (Ward and Griffiths, 1996)	76
Figure 3.7	Information Strategy Components (Earl, 2000)	78
Figure 3.8	Hierarchy of information strategy components (Gibb, Buchanan, and Shah, 2006)	79
Figure 3.9	Framework for information strategy formulation (adapted from Earl, 1989)	81
Figure 3.10	A unified approach	83
Figure 3.11	TOGAF Application Development Method (TOGAF, 2002)	90
Figure 3.12	The Enterprise Continuum (TOGAF, 2002)	91
Figure 3.13	TOGAF foundation components (TOGAF, 2002)	95
Figure 3.14	Business Strategy, Information Strategy, and Information System Architecture	100
Figure 3.15	IA Scope Matrix	104
Figure 3.16	From Organisational Mission to Information Resources (Buchanan, 1995)	106
Figure 3.17	The process meta model	108
Figure 3.18	Process Model: Example (Young, 2001)	109
Figure 4.1	Identifying an IA methodological baseline	174
Figure 4.2	IA Application	178
Figure 5.1	DMEM IA Scope	203
Figure 5.2	DMEM IA Methodology	204
Figure 5.3	DMEM adapted Identify stage	207
Figure 5.4	DMEM competitive forces	211
Figure 5.5	Example: Map DMEM key processes	213
Figure 5.6	Example: Model the prioritised process (UG teaching)	218
Figure 5.7	Example: Map Information Flow	225
Figure 6.1	SAC IA Scope	235
Figure 6.2	SAC IA Methodology	236
Figure 6.3	SAC adapted Identify stage	239
Figure 6.4	SAC Council and Committee structure	243
Figure 6.5	SAC Functional Structure	243

Figure 8.1	BC IA Methodology	278
Figure 8.2	The British Council Organisational Structure (British Council, 2005)	281
Figure 8.3	Example: Identifying BC Processes (Kassenova, 2005)	282
Figure 8.4	Example: Identifying Information Flow (Kassenova, 2005)	283
Figure 8.5	The Office of Marketing & Communication	289
Figure 8.6	OMC IA Methodology	290
Figure 8.7	Example: Identify OMC Information Flow (Roussakis, 2005)	294
Figure 8.8	MLF IA Methodology	301
Figure 8.9	Identify Organisational Structure (Martin, 2005)	303
Figure 10.1	Information Audit Scope Matrix	336
Figure 10.2	Earl, TOGAF & Zachman	337
Figure 10.3	A process flow model	340

Tables

Table 2.1	Literature Review parameters for this study (Bell, 1999)	30
Table 3.1	TRM taxonomy (TOGAF, 2002)	93
Table 3.2	The Zachman Framework (Zachman, 1992)	97
Table 3.3	From Information Audit to System Architecture Development	101
Table 3.4	The value of information resources (Buchanan, 1995)	112
Table 4.1	A relative comparison of IA Methodologies	176
Table 5.1	Example: Identify Objectives, Critical Success Factors & Performance measures	216
Table 5.2	Example: Process description	220
Table 5.3	Example: Use of adapted force field analysis	227
Table 6.1	Example: Process Description	247
Table 6.2	The SAC Application Portfolio	253
Table 6.3	Example: qualitative data display I	256
Table 6.4	Example: qualitative data display II	257
Table 8.1	Example: BC IA recommendations (Kassenova, 2005)	286
Table 10.1	A revised Buchanan & Gibb methodology	339

List of Abbreviations

ABC	Activity Based Costing
ADM	Architectural Development Method
BPM	Business Process Management
BPML	Business Process Markup Language
BPMN	Business Process Modelling Notation
BPR	Business Process Reengineering
CM	Content Management
CMMI	Capability Maturity Model Integration
COTS	Commercial of the Shelf
CSF	Critical Success Factor
DFD	Data Flow Diagram
DSS	Decision Support Systems
EA	Enterprise Architecture
IA	Information Audit
IC	Information Content
ICT	Information and Communication Technology
IDEF	Integrated Definition
III-RM	Integrated Information Infrastructure Reference Model
IM	Information Management
IR	Information Resource
IRE	Information Resource Entity
IRM	Information Resource Management

IS	Information System
ISA	Information Systems Architecture
IT	Information Technology
KM	Knowledge Management
MIS	Management Information Systems
OBS	Output Based Specification
PEST	Political, Economic, Social, Technological
RE	Requirements Engineering
SIB	Standards Information Base
SOA	Service Oriented Architecture
SSM	Soft Systems Methodology
STRIM	Systematic Technique for Role and Interaction Modeling
TAFIM	Technical Architecture Framework for Information Management
TOGAF	The Open Group Architectural Framework
TRM	Technical Reference Model
UML	Unified Modelling Language

Chapter One: Introduction

This chapter provides a research overview, beginning with the rationale for this study, then outlining the research aims and objectives, including an overview of the methodological approach adopted and a historical summary of the major milestones for this research. The chapter concludes with an overview of the dissertation structure.

1.1. The research rationale

The role of the information audit (IA), as defined by Buchanan & Gibb (1998), and cited by both practitioners and academics (e.g. Lamoral, 2001; Garratt & Du Toit, 2003; Alexopoulos & Theodoulidis, 2003; Botha & Boon, 2003), is to:

> ...provide a method for identifying, evaluating, and managing an organisation's information resources in order to fully exploit the strategic potential of information.

Expanding upon this definition, Buchanan & Gibb (1998) position the IA as key to the effective management of information. The ultimate goal of the IA, it is argued, is to provide integrated strategic direction for an organisation's management of its information resources and as such, Buchanan & Gibb (1998) state that the IA should be considered as the first step of information strategy development.

With such a central role, it might therefore be reasonable to assume that the IA would be widely accepted among organisations and a common part of information management practice, particularly given the phenomenal growth of information based services and online systems over the last decade, and the growing recognition of information as a primary resource and tradable commodity (Best, 1996). However, the IA does not appear to be widely practiced, with Di Mattia & Blumenstein (2000) reporting that, "there is no consensus on whether there is a benefit to be gained through an (information) audit".

Initial research by the author (Buchanan & Gibb, 1998) including further preliminary readings when proposing this study (which were later followed up in more depth [see Chapter 3 and Chapter 4]) identified several challenges faced when considering conducting an information audit, which are initially grouped below as those relating specifically to the information audit, and those relating to the field of information management. Each is introduced in turn below.

1.1.1. The Information Audit: complexity, scope, and value

In its simplest form, the purpose of the information audit is to (Buchanan & Gibb, 1998):

- identify an organisation's information resources.
- identify an organisation's information needs.

However, when used to its full potential the purpose of the information audit can also include (Buchanan & Gibb, 1998):

- Identifying costs and benefits of information resources.
- Identifying opportunities to use information resources for strategic competitive advantage.
- Integrating information and communication technology (ICT) investments with strategic business initiatives.
- Identifying information flows and processes.
- Developing an integrated information policy.
- Creating awareness of the importance of information resource management (IRM) and defining the management role.
- Monitoring and evaluating conformance with information-related standards, legislation, and policy guidelines.

One of the first challenges faced when considering an information audit is that there is no standard, agreed methodological approach. Instead, there exists a variety of academic and proprietary methods, some comprehensive, some no more than outline steps, which often require the practitioner to reference numerous textbooks to identify the numerous tools and technique(s) required to support the methodological process (Buchanan & Gibb, 1998). Related to these IA framework problems is the issue of scope. With the majority of IA methods advocating a top-down approach incorporating organisational analysis, in-depth mapping and analysis of information flow, and extending to cost/value analysis of individual information resources, the information audit may become a significant and costly undertaking. Progress has been made towards a more standard and pragmatic approach by several researchers, most notably Orna (1990), Buchanan & Gibb (1998), and Henczel (2000); but there still exist concerns regarding the complexity and scale of the undertaking (Blumenstein, 2000), and little practical guidance on the scope of the information audit, and how to tailor it to individual circumstances and goals. In a review of information audit methods, Botha & Boon (2003) concluded:

> ... more research is needed on the topic of information auditing and more methodologies need to be tested in practice. This would enable information professionals to develop reliable information auditing methodologies that can be used with confidence.

The above views have resulted in the following initial problem statements being identified for this research:

Problem statement one: there is no standard, agreed methodological approach to the information audit.

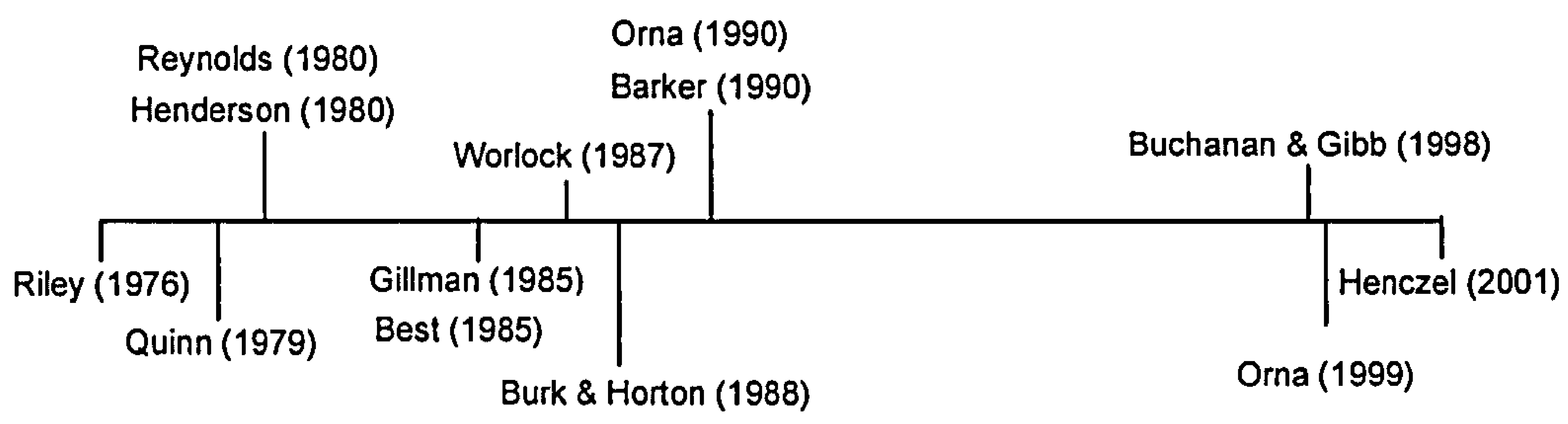
Problem statement two: there is little practical guidance on how to tailor the information audit to individual circumstances, and to manage scope.

A second related issue is that there is ambiguous linkage from information flow to organisational processes, which makes it extremely difficult to incorporate the information audit into established operational practice and to ultimately demonstrate business benefit (Chillarege, 2002; Elvin & Davies, 2002). As previously highlighted, the information audit has both a key operational and strategic role, particularly regarding ICT, but ironically, there is only limited explicit mapping from information audit methods to established information systems practices, with which it shares common goals, such as information systems architecture and systems development. This leads to a further problem statement:

> **Problem statement three**: there is ambiguous linkage from the information audit to related information system development practices, which limits the potential value of the information audit.

Historically (see Figure 1.1, page 6 [individual methods are discussed in Chapter Four]), early information audit methods (1976-1988) focused upon identification of information resources, but later methods (notably Orna,1990) added organisational analysis and the mapping of information flow, aspects of the information system often overlooked by early ICT planning and development processes, which were typically solution driven and based upon technical specifications and pre-derived requirements. In the early 1990s the information audit could be positioned as providing vital organisational context to information systems analysis. However, ICT development methods, particularly within the domain of systems development, have evolved rapidly since the early 1990s to now include extensive business process and information flow modelling tools and techniques, while the evolution of information audit methods, tools and techniques across the same period, has remained relatively static (see Figure 1.1, page 6).

Figure 1.1. Information Audit Methods



As a consequence, there is a danger that the information audit can be dismissed or overlooked by organisations in favour of more readily understood, and embedded, systems development methods and practice. The potential problem with dismissing the information audit is that firstly, most systems development approaches still place greater emphasis on the technical stages and components of development at the expense of organisational analysis (Weber & Weisbrod, 2003; Turner, 2003); and secondly, information modelling and analysis is typically narrowly focused on the solution/project domain, not the organisation as a whole (Young, 2001; Juristo, 2002; Dubois & Pohl, 2003), which negates the benefits of systems thinking (Dutta, 2003). Under these circumstances, organisations can find themselves lacking clear top-down strategic direction, and will typically suffer from a piecemeal approach to the management of information resources (Venkarraman & Henderson, 2000).

1.1.2. Information Management: theory versus practice

As an academic subject, information management (defined and discussed in Section 3.2, page 63) is well established at post-graduate level, and is also taught on some undergraduate courses, and within the wider educational community is supported by a large body of knowledge, several dedicated journals, and international research. However, as an applied professional discipline, information management (IM) is less clearly defined. While there is recognition and acknowledgement of the importance of IM in today's information society (Best, 1996), there remains little evidence of dedicated IM functions or strategic roles within organisations (Davenport, 2000; Du Toit, 1998); and while several information science or library oriented professional associations profess ownership of IM (e.g. Aslib, CILIP, ARMA), there remains no dedicated professional body.

It has been the author's own experience that, similar to the information audit, the principles and practices of IM are often applied to various degrees as part of other rapidly evolving ICT management and development functions, for example, the mapping of information flow through system analysis and design techniques (e.g. unified modelling language) commonly associated with the relatively new discipline of requirements engineering, rather than through explicit IM functions or roles. Further, the author has found limited evidence of the existence of information strategy/policy (defined and discussed in Section 3.3) or explicit IM functions/processes, as recommended by leaders in the field (e.g. M.J. Earl, E. Orna, D.A. Marchand, T.H. Davenport). This can in part be put down to problems of definition, but also suggests a potential divide between theory and practice (within the obvious initial limitations of being based upon author personal experience). These views lead to two further problem statements.

Problem statement four: there is limited evidence of dedicated IM functions or roles within organisations.

Problem statement five: there is limited evidence of the existence of information strategy within organisations.

It is considered outwith the scope of this study to extensively research IM as a professional discipline (e.g. with reference to problem statements four and five), but it is within scope to explore the relationship between the information audit and IM processes, regardless of whether or not the IM function is explicit or implicit within the organisation.

Consideration of the above problems statements led to the formulation of research objectives as discussed in the section which follows.

1.2. Research aims & objectives

The overall aim of this research is to advance the field of information auditing, with the particular goal of encouraging more widespread adoption and practice of information auditing. There are three key objectives:

1. To identify and/or develop a generic and universally applicable information audit framework (responding to problem statements one and two [see Section 1.1, page 4]);
2. To identify and explicitly map key relationships to information system development processes, in order to identify and demonstrate the potential extended value of the information audit (responding to problem statement three [see Section 1.1, page 5]);
3. To test the usability of the framework (in support of objectives one and two).

The above objectives raise the following research questions:

- What is the purpose and scope of the information audit?
- What should be the core methodological components/elements of a generic, and universally applicable information audit?
- What is the relationship of the information audit to evolving information system development processes, including information system architecture?
- How should the information audit be tailored to individual organisational circumstances and goals?
- How should information audit scope be managed?
- How usable is the information audit?

The main anticipated learning outcomes are as follows:

- Identification of the appropriate steps, goals and outcomes of a generic information audit framework.
- Identification and/or development of a suitable framework.
- Awareness of the organisational scope (both depth and breadth) of the information audit.
- Understanding of the practical steps and procedures required to successfully complete an information audit.
- Understanding of the relationship of the information audit to related information system management disciplines and development methods.

The anticipated key output is as follows:

- Identification of a suitable IA framework for generic and universal application.
- Explicit linkage to related information system development practices to potentially extend value.
- Identification of a method to scope the information audit to individual circumstances and organisational requirements.

1.3. Methodological approach

A qualitative approach supported by case studies was adopted for this research (preceded by extensive literature review). Other researchers (Tellis, 1997; Yin, 1984; Miles & Huberman, 1994) suggest that this is an ideal approach to holistic, in-depth investigation (supporting the exploratory nature of the research questions). With this approach, it was anticipated that the stated research questions would be further expanded upon to form working hypotheses, which in turn would be used to focus the study and resulting information gathered (also referred to as "study propositions [Yin, 1984]). As Patton highlights (2002):

> A qualitative design needs to remain sufficiently open and flexible to permit exploration of whatever the phenomenon under study offers for inquiry. Qualitative designs continue to be emergent even after data collection begins.

The key benefit of a qualitative approach is that research can begin with the stated research problems and then evolve through refinement of study propositions based upon the initial literature review and subsequent fieldwork. This approach builds in flexibility to allow identification and incorporation of emergent issues, with case studies supporting and increasing the depth of findings through further follow on investigation. Chapter Two discusses the research methodology in-depth.

1.4. Research origins

A brief historical overview is provided outlining research origins, timeline, major milestones and publications. This research was completed part time.

The early origins of this research can be traced back to the authors MSc dissertation submitted in 1995, which focused on the strategic role of the information audit. This research contributed to the author's later appointment in 1996 to the University of Strathclyde Information Strategy Office as a research fellow, where the author contributed to the development of the University's first information strategy. It was during this period that the author developed an information audit methodology, which was originally made available via the Information Strategy Office website (to provide guidance to academic departments) and later published in the International Journal of Information Management (Buchanan & Gibb, 1998). The co-author was Forbes Gibb who contributed a section on the relationship of the IA to other types of audits.

The first case study application of the IA methodology was completed 1998. There then followed a brief interlude (with regard to practical application) from 1999 to 2001, which was largely dictated by professional and personal commitments. In this period the author maintained an interest in the field, but opportunities to conduct audits were extremely limited due to various other commitments. However, the author continued readings and correspondence with several academic institutions and other organisations (largely with regard to the author's IA methodology). There were several key publications during this period, including a revised IA methodology by Orna (1999), and a new IA methodology proposed by Henczel (2001). Several case studies were also published during this period (very few existed prior to this), and some methodological debate followed. These publications provided a significant and timely update to the author's ongoing literature review. It was also during this period that the author began exploring the relationship of the IA to information systems development, and information system architecture. In parallel the importance of process modelling was also becoming more and more clear to the author. Identifying and exploring these key relationships further widened the body of knowledge applicable to this research (particularly in contrast to the author's early research up to 1995, which focused on the narrower strategic role of the IA [and was limited to the two IA methodologies in existence at that point in time]). The identification of these key relationships also provided significant input to the critique of information audit methodologies as the author was now proposing an extended role through the identification of natural synergy with related practices. Consequently, the material specific to IA was revisited, reassessed and updated for this research. In all, the research the author conducted during this period, coinciding with significant progress in the related fields of information systems architecture, and process and service management, contributed greatly to the author's literature review and overall thinking (the process oriented component of this research also led to the author's contribution to two papers published in 2006: Gibb, Buchanan, & Shah, 2006; Gibb & Buchanan, 2006).

The second case study was set up in 2002 and completed in 2003. The three usability trials were set up in 2004 and completed in 2005 (note. each case study and usability trial took approximately three months to complete, which when combined with initial setup and closure activity [e.g. feedback sessions with audit participants] led to total durations of between four to six months for each of the five audits conducted as part of this study).

Several of the major findings and output of this research have been published (with research supervisor) as a series by the International Journal of Information Management: Buchanan & Gibb, 2007; Buchanan & Gibb, 2008a; Buchanan & Gibb, 2008b.

1.5. Dissertation Structure

This chapter has provided the rationale for this study; including research aims, objectives, and outcomes, including an introduction to the methodological approach adopted.

Chapter Two discusses the research methodology in more depth. The nature of research, key elements of the research process, and associated tools and techniques are presented and critiqued, incorporating a rationale for the chosen methodological approach.

Chapter Three identifies and discusses the key management concepts, principles and practices central to the effective management of information. The primary goal of this chapter is to understand the scope of the information management domain in order to fully define the relative role and scope of the information audit. A holistic approach, drawing from business, ICT, and information management disciplines, and mapping from information strategy to information systems architecture was adopted, in order to identify the key relationships between business and ICT processes, and information management principles, tools and techniques.

Chapter Four provides a review of information audit practice. Early origins are discussed before identification of the key popular methods. Each of these methods are individually discussed and critiqued before a comparison is conducted to highlight the relative completeness, application, and usability of each. The chapter concludes by identifying a suitable method to be used as the basis for a generic and universally applicable information audit framework, to be applied and tested as part of the empirical component of this research.

Chapters Five to Eight present the findings of the empirical component of this research. Chapters Five and Six discuss the two case studies conducted by the author to test application of the IA framework. The individual IA briefs from each of the participating organisations are discussed, prior to discussion of proceedings and findings. Chapter Seven presents interim findings from these case studies and identifies considerations for the usability trials which follow. Chapter Eight discusses the three trials conducted by independent party under observation by the author. Again individual briefs are discussed prior to discussion of proceedings and findings. A summary IA methodological overview is provided for each trial for the purposes of context and background, but the focus of the discussion is on the user experience and feedback.

Chapter Nine presents and discusses the overall findings of this study, which are structured according to the original research objectives and questions as provided in Chapter One.

Chapter Ten provides a discussion of key findings, learning outcomes, and recommendations for further research. The author also reflects on the research experience.

Appendix One provides a copy of the Buchanan & Gibb (1998) publication, Appendix Two to Four provide supporting material from case study one (workshop agendas and minutes, survey questionnaire, inventory template), while Appendix Five and Six provide supporting material from case study two (interview notes and survey questionnaire).

Chapter Two: Research Methodology

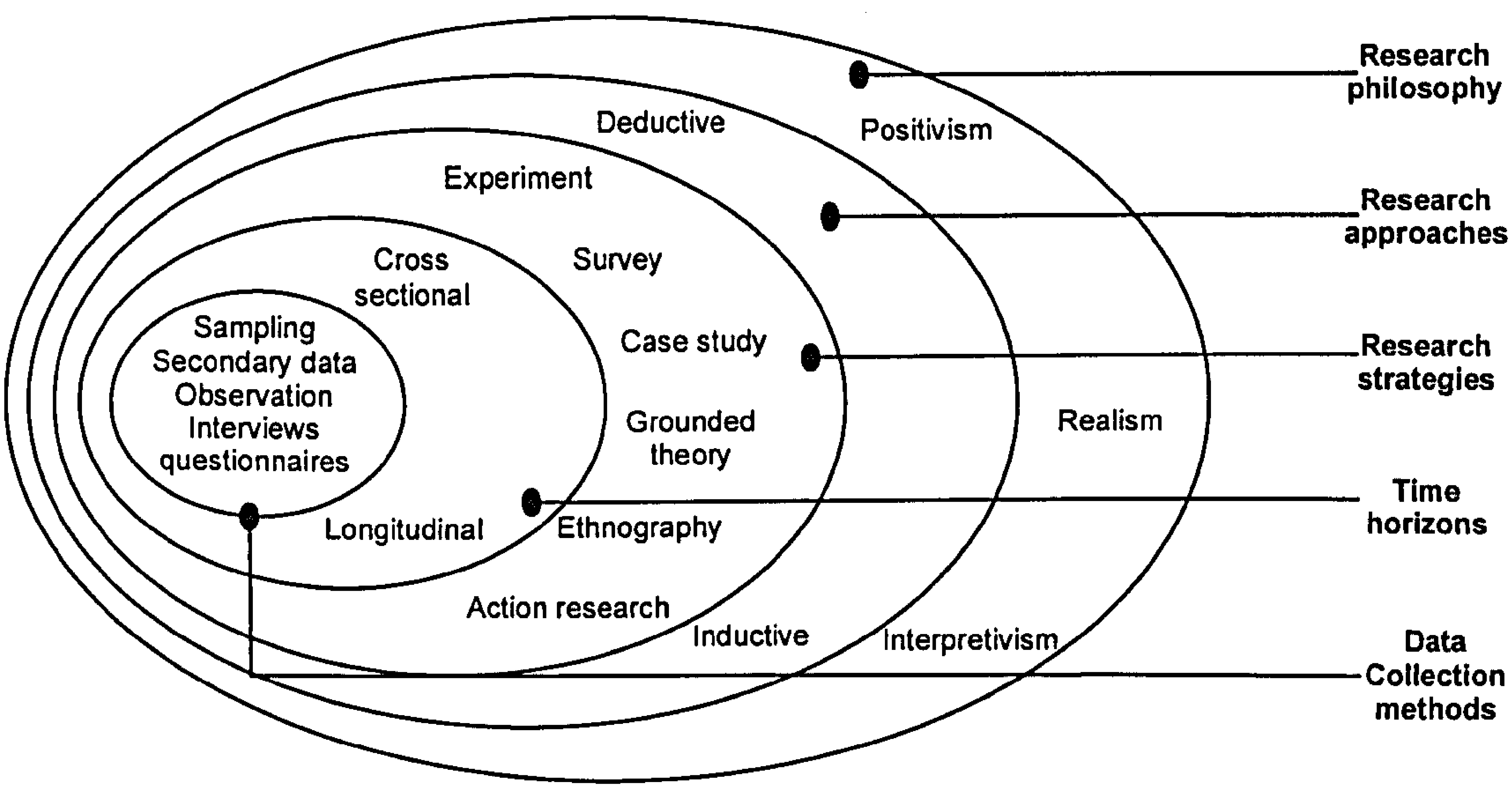
The following chapter discusses the research methodology adopted for this study. The nature of research, key elements of the research process, and the associated tools and techniques are presented and critiqued, incorporating a rationale and discussion of the chosen methodological approach, which is also summarised in the final section.

2.1. The nature of research: conceptual considerations

> The quality of the work done at the conceptual (theoretical) level largely determines the quality of the final empirical research.
>
> Ghauri & Gronhaug (2005)

Saunders et al (2003) identify five *research layers* (see Figure 2.1), which together constitute the key elements of research. The model provides a useful guide for identifying an appropriate research approach by encouraging step-by-step consideration of each of these key research elements.

Figure 2.1. Research Model (Saunders et al, 2003)



The key conceptual considerations for each layer in Figure 2.1 are discussed below and considered in relation to this study.

2.1.1. Research philosophy

The outer *philosophy* layer refers to the philosophical stance of the researcher. Saunders et al (2003) identify three dominant views: positivism, interpretivism, and realism.

Positivism reflects the view of the natural scientist, focused upon quantifiable social observation, with emphasis placed upon structured methods that facilitate replication and allow statistical analysis. The researcher adopts an independent and objective role, which neither affects nor is affected by the research (Remenyi et al, 1998). In contrast, interpretivism views the social world as too complex to be limited to quantifiable statistical methods (implying that the *black-and-white* stance of positivism is too simplistic[1]). Proponents argue that a rich picture of events and environment is required to gain contextual insight in order to understand fully social situations (sometimes referred to as social constructionism [Denscombe, 2003]). Finally, realism proposes that there are large-scale social forces which exist independent of individual human thoughts and beliefs, which must be taken into account, as they influence behaviour at an almost sub-conscious level. Realism acknowledges the importance of understanding overarching social and environmental forces, which can influence interpretation and behaviour (e.g. socially constructed interpretations and meanings).

Saunders et al (2003) argue that business and management research is "often a mixture between positivist and interpretivist, perhaps reflecting the stance of realism". In consideration of the potentially complex and somewhat ambiguous relationships between the information audit and related ICT processes, which were to be explored and better defined as part of this study, this study benefited

[1] The fundamental differences between positivism and interpretivism are similar to those found between hard and soft systems theory (discussed in section 3.4.1).

from a mixed approach. This allowed the study to be approached in a more holistic manner.

2.1.2. Research approaches

Research approaches can be either deductive or inductive. Deductive research tests a theory, exploring causal relationships between variables based upon a hypothesis. Deduction is typically based upon quantitative data (but not exclusively), collected through highly structured and controlled processes in order to facilitate replication of the experiment. Similar to positivism, the researcher adopts an independent role.

In contrast to deduction, inductive research builds a theory based upon qualitative research (although again, not exclusively), exploring the nature of the problem, and developing theory in a more evolutionary manner. An inductive approach facilitates better understanding of the research context in less well defined situations, and provides a more flexible structure allowing refinement of research emphasis as the research progresses (Ghauri & Gronhaug, 2005).

Ghauri & Gronhaug (2005) propose that when considering whether to adopt a deductive or inductive approach, the most important criterion is the nature of the research topic. They suggest that a topic which is well supported by a body of knowledge will lend itself more readily to a deductive approach, while new fields or topics where there is limited existing research may be better approached in an inductive manner. The lack of knowledge in the field of information audits (particularly empirical) has been highlighted as a major issue in Chapter One, as has the lack of a standard methodological approach to information auditing (see Section 1.1.1, page 4). Consequently, this study benefited from a predominately inductive approach allowing research to begin with the stated research problems and then evolving through refinement of the study propositions as the research progressed. This provided flexibility to allow identification and incorporation of emergent findings and issues.

2.1.3. Research strategies

The research strategy is the overall approach of the study. Saunders et al (2003) identify nine types:

- Experiment: the traditional classical approach, where a theoretical hypothesis is tested under controlled conditions through use of samples.
- Survey: provides a structured approach to gathering data from large numbers of study participants, typically through questionnaire, interview, or observation.
- Case study: an empirical investigation within the natural environment, typically using multiple sources of data.
- Grounded theory: an iterative process of induction and deduction where theories are developed through a process of mini research loops which test a theory, make further observations from the findings, and then test the refined theory again to either prove or disprove the predictions from the previous loop.
- Ethnography: interprets the social world through long-term observation of subjects.
- Action research: a three-step process which consists of change intervention, monitoring of implementation effects, and evaluation and change. It is strongly orientated towards action/change.
- Exploratory: seeks new insights, and to clarify understanding of a particular problem. Research typically begins broad in scope (exploring *why* type questions) and then becomes progressively narrower as the study progresses.

- Descriptive: seeks to gather preliminary data in order to better understand the domain prior to the full study.
- Explanatory: focuses on understanding the causal relationships between variables within the study area.

Saunders et al (2003) stress that research projects typically adopt a multi-method strategy, for two key reasons:

- Different methods can be used for different purposes, widening data collection, and ensuring that the most appropriate methods are used at all times (for example, descriptive research before questionnaire design and distribution).
- Multiple methods facilitate triangulation of data.

This study benefited from an exploratory, case study based strategy, preceded by descriptive research (literature review). Two key benefits where that this enabled an informed evolutionary process of data collection (see Section 2.2.3, pages 27-38), and facilitated triangulation of findings (see Section 2.3, page 43).

2.1.4. Time horizons

With regard to time horizons, a research project can be viewed as either cross-sectional or longitudinal. Cross-sectional studies research a particular phenomenon at a particular time, while longitudinal studies conduct research over time, often focused on change and development.

This study was predominately cross-sectional, focused on identification and testing of a generic and universal information audit framework, as opposed to tracking the evolution of a framework or changes to an organisation over time (which would also have expanded this study to include various elements of organisational behaviour). A retest of the framework within the same participating organisations would also have been unreliable, as it is reasonable to expect the organisations to have altered as a result of the first audit.

2.1.5. Data collection methods

The key data collection methods are generally regarded as sampling, secondary data, observation, interviews, and questionnaires:

- Sampling: provides a method to reduce data collection requirements by focusing on one or more subgroups from a larger population. The key to effective sampling is to ensure that the sample is representative of the wider population.
- Secondary data: provides data collected from other research projects, which can be reanalysed and utilised. Secondary data can either be raw (unprocessed) or compiled.
- Observation: is the systematic monitoring, analysis and interpretation of events, actions or behaviour.
- Interviews: are purposeful discussions, which can either be structured, semi-structured or unstructured, ranging from the formal to the informal, with the former based upon open exploratory questions and the latter based upon closed, structured questions. Interviews are particularly good for exploratory and/or in-depth research, but are labour intensive, and require a high degree of skill and/or experience from the researcher.
- Questionnaires: provide a method to reach a larger number of participants than would normally be achievable with interviews. Questionnaires can be posted, made available online, and used as the basis of a structured interview. However, in contrast to the more exploratory role of the unstructured or semi-structured interview, questionnaires are more typically employed to gather data on structured or standardised topics. The main

benefit is that they are the most efficient method of gathering data from large numbers of participants, but contingency must always be built in to allow for poor returns.

Similar to research strategy considerations, a multi-method approach is generally adopted for data collection (Saunders et al. 2003). Again, the main benefits are in matching methods to requirements, and allowing for triangulation of findings (Denscombe, 2003). In consideration of the exploratory and qualitative nature of the study, preference was given to methods which lended themselves better to this type of research. Consequently, a multi-method approach based upon case study, semi-structured interview and observation was deemed appropriate.

2.1.6. Theory versus practice

The conceptual considerations discussed in the previous sections (see Figure 2.1, page 17) facilitate detailed design of the *research process*, as they provide better understanding of the nature of the research; however, before moving on to discussion of the research process, one final point should be made: that for research to be of maximum value, it should contribute to the field. As Tranfield and Starkey (1998) state:

> Research should complete a virtuous circle of theory and practice.

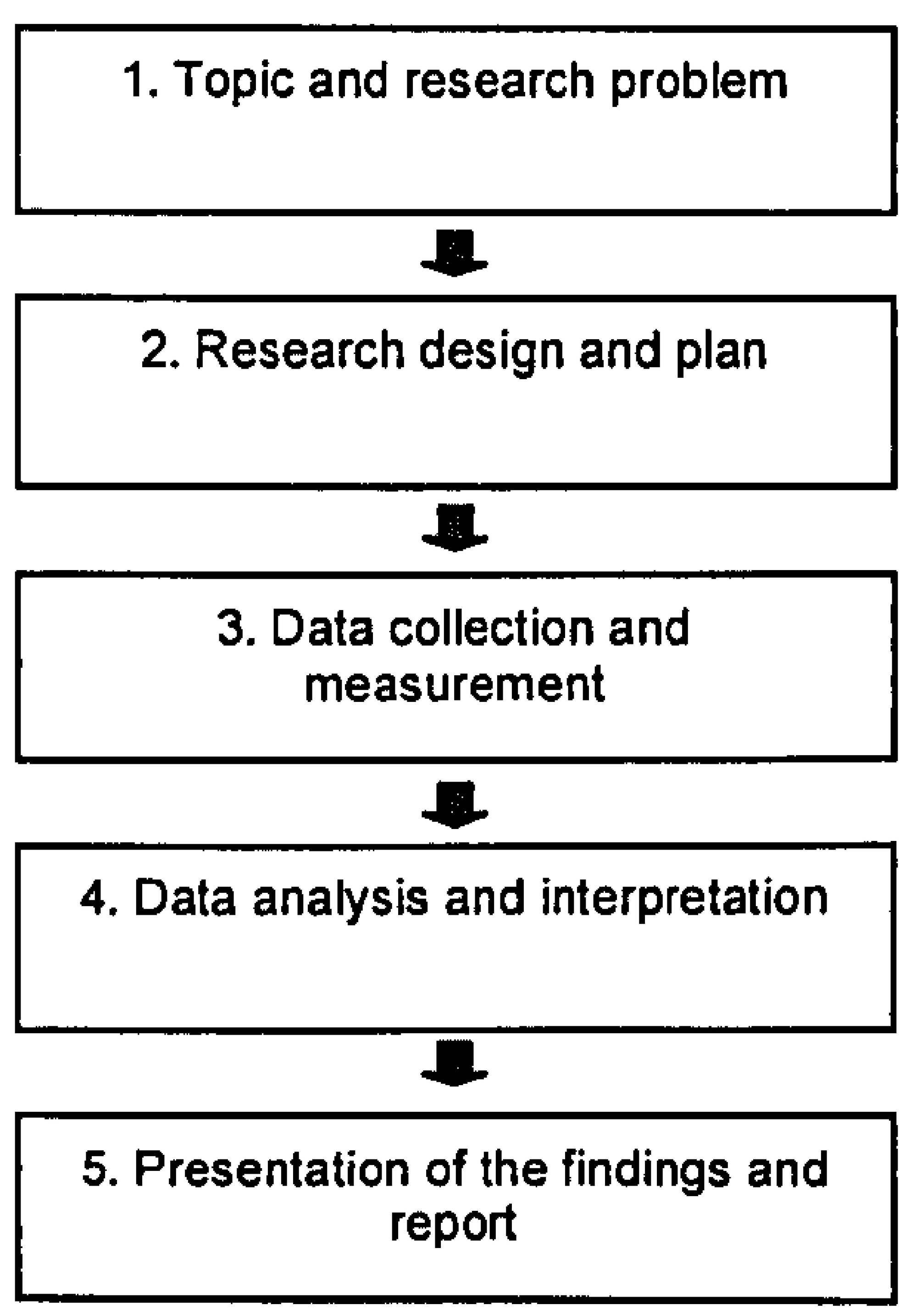
Tranfield & Starkey (1998) remind us that effective research (whether academic or applied) should develop ideas which can be related to practice, and as an ultimate goal, produce findings which progress practice. This is an important point, which is of particular relevance to this research topic, given the previously noted call from practitioners (Botha & Boon, 2003) for not only more research on

IA methodologies, but more importantly, for more empirical evidence (see Section 1.1.1, page 4).

2.2. The research process

Research is a systematic process of discovery, conducted to further knowledge and/or beliefs within a given field or discipline. Referring to research as a *systematic process* reminds us that research should be structured and planned out, and that research should be based upon logical relationships, and not just beliefs (Ghaum & Gronhaug, 2002). Figure 2.2 below provides a prototypical example of the research process or cycle[2]. Further definition is provided by detailed planning within each of the illustrated process stages.

Figure 2.2. The Research Process (Ghauri & Gronhaug, 2005)



Each of these stages are discussed in turn below specific to this study.

[2] For a similar example see Saunders et al (2003)

2.2.1. Topic and research problem

The first step in the research process clarifies and confirms topic, domain scope, research aims, learning outcomes, and key output. The key elements of the research proposal have already been presented and discussed (see Sections 1.1-2, pages 2-10) and will not be repeated here, but the research problem will be briefly reiterated as it influences direction (Ghauri & Gronhaug, 2005).

Initial research by the author identified several IA challenges, which led to the formulation of five problem statements (see Section 1.1.1-2, pages 3-8), with three proposed as the primary focus of this research:

- There is no standard, agreed methodological approach to the IA;
- There is little practical guidance on how to tailor the information audit to individual circumstances, and to manage scope;
- There is ambiguous linkage from the information audit to related ICT development processes, which undermines the value of the IA.

In turn, the above research problems raised a number of questions (see Section 1.2, page 9), exploratory in nature, which in summary sought to clarify IA purpose and scope, identify the core methodological components of an IA approach, identify methods to manage and tailor IA scope, and identify and define relationships to evolving information systems development processes.

In consideration of the exploratory aspect noted above, it was recognised that there was a strong investigative element to this research, which influenced the subsequent research design as discussed in the sections which follow.

2.2.2. Research design

As previously noted (see Section 1.3, page 11), a qualitative, exploratory approach supported by case studies is considered appropriate to holistic, in-depth investigation.

A qualitative research design allowed the research to begin with the stated research problems and to then evolve through refinement of study propositions based upon subsequent literature review, case studies and usability trials. Most significantly, this built in the flexibility to allow identification and incorporation of emergent issues as research progressed and data was collected.

2.2.3. Data collection and measurement

Data was collected in three stages:

1. Literature review.
2. Case study.
3. Usability trials.

2.2.3.1. Literature review

The primary aims of the literature review were to: critically review existing information audit methodologies; identify and analyse any associated empirical evidence; and to better understand and define the relationship of the information audit to related ICT methods and practice.

Saunders et al (2003) identify six key steps to a literature review, which are conducted through a cyclical process of refinement and further research. These steps are as follows:

- Define parameters: establishes the scope of the review. Bell (1999) identifies six key parameters: language, subject area, business section, geographical area, publication period, and literature type. The parameters for this study are provided in Table 2.1 (see page 30).
- Generate and refine key words: focuses the search on key areas, which for this study (initially) were: Information Management, Information Resource Management, Information Strategy, IT Strategy, Information Audit, Information System Audit, Information System Architecture, Systems Thinking, Enterprise Architecture. These key terms were used either individually or in combination to search literature sources.
- Conduct search: Literature sources are typically defined as primary, secondary, or tertiary. Primary are the original source, typically (but not exclusively) obtained via experiment and/or discussion and interview. Secondary sources are typically formal published output such as reports, theses, government publications, journals, books, newspapers, and the internet. Secondary sources are the most common source of literature. Tertiary sources are the indexes and abstracts. Secondary sources are desirable for any study, but of particular importance to this research were reports and/or case studies from previous information audits. Literature was predominately sourced through original full text.
- Obtain literature: key sources were anticipated to be academic refereed journals, professional journals, and books; accessed via ABI Inform, EMERALD, and Lexis Nexis. The internet was used but with reservations due to concerns regarding quality and credibility of material. Google was used as the primary internet search engine.
- Evaluate: material was evaluated according to relevance, currency, credibility, and quality. Relevance refers to relevance to research objectives and questions. Currency refers to such things as whether or not the article reflects current thinking, and whether or not it is likely to have been

superseded or not. Credibility refers to the credibility of the source: refereed journals and conference proceedings were deemed to have the highest credibility, closely followed by professional journals and books. Newspapers were also considered credible sources. Internet content was considered on a case-by-case basis. Finally, quality refers to how well written, researched, and presented the literature is; and also considers such questions as: does this contribute to the field, does the author take an objective position, are the findings plausible etc.?

- Record: a structured process of note taking and citation was followed for all material, including articles dismissed (to avoid repeat readings). Notes were taken according to the evaluation criteria above, and written in the style of abstracts. Cross mapping of key points and findings were also mapped as part of this structured note taking. Harvard was the adopted citation style.

It was anticipated that the literature review parameters might be refined as the literature review progressed and better understanding of the domain emerged, leading to revision and/or addition.

A key quality indicator during the literature review was to ensure traceability of collated material to research objectives and questions. This was monitored through explicit mapping of written material to objectives and/or questions, discussed within the introduction and/or conclusions of each respective chapter of the literature review.

Table 2.1. Literature Review parameters for this study (Bell, 1999)

Language	English
Subject area	Information Management
Organisational sector	All
Geographical area	Global
Publication period	Last 25 years
Literature type	Academic & professional journals; books; news articles; online articles.

2.2.3.2. Case study

Two case studies were conducted in total. It should be noted that neither study was conducted solely for the purposes of research as in both instances the auditor was initially approached by organisations requesting an information audit. As a consequence, the scope of the IA was dictated not by the auditor but by the brief provided by the organisation, with the methodology and approach then tailored accordingly. While this removed the opportunity to establish a controlled test case it ensured that the IA met the requirements of the participating organisation and maintained confidence in test results by removing the opportunity for the auditor to scope the IA to suit the methodology, rather than the requirements of the participating organisation.

Both organisations consented to findings being utilised for research purposes under the agreement that sensitive or confidential material would be withheld, that organisation specific information or findings identified or generated by the IA would be used selectively for illustrative purposes only (and within the context of methodological testing), and that the complete final audit report would remain the confidential property of the participating organisation. Staff within participating organisations were invited to participate without obligation and privacy was established through anonymity of responses.

Data was collected through the process of methodological testing and via post audit feedback session with participants.

Methodological testing

Three key evaluation measures were utilised for methodological testing:

- **Comprehensiveness:** the conceptual, logical, and structural comprehensiveness of the methodology.
- **Applicability:** the applicability and scope of the methodology, and the ability to tailor the methodology to individual organisational requirements.
- **Usability:** the perceived ease with which the methodology can be adopted and applied.

The above measures were developed and refined during the literature review largely driven by the research questions. Comprehensiveness was defined and then measured utilising a methodological baseline which was developed in response to "What should be the core methodological components/elements of a generic, and universally applicable approach to the information audit?". Applicability was defined and measured utilising an IA scope matrix which was developed in response to "What is the purpose and scope of the information audit?, and How would you manage scope?"; and also through critique and practical application of the guidelines and tools contained within the methodology (responding to "How would you tailor this approach to individual organisational circumstances and goals?"). Usability was primarily evaluated by the usability trials (through independent party); however, a degree of usability evaluation occurred during the case studies and preceding literature review (usability was evaluated during the literature review by examination of empirical evidence and consideration of the skills requirements of the respective methodologies and the corresponding level of tool support provided; and considered during the case studies through auditor reflection as part of methodological testing). Overall, the measures provided a framework for the reduction of qualitative data during the later analysis stages of this research.

Post audit feedback sessions with participants

Semi-structured group interviews occurred upon completion of each audit. These were conducted at the end of post-audit presentations where the key findings contained within the final information audit reports were summarised and presented back to the respective participants and stakeholders for discussion. The primary goal was to gather feedback on the methodological process and output generated from the perspective of the participant. A questionnaire was considered for this task but the researcher was aware that by the end of the audit process, the majority of participants would have already participated in one or more workshop sessions and/or interviews, and possibly completed a questionnaire for audit purposes; consequently they may not have warmly received another questionnaire. A pragmatic approach was therefore adopted. Utilising the end of the presentations provided access to participants without additional commitment on their part, while the semi-structured approach provided the following benefits:

- It allowed the researcher to probe answers, encouraging participants to further explain or expand upon responses
- The exploratory nature facilitated the gathering of new insights
- It allowed the researcher to explore relationships between variables

The questions asked during these sessions were:

- Do you feel the audit has met the brief/requirements?
- What do you consider were the strengths of the methodological process?
- Do you feel there were any weaknesses to this process?

It was anticipated that further follow on questions would be generated from participant responses as typifies an approach of this nature.

2.2.3.3. Usability trials

Three usability trials were conducted in total. Organisations were invited to participate through letter and/or email to the appropriate head of business, explaining the research and information audit process. Organisations consented to findings being utilised for research purposes under a similar confidentiality agreement as agreed for participants in the previous methodological testing stage. Again, staff within participating organisations were invited to participate without obligation and privacy was established through anonymity of responses. The auditors (post graduate students from the University of Strathclyde MSc Information Management) who conducted the usability trials were invited to participate through an online dissertation forum (the research topic was listed along with several others on the forum with a brief statement outlining the nature of the research). Interested participants then contacted the researcher to note interest. A meeting was then scheduled to discuss the research in more depth allowing the participant to withdraw if desired (once they fully understood the proposed research). Each participant/auditor was advised they would conduct an IA, and as part of this process, be willing to incorporate a usability trial. Their dissertation was to be a combined literature review and case study focused on conducting an IA (a typical example of a dissertation topic). The additional requirement was for them to be willing to be observed during the audit and to participate in a semi-structured interview post audit, neither of which contributed to their dissertation content or mark. No participants withdrew. Two were employees of the participating organisations, both in roles associated with information management. All were familiar with IAs through their previous postgraduate studies, but none had previous audit experience, which was considered of benefit for the purposes of usability trials as it removed a 'learning effect' variable which would have been introduced if experienced auditors had participated.

Observation

There are essentially two classifications of observation (Saunders et al, 2003):

- Participant: typically qualitative, concerned with events and meanings, with the researcher often "sharing" the experience of participants by participating in events. Participant observation is exploratory in nature, is good for understanding social situations, but can also be time consuming and challenging, particularly with regard to potential role conflict as a result of the dual roles of the researcher. In this study, the researcher dual roles were student dissertation supervisor and author/researcher (a mitigation strategy to account for any bias introduced by this dual role is discussed later in this section).
- Structured: typically quantitative, more concerned with frequency of events (and relationships). This is characterised by a high level of predetermined structure and quantitative analysis. Structured observation yields reliable

and replicable results, but data can be slow to collect, and is "limited to overt action or surface indicators from which the observer must make inferences" (Saunders et al, 2003).

The approach for this study did not fit neatly into either of the above classifications. The exploratory nature of this study negated a structured approach and pointed towards a participatory approach, but this study did not need to explore social situations in any depth (observation was focused upon application of the information audit methodology and only extended to immediate environmental factors influencing outcomes). Neither was the study concerned with social meanings and nuances; further, it was desirable for the researcher not to participate in the usability trials in order to maintain an independent position so as not to influence results. However, the participatory approach did not need to be dismissed as Gill and Johnson (1997) identified four classifications of participant observation, one of which was appropriate to this study: *observer as participant*. In this role the researcher/observer role was apparent to the participants, but there was no participation by the researcher. This non-participatory role was explained to participants from the outset.

In order for observation to be successful it was important that there was a clear distinction between supervisor role and observer role (the dual roles of the author during the usability trials), and that this was understood and agreed by both parties from the outset. It was also important that any opportunity to introduce bias was reduced. The supervisor role was clearly defined and communicated as primarily to provide guidance in research methods and ongoing support in managing a research project for submission of an MSc dissertation. The supervisor discussed IA specific content, but primarily from a depth and breadth perspective (for example, regarding completeness and standard of their literature reviews). The supervisor commented on quality of the discussion/critique but did not contribute directly to content (e.g. complete work for the student). Direction, when required, was provided by referring the participant to relevant published literature/authors and to lecture notes from a previous taught subject (participants had previously received classes which covered information audit methodologies and associated tools and techniques such as process modelling [not delivered by the author]). This ensured that participants came to their own conclusions based on critique of published literature in the field. These 'rules' are normal practice for dissertation supervision and were not introduced for the purposes of the usability trials. They demonstrate that the goal of not directly contributing to or influencing a student's dissertation is compatible with the non-participatory goals of observation.

Importantly, participants were asked to select an appropriate information audit methodology themselves. This introduced a risk that participants might not have selected the information audit methodology selected as the basis for a universal and generic framework by the author (and tested in the first two case studies), but the author felt that participants should not be led in the selection process. Participants were required to conduct their own literature search to identify and review the available information audit methods, to select an appropriate method, and to provide a clear rationale for their selection.

The nature of the observation was identical for all three usability trials: observer attendance at initial briefing/scoping sessions between auditor and participating organisation; observer inclusion in a sample selection of interviews between auditor and participants (one per audit one of which was via teleconference); and general observations arising from regular (weekly) meetings with auditors to discuss progress during the audit. Requests for guidance or direction to additional material (for example, interview technique, process modelling) also provided valuable input during observation.

Semi-structured interview

> Where it is necessary for you to understand the reason for the decisions that your research participants have taken, or to understand the reasons for their attitudes and opinions, it will be necessary for you to conduct a qualitative interview.
>
> Saunders et al (2003)

Semi-structured interviews occurred upon completion of the usability trials with each of the auditors (individually). Again, the semi-structured approach allowed the researcher to explore and gather new insights. The primary goal was to understand the information audit experience from the perspective of the practitioner, with a view to assessing the usability of the information audit methodology. Initial questions were open and of a more general nature, as follows:

- Tell me about the organisation you audited?
- Why did you select your chosen IA approach/methodology?
- Overall, how did you find the IA experience?

Participants were encouraged to discuss the experience from start to finish, facilitating narrative review (Schwab, 2005). Follow on questions were more specific:

- What were the strengths of the information audit methodology adopted
- Did you experience any difficulties or challenges?

It was anticipated that further questions would arise dependent upon proceedings and lines of investigation, as typified inductive research of this nature. A potential issue of significant concern during these interviews was the potential for both interviewer and participant bias. Interviewer bias can be communicated through comments, tone and/or non-verbal behaviour and can inadvertently lead participants. It was therefore vitally important that questions and behaviour remained as neutral as possible, and that the researcher remained constantly vigilant to this issue. A further, more subconscious, source of bias may have been unwillingness on the part of participants to critique an information audit methodology, which was authored by the researcher asking the questions. To mitigate for this potential risk, the following steps were taken:

- The researcher encouraged participants to critique the information audit methodology, by explaining that this was a key element of the research, which was not only a key requirement, but also warmly welcomed by the researcher. The researcher was aware that while communicating this message it was vitally important to convey a positive message and tone to put participants at ease. This message was conveyed from the outset and reinforced at regular intervals throughout the study.
- The researcher asked participants to include a written critique and reflection on the information audit process as part of their final dissertation. This was included in case any participant remained uncomfortable critiquing the information audit methodology face-to-face with the researcher (during the post audit interviews), providing a secondary source of information, which could be used to highlight relevant issues for exploration.

2.2.4. Data analysis and interpretation

As has been previously stated, this study adopted a qualitative, exploratory approach based primarily on case study, observation, and semi-structured interviews. The analysis of qualitative data is acknowledged as a complex and difficult task (Denscombe, 2003), which must be approached in a systematic and structured manner; however, qualitative data tends to lack the structured numerical characteristics of quantitative data and as a result, often requires conceptualisation and interpretation. Tesch (1990), in a study of popular approaches to qualitative analysis, identified four key strategies:

- Understanding the characteristics of language
- Discovering regularities
- Comprehending the meaning of text or action
- Reflection

Saunders et al (2003) argue that what each of these above strategies have in common is that they all disaggregate data into meaningful categories to facilitate systematic and rigorous analysis, allowing the researcher to:

- Comprehend and manage large amounts of qualitative data
- Integrate data from multiple sources
- Identify key themes and/or patterns for further exploration
- Develop and/or test hypotheses based on discovered themes and/or patterns
- Draw and verify conclusions

The first step in the process of qualitative data analysis therefore is categorisation, which classifies data into categories for further analysis. Classification can either be derived from the data if approached inductively, or based upon a predefined theoretical framework if approached deductively. This study adopted a predominately inductive approach, where categories emerged from data identified through dominant themes (for example, *comprehensiveness*, *applicability*, *usability*); however, categories were also derived from research objectives and questions (see Section 1.2, pages 4-5). Consequently an element of the deductive approach was included with initial categories derived from the research objectives and questions, but added to as the study progressed.

Further categories related to *usability* were identified during the literature review prior to the case studies, particularly to aid data collection during observation of the usability trials. The remaining categories emerged as part of observation and the post-audit interviews.

Once data was categorised the next step was to allocate data/findings to appropriate categories, through indexing and tabular cross-referencing (facilitated by the three key evaluation measures [see Section 2.2.3.2, page 31] which provided a framework for data reduction). From this point forward key emerging themes and relationships were sought with categories either subdivided or merged with others. At this stage, Saunders et al (2003) stress the importance of testing emerging relationships by seeking alternative explanations and negative examples that do not conform to the pattern or relationship being tested.

> By rigorously testing your propositions and hypotheses against your data, looking for alternative explanations and seeking why negative cases occur, you will be able to move towards the development of valid and well grounded conclusions.
>
> Saunders et al (2003)

Finally, it was acknowledged that the processes of data collection and data analysis form an iterative cycle, shaped and driven by emergent themes and relationships. From a practical point of view, this meant that sufficient time gaps should be placed between the various stages of data collection to allow preliminary analysis to occur, in case this influences the next stage of data collection.

2.2.5. Presentation of the findings and report

Findings were included in the final report and presented as per university regulations for submission of a PhD.

2.3. Reliability, validity, and causality

> The goal of error-free measurement, although laudable and widely recognised, is never attained in any discipline of scientific investigation. The amount of measurement error may be large or small, but it is universally present.
>
> Kan (2003)

Reliability and validity are the two key criteria of measurement quality. Reliability refers to the consistency of a number of measurements taken using the same measurement method on the same subject; validity refers to whether the measurement or metric really measures what it is intended to measure (and for its intended purpose).

Reliability is generally associated with random error introduced through variation in input, environment, or measurement. Random error is reduced when the entity to be measured is well defined, and a methodical, standard and repeatable measurement process is adopted. The simplest method of assessing reliability is the test/retest method, which is essentially a repeat of the initial measurement exercise, with the same group/entity, which is then *correlated* with the first (correlation measures the relationship or association between two variables). Determining whether or not a second-run is required is either based upon the output of the initial exercise (incomplete findings, un-anticipated results etc.), or observations during the exercise, which cast doubt on the reliability of the measurement (incomplete input, random error, noise etc.). However, a second run is an unrealistic expectation for this study (or any social science study) as it would be highly unlikely that an organisation would be willing to undergo an information audit twice (under identical circumstances) with no conceivable benefit, and the organisation and information system will have naturally evolved over time. In these circumstances, reliability could still be achieved to a degree through use of the same information audit methodology, but allowance was required during data analysis to account for tailoring of the methodology to organisational requirements, and differing environmental and organisational circumstances. It was therefore important that for each information audit, the organisational brief and resulting tailored methodology were clearly defined and considered.

Validity is concerned with ensuring that appropriate measures or metrics are employed to avoid systematic error, which is generally introduced through the selection of inappropriate measures or metrics, or through problems associated with the measurement of abstract, more difficult-to-define concepts (usability, business benefits etc.). Assessing validity is not as straightforward an exercise as reliability testing due to its more abstract nature, which calls for a greater degree of interpretation, analysis, and objective assessment in all but the most straightforward cases. Kan (2003) argues that it is often more applicable during day-to-day activity to think of validity as covering accuracy, completeness, and currency, which is improved through ensuring that input data is both accurate and reliable, and also through empirical verification of the results. Triangulation of findings from the literature reviewed, and the case studies and usability trials conducted, assisted with this.

Finally, *causality* is the identification of cause and effect, perhaps the ultimate goal of measurement. For this to be achieved, Kan (2003) recommends the following three criteria be adhered to:

- the cause must be logically or orderly structured to precede the effect
- the two variables must be empirically correlated
- the observed relationship between the two variables cannot be spurious (e.g. influence by a third variable).

Causality should not be confused with correlation, for although correlation demonstrates a relationship between two variables, it is not valid as a measurement of causality without adherence to the above three criteria.

2.4. Risks

There were four key risks identified for this study:

- Participation: there were obvious challenges in finding organisations willing to participate in this study, and who could then provide sufficient access to people and resources to allow an information audit to be conducted on their premises. In order to mitigate for any withdrawal or poor participation, five were sought in total, two in the first stage and three in the second, providing a small degree of redundancy in the event of withdrawal or incomplete participation.
- Time: the time period for completion of this study was open, but balancing work pressures with time to study required careful scheduling, particularly during the case studies.
- Bias: the author was aware that objectivity could have become an issue when the IA methodology under review was his own. Objectivity was maintained firstly, through continual self-monitoring; and secondly, through observation rather than participation during the usability trials. Steps were also taken during the interviews and subsequent data analysis to reduce the risk of bias, and to encourage participants to objectively critique the information audit method (see Section 2.2.3.3, page 38).
- Scope creep: there was a risk that, due to the exploratory nature of this research, this study might have wandered off at tangents to the main research objectives and questions. Scope was monitored through continual traceability exercises (e.g. does research effort/direction clearly link to the research strategy?, are research questions being addressed?, is this topic covered in sufficient depth for research aims?), with chapters clearly linked back to objectives and/or questions (particularly findings and conclusion). The research process also allowed for a broad initial scope, but was structured to narrow during later empirical stages.

Finally, and as previously noted (see Section 2.2.3.2, page 30), IA scope was defined according to the brief/requirements of the participating organisations, and then tailored accordingly. This removed the opportunity for the auditor to scope the audit to the benefit of the methodological process rather than to the requirements of the participating organisation (a further potential risk).

2.5. Limitations

The key limitations identified for this research were as follows:

- Five case studies provided a sufficient number for the objectives of this research, but this was considered by the researcher to be the minimum number allowable to test the information audit framework under a variety of conditions, and to be able to identify trends, patterns and dominant themes through multiple cases. The study would have benefited from further case studies, but a degree of pragmatism had to be applied by the researcher in consideration of the time required to complete each case study (3-6 months per study), and also in consideration of the logistical and resource challenges faced when canvassing organisations for participation. However, five studies is nevertheless substantially more than in previous studies and can consequently by considered positively.
- The case studies conducted were not repeat applications as circumstances, requirements, and scope of the information audit varied according to participating organisation, making each case study uniquely different. A retest of the method with the same organisation would also have been unreliable as the organisation's belief state and systems would have altered/evolved as a result of the first information audit (though not unique to this study, but true of any audit). As a consequence, analysis of the five case studies focused on the identification of general trends, patterns, and themes, rather than the correlation of repeatable measurements.
- Of the five studies, only one was from the private sector, with the remaining four from the public sector. As a consequence there is limited representation from organisations operating in a commercial environment. This was not ideal, but occurred based solely on availability of organisations to participate.

- As previously highlighted (see Section 1.1.1, page 4), there is a general lack of empirical data to compare findings to, which limits the opportunity to conduct empirical verification of results.

2.6. Summary

The primary goal of this research was to identify a suitable information audit framework for generic and universal use, and to test the usability of the framework. This goal was driven by three key research problems: the lack of an existing standard methodological approach to the information audit; limited guidance on how to tailor the information audit to individual circumstances and to manage scope; and ambiguous relationships to information system development processes which potentially undermined the value of the information audit. These problems raised a number of fundamental research questions regarding the role and scope of the information audit, which warranted further exploratory research.

A qualitative inductive approach was considered to be the most appropriate. The key benefit of this approach was that research could begin with the stated research problems and then evolve through refinement of study propositions as the research progressed. This built in flexibility to allow identification and incorporation of emergent findings and issues. The research was a combination of descriptive research (literature review) and case study, with the latter conducted in two stages: methodological test, and usability trial. Five case studies were conducted in total: two in the first stage and three in the second.

The primary aims of the literature review were to: critically review existing information audit methodologies to identify a methodology suitable for universal adoption; identify and analyse any associated empirical evidence; and to better understand and define the relationship of the information audit to related information systems methods and practice. A cyclical process of refinement and further research adhered to the following steps: review parameters were set; key terms were identified and used both individually and in combination; key sources were defined as academic refereed journals, but extended to professional journals and associations; and literature was evaluated according to relevance, currency, credibility, and quality. Data was allocated to appropriate categories to facilitate analysis and to identify emerging themes and relationships, which were then tested to ensure conclusions were well grounded.

For the stage one case studies, which were conducted by the researcher, data was collected through the process of methodological testing and also via post audit feedback sessions with participants. The primary goal was to test the comprehensiveness and applicability of the methodology, but also considering usability. These measures were identified and/or developed during the literature review (and utilised for initial selection of the methodology as part of a *static test*). Semi-structured group interviews with audit participants occurred upon completion of each audit. The questions asked during these sessions were: do you feel the audit has met the brief/requirements?; what do you consider were the strengths of the methodological process?; do you feel there where any weaknesses to this process? Further questions arose dependent upon individual proceedings and lines of investigation, as typified inductive research of this nature.

In the second phase, the researcher took the role of non-participatory observer with the audits conducted by independent party. The primary goal was to test usability of the methodology, but also to understand the information audit experience from the perspective of the practitioner. The auditors (post graduate students from the University of Strathclyde MSc Information Management) who conducted the usability trials volunteered based on open invitation provided via an online forum. Participants were required to conduct an IA as part of their dissertation project, and as part of this process, be willing to participate in a usability trial. Their dissertation was to be a combined literature review and case study focused on conducting an IA (a typical example of a dissertation topic). The additional requirement was for them to be willing to be observed during the audit and to participate in a semi-structured interview post audit, neither of which contributed to their dissertation mark. All auditors were familiar with IA methodologies through their previous postgraduate studies, but none had previous audit experience, which was considered a benefit for the purposes of usability trials as it removed the 'learning effect' that experienced auditors would have brought to the trials.

The nature of the observation was identical for all three usability trials: attendance at initial briefing/scoping sessions between auditor and participating organisation; inclusion in a sample selection of interviews between auditor and participants; and general observations arising from regular (weekly) meetings with auditors to discuss progress during the audit. Requests for guidance or direction to additional material also provided valuable during observation.

Semi-structured interviews occurred upon completion of the usability trials with each of the auditors (individually). Again, the semi-structured approach allowed the researcher to explore and gather new insights. Participants were encouraged to discuss the experience from start to finish, facilitating narrative review (Schwab, 2005). Initial questions were open and of a more general nature: tell me about the audit you conducted?; how did you find the experience?; what did you learn from this? Follow on questions were more specific: what worked and what did not?; what were the strengths of the information audit approach adopted, and what were the weaknesses?; did you feel you had all the necessary skills required?; were the information audit guidelines and supporting material sufficient? A potential issue of concern during these interviews was the potential for both interviewer and participant bias. To mitigate for this the researcher positively encouraged participants to critique the information audit methodology, and reinforced this message at regular intervals throughout the study.

This study adopted a predominately inductive approach to qualitative data analysis guided by research objectives and questions, but with categories or themes emerging as research progressed (however it could be argued that an element of the deductive approach was included as initial categories and themes were derived from the research objectives and questions). Further categories and themes were identified during the literature review prior to the case studies, and also emerged as part of case study observation and post-audit interview. The three key evaluation measures (e.g. comprehensiveness, applicability, usability) provided an overall framework for qualitative data reduction and analysis (see Section 2.2.3.2, page 31). Data/findings were allocated to appropriate categories and associated and evolving sub-categories, through indexing and tabular cross-referencing. Key emerging trends and relationships were sought with categories either subdivided or merged with others. Findings were explicitly traceable to objectives and presented as per university regulations for submission of a PhD.

Chapter Three: The Management of Information: key concepts

The following chapter identifies and discusses the key management concepts, principles and processes central to the effective management of information. The primary goal of this chapter is to understand the scope of the information management domain in order to fully define the relative role and scope of the information audit. This addresses research questions one and two:

1. What is the purpose and scope of the information audit?
2. What is the relationship of the information audit to evolving information system development processes, including information system architecture?

A holistic approach, drawing from business, ICT, and information management disciplines, and mapping from information strategy to information systems architecture was adopted, in order to identify the key relationships between business and ICT processes, and information management principles, tools and techniques.

Beginning with a discussion of the information spectrum, the unique characteristics of data, information, and knowledge are discussed, followed by a brief history tracing the evolution of information management and the related concept of the information resource. Information strategy is discussed with particular attention to the relationship with business strategy and ICT. Finally, two popular approaches to information system architecture are presented, representing what is argued to be the final, detailed layer of information management, prior to system development, which is considered a separate discipline, and consequently outwith the scope of this research.

3.1. Data, Information, and Knowledge

The unique characteristics of data, information, and knowledge, and the relationship between these three elements, are central to the information audit, as they identify the spectrum of information (see Figure 3.1 below), but more importantly, highlight key differences in structure, state, and application, which have implications for the identification, evaluation, and management of information resources.

Figure 3.1. The Information Spectrum

The following sections consider the characteristics of each element of the information spectrum. Key information management considerations are identified and the associated role of the information audit is discussed.

3.1.1. Data

Data are facts concerning objects, events or other entities. Data can be quantitative, being a measurement of a particular property (such as age or quantity), and can be objective, the value being unaffected by personal interpretation. In temporal terms, data can be historical, and when used to forecast, predictive. Data can also be non-quantitative, indicating a property that classifies an object into a category (such as a profession or address), and can be subjective, acquired through personal assessment and subject to variability.

Finally, it is important to emphasise that raw data has no intrinsic value until it can be exploited by turning it into information.

Database management systems (DBMS), which store and manage data, are the foundation of all information systems. They support transaction processing, querying, publishing, and the acquisition of business intelligence about customers, markets, products and services. A basic premise behind the DBMS approach is to view data as a corporate resource, whose value can be shared and exploited across the breadth of an enterprise. This is achieved by removing as much contextual structure as possible from data, with the explicit purpose of isolating data and function, making data resources more easily shareable across different functional contexts.

The amount of data that needs to be stored continues to grow rapidly as ever more data is captured through online transactional processing (OLTP) systems and digital interfaces such as the Internet. For example, researchers at the University of California at Berkeley (Lyman and Varian, 2003) estimate that:

- The world produced 5 exabytes of unique information in 2002, which is approximately 800 megabytes per head of population.
- New information generated in 2001 and 2002 was more than accumulated in the entire history of mankind.
- 92% of new information is currently stored on magnetic media, mostly on hard disks. Printed documents comprise only .003% of the total.
- The WWW contains approximately 170 terabytes of information, seventeen times the size of the Library of Congress print collection.
- Instant messaging generates 5 billion messages per day, or 274 terabytes of information per year.
- Email generates approximately 400,000 terabytes of new information per year worldwide.

- the total amount of new information generated is expected to double annually.

Key applications, such as customer relationship management (CRM), enterprise resource planning (ERP), records management, now central to many organisations' day-to-day business, have intensive data processing and generation requirements. For example, the world's largest retail chain, WalMart, has seen its data warehouse grow by a factor of 400 over the past 14 years (Tonner, 2003). Industry research group Winmark, estimate that among companies with more than 500 staff, data storage requirements are growing at 21.5% annually (Pritchard, 2003). Apps (2002) quoting research by Gartner, reports that 93% of businesses which experience significant data loss, are out of business within five years.

As a consequence of such phenomenal growth in data volumes, it is now estimated that for every dollar spent on server hardware to support applications an equivalent dollar is now also spent on storage, with businesses no longer thinking in terms of gigabytes (1000 megabytes) of storage capacity but in terabytes (1000 gigabytes), or even petabytes (1000 terabytes); for example: BT is managing in excess of 2 petabytes at its six data centres in the UK; Lloyd's routinely maintain 2 terabytes of date at their production and backup sites; and Barclay's backup provider holds 2.5 petabytes on 80,000 physical tapes (Pritchard, 2003). With such phenomenal growth, further data volume classifications, such as exabyte (1M TB), zettabyte (1B TB), and yettabyte (1000B TB) may soon be widely quoted.

From an information management perspective, the key concerns at this end of the information spectrum (see Figure 3.1, page 55) are, not surprisingly, typically associated with data protection/storage, and records management and regulatory compliance. Data is often implicitly identified by the information audit as part of information mapping (typically captured as *sources* of information). However more explicit data questions to be answered by an information audit would include (Gibb, 2006):

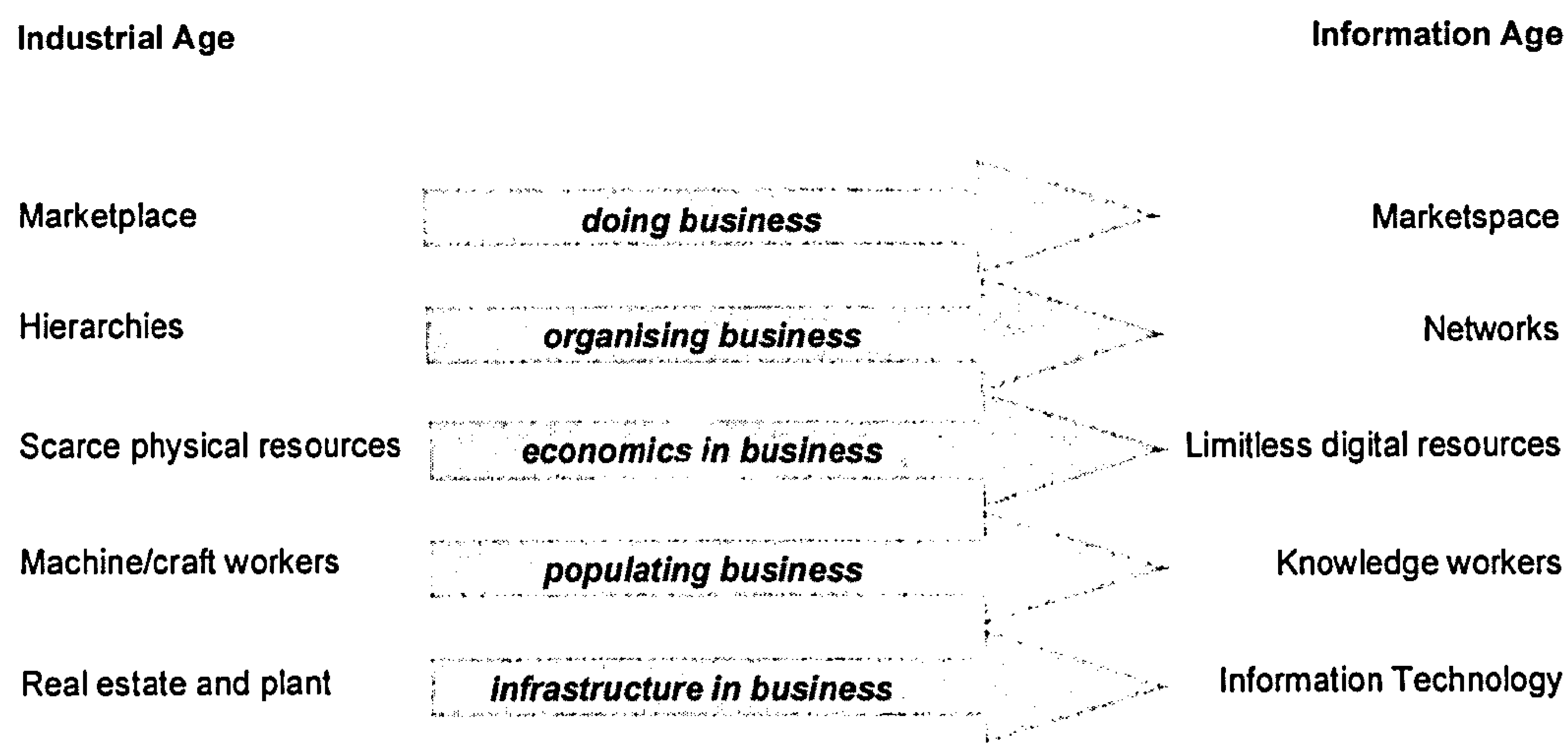
- What are the sources of data?
- How is this data retrieved and analysed?
- What is done with this data?
- What legal and regulatory requirements are applicable?

3.1.2. Information

Information is generated through the structured processing and refinement of data, and importantly, through the application of context and meaning. In basic everyday use, information guides and informs individual and organisational decision making processes; but when effectively managed and processed, information facilitates the generation of intellectual capital, which underpins innovation and growth. In today's society, we are now widely acknowledged as belonging to a post-industrial information age (see Figure 3.2, page 59). Information, now more than ever, is regarded as a valuable, and tradable, organisational asset, which, significantly, can be reused, shared and distributed with limited loss of value. Companies are now regularly bought and sold on the basis of their intellectual assets or ability to provide digital convergence across markets (Earl, 2000), and society is now provided with information-based entertainment (infotainment) through a plethora of digital products and information services.

From an information management perspective, the focus at this point in the information spectrum (see Figure 3.1, page 55) is typically associated with operational reporting and decision support. Analytical, database driven information systems improve the quality of information that is available for decision-making by providing powerful tools for analysis and exploration. The key system families can be summarised as: management information systems, decision support systems, and executive information systems.

Figure 3.2. The information Age (Earl, 2000)



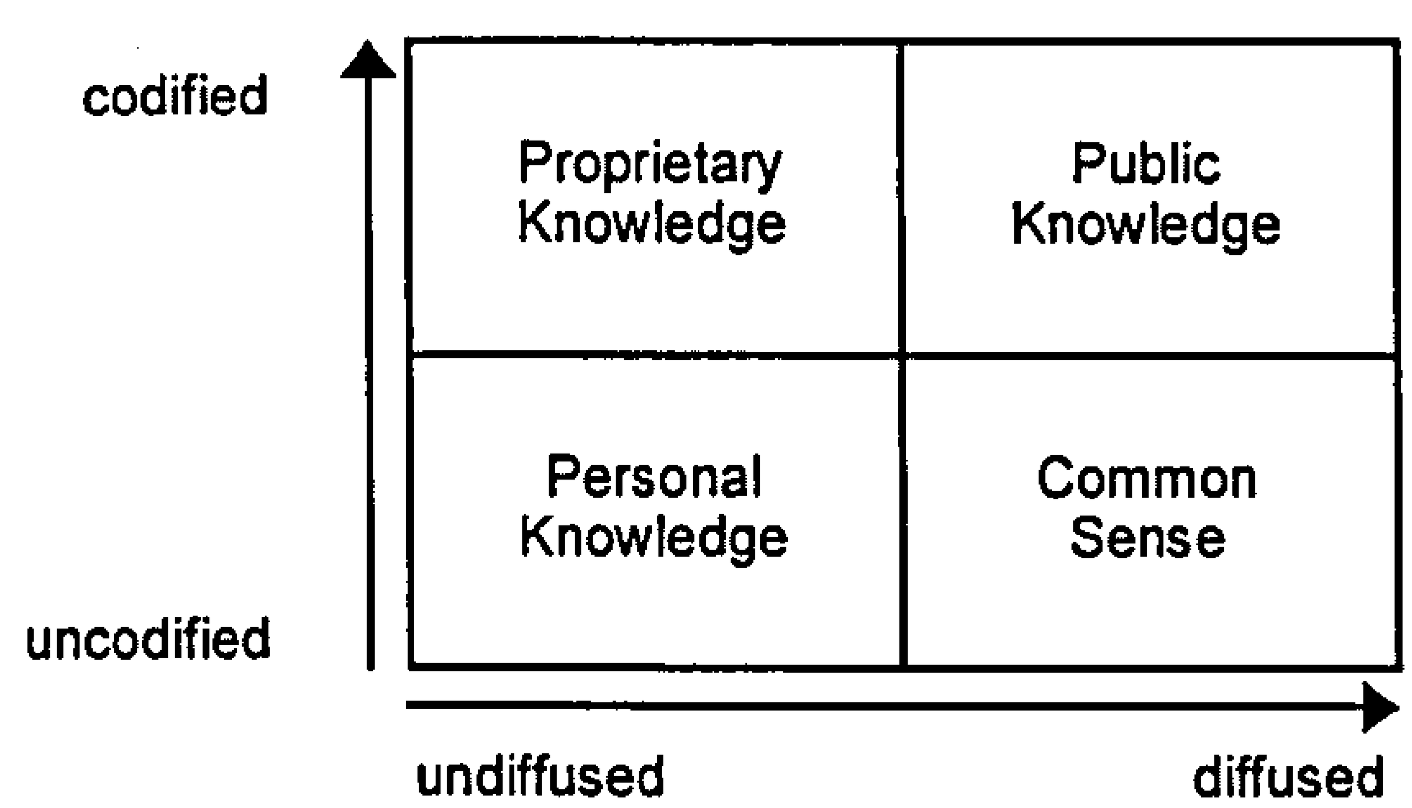
Identifying information as part of the information audit involves identifying information resources and systems, and mapping information flow. The key questions that need to be answered are (Gibb, 2006):

- What information is required to support tasks/processes?
- What information systems do you use?
- How is this information obtained?
- How is this information used?
- How important is this information to the task/process?
- What is done with this information?

3.1.3. Knowledge

Knowledge is the final high-value stage of the information spectrum, with knowledge regarded as a primary source of wealth. Boisot (1987) classified knowledge into four types according to their respective degrees of codification (ability to be transmitted) and diffusion (ability to be shared). This is illustrated in Figure 3.3 below.

Figure 3.3. A typology of knowledge (Boisot, 1987)



The characteristics of each knowledge type are as follows:

- **Personal knowledge** is characterised by lacking codification and being undiffused. It is held in people's heads and represents internal perceptions and insights, and the expertise that is used to carry out tasks and make judgements. It is accessible only to its possessor and is inherently non-transmissable in its current form.
- **Proprietary knowledge** complements personal knowledge in that it represents codified expertise that can be shared within a closed group of users. When aggregated, this codified expertise represents the intellectual

capital owned by an enterprise and is a measure of its ability to differentiate itself from its competitors. This differentiation potential is dependent on the fact that, as this knowledge can now be shared, barriers must be imposed to prevent its diffusion, or controls must be available to protect its owners once it has been diffused.

- **Public knowledge** is highly codified and diffused and represents that which is found in textbooks, journals, newspapers, archives, databases, TV broadcasts, etc. It is readily available (albeit at a price) and is therefore open to scrutiny. From an organisational perspective it represents the knowledge involved in publicising or confirming its expertise (that is, its proprietary knowledge).
- **Common sense** is highly diffused but is not written down. It represents a shared cultural, social and political context that has the useful function of minimising the redundancy in communications and other inter-personal transactions. Ironically, as this knowledge is not codified, assumptions about shared values and protocols may cause friction or result in a lack of communication as enterprises become more multi-national.

Boisot's typology of knowledge is not exhaustive, and uses the extremes of the dimensions of codification and diffusion to bring home its message (Boisot, 1987); however, the model also provides important indicators of the types of knowledge, systems and activities that are likely to be encountered during an information audit and the relative applicability of knowledge to tasks. For example:

- The more codifiable the knowledge, the more amenable it will be to systems such as MIS, EIS and OLAP (online analytical processing), which produce routine reports from structured data that comes from other operational systems.

- The less codifiable the information the more amenable it will be to inductive or machine-learning techniques such as artificial neural networks and data mining.
- The more diffused the knowledge, the less likely it is that it will be capable of differentiating one company from another and hence potentially conferring competitive advantage.
- The less diffused it is, the more proprietary and commercially sensitive it is likely to be.

A challenge with knowledge-based information systems is that, in several instances, the applications employed are simply data and information management technologies re-branded by opportunistic vendors (the term as used in the marketplace tends to encompass technologies that do not strictly fall within its precise meaning: for example, intranets, enterprise information portals, and document search and retrieval systems). However, several key applications can be identified: expert systems, case-based reasoning systems, and intelligent agents.

From an information management perspective, the key concerns at this final point in the information spectrum (see Figure 3.1, page 55) are typically associated with harnessing and utilising organisational knowledge and expertise. Identifying the knowledge base as part of an information audit involves identifying, mapping, and facilitating access to the tacit and explicit knowledge assets which the organisation has at its disposal (tacit assets will also have to be assessed as to whether they ought to be [or can be] converted into explicit assets through codification). The key questions that need to be answered as part of the audit are (Gibb, 2006):

- Who are the experts, networks and communities which hold, or can provide, knowledge of use to the enterprise?

- What documented experience or experimental results do we have that can be shared to improve performance.
- What intellectual property do we have?
- Where can we store, and from where will we subsequently retrieve, the relevant knowledge?
- Why is this knowledge important in the first place?

The information spectrum demonstrates that, for an IA to be effective, it must incorporate both hard and soft systems theory (see Section 3.4.1, page 86). Data and information, to various degrees, can be represented from a hard systems perspective, but knowledge cannot, requiring both hard and soft system approaches. Further, information systems are designed and built in response to the needs of the organisation and its environment. They take into account complex social, economic, organisational, and ergonomic requirements and relationships, as well as having to be technically and logically sound.

3.2. Information Management

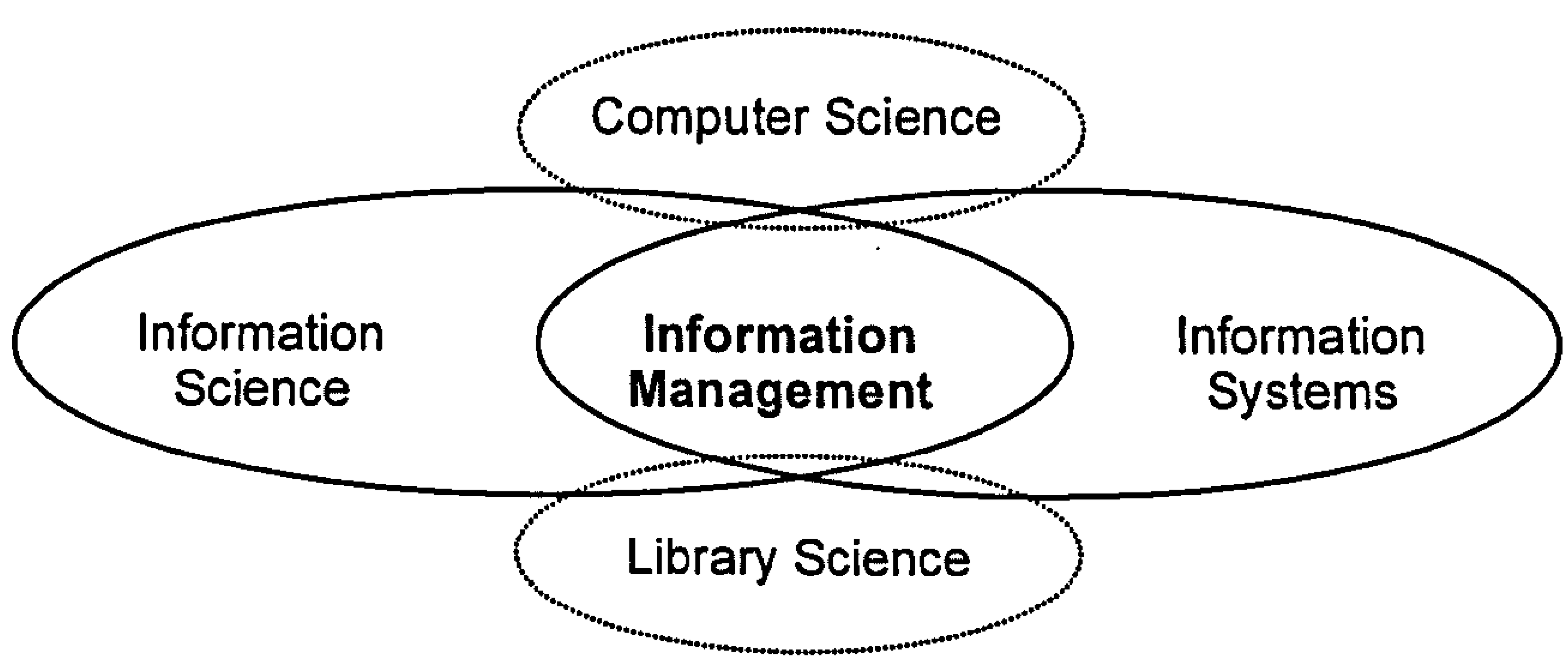
The discipline of Information Management (IM) is concerned with the management and administration of data, information, and knowledge. IM origins are primarily found within the related disciplines of Information Science and Information Systems (Gorman & Corbitt, 2002), but also extend to Library Science and Computer Science. Each of these disciplines can be defined as follows:

- Computer Science: the study of the theoretical foundations of information and computation and their implementation and application in computer systems. Many diverse fields exist within the broader discipline of computer science; some emphasise the computation of specific results, while others relate to properties of computational problems (Wikipedia, 2006).
- Information Science: is a discipline which 'investigates the characteristics of information and the nature of the information transfer process, whilst not losing sight of the practical aspects of collecting, collating and evaluating information and organizing its dissemination through appropriate intellectual apparatus and technology' (Feather and Sturges, 1997).
- Library Science: the study of issues related to libraries and the information fields. This includes academic studies regarding how library resources are used and how people interact with library systems. Basic topics include the acquisition, cataloging, classification, and preservation of library materials. The organisation of knowledge for efficient retrieval of relevant information is also a major research goal. Not to be confused with information theory, the mathematical study of the concept of information, or information science, a field related to computer science and cognitive science (Chowdhury et al, 2008).
- Information Systems: the discipline concerned with the development, use, application and influence of information systems. An information system is a

technologically implemented medium for recording, storing, and disseminating linguistic expressions, as well as for drawing conclusions from such expressions. Often studied as a branch of computer science (Wikipedia, 2006).

IM could be considered as a hybrid of the above four disciplines (see Figure 3.4 below), established in the 1980's to bridge an emerging gulf between business and information technology, and to establish procedures and practice for the effective management of information resources (for a definition of information resources see Section 3.2.2., page 70). One further key discipline, often, though not exclusively, studied as a branch of information management is the discipline of knowledge management. Although acknowledged as a term with several meanings (Marchand et al, 2000), knowledge management can be summarised as an approach to improving organisational outcomes and organisational learning by introducing processes and practice for making knowledge assets available for transfer and reuse across the organisation (see Section 3.1.3, pages 59-62).

Figure 3.4. Information Management



As previously noted (see Section 1.1.2, pages 6-8) IM is well established as an academic discipline, but less so as a professional discipline: there is recognition of the importance of IM in today's information society, but limited evidence of dedicated IM functions or roles within organisations (Davenport, 2000; Du Toit, 1998); and while several information science or library oriented professional associations profess ownership of IM (e.g. Aslib, CILIP, ARMA), there remains no dedicated professional body.

3.2.1. The Information Challenge

As noted in the previous section (see Section 3.1, pages 54-62) the acquisition, management, and exploitation of information is central to almost every business activity and in almost all instances will determine the success or failure of the organisation. The reasons for this can be summarised as follows:

- **Information is both an input and output of business processes**: all processes require information inputs and generate information outputs.
- **Information can generate knowledge**: information (properly refined and processed) generates knowledge, which in turn drives strategic and competitive advantage.
- **Information and Communication Technology challenges conventional business processes**: Information and Communication Technology (ICT) enables business process reengineering (BPR) and advancement. Hammer and Champy (1994) define BPR as "the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service, and speed." Champy (2002) points out that these reengineering improvements can be both internal and external, with ICT used to connect businesses with other

businesses and companies with their customers to achieve dramatic improvements in efficiency and value (referred to as "x-engineering").

Organisations have historically responded to this information challenge by investing extensively in ICT. However there is considerable evidence that many organisations have underestimated the importance of information management, and that this has resulted in poor planning, minimal potential exploitation of ICT resources, and consequently, a failure to fully exploit the strategic potential of information (Davenport, 2000).

In one of the first extensive studies which highlighted these gaps, Remenyi (1993) reported that, in several instances, organisations had failed to realise the potential strategic benefits of ICT because they had mistakenly regarded ICT as merely a replacement for manual and administrative functions rather than as a strategic resource. Remenyi highlighted several ICT management problems:

- the "culture gap" between ICT managers and business managers resulting in mistrust, poor working partnerships, and a lack of strategic alignment.
- a lack of procedures or a policy statement for the acquisition of ICT as well as operational guidelines e.g. data security, file management etc.
- a failure to measure the benefits delivered or derived from information systems.
- a failure to deliver cost effective systems and to adequately measure costs.
- a lack of integration between information systems resulting in substantial amounts of data duplication, data entry, and data processing etc.

The fundamental problem was that in many instances organisations had failed to integrate ICT investments with strategic business initiatives, and as a result, had failed to exploit the full potential of information.

Earl (1989, 2000) has consistently argued that senior managers needed to take responsibility for positioning the use of ICT as an enabling force in shaping business plans and initiatives. This required senior management and other key stakeholders to become more aware of the opportunities and associated competitive threats presented by ICT. As ICT becomes more and more embedded in business operations and increasingly more pervasive in business thinking, ICT activities begin to take on more complex organisational forms. Precise functional responsibility gives way to various hybrid arrangements as more managers become information managers with some responsibility for ICT supply. However so important is information to the business that softer controls and more widely separated organisational structures cannot be allowed to create technological confusion and information overload. Therefore senior managers need to address issues of integration, compatibility, and manageability.

Earl (1989) argued that the requirement was for a clearly defined information management function that cast off the traditional and mistaken view that the management of IT as a technical rather than corporate issue. It was no longer sufficient to be only technically competent to manage IT and information systems. A multi-disciplinary approach was required that combined business skills (e.g. technical, managerial, financial, communication etc.) in order to effectively bridge the gap between IT and the organisation's strategic business initiatives.

3.2.2. The Information Resource

In the 1990's the main concerns for information management were identified by Remenyi (1993) as:

- reduce information system costs.
- increase information system benefits.
- develop internal partnerships and system ownership.

In response to these concerns, Remenyi (1993) proposed that what was required was a new paradigm for information management that applied basic business principles through a process of commercialisation:

> To ensure commercialisation, and therefore value for money, in the mid-1990s, firms will have to manage their *information resources* in innovative ways which will tend to reshape the business, use information and data more fully and ultimately deliver real and measurable benefits. This means inter-alia that better costing systems and better benefit measuring and managing systems are required. (emphasis added)

Remenyi's reference to information as a resource acknowledged a key step in the evolution of Information Management. Viewing information as a resource recognised that ICT was not the solution to problems of information management and reflected growing awareness that the emphasis needed to shift from the technology to the content of information (Best, 1985; Cronin, 1985; Vickers, 1985; Marchand & Horton, 1986; Orna, 1990; Massey, 1995). Early proponents argued that information should be regarded as a resource that should be managed and accounted for like any other resource. This management philosophy was commonly referred to as *information resource* *management*, a term originally popularised by Burk and Horton (1988) as part of their own information audit methodology:

> Information resource management (IRM) is the process within the information management arena that serves the *corporate* interest. IRM seeks to harness information for the benefit of the organisation as a whole by exploiting, developing and optimising information resources. The interests of the organisation are usually manifested by its corporate goals and objectives. Thus, IRM is the managerial link that connects corporate information resources with the organisation's goals and objectives... Corporate IRM policies focus on inventorying, defining requirements, costing, valuing and fixing accountability for safekeeping and results.

Burk and Horton (1988) defined information resources as those sources of information critical to an organisation's success or required to achieve its goals and objectives. The first step towards effective information management was to determine what and where the organisation's information resources were. This, it was argued, was the primary role of the information audit.

3.2.3. The information audit

Early information audit definitions (Reynolds [1980], Burk & Horton [1988]) focused on identification of formal organisational reports with an emphasis on document management (discussed in Section 4.2); however more recent definitions have expanded upon this relatively narrow focus, acknowledging the importance of organisational perspective and the many different types of information resource (beyond documents).

Buchanan & Gibb (1998) define the information audit as a process for discovering, monitoring and evaluating an organisation's information resources in order to implement, maintain, or improve the organisation's management of information. A similar definition is provided by the ASLIB information Resources Management Network, which describes an information audit as:

> A systematic examination of information use, resources and flows, with a verification by reference to both people and existing documents, in order to establish the extent to which they are contributing to an organisation's objectives (Orna, 2004).

Buchanan & Gibb (1998) state that the information audit should not be considered as an option, but as a necessary step to determine the value, function, and utility of information resources in order to fully exploit the strategic potential of information, and should be considered the essential first step towards an effective information strategy. As previously noted (see Section 1.1.1, page 3) and summarised here, in its simplest form, the objectives of the information audit (Buchanan & Gibb, 1998) could be limited to the identification of information resources and associated requirements and needs, but could also then be extended to cost benefit analysis, mapping of information flow and processes, strategic alignment and direction setting, and adherence to information standards and policy. Buchanan & Gibb (1998) proposed that a universal information audit should include the capability to achieve all of these objectives (with some as options) to provide a truly comprehensive and integrated (with business strategy) strategic approach. This strategic approach would as its ultimate goal, produce an integrated information strategy, similar in approach to Earl's (1989) multiple methodology for information system strategy formulation (see Figure 3.9, page 81).

The exact methodological boundaries of an information audit are difficult to pinpoint in relation to other types of audits as, dependent upon application, the IA may subsume more specific audit processes or be subsumed by others

(Buchanan & Gibb, 1998); for example, the communications audit or systems audit (see Figure 3.5 [page 73] for a typology of audits).

The business audit is designed to assess the health of the organisation in terms of its current strategy, its target and potential markets, and the products and services it has to meet those market demands, which has overlap with the initial strategic analysis stage of an information audit (IA methods are discussed in Chapter 4).

The communication audit is designed to evaluate the management style of the organisation and the methods for communicating to and with its workforce. It is concerned with the sociological and organisational aspects of information flow.

The systems audit evaluates the functionality, usability and effectiveness of specific applications, while the associated technology audit is principally concerned with ICT asset management.

One further key relationship is that between the information audit and the knowledge audit. Wood (2004) identifies the following key distinctions:

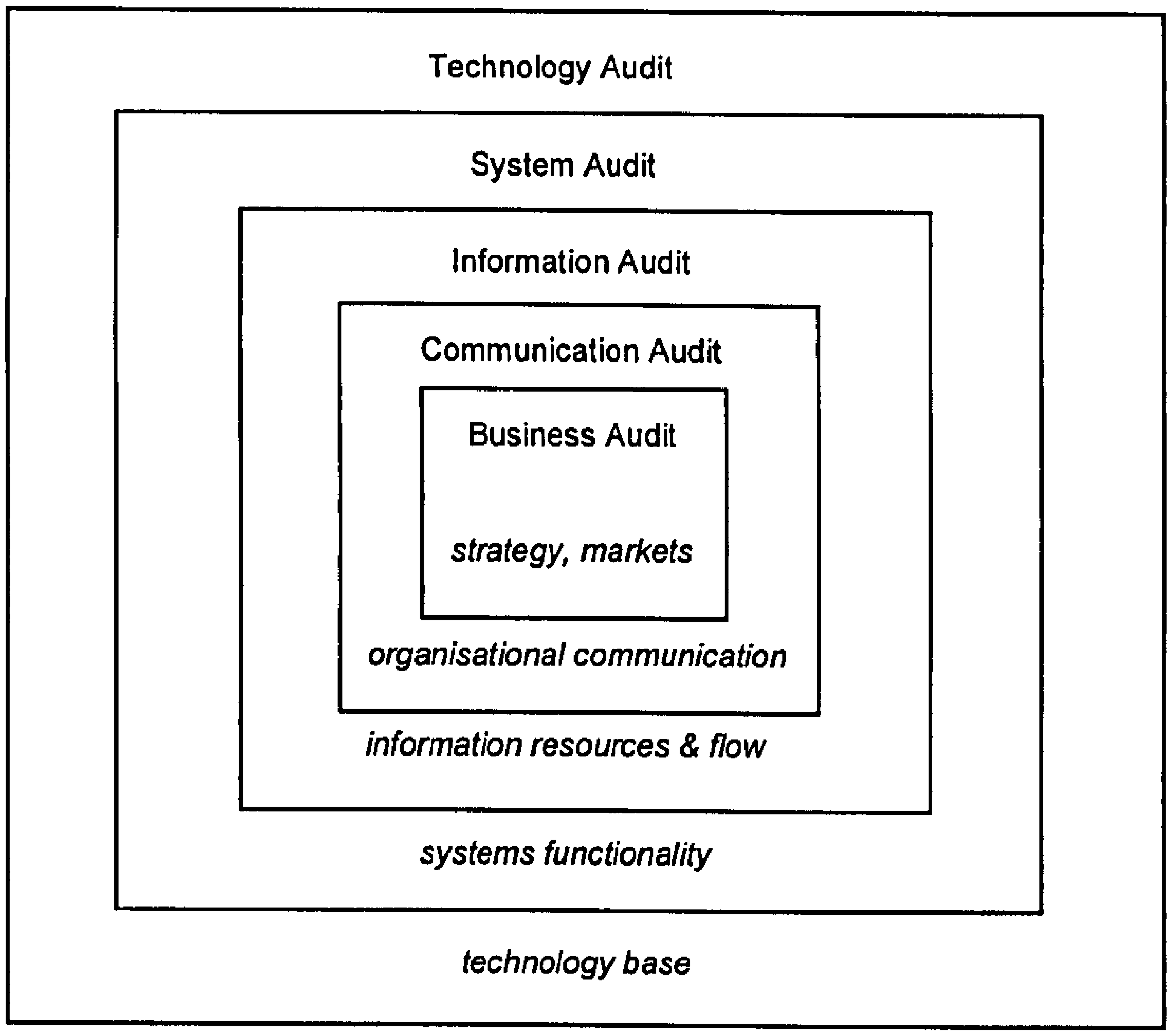
- Information audits will have a people element but are primarily focused upon information objects, recorded information in the form of records, documents, reports, memos, web pages etc.
- A knowledge audit will focus upon tacit knowledge, the knowledge that people hold in their heads in terms of experience and expertise. The knowledge audit will be more people centric than an information audit.
- A knowledge audit will make use of techniques such as social network analysis where people, their knowledge and relationships are mapped in terms of degrees of connectedness and how they value each other's knowledge.

- Knowledge audits tend to make less use of questionnaires and more use of group interviews and techniques such as storytelling to capture information about organisational knowledge.

The depth of IA analysis is also a little ambiguous. Most popular methods (Orna, 1990; Buchanan & Gibb, 1998; Henczel, 2000) advocate a top-down approach incorporating organisational analysis, in-depth mapping and analysis of information systems/information flow, and cost/value analysis of individual information resources. The information audit can quickly become a significant and costly undertaking. Progress has been made towards a more standard and pragmatic approach by several researchers, most notably Orna (1990), Buchanan & Gibb (1998), and Henczel (2000); but there still exists widespread practitioner apprehension regarding the complexity and scale of the undertaking, and little practical guidance on the scope of the information audit, and how to tailor it to individual circumstances and goals (Buchanan & Gibb, 1998; DiMattia & Blumenstein, 2000; Botha & Boon, 2003).

A second related issue is that there is ambiguous linkage to ICT development processes, which makes it extremely difficult to incorporate the information audit into established operational practice and to demonstrate business benefit (Chillarege, 2002; Elvin & Davies, 2002). As previously highlighted, the information audit has both a key operational and strategic role, particularly regarding ICT; but ironically, there is only limited explicit mapping from information audit methods to established ICT development processes with which it shares common goals, such as information systems (enterprise) architecture and systems development.

Figure 3.5. Typology of Audits (Buchanan & Gibb, 1998)



The following sections discuss each of these key relationships.

3.3. Information Strategy

Strategy provides organisational direction and focus. Without direction an organisation risks failure. An information strategy acknowledges the strategic importance of information and ICT to organisational success, and is a direct output of the IA, or facilitated by IA output.

3.3.1. Strategy components

There are five key components commonly found within a strategy (Business Rules Group, 2005):

- **Vision**: a statement of what an enterprise ultimately wants to be or become. Vision statements typically set high expectations with a long-term focus, and are almost always market-oriented (e.g. to become the dominant player in the respective market).
- **Mission**: a top-level, often generalised, operational statement of what the enterprise wants to do (providing the vision statement with business context). They are typically statements about provision of services and products to particular market segments or highlighting key activities. Statements also define the core values of the enterprise, although often generalised to be more enduring. They are similar to vision statements, often market oriented.
- **Goals and objectives**: statements about a particular end state that the enterprise wishes to achieve over the medium to long term (1-3 years). Goals are more dynamic than mission or vision statements, as they must respond to market forces, and evolve to take advantage of *ad hoc* business opportunities. They define competitive position, and include targets and milestones. Objectives are specific, quantifiable and attainable short-term targets, which are used to measure the degree to

which the enterprise is realising its goals. Objectives must be time-limited, and associated with unambiguous and measurable criteria for success.

- **Policies**: operational guidelines defining how the enterprise conducts business, including boundaries and constraints. They are typically focused upon internal processes and procedures, but also include and are influenced by external requirements, for example, legal and regulatory, or customer expectations. They are predominantly 'hard' guidelines motivated by legal or business efficiency goals, but are also influenced by 'soft' factors such as moral and ethical expectations. Policy shapes and influences the courses of action which will be undertaken in order to achieve the desired goals and objectives.
- **Courses of action**: are the specific steps which will be taken to realise goals and objectives. A course of action is a particular plan, project or initiative which combines and exploits a set of business resources in order to achieve a goal and/or objective. Actions can be strategic (long-term) or tactical (short-term) in nature. Typically they are short-term leading towards a longer-term goal, particularly when closely associated or dependent upon ICT.

3.3.2. Information Strategy models

A number of models have been developed to help in the development of an information strategy and two of the more popular approaches are discussed below.

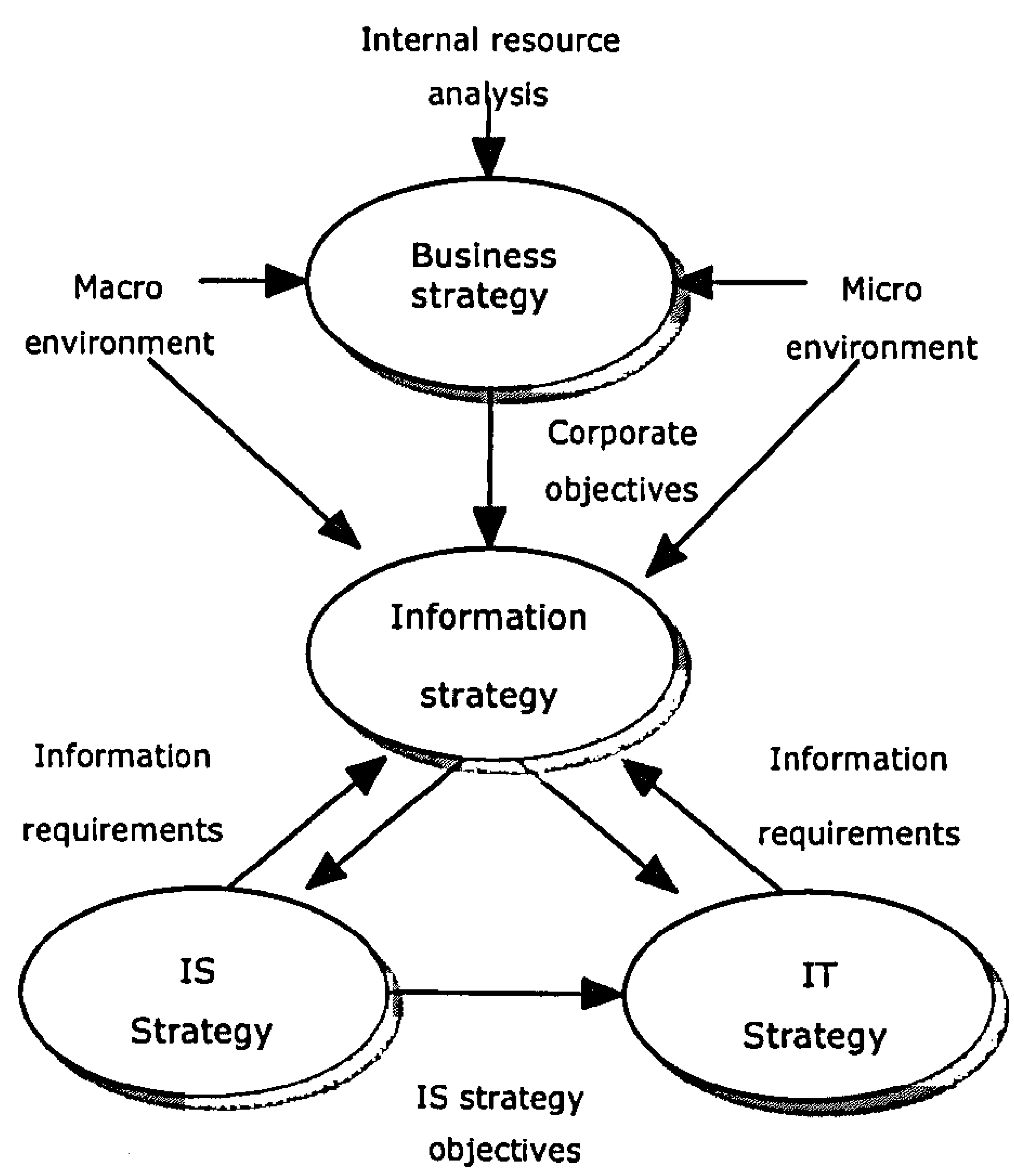
Ward and Griffiths (1996)

Ward and Griffiths (1996) identify three key information strategy components:

- business information strategy
- IS strategy
- IT strategy

Business information strategy is concerned with identifying, evaluating and defining the information and associated applications that are necessary to support business goals. *IS strategy* defines in greater detail the requirements for business services and how these will be delivered by business applications. *IT strategy*, on the other hand, is concerned with the infrastructure that will support the delivery of the necessary business applications. The relationships between these three components (and business strategy) are shown in Figure 3.6.

Figure 3.6. Information Strategy (Ward and Griffiths, 1996)



Ward and Griffiths' model is useful in terms of its recognition of the need to focus on content, systems and infrastructure but lacks an explicit activity concerned with effective information management. Earl's model (see below) is important in that it articulates the need for an enterprise-wide stance on information management.

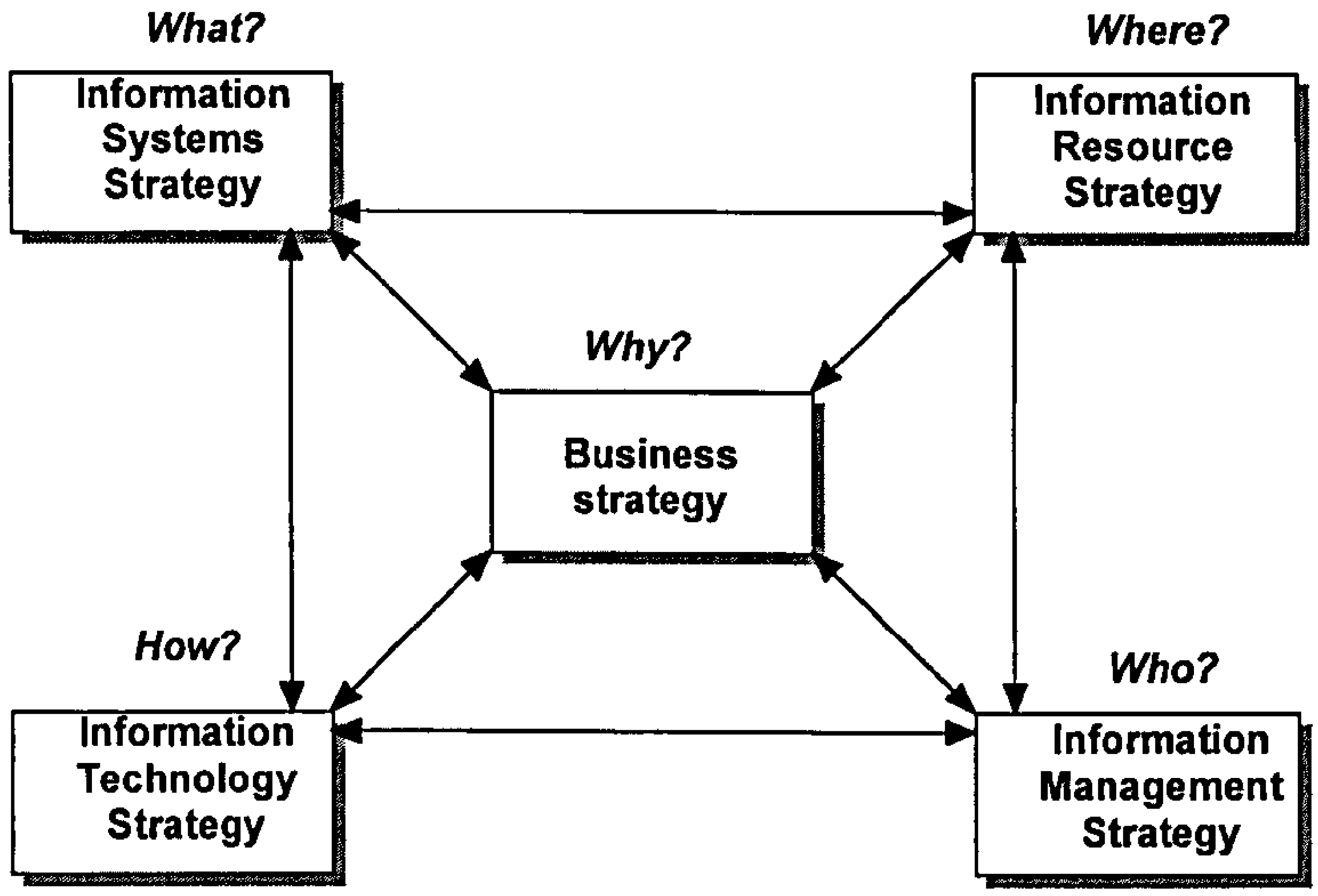
Earl (2000)

Earl (2000) identifies four key information strategy components (see figure 3.7), which provide a taxonomy for information strategy:

- Information Technology
- Information Systems
- Information Management
- Information Resource

Gibb, Buchanan, and Shah (2006) argue that Earl's use of the term 'information resource strategy' is perhaps unfortunate in that there has been a long-standing use of the term information resource to refer to all of the resources used to exploit information: information personnel, technology, systems, and content. They propose that a more appropriate term would be *information content* with associations to *content management*. Nevertheless Earl's model is important in making the distinction between the technologies needed for information processing (IT), the applications which support or instantiate business processes (IS), the information which businesses generate or consume (IR), and the over-arching management of all of these resources to satisfy business strategy (IM). However the replacement of the term *information resource* with the term *information content* is adopted from this point forward.

Figure 3.7. Information Strategy Components (Earl, 2000)



Information Technology Strategy

IT strategy is concerned primarily with technological infrastructure such as network architecture, standards, security, data integrity, service availability and maintenance, support and procurement. It answers the *how* question: how will we deliver business requirements? This covers desk-top platforms, peripherals, networks, servers and other shared computer processing capability and repositories of data, operating systems and software tools. The key goal of the IT strategy is to ensure that there is a robust but flexible platform infrastructure which can support the range of applications required to satisfy organisational objectives.

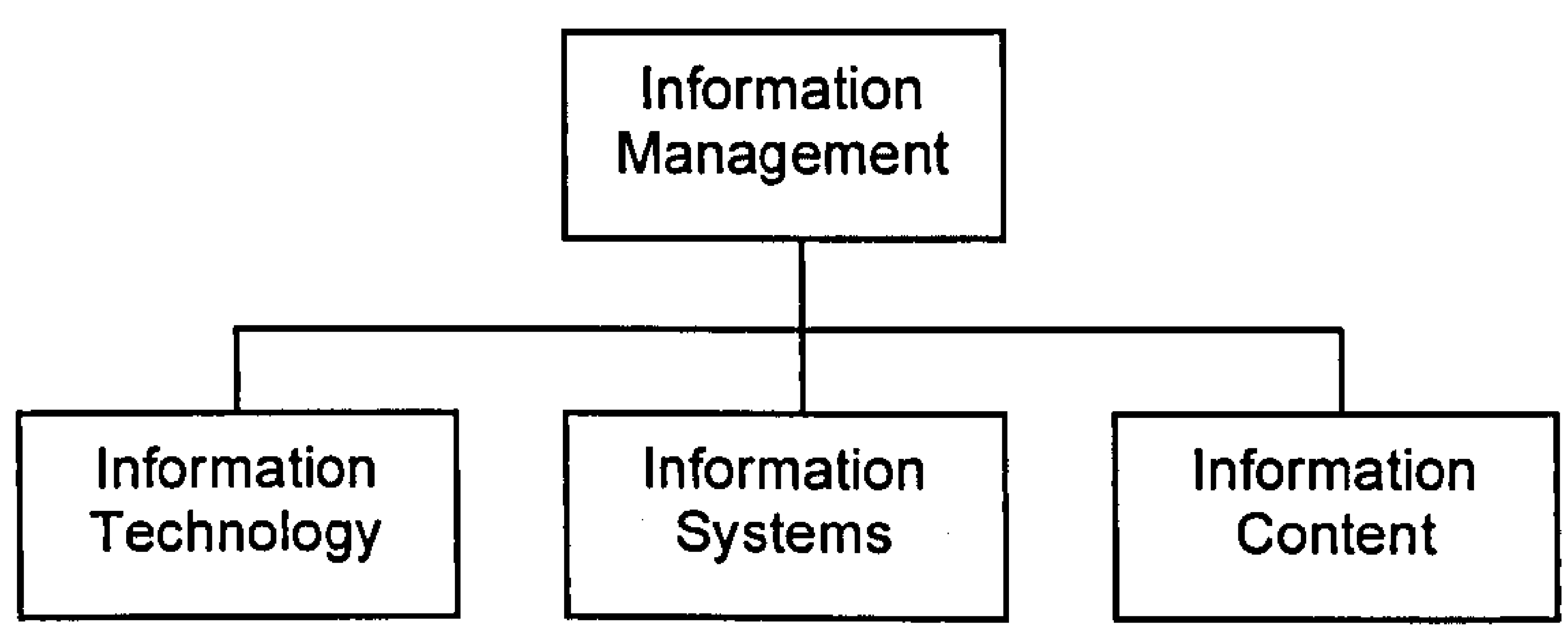
Information Systems Strategy

IS strategy is concerned with ensuring that IS development is in tune with organisational needs and hence with identifying and prioritising applications for development. This requires a focus on business and process models, data definitions, information architectures, and user needs. It is therefore concerned with the *what* question: *what applications set is required to meet business objectives.* An IS strategy will focus on enterprise-wide application needs and the systems which provide functional integration.

Information Management Strategy

IM strategy has a central role in defining the overall information strategy and associated performance measures. It is concerned with identifying and specifying the roles and responsibilities necessary for the delivery, support and development of IS and IT functions and activities (as illustrated in Figure 3.8 below). This involves establishing clear ownership and accountability for information activities and addresses the *who* question: e.g. who resources, authorises, quality assures, tests, maintains, controls, etc.

Figure 3.8. Hierarchy of information strategy components (Gibb, Buchanan, and Shah, 2006)



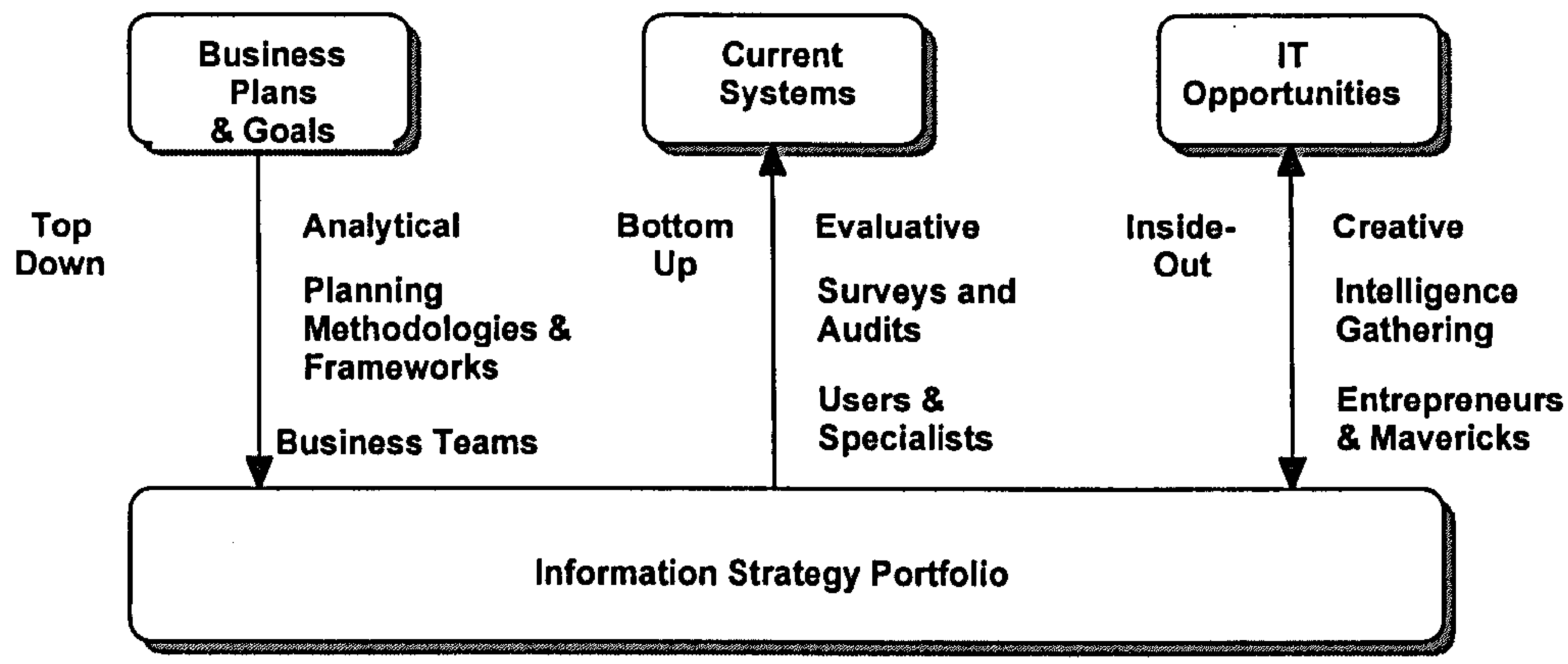
IM strategy is also concerned with the co-ordination of all related information resources and establishing the appropriate controls, guidelines and procedures which are necessary to ensure the quality, availability, protection and timeliness of information. Finally, it is concerned with identifying and ensuring that the competencies needed to deliver and exploit information, systems and technologies are available to the business.

Information Content Strategy

With the revised definition provided by Gibb, Buchanan, and Shah (2006) information content strategy is focused on information content and its management. Earl suggests that this is about answering the *where* question but it is perhaps simpler to view it as another *what* question: *what information do our employees, suppliers and customers need for us to be an effective business?* Information resource strategy must therefore consider categorisation of information (by subject, use, confidentiality, etc.), version control, archives, documents standards, metadata for information resource description, retention and disposal policies, and information quality. Categorisation is a particularly important activity as efficient and effective retrieval and protection is predicated by effective analysis and indexing. Importantly, information resource strategy involves information on all forms of media (paper, film, tape, disc, etc.) and all forms of information (image, sound, text and data). In addition, depending on the approach taken to knowledge management, it may include intellectual capital such as patents and copyrighted material.

Earl suggests that the creation of these strategies can be assisted by using a three-pronged attack to identify where the enterprise wants to be, what resources the enterprise currently has (and by implication what it does not have) to achieve this desire, and what technological opportunities there are to bridge the gap (see Figure 3.9, page 81).

Figure 3.9. Framework for information strategy formulation (adapted from Earl, 1989)



Leg one of Earl's model matches IS investments with business needs by adopting an analytical top-down approach supported by a formal methodology and inputs from business teams. These business teams should involve representatives from relevant stakeholder groups and not be restricted to technical specialists. Leg two evaluates current information management capabilities by conducting bottom-up surveys and internal audits to identify gaps that need to be filled. Leg three is concerned with looking outside the business to identify opportunities afforded by IT which may yield competitive advantage or create new strategic options by a creative approach that encourages entrepreneurial managers to generate innovative solutions. It is also concerned with monitoring competitors' utilisation of IT. It is therefore part of the environmental analysis that should be undertaken as part of strategy development. An information audit would encompass all of these legs (as stages of the audit), with the second leg expanded to become the identification and evaluation of information resources (which would include information systems). As a basic framework, the information audit would begin by identifying the business goals and activities, before identifying the related information resources, and then exploring innovative IT solutions as part of the final information audit strategy analysis and formulation stage.

Earl's taxonomy provides a logical breakdown of information strategy components, which, it is proposed, could be used to manage information audit scope, addressing problem statement two (see Section 1.1.1, page 4): *there is little practical guidance on how to tailor the information audit to individual circumstances, and to manage scope.* Following Earl's taxonomy (see Figure 3.8, page 80), it is proposed that an IA could focus on one or more components, dependent upon individual circumstances and purpose. This makes explicit the implicit relationship between IA and Information Strategy, that is: if a key output of the IA is an information strategy, then IA scope should align with information strategy taxonomy. The further benefit realised by this structuring, is that it provides a model for managing the scope and application of the IA. This concept is further explored in section 3.5 (pages 102-104).

3.3.3. The relationship between information strategy and business strategy

> As we enter the 21st century, one thing is clear: business strategy cannot and should not be designed and deployed in isolation from IT. It is no longer acceptable for business strategists to play the lead role and the IT strategists the support role; both should take the lead in designing the business platform. (Venkatraman & Henderson, 2000)

Business strategy has long been regarded as the parent of information strategy. From this traditional perspective, business strategy drives and governs ICT development and procurement, with ICT viewed as infrastructure supporting business processes; however, in today's online, digital world, this relationship has evolved to become much more mutually dependent.

ICT now shapes and influences the business environment, creating new markets and business models, and offering competitive advantage in existing markets through new service offerings and delivery channels. As a consequence, there is now growing recognition that a unified, iterative approach should be taken to business and information strategy development (see Figure 3.10 below).

Figure 3.10. A unified approach

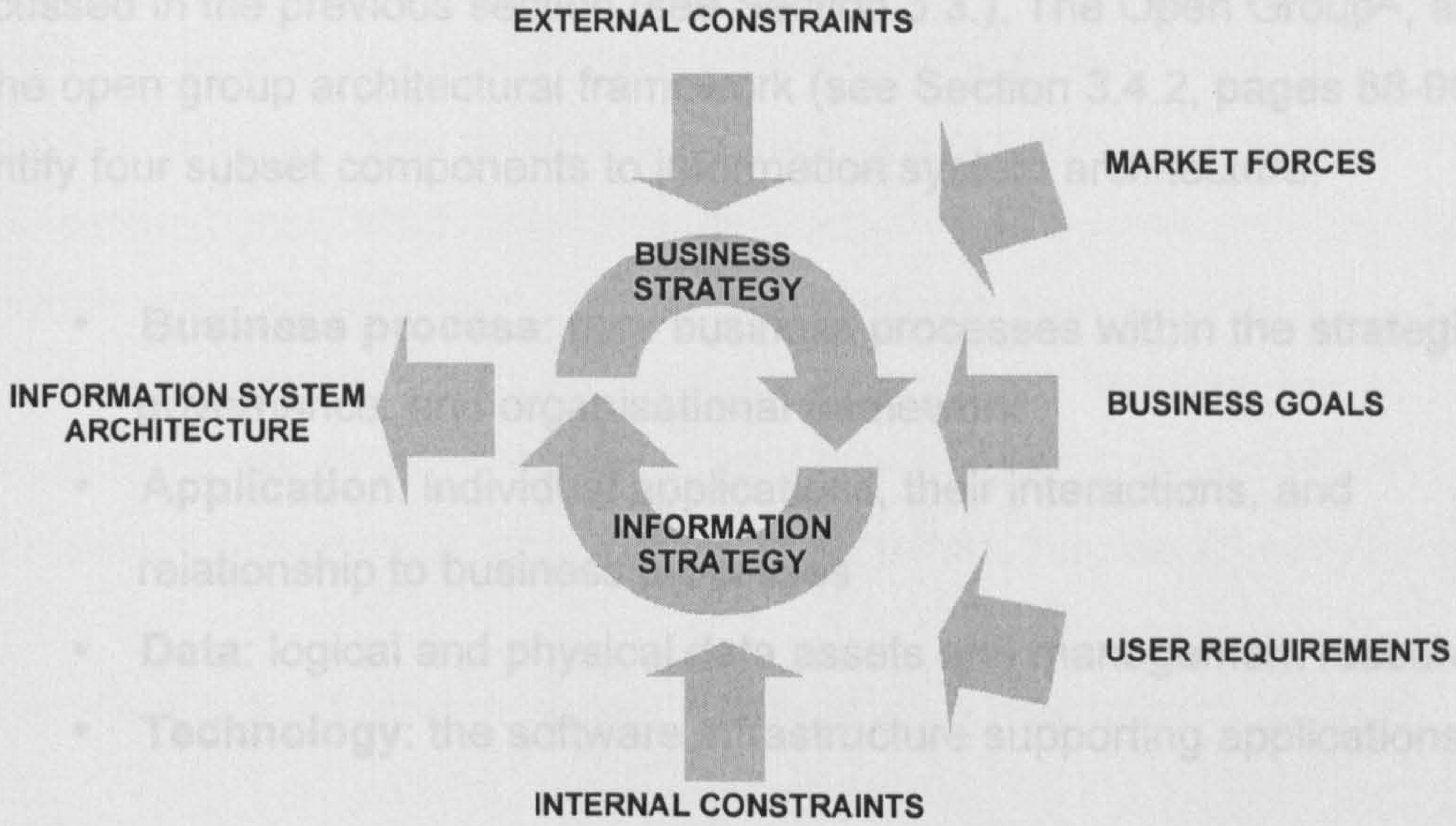


Figure 3.10 also introduces the relationship between information strategy and information systems architecture, explored further in the next section.

3.4. Information System Architecture

The definition of information system architecture as provided by IEEE[1] standard 1471–2000 is:

> The fundamental organisation of a system, embodied in its components, their relationships to each other and the environment, and the principles governing its design and evolution.

Drawing parallels with Earl's breakdown of information strategy elements discussed in the previous section (see Section 3.3.), The Open Group[2], as part of the open group architectural framework (see Section 3.4.2, pages 88-95), identify four subset components to information system architecture:

- **Business process**: core business processes within the strategic, governance, and organisational framework
- **Application**: individual applications, their interactions, and relationship to business processes
- **Data**: logical and physical data assets and management resources
- **Technology**: the software infrastructure supporting applications

This direct mapping from information strategy to information system architecture (see Figure 3.14, page 101) further supports the proposal to adopt Earl's Information Strategy taxonomy as part of an *IA Framework*. To further develop this framework, the following sections review popular approaches to architectural representation and development, with a view to identifying the

---

[1] http://www.ieee.com

[2] http://www.

relationship between IA, Information Strategy, and Information System Architecture development. However, prior to discussing system architecture, it is important to highlight the importance of system thinking to architectural representation and development.

3.4.1. Systems Thinking

> With information systems now permeating almost every aspect of our environment, systems' thinking has never been more relevant to engineers and managers.
>
> Dutta (2003)

A system is a set of logically related components (software, hardware, processes, people, data), brought together to accomplish a predefined organisational goal, which in information systems, is achieved primarily through the processing of information. Importantly, systems have *emergent properties* that would not exist if their component parts were not linked together (organisations are excellent examples of these emergent properties, as collectively, employees generally achieve more than they would individually).

Systems share the following six key characteristics (Buchanan, 2003):

- The components of a system work towards a collective goal
- Systems do not work in isolation, but within an environment
- Systems are hierarchical
- Systems can be complex, and made up of other, smaller subsystems
- Coupling defines how closely linked subsystems are
- The output of a subsystem is the input to another.

Any reasonably complex system will contain various *sub-systems*: entities grouped together to perform specific tasks that contribute to the overall purpose of the whole system. Every system has a boundary, outside of which exists the *system environment*, where there are entities, which affect the system, but cannot be controlled by the system. The key starting point for the analysis or design of any system is to decide what should be regarded as inside the system, and what should be regarded as out-with the system, but part of its environment. These conventions are important as they have implications for the management and performance of the system. For example, the entities within a production system can be regulated by its managers to ensure that it generates products in the desired numbers, and to the desired specifications; however, the markets where these products will be sold are subject to market forces largely out with the control of production managers, and variations in demand can result in over- and under-production. The market, therefore, is part of the system environment.

Within systems theory, there are two quite strongly conflicting views about the fundamental nature of systems and how they should be defined, modelled, and measured. These differing perspectives are referred to as hard and soft systems theory:

- **Hard systems:** a view commonly advocated by professionals working in the manufacturing, engineering, and information technology sectors. They maintain that systems are tangible: one can see them, touch them, measure them, and follow the progress of inputs through various transformation processes to the intended outputs. The basis of this view is grounded in the information theory model of Claude Shannon (1948) but can be seen applied in many requirements engineering tools, for example, state transition diagrams, data flow diagrams, dialog maps.

- **Soft systems:** a view supported most strongly by professionals working within social systems, arguing that systems are based on ideas, or models of the world, and that only parts of these systems are represented by objects in the physical world (for example, organisational or market characteristics, such as management conservativeness, or user willingness to accept change, impact acceptance and deployment of information systems, but both are difficult to define and measure). An example approach to soft systems modelling is provided by Checkland & Scholes (1990).

Despite the philosophical debate on these views, it is hard to believe that there is a single, correct answer, as both approaches provide useful insights into the processes and information flow that underpin an organisation. For example, when we consider the information spectrum (see Figure 3.1, page 55), data and information can be readily mapped and represented from a hard systems perspective, but knowledge is not so straightforward, requiring both hard and soft system approaches to fully model this key resource. Further, information systems are designed and built in response to the needs of the organisation and its environment. As previously noted (see Section 3.1.3, page 87), they take into account complex social, economic, organisational, and ergonomic requirements and relationships, as well as having to be technically and logically sound.

For an IA to be effective it must incorporate both hard and soft systems theory. The challenge is identifying the individual elements to be modelled, and the appropriate level of detail required. The following sections look at architectural frameworks which model the organisation as a whole.

3.4.2. Information System Architecture Frameworks

The definition of architecture as provided by IEEE[3] standard 1471–2000 is:

> The fundamental organisation of a system, embodied in its components, their relationships to each other and the environment, and the principles governing its design and evolution.

Beveridge and Perks (2003) define enterprise architecture as:

> The collection of strategic and architectural disciplines that encompass the information, business system, and technical architectures.

The Open Group[4], upon which Beveridge and Perks' definition is based, further define this as consisting of four subset architectures:

- Business process: core business processes within the strategic, governance, and organisational framework
- Application: individual applications, their interactions, and relationship to business processes
- Data: logical and physical data assets and management resources
- Technology: the software infrastructure supporting applications

Two popular approaches to architecture development are discussed: The Open Group Architectural Framework (TOGAF), and the Zachmann Framework.

---

[3] http://www.ieee.com

[4] http://www.opengroup.org

The Open Group Architectural Framework

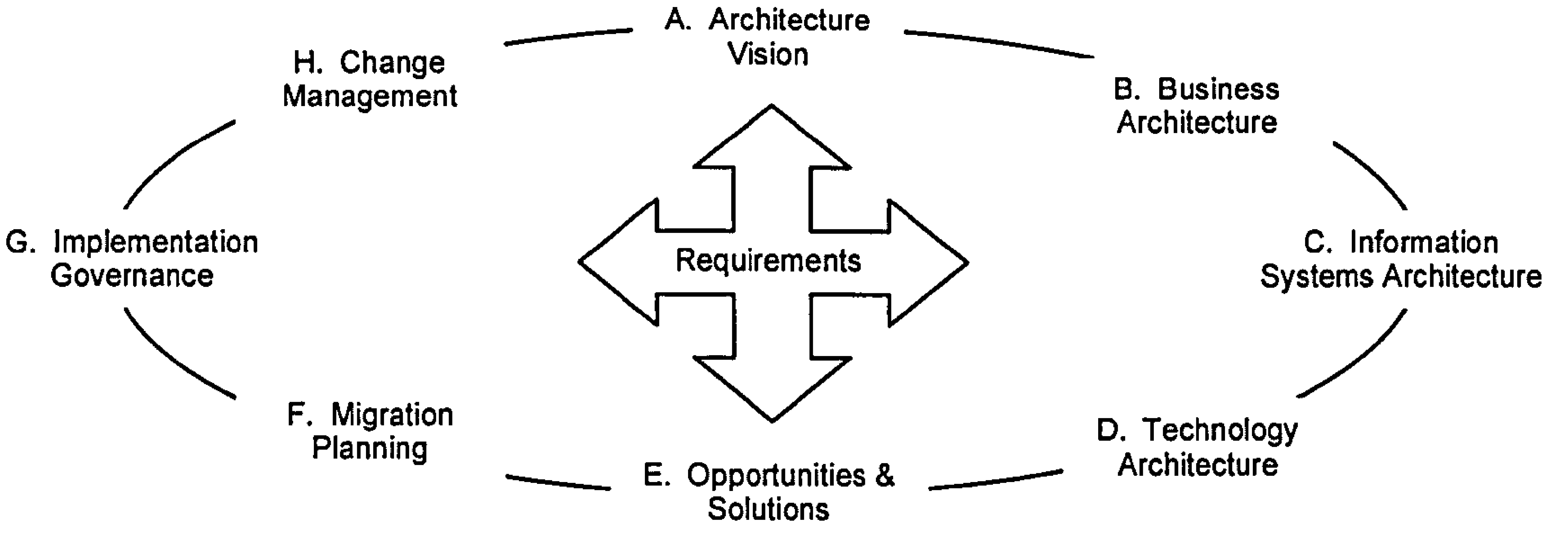
The Open Group Architectural Framework (TOGAF) is an enterprise architecture development method, which can be applied at the enterprise, multi-system, or single system level of an organisation. The original version (1) released in 1995 was based on the Technical Architecture Framework for Information Management (TAFIM), developed over several years by the US Department of Defense. Since 1995 TOGAF has evolved year-on-year through extensive industry consultation and user-group feedback and involvement; the following discussion references TOGAF Version 8 Enterprise Edition.

TOGAF consists of three main parts:

1. **Architectural Development Method**: The architectural development method (ADM) is at the core of the TOGAF model, providing a systematic step-by-step approach to enterprise architecture development. In overview, there are nine stages to the architectural development method, as illustrated in Figure 3.11 (see page 91). The model begins with traditional (e.g. project management) setup tasks associated with scope, definition, and management processes. The next phase continues scoping and establishing the remit of the architectural exercise, but with the emphasis now on vision, strategic alignment, and organisational recognition and endorsement. The following three phases focus on systematic architectural modelling (baseline and target) of the business domain, information systems, and technology platform(s). The final four phases are concerned with migration planning, change management, implementation and governance (parallel rather than sequential processes). ADM is regarded as a continuous, cyclical, and iterative process with the first iteration regarded as the hardest, primarily due to having just set out on the enterprise continuum (see Figure 3.11, page 91), and consequently lacking reusable building blocks and resources from

previous cycles (building blocks are a core feature of TOGAF which are discussed later).

Figure 3.11. TOGAF Application Development Method (TOGAF, 2002)

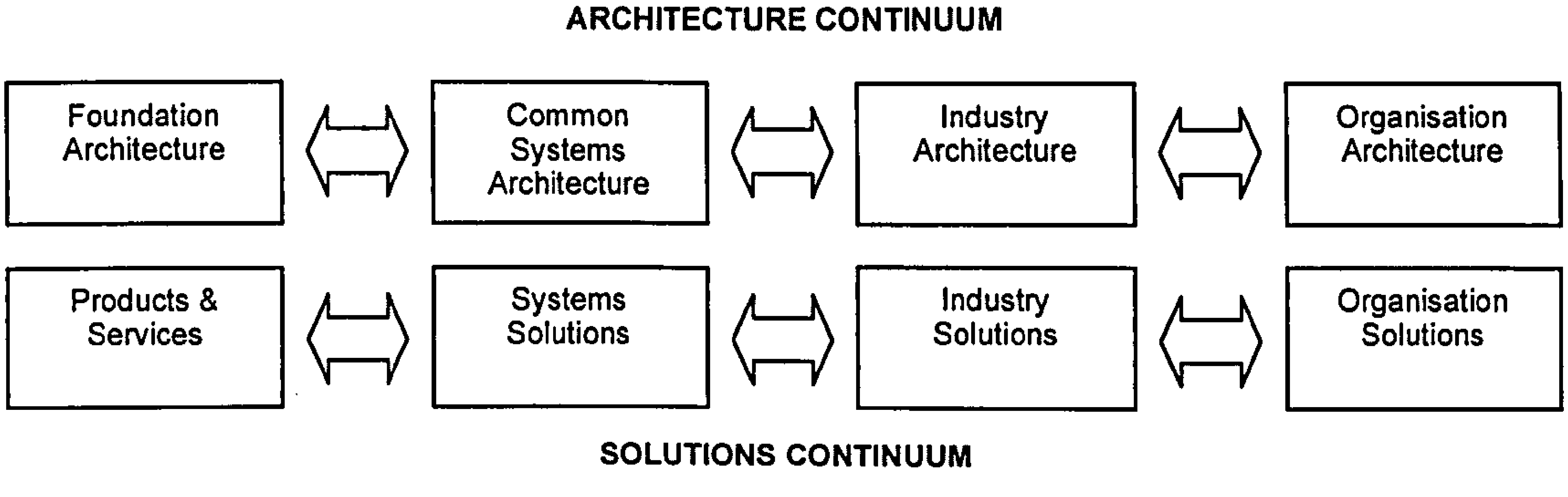


2. **Enterprise Continuum**: a virtual repository of architectural artefacts and assets, which exists to enable architectural development. This continuum is expressed by TOGAF as a combination of two complementary architectural concepts:
    - Architectural continuum: provides a way to define and understand generic architectural rules, representations, and relationships among foundation frameworks (baseline generic service platforms); and to discover commonality and eliminate unnecessary redundancy. Presented as an evolutionary process, which begins with the TOGAF foundation architecture, through common system architectures (security, network etc.), and industry specific architectures, to an organisation's own individual architecture (see Figure 3.12, page 92). The continuum represents a progression from logical to physical, and from general to specific, with the design process based upon adoption/leverage of reusable architectural components and building blocks.

- Solutions continuum: the solution continuum (products & services, system solutions, industry solutions, organisation solutions) represents the implementation of the architecture at the corresponding levels of the architecture continuum. At each level, the solutions continuum is a population of the architecture with reference to building blocks, either purchased products or built components, that represent a solution to the enterprise's business need expressed at the respective level. A populated solutions continuum can be regarded as a solutions inventory or reuse library, which can add significant value to the task of managing and implementing improvements to the ICT environment.

3. **Resource Base**: The TOGAF resource base specifies the resources required to support EA, and provides a selection of guidelines, templates, and background information to support the use of the TOGAF ADM. The resource base is also a repository of case studies, and includes guidelines for evaluating architectural tools.

Figure 3.12. The Enterprise Continuum (TOGAF, 2002)



The enterprise continuum, at the highest level, is a conceptual model providing a logical schema for architecting ICT systems; the actual physical repository of architectural assets (based on this model) is sourced both internally and externally (e.g. industry reference models). TOGAF provides the following reference models, which provide the foundation for the enterprise continuum:

- **Foundation architecture**: this comprises a Technical Reference Model (TRM) of generic services and functions, and a Standards Information Base (SIB):
    - Technical Reference Model: defines the standard application platform and associated interfaces, and ensures that higher-level building blocks (which provide business solutions) have a complete, robust platform on which to operate. The TRM is platform- centric, in that it focuses upon the services and structure of the underlying platform necessary to support the use and reuse of applications. In particular, it pays attention to the interfaces between platforms and supported applications, and between the platform and the external environment, with an emphasis on interoperability and portability. Expressed another way, it provides a catalogue of all the technical services required to support business systems. A simple, high-level breakdown of the core TRM services is provided in Table 3.1 (see page 93).
    - Standards Information Base: an online database[5] of facts and guidance about information systems standards, sourced from: ISO[6], IEEE[7], Internet Society[8], WWW Consortium[9], and the

---

[5] http://www.opengroup.org/sib2/

[6] http://www.iso.org/iso/en/ISOOnline.openerpage

[7] http://www.ieee.org/portal/index.jsp

[8] http://www.isoc.org/

[9] http://www.w3.org/

Object Management Group[10]. The standards are all Open Group standards, which have been approved by members as appropriate for architecture specification and procurement.

Table 3.1. TRM taxonomy (TOGAF, 2002)

Data Interchange Services	**System and Network Management Services**
Graphics and Imaging Services	**International Operation Services**
Location and Directory Services	**Operating System Services**
Network Services	**Software Engineering Services**
Transaction Processing Services	**User Interface Services**
Security Services	**Data Management Services**

- **Integrated information infrastructure reference model (III-RM)**: a common system architecture that focuses upon requirements, building blocks, and standards for open, internet-based information flow. The Integrated Information Infrastructure Reference Model (III-RM) is a subset of the TOGAF TRM in terms of overall scope, but also expands on the TRM by focusing on the application space (as opposed to the application platform space focused on by the TRM), in particular, the business applications and infrastructure applications required to provide an integrated information infrastructure. A key goal of the III-RM is to support and enable 'boundary-less information flow'. The III-RM model assumes the existence of an underlying computing and network platform, and consequently focuses upon

[10] http://www.omg.org/

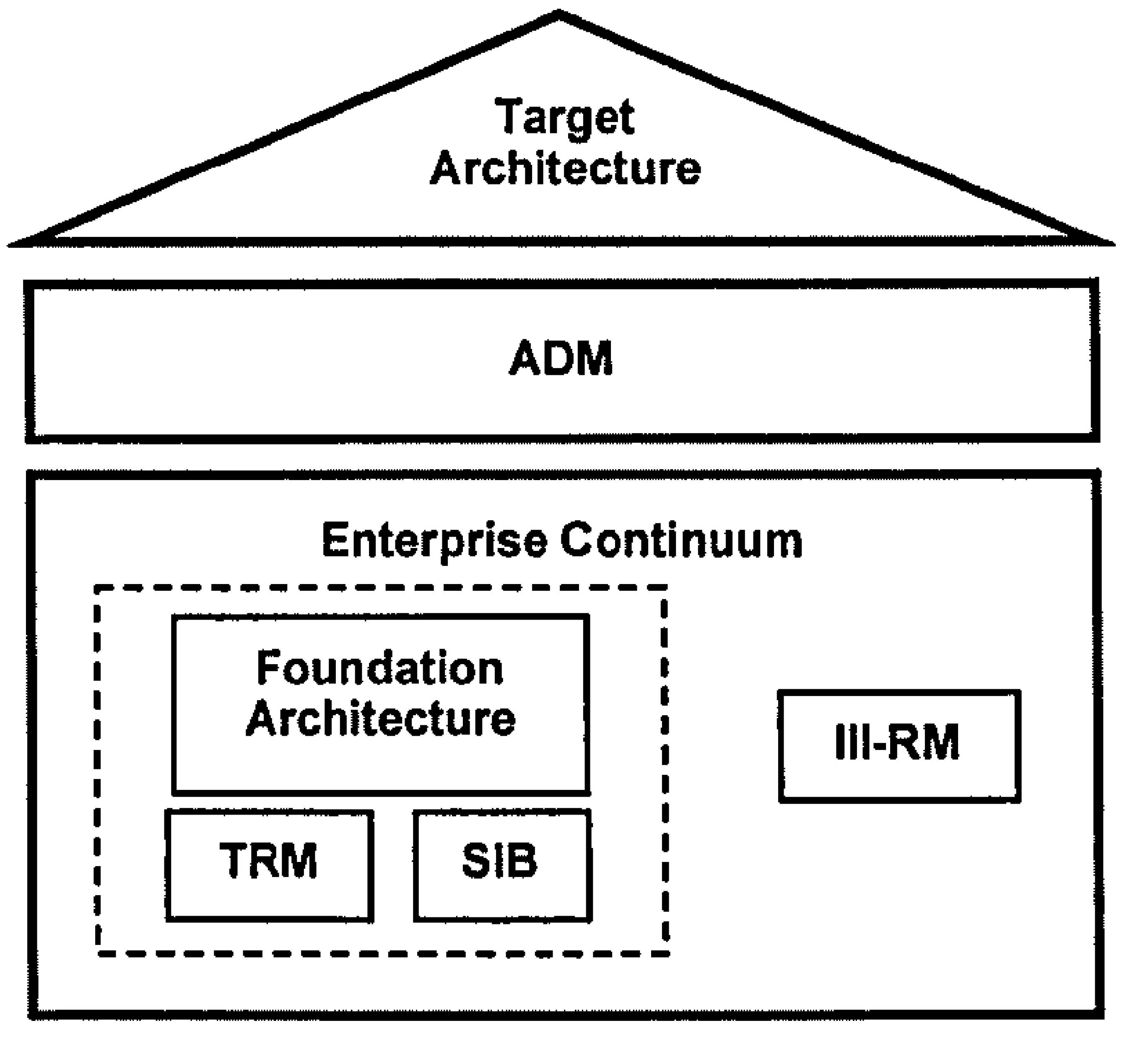
the application components and application services software essential for an integrated information infrastructure. The Open Group acknowledges the existence of further business applications and infrastructure applications than those depicted by the III-RM model, pointing out that the model focuses upon the subsets relevant to the Boundary-less Information problem space. The components of the model are defined as follows:

- Business applications: provide an environment which provides a rich set of end- user services for transparent access to heterogeneous systems, databases, and file systems. There are three types depicted by the model: information provider applications provide responses to client requests, and rudimentary access to data; brokering applications manage requests from clients which require access to multiple information sources; information consumer applications deliver content to the user of the system, and provide services to request access to information.
- Infrastructure applications: provide build and support services. Two types are depicted:
    - development tools are the applications for modelling, designing and constructing the integrated information infrastructure. This includes tools for business, process, and data modelling, as well as traditional application construction tools
    - management utilities provide services to understand, operate, tune, administer and manage the integrated information infrastructure (including storage management utilities).
- Application platform: a subset of the TRM, focused upon services which ensure effective and consistent transfer of data between processes, and support fast and efficient development, deployment and management of applications.

- Interfaces: include formats and protocols, application programming interfaces, switches, and data values etc.
- Qualities: refers to operation and support standards as typically defined within a service level agreement.

The relationship of these models to each of the previously introduced elements of TOGAF, are illustrated in Figure 3.13 below. This represents the complete TOGAF model.

Figure 3.13. TOGAF foundation components (TOGAF, 2002)



Zachman Enterprise Architecture Framework

> When the question is asked, 'What is information systems architecture?' the answer is, 'There is not *an* information systems architecture, but a *set* of them!' Architecture is relative. What you think architecture is depends on what you are doing. (Zachman, 1987)

The Zachman framework (Zachman, 1987) was proposed as an approach to information systems architecture, which tackled the acknowledged, but then only partially addressed requirement for multiple stakeholder views of an information system architecture. Zachman drew on proven architectural principles and processes from the construction, manufacturing, and avionics industry, to develop a framework suitable for information systems architecture (long before the term *enterprise* architecture was coined). The framework provides a comprehensive and modular classification of viewpoints and models, representing and relating all stakeholder perspectives, and allowing architects to focus on selected aspects of the system without losing sight of the bigger picture. In the years since its publication it has become the de facto standard for many within the system architecture practitioner community.

The framework is a matrix of six columns and six rows providing thirty-six cells representing the views of a information system architecture (see Table 3.2., page 97[11]). The initial framework was made up of the first three columns (Zachman, 1987), but this was later expanded (Sowa & Zachman, 1992) to the six as illustrated. The columns represent the abstractions (or descriptions), which are possible, and which, when isolated, contain the complexity of the design problem.

> ...it is complicated enough to design the process-to-process relationships of an enterprise without attempting to address the entity-to-entity and location-to-location design issues at the same time... The challenge here is to design each while understanding the impact on the integrity of all the others to avoid being surprised by undesirable side effects appearing long after it is possible to contain them. (Sowa & Zachman, 1992)

---

[11] see: http://www.zifa.com

The columns of the framework represent the questions, which lead to the different perspectives. They are as follows:

- What the system is made of
- How the system works
- Where the system components and connections are
- Who does the work
- When things happen
- Why various choices are made

Table 3.2. The Zachman Framework (Zachman, 1992)

	DATA *what*	**FUNCTION** *how*	**NETWORK** *where*	**PEOPLE** *who*	**TIME** *when*	**MOTIVATION** *why*
SCOPE	List of things important to the business	List of processes the business performs	List of locations in which the business operates	List of organisations important to the business	List of events/cycles significant to the business	Lists of business goals & strategies
BUSINESS MODEL	Semantic model	Business process model	Business logistics system	Work flow model	Master schedule	Business plan
SYSTEM MODEL	Logical data model	Application architecture	Distributed system architecture	Human interface architecture	Processing structure	Business rules model
TECHNOLOGY MODEL	Physical data model	System design	Technology architecture	Presentation architecture	Control structure	Rule design
DETAILED REPRESENTATION	Data definitions	Program	Network architecture	Security architecture	Timing definition	Rule specification
FUNCTIONING ENTERPRISE	**Data**	**Function**	**Network**	**Organisation**	**Schedule**	**Strategy**

The rows represent the perspectives. They are as follows:

- Scope: represents the contextual view of the *planner* or investor who wants an estimate of the scope of the system, what it would cost, and how it would perform
- Business model: represents the conceptual view of the *owner* who wants to understand the business process model, and the relationship between entities and processes
- System model: represents the logical view of the *designer* who must determine the data elements and functions that represent business entities and processes
- Technology model: represents the physical view of the *builder* who must adapt the information system model to the details of the programming languages, I/O devices etc., and consider the constraints of tools, technology, and resources
- Detailed representation: represents the out-of-context view of the *subcontractor* who typically works from detailed specifications, often at the module level.
- Functioning enterprise: represents the operational system view.

Zachman is a logical framework, which does not prescribe or describe any particular method, representation technique, or automated tool (although prescriptive guidance is provided through consulting services available via the Zachman Institute[12]). It is a basic structure for a set of architectural representations of an enterprise architecture. The Open Group state that the main strength of the Zachman framework is that "it provides a way of thinking

[12] http://www.zifa.com

about an enterprise in an organised way, so that it can be described and analysed".

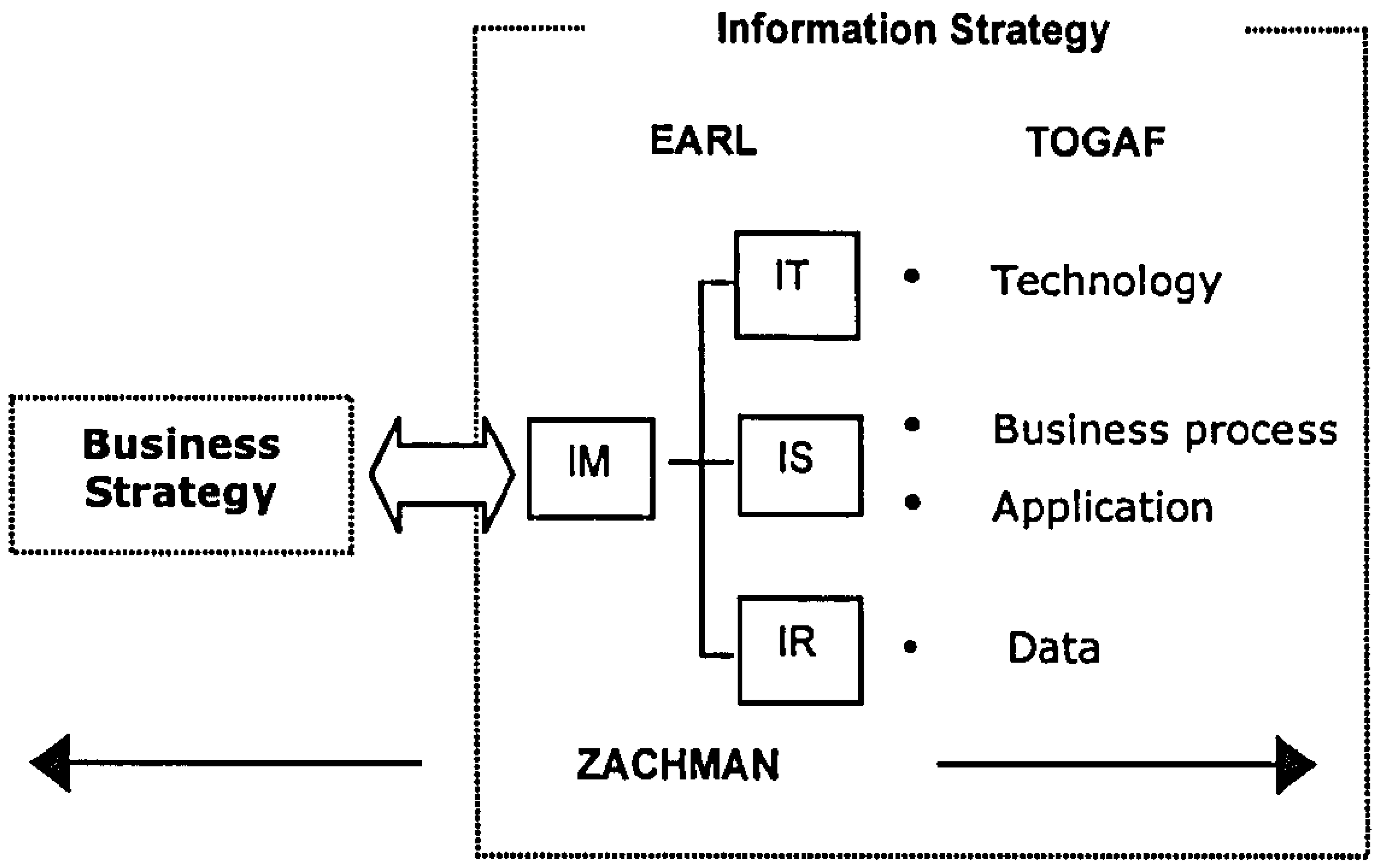
In contrast to Zachman, the TOGAF framework provides a step-by-step method for enterprise architecture planning, development, and change management. While Zachman is simple and non-prescriptive, TOGAF is detailed and prescriptive; however, rather than viewing the frameworks as either/or approaches, they should be considered as highly compatible components of an overall tailored approach to system architecture development. Viewed in combination, TOGAF provides the methodological step-by-step development process, while Zachman guides representation, analysis and design.

3.4.3. Information System Architecture and the Information Audit

The architectural frameworks discussed in the previous section are important to the information audit, as they identify the next stage of information system development following on from the establishment of information strategy. This assists in further defining the role and purpose of the information audit by identifying the stages/steps which both precede and follow the IA.

In an ideal best practice scenario, the information system architecture would be driven and guided by information strategy, with both facilitated by the output of the information audit. The Zachman framework identifies the architectural entities essential to a "system view", while TOGAF extends Earl's taxonomy, bridging the gap between information strategy and information system architectural development. These key relationships are illustrated in Figure 3.14 (page 100).

Figure 3.14. Business Strategy, Information Strategy, and Information System Architecture



To achieve convergence and integration with the information audit, synchronicity should be sought between the outputs of the information audit and the respective inputs to both strategy and architectural development. While the link between the information audit and information strategy has been formally acknowledged and incorporated into audit methodologies (most notably Orna [1990] and Buchanan & Gibb [1998]), the link from audit to system architecture has not. It is the author's opinion that this is a key gap. To bridge this gap and position the information audit as a useful aid to both information strategy and information system architecture development would require the information audit to integrate into the model illustrated in Figure 3.14 above. Providing this linkage would address problem statement three (see Section 1.1.1, page 5): *there is ambiguous linkage from the information audit to related information system development practices, which limits the potential value of the information audit.* At a high level this could be accomplished by incorporating representations or views into an information audit methodology, which mirror those presented in Figure 3.14 above (establishing an information audit taxonomy). At the more detailed level, synchronicity between inputs/outputs is required. For example (illustrative only as dependent upon analysis of individual IA methodologies), the output of an information audit (as defined in Section 3.2.3, pages 71-72) could map (approximately) to the top two rows of the Zachman framework: Scope and Business Model; and contribute to the application architecture component of the system model (see Table 3.3 below). The remaining cells of the Zachman framework are more closely associated with systems development and consequently considered out with the scope of the IA (and architecture).

Table 3.3. From Information Audit to System Architecture Development

	DATA *what*	FUNCTION *how*	NETWORK *where*	PEOPLE *who*	TIME *when*	MOTIVATION *why*
SCOPE	List of things important to the business	List of processes the business performs	List of locations in which the business operates	List of organisations important to the business	List of events/cycles significant to the business	Lists of business goals & strategies
BUSINESS MODEL	Semantic model	Business process model	Business logistics system	Work flow model	Master schedule	Business plan
SYSTEM MODEL	Logical data model	Application architecture	Distributed system architecture	Human interface architecture	Processing structure	Business rules model
TECHNOLOGY MODEL	Physical data model	System design	Technology architecture	Presentation architecture	Control structure	Rule design
DETAILED REPRESENTATION	Data definitions	Program	Network architecture	Security architecture	Timing definition	Rule specification
FUNCTIONING ENTERPRISE	Data	Function	Network	Organisation	Schedule	Strategy

note. shading denotes were IA output can provide input to system architecture development.

Absolute matching of input/output could be sought through detailed specification of IA tasks and standardised output, but it is the author's belief that the above general mapping would suffice in most IA instances, with the benefit of not overly extending or complicating the IA process. As a research exercise, explicitly mapping respective inputs and outputs to each other would be a valuable exercise, but is deemed outwith the immediate scope of this study; however, it is noted as a key area for further research. The immediate value of Table 3.3 (page 101) is in illustrating the relationship between the outputs of the IA, and the inputs to the architectural development process (in response to problem statement three [see Section 1.1.1, page 5). While it is the author's belief that absolute matching of input/output is not necessary, the establishment of an information audit methodology taxonomy is deemed both necessary and of high immediate value. This is explored further in the next section.

3.5. The scope of the information audit

The previous sections (3.1-4, pages 54-102) provided key direction for the role of the IA, particularly with regard to defining scope and application. Key observations/recommendations were that:

- Earl's (2000) taxonomy (adopting the revised model proposed by Gibb, Buchanan & Shah [2006]) provides a logical breakdown of information strategy components, which can be used to manage and direct information audit scope. It is proposed that an IA could focus on one or more components, dependent upon individual organisational circumstances and the purpose of the audit.
- Information System Architecture models provide the key linkage from information audit to enterprise architecture development and management. While the link between the information audit and information strategy has been formally acknowledged and incorporated into audit methodologies

(most notably Orna, 1990 and Buchanan & Gibb, 1998), the link from audit to information system architecture has not. The Zachman (1987) framework identifies and defines the organisational and architectural entities essential to a "system view" and can be mapped to output of the IA, while TOGAF extends Earl's taxonomy, bridging the gap between information strategy and information system architecture.

This mapping provides a number of key benefits. In summary, Earl provides a useful taxonomy (supported by TOGAF), which would provide the information auditor with the flexibility to focus on one or more individual IS elements (and manage scope), while Zachman provides integration from IA output to EA input, extending the value realised from the IA, and correctly putting information requirements before technology solutions. Alignment and reuse can then be achieved between the respective outputs of the audit and the inputs to both strategy and architectural development.

As previously highlighted, alignment across these related frameworks/models would be facilitated by the establishment of an information audit taxonomy which aligned with the taxonomies of Earl (2000), TOGAF, and Zachman (1987), allowing the IA to be scoped by information strategy component, based upon stakeholder perspective and/or organisational imperative. A further dimension proposed to support this taxonomy is information audit 'view'. This would allow the information audit to be scoped by information strategy component and by organisational perspective (e.g. the organisational focus and corresponding level of detail required of the information audit). Views (or perspective) are important as they provide guidance for the information audit; for example, it is not enough to know that the focus might be information systems, what level of detail is required and for what purpose (the required depth of information audit was highlighted as an issue in Section 3.2.3, page 73). Similar questions are raised for the other three elements. The question now raised is: what are the elements of this second dimension?

The previous sections have highlighted and mapped the role of the information audit in relation to information strategy and information resource management. It is proposed by the author that these could be considered as *strategic* and *resource* perspectives respectively. A further view, which should be added, in acknowledgement of the importance of business process management (Gibb, Buchanan, & Shah, 2006), is the *process perspective*. The now complete proposed information audit scope matrix is illustrated in Figure 3.15 below.

Figure 3.15. IA Scope Matrix

	Information Management	**Information Technology**	**Information Systems**	**Information Content**
Strategic				
Process				
Resource				

The benefits of IA "perspectives" are that, similar to Earl's taxonomy, they allow the IA to be tailored to individual requirements and *provided with a particular focus according to organisational needs* (the key). It is the author's belief that it would be unlikely that one view would be taken in isolation (as there is some dependency: for example, conducting a resource view without strategic or process input would lack organisational context or direction), but highly likely that two would be used in combination, with one receiving particular attention over another. Each of these proposed IA views are introduced and discussed in more depth below.

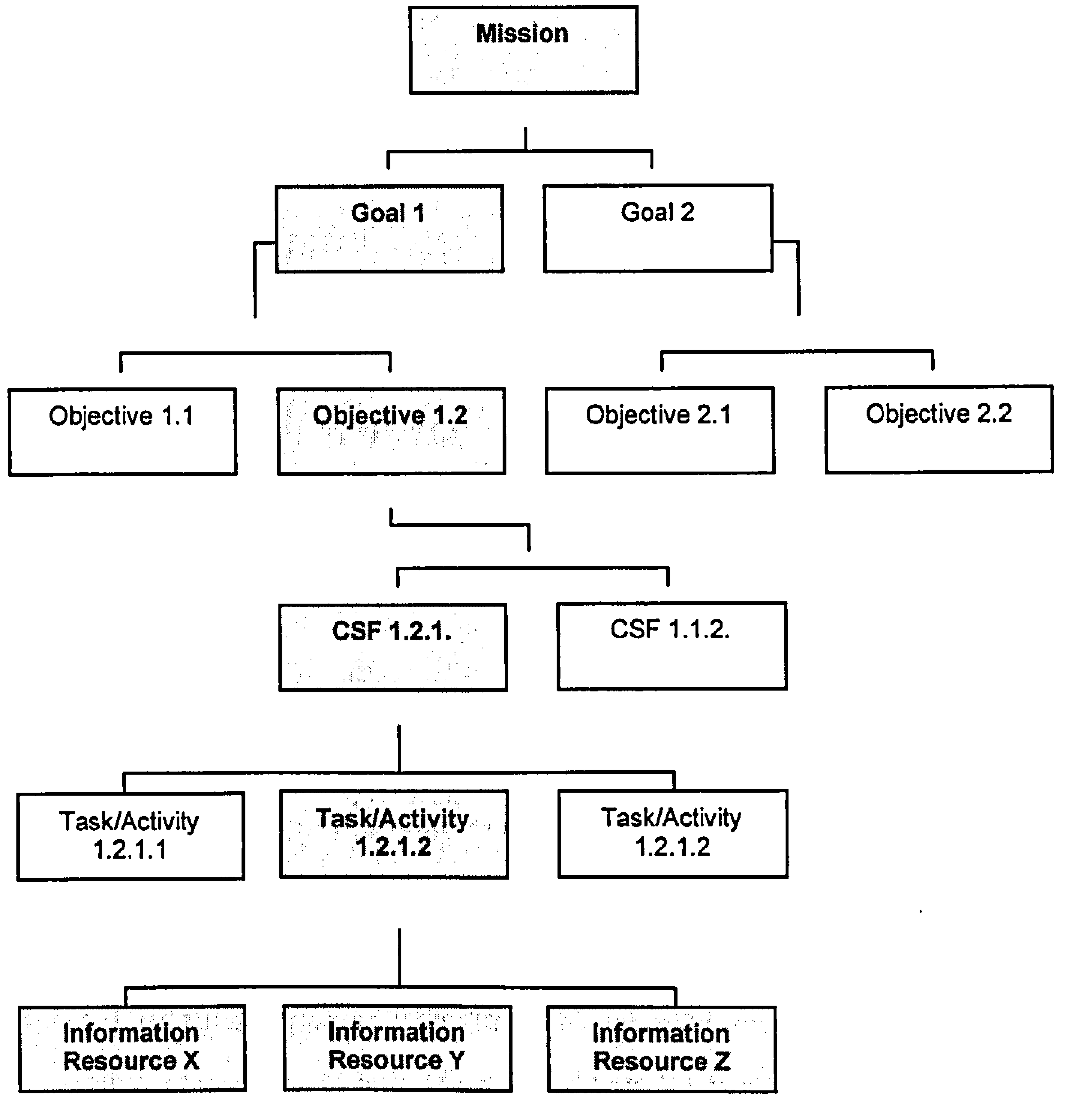
3.5.1. The Strategic Perspective

The strategic perspective would focus upon the realisation of strategic objectives through mapping and analysis of the relationship from organisational mission to information resources. Buchanan (1995) proposed a simple hierarchy to define and map this relationship (see Figure 3.16, page 107), which has also been incorporated into Henzcel's (2000) approach to information auditing (see Section 4.6, page 160). The model focuses on two key high-level components of strategy (see Section 3.3.1, page 74-75): mission, goals and objectives; and then drills down to map from success factors to tasks and related information resources. Buchanan (1995) defined the key elements of this hierarchy as follows:

- **Mission**: provides the high-level operational direction and defines core values.
- **Goals:** are statements about a particular end state that the enterprise wishes to achieve over the medium to long term in accordance with the mission statement.
- **Objectives**: are the specific, quantifiable and attainable short-term targets, which measure the degree to which the enterprise is realising its goals.
- **Critical Success Factors (CSFs)**: are those factors essential to the achievement of objectives.
- **Task/activity**: are the specific steps which will be taken to ensure CSFs are met, and objectives realised.
- **Information Resources**: are those information resources required to support the achievement of tasks/activity.

The three top levels of Mission, goals, and objectives can be mapped to the four top levels of the Business Rules Group (2005) hierarchy (see Section 3.3.1, page 75), but then include unique lower level elements (CSFs and tasks) to provide the link from objectives to information resources for the specific purposes of the IA (the Business Rules Group hierarchy does not require this link being entirely focused on strategy).

Figure 3.16. From Organisational Mission to Information Resources (Buchanan, 1995)



In the strategic IA perspective, information resources are identified, but not inventoried. Priority and resulting depth of analysis would focus on those resources identified to be of greatest strategic importance (Buchanan [1995] proposed assigning values to resources on a scale of 1-5 according to degree of importance to the related task [see Table 3.4, page 112]). Any inventory information gathered would be viewed as a by product of the strategic investigation, which could, of course, be built upon in a later IA.

Typical questions to be answered by the IA would include:

- What is our mission?
- How can we achieve this?
- What is essential to our success?
- What information resources do we use/require?
- Are there any constraints?
- Where can we use information resources to our competitive advantage?

The key output of a strategically oriented IA would be an organisational information strategy. Recommendations would focus upon future strategic direction and the enabling role of information resources.

3.5.2. The Process Perspective

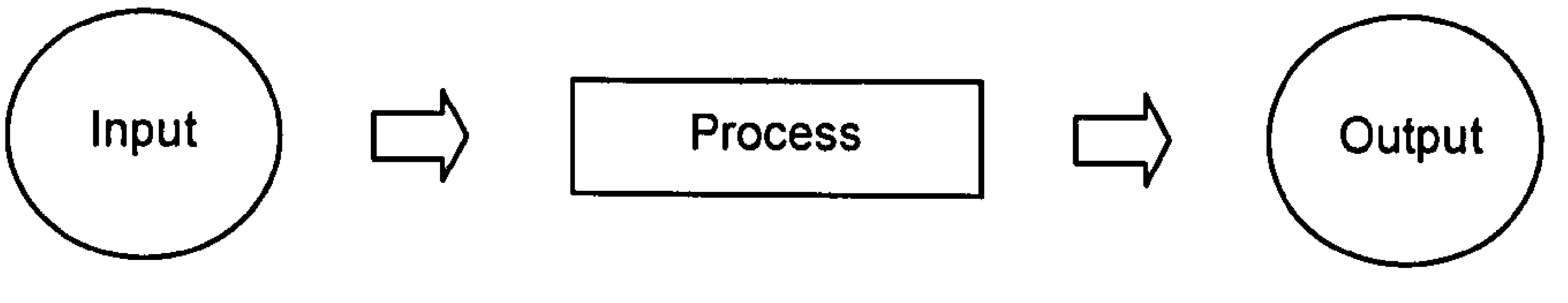
The process perspective focuses upon work flow and associated information flow through modelling of organisational processes. In simple terms, a process is a set, or sequence, of activities, that results in the accomplishment of a task, or the achievement of an outcome. While a functional structure is necessary to define reporting lines and to organise physical assets, an overemphasis on functions can create barriers to effective information flow and encourage managers to adopt protectionist stances, thereby constraining the value that can be generated by the enterprise. A process perspective transcends this functional view as it forces the enterprise to look at how information flows and how functions must co-operate in order to achieve customer satisfaction (Gibb, Buchanan & Shah, 2006).

The link between business processes and information strategy is an important one (Champy [2002], Gibb [2005]). Business processes enable business objectives, with information strategy fundamental to the effective operation of processes by ensuring an effective and efficient ICT infrastructure is in place.

Processes are one element of a system, and inherit several system characteristics. They begin with an input, and end with an output (see Figure 3.17); they contain sub-processes; have one or more customers, and typically, several stakeholders. They can be divided into three main types (Ould, 1995):

- Core processes (servicing external customers through fulfilling orders, manufacturing, insurance policy processing, etc.,)
- Support processes (servicing internal customers and providing administrative back-up for core processes, e,g. managing finances, purchasing, data processing)
- Management processes (planning, organising and overseeing the enterprise).

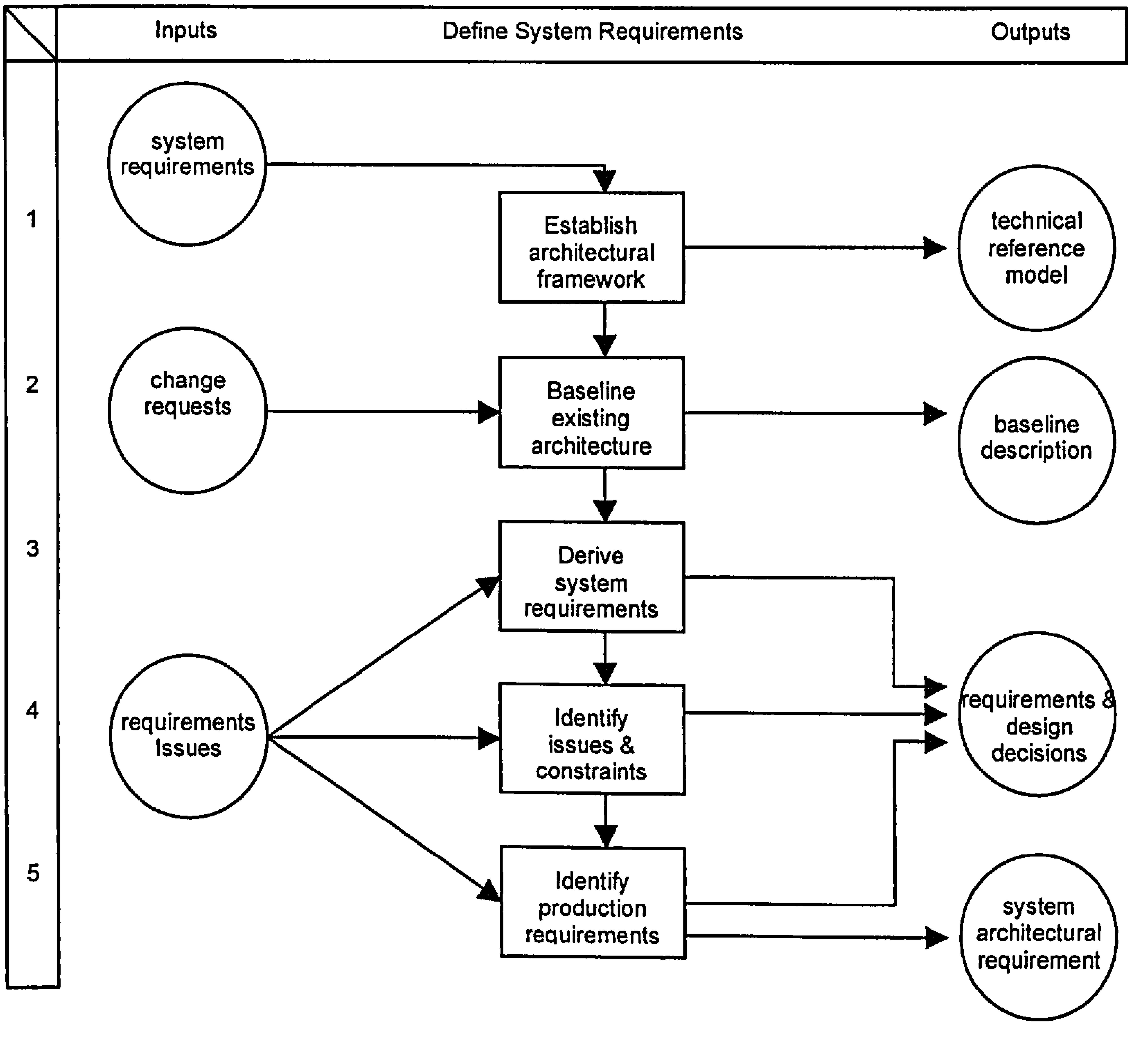
Figure 3.17. The process meta model



It is also important to distinguish between processes which are transactional and those which are analytical. A transactional process can be defined as the organised chain of activities by which an initial input of resources is converted into a pre-specified output, such as a product, service or processed information. A key objective of such processes is to impose standardisation. Standardisation is important for transaction-oriented processes as it helps to maintain the quality and consistency of the output. Transactional processes can be easily modelled and represented (for example: data structures, functions and workflows as defined by the Zachman Framework) and hence are amenable to implementation as information systems. In contrast analytical processes are not as easily represented (or standardised) as they include steps which are not easily mapped or measured; for example, judgement decisions. Output can be specified, but individual processes are often fuzzy.

Processes exist as day-to-day tasks and, if documented, are illustrated at the highest level as input-output based macro-level flowcharts (see Figure 3.18 below). Common techniques for more detailed modelling include: STRIM, UML, DFD, and IDEF.

Figure 3.18. Process Model: Example (Young, 2001)



Fundamental to effective modelling is to recognise that it is an incremental and iterative process, which benefits from a structured approach. Ould (1995), as part of the STRIM methodology, recommends an eight-step process modelling process:

1. Determine modelling objectives to provide overall scope, direction and purpose (measurement and improvement, system development etc).
2. Establish an overall picture to provide a high level perspective.
3. Interview senior personnel to verify objectives, discuss and refine the overall picture, and identify suitable representative personnel to participate in the modelling sessions.
4. Interview groups as part of facilitated modelling sessions (workshops), which identify and explore process goals, procedures, roles, resource usage, and information flow etc.
5. Interview individuals to define the process in detail (representative of the roles identified in the previous modelling sessions).
6. Review, revise, and validate models through feedback sessions (individual and/or group).
7. Analyse the models (final analysis as analysis began from the outset)
8. Respond to the analysis as per the objectives.

Ould (1995) provides a step-by-step approach to process modelling, which would be difficult not to follow due to its extremely logical nature.

Typical questions to be answered by a process oriented IA would include:

- What do we do?
- How do we do it?
- What information resources do we require?
- What systems do we use?

- What information related problems do we experience?
- What could we do to improve what we do?

The key output of a process oriented IA would be process based mapping and analysis of information flow and related information resources. Recommendations would focus upon improving existing workflow through better information provision, support and management.

3.5.3. The Resource Perspective

The resource perspective focuses on identification, classification, and evaluation of information resources. As previously noted, information resources are those resources, which facilitate the acquisition, creation, storage, processing, or provision of information; that in turn, generates the knowledge or other value required to achieve the goals of the organisation (Buchanan & Gibb, 1998). It is important to once more reiterate that this definition of information resource extends to all information personnel, technology, systems, and content (e.g. spanning Earl's [2000] taxonomy of IM, IT, IS, and IR).

In contrast to the strategic and process perspectives, which primarily identify those resources associated with a strategic goal or in-scope operational process, the resource view sets out to comprehensively identify and inventory all information resources. Data would be collected on each resource (owner, task[s] supported, source, medium/channel, cost etc.), and values would be assigned to each resource according to importance to the task supported (see Table 3.4, page 112). This then allows the auditor to differentiate between those resources of strategic importance, those fulfilling an important support role, and those either not used, or of little value to the organisation. Values can be collected by interview and/or questionnaire but would also ideally be verified through group discussion (Buchanan & Gibb, 1998).

Table 3.4. The value of information resources (Buchanan, 1995)

VALUE	DESCRIPTION
5	Critical to the task
4	Provides significant benefits or adds value to the task
3	Contributes directly to the task but not essential
2	Provides indirect or minor support to the task
1	Not used or has no perceived benefits for the task

Typical questions to be answered by a resource oriented IA include:

- What are our information resources?
- How do we use them?
- How do we manage and maintain them?
- Are we conforming to applicable regulatory requirements?
- Which are our key information resources?
- Which are of no value to us?
- Are there opportunities to better manage our information resources?
- What problems do we have with information resources?

The key output of a resource oriented IA would be a detailed inventory and evaluation of an organisations information resources. Recommendations would focus upon more efficient and effective information resource management.

3.6. Summary

The primary goal of this chapter was to understand the scope of the information management domain in order to fully define the relative role and scope of the information audit. This addressed research questions one and two (see Section 1.2. page 9) as summarised below:

1. What is the purpose and scope of the information audit?

With regard to 'purpose', the definition initially put forward by this author and utilised for this study was as follows (Buchanan & Gibb, 1998):

> The purpose of the information audit is to provide a strategic approach to identifying, evaluating, and managing an organisation's information resources in order to fully exploit the strategic potential of information. As an ultimate goal, the IA generates or facilitates the development of an information strategy.

This definition is still applicable, but it would benefit from refinement, to incorporate the relationship to information systems identified by this research, most notably to information system architecture. A proposed revised definition is as follows:

> The purpose of the information audit is to provide a holistic approach to identifying, evaluating, and managing an organisation's information resources and information flows, in order to ensure effective and efficient organisational information systems. The IA provides both strategic and operational direction, and contributes directly to information system development.

With regard to 'scope', it is proposed that Earl's (2000) information strategy taxonomy can be used to manage and direct information audit scope, as it provides a logical breakdown of information strategy components: information management, information technology, information systems, and information content (as adapted by Gibb, Buchanan, and Shah [2006]).

Zachman introduces the concept of *perspectives*, acknowledging that there are multiple stakeholder views of information system architecture. The benefits of perspectives are that, similar to Earl's taxonomy, they allow the IA to be tailored to individual requirements and *provided with a particular focus according to organisational needs* (the key). The author proposes that this adds a further dimension to scope (and Earl's taxonomy), allowing the IA to be scoped not just according to information strategy component, but also by stakeholder perspective and/or organisational imperative. These perspectives are introduced as *strategic, process*, and *resource* views. The resulting two-dimensional IA scope matrix is illustrated in Figure 3.15 (see page 105).

2. What is the relationship of the information audit to evolving information system development processes, including information system architecture?

The output of the information audit provides key input to information systems architecture frameworks. TOGAF extends Earl's taxonomy, bridging the gap between information strategy and information system development. The Zachman framework identifies the architectural entities essential to a "system view", with the output of the information audit mapping directly to the top two rows of the Zachman framework: Scope and Business Model; and contributing to the application architecture component of the System Model.

To extend the value and benefit derived from the IA, the recommendation from this research is that alignment and reuse should be sought wherever possible (subject to individual organisational requirement) between the outputs of the IA and the inputs to Information Systems architectural development.

Chapter Four: Information Audit Methods

The following provides a review of IA methods. Early origins are discussed before identification and discussion of commonly cited approaches. Each of these methods are individually discussed and critiqued before a comparison across approaches is conducted to highlight the relative completeness, application, and usability of each. The chapter concludes by identifying a suitable method to be used as the basis for a generic and universally applicable information audit methodology, which is then applied and tested as part of the empirical component of this research.

4.1 Background

A key consideration when reviewing IA methodologies is that, as yet, there is no single accepted methodology that is supported by statute, standard, or professional association. The information audit is a relative newcomer to auditing and as such, is continually evolving as new methods and techniques are developed and its purpose and scope is further refined. This methodological evolution is presented and discussed in the following sections, which introduce the key IA methods in chronological order according to their development.

4.2. Methodological Origins

The concept of the information audit (IA) was first introduced by Riley (1976) but it was not until the 1980s that IA methods began to be developed. These early methods were classified by Barker (1990) as follows:

- **Cost-benefit methods** (Riley, 1976; Henderson, 1980): a comparative analysis of information products and services based on their cost and perceived benefit.
- **Geographical approaches** (Gillman, 1985): the identification of the major components of the information system in order to map their relation to one another.
- **Hybrid approaches** (Quinn, 1979; Worlock, 1987): hybrids of the cost-benefit and geographical methods.
- **Management information audits** (Reynolds, 1980): confined to the identification of formal information and reports with a strong emphasis on management information systems.

Barker reviewed the various methods in an attempt to arrive at a definitive methodology but found this a difficult task as each of the above methods had its own particular limited purpose and scope. The solution was to match the method(s) to the particular purpose and situation, possibly requiring more than one method depending on the objectives of the information audit. However, determining the objectives of the information audit also proved difficult as it varied from one method to another. In order to identify a standard set of objectives, Barker referred to the objectives of the operational audit as defined by Gruber (1983):

- To define the purpose of the audited system and to establish how effectively it is being accomplished.

- To establish whether the purpose is in congruence with the purpose and philosophy of the organisation.
- To check on the efficiency and effectiveness with which the resources are used, accounted for and safeguarded.
- To discover how useful and reliable the information system supporting the organisation is.
- To ensure compliance with obligations, regulations, and standards.

Barker then used these objectives to guide development of a ten-stage information audit model:

- Establish the operational objectives and define the organisational environment.
- Determine the user information requirements.
- Inventory the information resources.
- Identify system failures and key control points.
- Evaluate system failures.
- Test key control points.
- Generate alternative solutions for system failures.
- Evaluate the alternatives.
- Check conformity of the system with existing regulations and standards.
- Propose recommendations.

Barker's method emphasised control processes e.g. monitoring, testing, and checking, that reflected the influence of the operational audit. This is a characteristic trait of early information audit methods, which typically took a predominantly operational view of information resources, as opposed to the more strategic 'enabling' view characteristic of later approaches to the information audit which emerged in the 1990's (for example Orna, 1990 [discussed in Section 4.4], Buchanan & Gibb, 1998 [discussed in Section 4.5]).

However Barker's method remains a notable step in information audit method development as it was far more comprehensive than its predecessors (as identified by Barker) and provided a clear and useful statement of objectives for each stage of the information audit process. However, although appropriate tools and techniques were identified and discussed by Barker, the method lacked a clearly defined systematic approach to the actual audit process, and required further development to be universally adoptable.

One other notable approach from this period (either omitted or overlooked by Barker) was provided by Best (1985). In contrast to Barker, Best developed an information mapping method to assist in the strategic implementation of IT. Information mapping locates information resources within the organisation with reference to a set of co-ordinates based upon a conceptual model or map of identified information resources with a view to graphically representing the whole or part(s) of the information system under study.

Best's (1985) method consisted of eight steps:

- **Definition and disaggregation of the corporate mission**: the definition should include: environment, processes, clients, activities, ownership etc. (at the level of organisation at which IT is being considered).
- **Definition of the organisational structure**: the organisation's existing structure is examined in order to identify any discrepancies between its structure and its definition of corporate mission.
- **Definition and analysis of problem areas**: problems are identified and a decision is made as to which problems should be tackled and

which should be left (determined by the scope and budget of the programme).

- **Production of first information map**: production of working papers and maps of information flow, function, and purpose in the chosen area(s) that summarise the preceding steps.
- **Examination of IT options**: based on the functions and linkages identified in the first information map, IT options should be reviewed to assess opportunities for integration and automation of existing applications in new areas.
- **Production of second information map**: comparison of the first information map and the identified IT options to produce a second map which will advise on IT options and outline a programme of investment with cost/benefits.
- **Produce recommendations**: recommendations for the first phase of implementation derived from the second information map.
- **Implementation**: implementation of the recommendations.

Best's method was a form of systems analysis designed to improve an organisation's use of IT, and as such focused primarily on IT issues (and again providing a more operational than strategic view). It was limited in its analysis of information resources and user requirements, but provided an early example of information mapping, popularised in the first comprehensive IA approach, put forward by Burk and Horton (1988).

Prior to discussing Burk and Horton it should be noted that one further methodology was identified during this literature review, which was one proposed by Wood (2004); however Wood focuses more on definition and key considerations than an explicit methodological process. Carlisle (2005), in a review of Wood's methodology commented, "there is not enough detail in this paper alone to allow a person or organization to conduct an information audit" and forewarned readers that the paper “is badly edited – some sentences are garbled enough that it is difficult to determine their meaning – and filled with typographical and grammatical errors”. The author concurred with Carlisle’s assessment and, as a consequence, did not include Wood (2004) within the more comprehensive review of IA methodologies which follows.

4.3 Burk & Horton (1988)

InfoMap, developed by Burk and Horton (1988), provided a step by step process to discover, map, and evaluate information resources. InfoMap represented the first formal IA methodology. In contrast to its predecessors, the methodology provided a detailed framework for carrying out a comprehensive stock-take (referred to as the inventory process) of the organisation's information resources. Notably, the methodology also proposed a method to measure the cost and value of information resources.

4.3.1. Methodology

There are four main stages to InfoMap:

1. Survey.
2. Cost/Value.
3. Analysis.
4. Synthesis.

Each is discussed in turn below.

Survey

The organisation's existing information resource base is defined by carrying out a preliminary inventory of all information resources. The main method of data collection is carried out via interviews with appropriate members of staff (those members involved in using, handling, supplying, and managing information). Further sources of data will include documents, reports, inventory lists, policy statements, and external organisations etc.

Each information resource is recorded and classified on an inventory data form. There are three steps to the classification process:

1. **All potential resources are categorised as sources, services or systems**:
   - **Source**: a place, store or person from which information can be obtained (either internal or external to the organisation):
   - **Service**: a service that supports or assists the acquisition, processing, transmission or production of information and data:
   - **System**: a structured and integrated series of processes for handling information or data e.g. systematic and repetitive processing of inputs, file updates and outputs.
2. **Each category is subdivided into generic groupings called types**: Important distinctions between types are identified (determined by the organisational culture and particular use of each resource).
3. **Within each type the information resource entities are identified**. An information resource entity (IRE) is "a configuration of people, things, energy, information and other inputs that has the capacity to create, acquire, provide, process, store or disseminate information" (Burk & Horton, 1988).

The inventory data form is not intended to accumulate masses of detail on each information resource but instead to provide a succinct overview for collective analysis once the inventory is completed.

Cost/Value

A multi-disciplinary approach drawing from accounting, business, and economics was developed in order to measure the cost and assess the value/benefits of each IRE to relate cost and value in the form of ratios to provide an overview of costs and value across the organisation.

The elements of each IRE that determine its cost were identified. Burk and Horton proposed three elements to cost:

- Functional: doing something e.g. acquisition, editing, indexing, storing, translating, training etc.
- Resource: using something e.g. administrative overheads, IT, labour, capital etc.
- Temporal: using time e.g. depreciation, development, processing etc.

Burk and Horton (1988) pointed out that "no single method for measuring cost will suffice for each and every IRE listed in the preliminary inventory". They suggested that clusters of IREs would probably be identifiable that would benefit from a particular method while other clusters would require another method. It was also recommended to use costing methods which were currently applied by the organisation. The costing methods recommended were:

- Direct costing.
- Adsorption (imputed) costing.
- Standard costing.
- Cost estimating.
- Cost finding.
- Opportunity costs.
- Life-cycle costing.
- Qualitative (non-financial) costs.

Burk and Horton acknowledged that measuring cost could be a difficult task because the necessary cost data could be difficult to trace and compile. If this was the case, Burk and Horton recommended that rough approximations be sought.

> A basic objective of mapping information costs is often to highlight the order of magnitude, or even the existence of information costs, without primary concern for accuracy or comprehensiveness (Burk and Horton, 1988)

Once the cost of each IRE had been determined they were then ranked in order of decreasing cost using broad categories of cost e.g. High, Middle, Low, Zero. The next step was to assess their value.

Assessing the value of IREs was potentially the most difficult and imprecise stage in the InfoMap process due to a lack of any available and applicable methods to measure value quantitatively and with precision. However it was deemed essential, in order to identify organisational resources:

> We have set out to examine information entities on the premise that *information is a resource*, so we need means for determining the *role* that specific information actually plays, and we need to understand its significance to the organisation as a whole. (Burk and Horton, 1988)

Burk and Horton proposed a two step process to determine the value of an IRE. Firstly, the nature of the values of each IRE were identified, and secondly, the relative value of each IRE was then determined.

Five categories of value were provided to identify the particular elements of value for each information resource. The first two categories related closely to the information itself while the other three categories related to the impact of IREs on particular organisational attributes:

- **Quality of information itself**: e.g. accuracy, credibility, currency, pertinence etc.
- **Utility of information holdings**: e.g. adaptability, ease of use, ease of access, format and presentation etc.
- **Impact on organisational productivity**: e.g. improved decision making, productivity gains, reduction in "noise", timeliness.
- **Impact on organisational effectiveness**: e.g. discovery of new markets, customer satisfaction gains, meeting goals and objectives etc.
- **Impact on financial position**: e.g. cost reductions, cost savings, return on investments, exploitation of existing assets.

Three rating methods were then recommended to assess and rank the IRE values; however Burk & Horton failed to adequately explain the relationship between these two steps. The assumption is that the elements of value are used to identify the particular value elements for each information resource before assessing its overall strategic value to the organisation. However the link is unclear and is further confused by the fact that the rating methods do not explicitly relate to the value elements. The rating methods were as follows:

- **Resource effectiveness index**: the effectiveness with which the IRE supports the activity it was designed to support.
- **Importance to activity index**: the strategic importance of the IRE in carrying out the activity.
- **Importance to organisation index**: the strategic importance of the activity supported.

Each index was then rated on a scale from 10 to 0, with 10 as the most effective/important, and 0 as least effective/important. Once a value had been obtained for each index, all three could then be multiplied together to create the value index for the particular IRE. Once all IREs had been completed they could then be ranked to compare values. The purpose here was to identify and group IREs in terms of broad categories of value e.g. high, medium, low, zero (rather than attempting to identify fine distinctions).

The costs and values could then be compared. Four cost/value ratios were recommended:

- **Monetary**: a numeric index relating the monetary unit measure of cost with the monetary unit indicator of value. This could prove problematic because quantitative measures of both cost and value are seldom available.
- **Rank order**: a comparison of two indexes created to reflect the rank order of cost and value. Cost effective IREs are identified by the rank-order ratio. Care had to be be taken to ensure that indexes were consistent to ensure accurate results.
- **Activity**: a comparison of input effort (cost) with output benefits (value) in terms of activities e.g. the ratio of information collected to information used.
- **Descriptive**: a comparison of qualitative or quantitative measures of cost with qualitative measures of value.

Analysis

Three basic information resource mapping techniques related the identified IREs to the structure, functions and management of the organisation. Through this process the particular functions and configurations of IREs could be identified and related to the organisation to identify organisational resources.

Locating information users, suppliers/handlers and managers

A two dimensional matrix (referred to as an information resource worksheet) was used for each of the groups e.g. users, suppliers/handlers, and managers. The vertical axis (rows) consisted of all the identified generic information resource types grouped by category. The horizontal axis (columns) consisted of the identified organisational units and optionally could include columns to codify general characteristics of the resource types e.g. manual vs. technology based, supplier category, user category etc. On each matrix an X was placed in the appropriate cell (the intersection between row and column) wherever a relationship had been identified between an information type and an organisational unit. The end product was a set of three worksheets that showed who was using what and where, highlighting the distribution of resources throughout the organisation.

Mapping the spectrum of information resources

This map took the form of a grid with a north-south axis representing a spectrum of Functions-Holdings and an east-west axis representing a spectrum of Media/Conduit-Content. The Functions (north) end represented information flows e.g. those activities, actions or movements required for the flow of information and the Holdings (south) end represented information assets e.g. electronic or physical holdings. The Media/Conduit (east) end represented the medium and the Content (west) end represented the meaning. Each IRE was then positioned on the map thereby providing a number of illustrative benefits for the analyst:

- Provided a common framework to analyse IREs.
- Revealed natural relationships by clustering IREs by resource characteristics.

- Highlighted gaps and concentrations of IREs.
- Illustrated the context and value of each IRE to the organisation.

Locating cost data and financial controls

The purpose of this step was to determine to what extent the costs of each IRE are recorded or reflected in the accounts of the organisation; and what financial controls are applied by management to these costs. The first step is to review the costs index of the IREs in order to select a sample for analysis. The sample should include those IREs with the highest costs.

Reference is made to the organisation's accounting and financial systems to identify whether and to what extent the selected IREs from the sample are represented. However, Burk & Horton acknowledged that this could be problematic because in many cases the costs for IREs would be indirectly accounted for and consequently difficult to trace. To add to the problem the terminology could differ between items, thus requiring investigation and consultation with accountants and financial managers. Burk and Horton recommended perseverance until three broad categories emerged:

- IRE costs fully represented.
- IRE costs partially represented.
- IRE costs unrepresented.

The selected IREs could then be analysed to compare the organisation's own knowledge of cost with the measure of value and, if available, the cost/value ratio. The results highlighted:

- The organisation's ability to monitor and control costs.
- Expenditure sinks.

- Critical IREs and the level of financial control e.g. those IREs of high value, high cost and strategic value.
- Differences between IRE costs identified as part of the audit in comparison with the organisation's knowledge of IRE costs.

Synthesis

In this, the final stage of InfoMap, the objective was to synthesise the findings and position them within the context of the organisation's business, strategic plans, goals and objectives. The principle was that by careful selection of a set of resource criteria the organisation's information resources could be identified along with their relative strengths and weaknesses.

In selection of the resource criteria careful attention needed to be paid to the specific context and role of each IRE. The criteria related to the three fundamental aspects of IRM:

- The nature of the IRE.
- The cost of the IRE.
- The value of the IRE.

The nature of the IRE

Each IRE was examined to determine whether or not it should remain a *bona fide* information resource or be subsumed by another. This is described as testing the structural integrity of the IRE, e.g. whether or not it is a self contained source, service or system or merely an element of another more structured IRE.

The cost of the IRE

Two methods of applying cost criteria are suggested:

- **Absolute costs**: using a threshold cost level to identify information resources e.g. IREs with total costs that exceed £50,000 or are in the High or Medium cost category.
- **Relative costs**: using a threshold ratio to relate the costs of the IRE to another resource cost e.g. IREs with total costs that exceed £50,000 and are used by the Marketing Department.

The value of the IRE

Value was measured based on a combination of absolute and comparative criteria with an emphasis on value (e.g. IREs that support strategic objectives):

> For most organisations, we believe that consideration of strategic roles and values, rather than of costs, should dominate thinking in the development of your resource criteria (Burk and Horton, 1988)

For example:

- The IRE is an internal source used for research and development, and:
- The IRE has total costs exceeding £50,000, and:
- The IRE is in the High value category.

Once the criteria had been established those IREs that satisfied the criteria would be the organisation's information resources.

The relative strengths and weaknesses of the information resources in relation to other IREs within the organisation and/or other IREs external to the organisation could now be identified. Statements (or criteria) were established to represent strength/weakness factors in relation to the four main components of the IRM process:

- Information holdings
- Information functions
- Information accounting and budgeting
- Information management

Each statement was then considered within the context of the organisation to determine whether the statement reflected a relative strength or an important weakness. One further category, *average* was applied where the organisation was perceived to be normal in relation to the statement. Finally, the answers were related to the appropriate IREs to highlight strengths and weaknesses.

4.3.2. Critique

When introduced, InfoMap was the most comprehensive method available to identify and define an organisation's information resources, and was supported by Infomapper Software, which provided a tool for information mapping. For an organisation embarking on an information audit, there were a number of benefits:

- Provided a step-by-step, detailed methodology.
- Identified *all* formal information resources (e.g. comprehensive rather than selective).
- Provided a measurement of the cost and value of IREs.

- Drew attention to problems and opportunities relating to current information management practices and policies.
- Created and stimulated awareness of the importance of IRM.

However, there were also a number of important considerations regarding the applicability and usability of InfoMap (Buchanan & Gibb, 1998):

- The overall purpose was discovery and awareness of information resources, not how to manage information.
- The process was extremely time consuming and could incur considerable expense due to its comprehensive, and detailed inventory approach.
- Measuring cost and value added to time and complexity yet, in most instances, results were no more than rough approximations.
- Attention was focused on the inventory of information resources (a *bottom-up* approach) and did not include an organisational analysis e.g. the organisational structure, business drivers and goals, culture and values, and processes etc., (important in considering the context of each IRE and attitudes towards information e.g. the current management approach).

One of the most important limitations of InfoMap was the neglect of the issue of organisational context noted above for, although context is vital in determining the value and strategic importance of IREs, at no stage is context fully addressed by InfoMap (Burk and Horton do point out the importance of context at various stages but do not provide any method or technique for analysis). As Barclay and Oppenheim (1994) noted:

> In many ways, the InfoMap methodology is very simplistic and does not take different organizational cultures into enough consideration.

In a documented case study covering practical application of InfoMap, Underwood (1994) highlighted that because InfoMap is dependent on users identifying information resources, more emphasis is placed on the discovery process than the *use* of such information. This then made analysis of the results difficult because of a lack of detailed knowledge regarding the context of information use within part(s) of the organisation.

Underwood (1994) argued that InfoMap required participants to have a stable and coherent set of views about the range and value of information resources within the organisation. Underwood argued that this "world view" was typically found in organisations that had reached a point of evolutionary stability (or maturity) and therefore had comparatively little to gain from an information audit (the author is of the opinion that any organisation that has never carried out an information audit still has much to gain from the process and is therefore not in full agreement - however Underwood makes an important point that deserves attention). The organisations with the most to gain from an information audit would be those experiencing instability, but ironically could be hampered by their own organisational immaturity. Underwood provided an example of this problem from a recent case study.

The organisation being audited was three years old, had a highly divisionalised structure, and was going through a period of rapid growth and change. At the time of investigation the organisation was considering a central information service or resource centre to support the various divisions. The first step was to establish an information map of the organisation. The chosen methodology was InfoMap. However, this proved difficult to apply in this particular case:

> Faced with uncertain and changing conditions, the response of many organisations is to try to establish some fixed points from which a clear

> sense of direction can be established... ...in this case the fixed point took the form of a belief within some divisions that each should be responsible for developing and maintaining its own sources of information and should make little conscious attempt at sharing or 'pooling' resources to build up an organisation wide resource (Underwood, 1994).

This problem made it extremely difficult to establish a shared organisational view of information resources and to persuade divisions that resources available to them could also be of value elsewhere in the organisation. In the end, Underwood concluded that the results of the audit provided no common view and ultimately relied more on the judgement of the consultants. Underwood's experience highlights the importance of organisational analysis.

One final point regarding the Burk & Horton methodology relates to the InfoMapper software. In a trial conducted at Trainload Coal, Barclay and Oppenheim (1994) concluded that the software was inflexible, cumbersome and of limited value. Both the authors and participating organisation concluded that it would have been simpler to have adapted an existing off-the-shelf database application to capture IRE data.

4.4 Orna (1990, 1999)

In contrast to the bottom up approach of InfoMap, Orna's (1990)[1] top down approach places more emphasis on the importance of the organisational analysis. While InfoMap focused on static IREs, Orna's method has an information flow based approach that focuses more on dynamic information processes. Also, while the end product of InfoMap is a series of maps (or tables) to provide an inventory of information resources, the end product of Orna's approach is a corporate information policy.

4.4.1. Methodology

There are four main stages to Orna's (1990) method:

1. Initial investigation.
2. Information audit.
3. Balance sheet.
4. Policy development.

Each is discussed in turn below.

Stage one: the initial investigation

In contrast to InfoMap, Orna begins with an investigation of the organisation, with the knowledge gathered forming the basis of the information audit. Orna (1990) points out:

[1] Orna (1999) and Orna (2004) also present this methodology.

Without a thorough understanding of the organisation's objectives, we are in danger of misinterpreting our findings about its information resources and the way it uses information.

The aims of this stage are to understand the organisation's:

- objectives and priorities.
- organisational structure.
- management philosophy.
- the relationship of all these to its environment.

Objectives and priorities

The organisation's objectives and priorities are identified: firstly, by reviewing current statements, plans, and appropriate documents, and, secondly, by inviting key personnel to discuss their interpretation of these documents, and their definition of their role in meeting these objectives. It is important to identify the degree, or lack of consensus among managers and to understand fully the organisation's objectives, in order to be able to analyse the results of the information audit, and to make appropriate recommendations.

Organisational structure

The organisational structure is identified both geographically and hierarchically. Particular attention is also placed on the decision making processes, power structure, and formal responsibilities of managers. Orna points out that the organisational structure determines information flow (a central theme of this method) and can either support or hinder an organisation's progress towards an information policy and strategy. It is therefore important to identify any possible conflict between organisational structure and achievement of the organisation's objectives.

Management philosophy

The management philosophy is a reference to the organisational culture (the values, attitudes, beliefs and behaviour of the organisation). Orna points out:

> The organisational culture is a potent influence on how the organisation values information, on the way information flows, and on how information is used.

The management philosophy should begin to become apparent during the first two steps of the initial investigation. However further areas to be investigated include: human resource management, industrial relations, organisational communication, inter-personnel relations and change management.

The relationship of all these to its environment

Preliminary conclusions about the significance of information for the organisation are now possible from the knowledge gathered during the initial investigation. For example, is information:

- correctly recognised and appropriately acted on?
- correctly recognised but inappropriately acted on?
- totally or partially unrecognised?

The conclusions drawn then provide direction for the information audit stage.

Stage two: the information audit

Much of Orna's information audit process is derived from InfoMap (discussed in Section 4.3, pages 123-136). For example, Orna recommends adoption of Burk and Horton's data inventory form, classification scheme, and method of determining cost and value (although Orna is sceptical of the cost/value ratios). However Orna's method differs from InfoMap in three important ways:

- Information flows are identified and charted to illustrate the dynamic flow of information in the organisation.
- Human resources are identified e.g. the background (education and training) and experience of those responsible for managing information, and their position in the management hierarchy.
- Technology resource maps are created to illustrate the distribution and use of technology (from IT to card indexes).

These important differences facilitate more in-depth analysis of the organisation:

- The technology maps are related to the information flows to identify the relationship between technology and flow of information. It is then possible to identify areas where technology either supports or hinders information flow, and to identify potential opportunities for development.
- By identifying human resources the organisation can be made more aware of the human information resources that are available. Also, the relationship between professional background and level in the management hierarchy can highlight the level of value attached to information by the organisation.

Other issues dealt with by Orna include organisational reporting lines, and whether the people who manage information resources are also the ones who select the related IT (and whether it is an appropriate selection or not).

Stage three: the balance sheet

The purpose of this stage is to relate the findings of the information audit to those gathered during the initial investigation:

> In drawing up the balance sheet we are superimposing the information audit findings on the objectives of the enterprise, with a view to seeing where the information resources and activities are a good match with the objectives, where there are failures and total mismatches, and where there are difficulties caused by partial mismatches (Orna, 1990).

The balance sheet is drawn up by creating a profile that has similarities to force field analysis. Enabling and restraining forces (referred to by Orna as positive and negative scores) are identified that have an impact on the objectives of the organisation. The results of the profile then form the basis for the recommendations and conclusions formed as part of the policy development stage.

Stage four: policy development

The final stage of Orna's method is the development of a corporate information policy to define:

- The objectives of information use in the enterprise.
- The priorities among these objectives.
- The technology for information management.

- The systems for information management, who manages them, and their responsibilities.
- The enterprise's resources of information, and its resources for managing them.
- Criteria for monitoring information activities.

Orna's distinction between information policy and information strategy is that policy focuses on operational rather than tactical factors, providing guidance and direction through establishment of principles of operation, while strategy focuses on business goals and targets. Strategy is more dynamic while policy is more enduring. However, it is important to note that Orna (2004) considers policy and strategy to be similar and at times one and the same (the author does not agree with this view, considering policy to be more enduring and longer term than strategy, with policy focused on governance and standards, and strategy focused on shorter term tactical objectives and goals).

Once the main objectives of the information policy are accepted and understood, the next step is to select areas for development (these will have been highlighted by the balance sheet). Orna suggests beginning with a combination of smaller projects (referred to as policy "packages") that will provide quick and clear results for the organisation. Larger projects should begin once the process of change has become firmly established and been accepted by the organisation.

Orna (1999) is essentially the same core IA methodology as the original four step method discussed above, but expanded to ten steps to include key activity pre and post audit. The ten steps are summarised as follows:

1. Analyse the information implications of key business objectives: conducting a high-level preliminary review to confirm strategic and operational direction.

2. Ensure support and resources from management: obtaining senior management commitment to the audit.
3. Get support from people in the organisation: obtaining wider organisational commitment.
4. Plan the audit: project planning, team selection, and tools and techniques selection.
5. Finding out: identifying information resources and information flow, including high-level cost and value assessments.
6. Interpreting the findings: analysis of findings based on current state versus target state.
7. Presenting the findings: reporting on the audit.
8. Implement changes: establishment of information policy and realisation of audit recommendations.
9. Monitor effects: measuring change.
10. Repeat the audit cycle: establishing the audit as a regular exercise.

4.4.2. Critque

Orna's original (1990) methodology had three main advantages over previous IA methods:

- A 'top-down' organisational analysis is carried out.
- Dynamic information processes (information flows) are identified.
- The end product is a corporate information policy.

However, a potential problem with Orna's method was that it lacked the practical tools and techniques required to carry out several of the steps (Nickerson, 1991; Buchanan & Gibb, 1998). For example, during the initial investigation (stage one) an organisational analysis is carried out that requires an in-depth investigation of the organisation's objectives, structure, and culture. Orna (1990) emphasises the importance of this stage:

> ...if we don't fully understand what it (the organisation) thinks it is in business for, we risk misinterpreting what we find at later stages, assigning inappropriate values to information resources, and choosing information solutions that are so bad a match that they harm its interests rather than furthering them.

The message is clear: the success of the audit could hinge on the initial investigation. However, to carry out the initial investigation requires a number of important research skills (e.g. interview technique, qualitative data analysis, organisational analysis tools to identify the organisation's mission, environment, structure, and culture etc.) that could easily be underestimated due to their potential complexity and the need for a structured methodical approach. Combined with the business skills required for the information management function, the necessary qualifications of the information auditor became considerable.

While not entirely addressing these limitations in the revised methodology (Orna, 1999), Orna does provide examples and practical insights (Orna,1999; Orna, 2004), which go some way to addressing these limitations.

4.5 Buchanan & Gibb (1998)

Buchanan & Gibb (1998) proposed a top-down approach similar to Orna's, but with some expanded stages and the addition of tools and techniques to support each of the stages. The tools and techniques recommended, drawn from several management disciplines, were selected by Buchanan & Gibb based upon their widespread use in business and hence their familiarity to many practitioners. Buchanan & Gibb acknowledge that there are other other similar tools which could be substituted for those provided depending on the specific remit of the information audit and the preferences of the auditor.

4.5.1. Methodology

There are five main stages to their IA methodology:

1. Promote.
2. Identify.
3. Analyse.
4. Account.
5. Synthesise.

Each is discussed in turn below (Note. the following [pages 145-155] is an extract from Buchanan & Gibb [1998]. The complete paper is provided in Appendix 1).

Promote

The purpose of this stage is to promote support and co-operation for the information audit. There are three steps. The first two steps are completed by the working group while the final step is completed by the auditor. They are as follows:

1. Promote the benefits of the information audit. Ideally the organisation should hold a conference or series of seminars. However, if this is not practical a conference paper should be circulated that explains the role of the information audit and why the organisation needs one. The purpose of this step is twofold:
   - To promote support and co-operation by increasing awareness and understanding of the strategic importance of information resource management and highlighting the benefits to be gained from the information audit.
   - To reduce suspicion and hostility among staff members by explaining the purpose of the information audit.

2. Foster co-operation throughout the organisation. Achieved by circulating a passport letter (a technique common to communication audits [Hamilton, 1987]) signed by the chief executive that succinctly reiterates the issues addressed by the previous step and informs staff of the procedures to be followed during the information audit. The passport letter acts both as a medium of introduction for the auditor, and as a symbol of approval from the top executive.

3. Carry out a preliminary survey of the organisation. The purpose of this step is to allow the auditor the opportunity to make preliminary assessments of the level of awareness and value of information throughout the organisation by a simple informal walk-around (Hamilton, 1987). This is a vital step as it will determine the level that the information audit should be set at, e.g. depth of explanation required, level of support, suitability of methods etc.

Once this stage has been completed there should exist, at the very least, greater understanding of the importance and purpose of the information audit and improved co-operation and support for the information audit process. The auditor will also have a valuable preliminary picture of the organisation on which to base further investigation in the next stage.

Identify

This stage begins with a top-down strategic analysis of the organisation which step-by-step builds up a rich picture of the organisation's mission, environment, structure, and culture. Towards the latter part of this stage, and in conjunction with the strategic analysis, the organisation's information resources and information flows are identified (as part of the overall objective of identifying the strategic relationship between the organisation's mission and the identified information resources).

There are six steps. The first four are carried out in a workshop by the working group. The final two are completed by the auditor. Although the information resource identification step is the last one, in reality the information resource inventory is gradually built up during each of the preceding steps. The purpose of the final step is to finalise the inventory and to complete a more detailed survey of the information resources.

The identify stages are as follows:

1. Identify and define the organisation's mission. The organisation's mission provides strategic vision and defines the purpose, values, and objectives of the organisation which determine its strategic direction. A thorough understanding of the organisation's mission is essential in order to assign

appropriate values and priorities to information resources, and to provide integrated strategic direction for the information audit process and resulting information strategy. There are three main steps:

1. Abell's (1980) business definition framework is used to define the business the organisation is in and whether or not future activities should remain extensions of the original business or become more diversified in unrelated areas (perhaps through innovative use of IT).
2. Synnott's (1987) interpretation of portfolio analysis is used to identify objectives and to assess how the balance of activities and resources that make up the organisation's business contribute to its strategic potential.
3. For each objective the critical success factors (CSF), key tasks/activities, and related information resources are identified in a manner similar to Pellow and Wilson's CSF approach (1993).

2. Identify and define the organisation's environment. The organisation's environment refers to the political, economic, social, and technological influences (PEST) that affect the organisation. Buchanan & Gibb stress the importance of understanding the business environment in order to fully understand information needs, and to ensure that information solutions fit the specific business environment. There are two main steps:
   1. PEST analysis (Johnson and Scholes, 1993) is used to identify environmental influences.
   2. Porter's (1980) model of competitive forces is used to identify the organisation's competitive position, the competitive forces affecting this position, and the role information plays in influencing these forces.

3. Identify and define the organisation's structure. The organisation's structure refers to the hierarchical and geographical allocation of work roles and functions that create the pattern of interrelated activities that

allow the organisation to conduct, co-ordinate, and control its work activities. The organisation's structure will determine the flow of information and either facilitate or hinder the development of an information strategy depending on the compatibility between the strategy and the structure. Therefore it is important to ensure that both strategy and structure are compatible. There are three steps:

1. The basic organisational structure is identified (this can be either a traditional functional model or a process model as recommended by Hammer and Champy [1994]).
2. Mintzberg's (1988) method is used to determine the structure/strategy fit of the organisation.
3. Preliminary information flow requirements are identified similar to Orna's (1990) flow based approach.

4. Identify and define/describe the organisational culture. The organisational culture is the set of values, attitudes, beliefs and behaviours shared by members of the organisation. The organisation's culture will influence the value the organisation puts on information, the way information flows, and how information is used. Buchanan & Gibb stress that it is important to ensure that the organisation's culture facilitates (rather than hinders) the development of the information strategy. There are two steps:
    1. Stakeholder analysis (as illustrated by Grundy [1993]) is used to identify and track key stakeholder influences on the information strategy.
    2. Lewin's (1947) method of force field analysis is used to diagnose and evaluate the enabling and restraining forces that affect the information strategy.

5. Identify information flows. According to Orna (1990) the organisation's information flows:

"give an insight into what information is generated in the organisation, who generates it, who uses it, and how they use it. It shows who has the authoritative information on given subjects, who can be expected to know what, and who cannot be expected to know. It also reveals gaps in information provision, and shows missing links in chains of information".

This step identifies the general information flows based on the findings of the previous steps and superimposes them on the organisational (or process) model.

6. Identify the organisation's information resources. A preliminary inventory of the organisation's information resources will have been gradually built-up during the preceding steps and systematically linked to the organisation's mission, objectives and key tasks. The purpose of this step is to finalise the inventory and then interview information users (by the auditor) in order to build-up a more detailed picture of each information resource relative to the activities it supports. There are two steps:
    1. A database is built to store detailed information on each information resource (resources are categorised based on Burk and Horton's [1988] classification).
    2. The working group nominates participants to be interviewed (identified information users) who are provided with the list of key tasks and related information resources and asked to discuss the value (on a scale of 1 to 5), function, and utility (including any problems/possible improvements) for each information resource relative to the task supported.

Once the identify stage has been completed the organisation will have a comprehensive database of its information resources with each information resource clearly linked to the organisation's mission, related goals, objectives, and activities. The rich picture produced by this stage will also illustrate the strategic fit between the organisation's mission (including alignment of business and information strategy), environment, structure and culture, and will highlight problematic situations and future objectives as a basis for detailed analysis in the next stage.

Analyse

The purpose of this stage is to analyse and evaluate the organisation's information resources and to formulate action plans to improve problematic situations and achieve objectives identified during the identify stage. There are four steps to the analyse stage. The first three are completed by the auditor in consultation with appropriate members of staff (e.g. to clarify, discuss, or further investigate information resources). The workshop resumes for the fourth step. The steps are as follows:

1. Evaluate the information resources. Information resources are evaluated according to their strategic importance, utility, and associated problems in order to identify appropriate management strategies for each information resource. They are evaluated as follows:
   1. Strategic importance is evaluated firstly by assessing each resource in relation to the task(s) it supports and the strategic relationship between the tasks, CSFs, and objectives supported, and secondly according to the arithmetic mean of the value assigned for each information resource relative to the task supported.
   2. Utility identifies what each information resource should, could, and is being used for, thus identifying whether or not users are properly

exploiting the full potential of the resource. Utility is evaluated firstly, by defining the information resource's utility independently of what it is being used for by the organisation, and secondly, to then use this definition to determine whether or not the information resource is being properly utilised and to identify the potential strategic value of the resource (e.g. potential new applications). Once these two steps have been completed McFarlan and McKenney's (1984) Strategic IT/IS grid can be used to position information resources according to their existing strategic importance (mean value) and planned importance (future utility) to help identify appropriate strategies for each information resource.

3. Problems are evaluated according to the nature of the problem. For instance, is the problem one of awareness, availability, accessibility, or appropriateness? Potential solutions can then be identified with the decision as to whether or not to implement them based on balancing the strategic importance and utility of the resource against the severity of the problem and the steps required to implement the solution (explored further during the action plan stage below).

2. Produce the detailed information flow diagram. The purpose of this step is to develop detailed information flow diagrams to illustrate who is using what and where. This is achieved by superimposing the identified information resources onto the general information flow diagrams produced earlier.

3. Produce the preliminary report. The purpose of this step is to provided a summary account of the information audit process, findings, recommendations and general areas of concern to support and focus the formulation of action plans in the next step.

4. Formulate action plans: The purpose of this step is to identify and define the action plan(s) required to improve problematic situations and realise objectives that have been identified by the information audit. Checkland and Schole's (1990) soft systems methodology is proposed to provide a practical step-by-step method to deal with complex, unstructured, or poorly defined problematic situations. This step should produce a set of recommendations for action to improve such situation(s).

Once this stage has been completed the organisation will have identified the strategic importance and utility of each of its information resources and the appropriate management strategies. The organisation will also have a set of recommendations for action to improve problematic situations and/or to achieve goals. The next stage in the information audit is to cost the information resources in order to assign accurate costs to information resources and associated management strategies and action plans.

Account

The purpose of this stage is to cost the organisation's information resources in order to be able to assign accurate costs to information resources and associated services, to compare costs to value and other benefits, and to be able to perform cost analysis and cost modelling as part of the development and evaluation of an information strategy. Buchanan & Gibb state that this stage should be completed by the auditor in close consultation with the finance function of the parent organisation.

The cost and value of information resources is recognised as a problematic area (Badenoch, 1994; Orna, 1990; Burk and Horton, 1988). Accounting standards have not been fully developed in this area and few organisations have attempted to include information resources as assets in their books (Reid, 1994). Given the potential complexity of the exercise this stage is not represented by a rigid methodology. Instead, Buchanan & Gibb propose three approaches, which can be used individually or in combination:

- **Activity based costing** (ABC): ABC identifies the costs for information resources by measuring the causal relationship between activity cost and information resource use (Turney, 1996).
- **Output based specification** (OBS): OBS is a quality performance measurement system that also provides, where required, a mechanism to link payment to quality performance by identifying the minimum quality standards and quality indicators for each information resource (rather than the costs). ABC and OBS can be usefully combined to provide a more rigorous analysis of inputs and outputs to a process.
- **Glazier's model**: Glazier's (1993) model is a novel approach to the measurement of information assets in order to identify opportunities to improve revenue streams, reduce production costs, and focus on customer demand (as the most tangible evidence of delivered value).

Once this stage has been completed the organisation will have identified the costs, or cost indicators, for each information resource, depending upon the choice of costing method(s). Buchanan & Gibb state that Burk and Horton's (1988) cost elements could be incorporated into each approach as a method of identifying traditional functional costs.

Synthesise

The purpose of this stage is to report on the complete information audit process and to synthesise the findings/recommendations in order to provide integrated strategic direction for the organisation's future management of information.

There are two steps to this stage. The first step is completed by the auditor, with the second completed by the working group. The steps are:

1. The information audit report. The purpose of this step is to provide a detailed and complete account of the information audit process, findings, and recommendations for analysis, review, and reference purposes.

2. The information strategy. The purpose of this step is to provide integrated strategic direction and management guidelines for the organisation's future management of information in relation to the organisation's mission and objectives.

4.5.2. Critique

The benefits of Buchanan & Gibb over previous IA methods are:

- It provides a complete, step-by-step, top-down methodology.
- It provides a comprehensive IA tool-kit that can be tailored to individual organisational and audit team requirements.
- The relationship between the organisation's business strategy and information strategy is explicitly mapped.
- It proposes established accounting and service management approaches for the costing of information resources.
- It provides the organisation with an information resource database inventory, which maps IREs to business objectives.

However, Buchanan & Gibb (1998) also noted some areas of potential concern:

- The depth and breadth of the approach may make it impractical for many organisations to resource.

- Synthesis between stages may not always be clear and unambiguous due to the multi-disciplinary nature of the approach.
- There can be practical difficulties in modelling relationships between business objectives, critical success factors, tasks, and information resources, most notably because of complex many-to-many relationships.
- Although process modelling is identified as a recommended management tool the information audit methodology is predominantly task-oriented and hierarchical in nature.

4.6. Henczel (2001)

Henczel (2001) provides a methodology similar in approach to both Orna (1990), and Buchanan & Gibb (19988), drawing extensively from both.

4.6.1. Methodology

There are seven stages to Henczel's (2001) IA method:

1. Planning
2. Data Collection
3. Data Analysis
4. Data Evaluation
5. Communicating Recommendations
6. Implementing Recommendations
7. The Information Audit as a Continuum

Each stage is discussed in turn below.

Planning

The purpose of this stage is essentially twofold: IA planning and preparation, and submission of a business case for approval to proceed with the IA. There are five steps outlined:

1. Develop clear objectives
2. Determine scope and resource allocation
3. Choose a methodology
4. Develop a communication strategy
5. Enlist management support

In step one Henzcel emphasises the importance of understanding the organisation's mission, goals and objectives, organisational structure, and culture, in order to fully define the IA objectives. There are limited practical guidelines for this step, but Buchanan's (1995) model is adopted to illustrate the relationship from mission to information resources.

The first part of step two defines the scope of the IA, according to two key elements:

- Organisational coverage: either organisation-wide, business division/unit specific, or by operation/function.
- Type of information: by type of information resource (Henzcel defines these as records management, archives and IT departments, and traditional information resources).

The second part of step two is to identify the required resources. Henzcel recommends that the IA is led by an information manager, supported by an audit team drawn from stakeholder groups within the organisation. Significantly, Henczel's method is oriented to information service professionals and librarians who wish to conduct their own internal IA without dependency on external consultants. This is a departure from previous methods, which are all neutral on this point, each identifying the relative strengths and weaknesses of internal vs. external, before leaving it to the organisation to identify appropriate resources based upon organisational capability, resource availability, and identified constraints (this point is returned to in a later discussion of method usability [see Section 4.7.3, page 188]). Henzcel also briefly discusses the need for physical, financial, and technical resources as part of this step.

In step three an appropriate methodology for data collection, analysis, and evaluation is identified, based upon IA objectives, and in consideration of the organisational structure and culture. Step four identifies and establishes the necessary communication channels, while the final step ensures that there is senior sponsorship and commitment to the IA process.

The final output of this stage is a detailed business case, outlining the objectives, rationale, structure, and anticipated outcomes of the IA, for approval by senior management.

Data collection

The purpose of this stage is the collection of data regarding information resources, and the initial mapping of information flow. There are three steps:

1. Develop information resource database
2. Prepare for survey
3. Conduct survey

The first step is based upon the approach originally put forward by Buchanan (1995), and then by Buchanan & Gibb (1998), and as previously discussed in Section 4.5.1 (see page 149). In the second step, preparations for the survey are finalised, including:

- Identification of the data to be collected
- Confirmation and communication of management support
- Scope of the survey
- Data collection methodology, procedures and timeline
- Allocation of resources

The third step is data collection. Henzcel recommends three techniques, which can either be used individually or in combination: questionnaire, focus group, and interviews. Henzcel states that it is important to rate identified information resources according to importance to the task supported, as this aids later analysis. The classification scheme for this rating is adopted from Buchanan (1995).

Data analysis

The purpose of this stage is structured analysis of the data collected. There are four steps:

1a. Data entry into the information resource database
1b. Data preparation of remaining survey data
2. Data entry into analysis tools
3. Analysis

Step one is population of the information resource database, and generation of reports for analysis of findings. Henczel suggests the following example reports:

- Tasks supported by each information resource
- Information resources that support the tasks of each business unit
- Importance of each information resource to the tasks they support
- Information resources that support each organisational objective
- Tasks for which the 'ideal' resource is not provided
- Duplications of resources

The parallel step of data preparation specifies how the collected data will be edited and coded in preparation for analysis. Henzcel recommends creation of a data preparation plan, which states the procedures and rules for dealing with anomalies such as missing data, inconsistencies, and contradictions. Step two is entry of data into specialised qualitative analysis tools. Henczel separates these tools from the information resource database, but it is reasonable to assume that the database could provide much of the required functions, if desired. The final step in this stage is analysis of the now compiled data. Henzcel specifies three separate tasks:

- The analysis of survey data
- The mapping of information flows
- The matching of information resources with organisational objectives

The analysis of survey data is based upon the coded responses to the questions asked in stage two, and provides key findings regarding information use and needs. The approach adopted is non-specific, with Henczel focused upon general guidelines for data analysis. In the next step, Henzcel maps information flow similar to Orna's approach (see Section 4.1, page 140). Henzcel states that information flow can be based upon the organisational chart, with diagrams used to identify gaps, bottlenecks, and duplication. The final task identifies those information resources of strategic importance to organisational objectives, sourced from the information resource database, and again based upon the criteria put forward by Buchanan & Gibb (1998).

Data evaluation

The purpose of this stage is evaluation and interpretation of data, and formulation of recommendations. There are five steps:

1. Evaluate the problems and opportunities
2. Analyse the gaps
3. Interpret mapped information flows

4. Develop strategies
5. Formulate recommendations
6. Develop an action plan for change

The purpose of step one is to articulate the problems identified by the IA. Henczel recommends that, once identified, these are looked at from a holistic perspective to determine whether or not they need to be addressed. Evaluation criteria such as strategic significance, cost/benefit, and ability to solve within the practical constraints of the organisation are recommended. The next step is then to compare "current" information provision with "ideal" through identification of gaps, duplications, and over provision. This gap analysis is based upon the survey responses and additional data collected in the information resource database.

Step three is evaluation and gap analysis of the identified information flows. Henczel discusses each of these steps in the above order but steps one and three are presented diagrammatically as parallel activities prior to step two, which more accurately reflects the order in which they would be conducted.

Step four considers solutions to the problems highlighted by the previous steps. Henczel provides fourteen selection criteria, which can be used to assess the suitability of individual solutions, in order to identify the most appropriate solution for each given problem. Weighted values are suggested against each selection criterion, with the solution with the highest weighted value selected as the most appropriate one. However, while this provides a useful structured approach there is very little guidance, and no explanation to support the weightings and scales.

The final two steps of this stage are the preparation of the recommendations and related action plans. Henzcel states that each recommendation should include a statement of cost, description of process requirements/change, and quantifiable goals, with the action plan detailing the proposed implementation path for each of these recommendations.

Communicating the recommendations

The purpose of this stage is communication to stakeholders. There are five steps:

1. Production and dissemination of the written report
2. Publication to intranet/website
3. Oral presentation
4. Personal feedback to participants and stakeholders
5. Seminars

Henzel provides guidance on each of the above, and suggests that steps one and two can be delivered in parallel, as can three and four, followed by a series of seminars and personal feedback to participants; however, general guiding principles are provided rather than prescriptive steps.

Implementing the recommendations

The purpose of this stage is establishment of an implementation program. There are six steps:

1. Understand the change process
2. Develop an implementation program
3. Implementation
4. Incorporation of changes into formal plans (strategic, marketing, business)

5. Develop a post implementation strategy
6. Develop an information policy

The basis for the detailed implementation plans are the action plans developed in the *data evaluation* stage. The first step is to identify and specify the requirements for change management (Henzcel provides a list of key considerations for a change programme). The next step is development of the schedule for implementation, with each recommendation individually specified, including objectives, impact, and parameters. The final steps are realised as part of implementation: recommendations are incorporated into business plans where clear identified relationships exist; a post implementation strategy is specified to measure the outcomes of the implemented recommendations; and an information policy is developed for ongoing information management.

The information audit as a continuum

Henzcel describes the purpose of this stage as to establish the IA as a regular, cyclical process. There are two steps:

1. Measure and assess changes
2. Develop ongoing process of matching services with needs

The first step measures the impact of the implemented recommendations and measures the level of improvements realised, while the second step establishes processes to maintain the information policy and information resource database for subsequent iterations of the IA. Similar to the preceding two stages, Henzcel provides general high-level guidelines and/or principles, rather than step-by-step procedures or instruction.

4.6.2. Critique

Given Henzcel adopts an approach similar to both Orna (1990), and Buchanan & Gibb (1998), it is not surprising that the main strengths of her method constitute several of the combined strengths of Orna, and Buchanan & Gibb:

- A 'top-down' organisational analysis is carried out.
- The relationship between the organisation's business strategy and information strategy is identified and mapped.
- Dynamic information processes (information flows) are identified.
- It provides the organisation with an information resource database inventory.
- The end product is a corporate information policy (Henzel adopts Orna's [1990] definition of information policy) providing strategic direction and management guidelines for the organisation's future management of information.

However, while there is little evidence of evolutionary IA development, it is worth noting that Henzcel's method does introduce an explicit stage to establish an IA continuum, emphasising the iterative, cyclical nature of the IA process.

There are a number of potential criticisms to Henzcel's approach:

- Similar to Orna's approach, Henzcel's methodology lacks practical guidance in several key stages.

  > At times it is too vague and evades detail by claiming much depends on each organisation's culture. (Webster, 2001)

  For example:

- The importance of understanding the organisation's mission, goals and objectives, organisational structure, and culture are discussed, but there is little guidance on how to identify or analyse these key elements.
- Henczel discusses the potential complexity of detailed information flow modelling, but provides limited, high-level guidelines.
- The selection criteria used as part of *develop strategies*, *formulate recommendations*, and *develop action plans* lacks detail on weightings and scales, essential to their use.
- The information policy discussion is extremely brief.

- Henczel only briefly mentions process. Information flow can be considered a form of process representation, but Henzcel's examples are based upon organisational structure, which is contrary to the cross-functional characteristics of a process.
- Henzcel adopts Buchanan & Gibb's (1998) information resource database approach, but does not address their own published concerns regarding the potential complexity of this approach.
- Allocation of costs to information resources is briefly mentioned as a further step during the data analysis stage, but there is no explicit stage/step, discussion or guidelines. It may be that Henzcel is acknowledging the complexity and challenges of this step, and as a result choosing to omit it; but if so, this is not discussed.
- With regard to measuring the impact of change, Henczel states that "some measures will be quantifiable, but most will relate to how the information users perceive the improvements or benefits". This is a generalisation, with an unecessary bias to qualitative metrics.

One further, more general criticism, is that Henzcel states that "Most organisations have significantly large pockets of employees who do not have a need for information resources to do their work" and recommends that certain groups can be excluded who are known not to be information users. This is a potentially dangerous statement as the vast majority of members of an organisation will be information users to a greater or lesser extent. No members of an organisation should be considered as having no need for information resources to do their work. The key to a successful IA is to identify the information users relative to the processes and/or functions within the scope of the IA. Some may be omitted from the audit, but this should be done with care.

4.7. Comparison of IA Methods

In order to conduct a comparative analysis and critique of the four key IA methods discussed in the previous sections (see Sections 4.3-6), three key evaluation measures are proposed:

- **Comprehensiveness:** the conceptual, logical, and structural comprehensiveness of each methodological approach as compared to an identified methodological baseline (see Section 4.7.1, page 175).
- **Applicability:** the applicability and scope of each approach, and the ability to tailor the approach to individual organisational requirements.
- **Usability:** the perceived ease with which the method can be adopted and applied.

Each of these measures is discussed in turn below.

4.7.1. Comprehensiveness

A challenge with attempting to assess the relative comprehensiveness of each of the four respective information audit methodologies is that, given that there is no standard, agreed methodological approach to information auditing (see Section 1.1.1, page 4), there exists no master reference model nor independent guide to the methodological stages of an IA (ideally a 'methodological baseline' against which individual IA methodologies could be compared and contrasted for comprehensiveness and relative completeness). However, work has been conducted in this area by both Dalton (1999), and Botha & Boon (2003). Both are discussed below.

Dalton (1999) identified common key stages through examination of published literature on information auditing, with individual stages of IA methodologies identified and then extracted for tabulation, analysis and comparison. Dalton's goal was to "discover which features were common and were therefore a necessary component in a model of the information audit process". The common features identified by Dalton (1999) were:

- A particular philosophy should be adopted with scope and objectives clearly defined.
- Must involve at least one of the functions of inventorying, advisory or compliance with a comprehensive information audit containing all three.
- Constraints on the audit should be carefully considered.
- Organisational goals and strategies should be recognised.
- Senior management backing is essential.
- Extensive preparatory work is important.
- Appropriate and consistent data gathering, analysis and reporting tools should be assembled.
- Must contain activities which fall into each of the categories of: fact finding; analysis and interpretation; and reporting.
- Must be systematic and consistent in approach throughout.
- Inventorying information resources and examining users' information needs through questionnaire and interview are common activities.

Dalton also identifies several further features, which he describes as applicable to particular circumstances. These are (Dalton, 1999):

- Variations in approach, e.g. top-down, bottom-up or a combination of both
- Focus can range from a single functional unit to a whole organisation
- A specific problem area or system may be auditied e.g. IT infrastructure or internally generated information

- Audits may include a combination of two or more of the inventorying, compliance testing or advisory functions
- The audit team may be composed of members of staff from the organisation being audited or external staff or a combination of the two
- Piloting may or may not take place
- Variations occur in data collection
- A cost/benefit approach may or may not be taken
- An inventory approach may or may not be taken
- Alternative solutions may or may not be generated
- Recommendations and/or solutions may or may not be proposed
- Monitoring and feedback processes vary
- Specific pre-audit activities may be separated from the audit proper or they may all be considered as part of the information audit

A limitation with Dalton's model, for the purposes of this study, are that his list of common features includes several which could more properly be considered general recommendations (e.g. senior management backing) and project management 'scope' considerations (e.g. piloting may or may not take place) rather than IA specific methodological stages/steps, which limits his models usefulness as a methodological baseline against which other methodologies can be immediately compared and contrasted. A further limitation is that the IA methodologies that he compared are not identified so the relevance of his model to the IA methodologies focused upon for this study is not immediately apparent and would need to be tested through repeating the mapping exercise.

Botha & Boon (2003) reviewed IA methods to establish guidelines for a standardised IA methodology. They first classified IAs according to Barker's (1990) classification (see Section 4.2, page 118), and then identified the common stages for the IAs associated with three of the five classifications:

operational advisory, geographical, and hybrid (no explanation was provided as to why these three were focused on). The results were as follows.

For operational advisory audits, the common stages were identified as (Botha & Boon, 2003):

- Define the organisational environment
- Planning
- Identify users' information needs
- Design the questionnaire
- Send memos to interviewees/make appointments with interviewees
- Investigate technology
- Analysis
- Costing and Valuing
- Test key control points
- Generate alternative solutions/evaluate alternatives
- Monitor adherence to existing standards and regulations
- Write the final report
- Implement monitoring mechanisms

For geographical audits, the common stages were identified as (Botha & Boon, 2003):

- Analyse the users' information needs
- Compile an information inventory
- Match the identified information needs to the identified information sources
- Design a solution
- Design an implementation plan

For hybrid audits, the common stages were identified as (Botha & Boon, 2003):

- Promote (market) the information audit
- Define the organisational environment
- Planning
- Collect data
- Analysis
- Costing
- Compile the final report

Botha & Boon's models are more usable for the purposes of this study than Dalton's (1999), but the author questions the value/usefulness of Barker's (1990) classifications as they have not been popularly adopted for anything other than historical classification of IA models and origins, and include several IA models (particularly those associated with operational advisory approaches) which are no more than summary guidelines or have been superseded by the IA methods focused on for this study (see Section 4.2, page 118-122). Further, the level of identified stages across models is not consistent. For example, for the operational advisory model, "send memos" and "analysis" are both considered phases, yet the latter is a significantly greater undertaking than the former. Botha & Boon's distinction between 'geographical' and 'hybrid' audits is also debatable as the former refers to information mapping, which can easily be included in the latter. One further limitation is that while Botha & Boon included Orna (1990) and Buchanan & Gibb (1998) in their investigation, they do not include Burk & Horton (1988) or Henzcel (2001), with no explanation for this omission provided.

However, limitations aside, the models do provide useful guidance for development of a 'methodological baseline', particularly the hybrid model, which, due to its broader remit and definition, is considered by the author to be the most applicable to the IA methodologies within scope for this study (Botha & Boon [2003] mapped both Orna [1990] and Buchanan & Gibb [1998] to the hybrid model). However the omission of both Burk & Horton (1988) and Henzcel (2001) from Botha & Boon's (2003) study limits its usefulness, as these are both considered key IA methodologies by the author.

In light of the noted limitations with both Dalton (1999) and Botha & Boon (2003), the author elected to conduct a mapping/modelling exercise of his own. The approach was similar to both Dalton's and Botha & Boon's, but focused upon the IA methodologies selected for this study, including the two omitted by Botha & Boon. This model was then compared and contrasted with Botha & Boon's (2003) hybrid model.

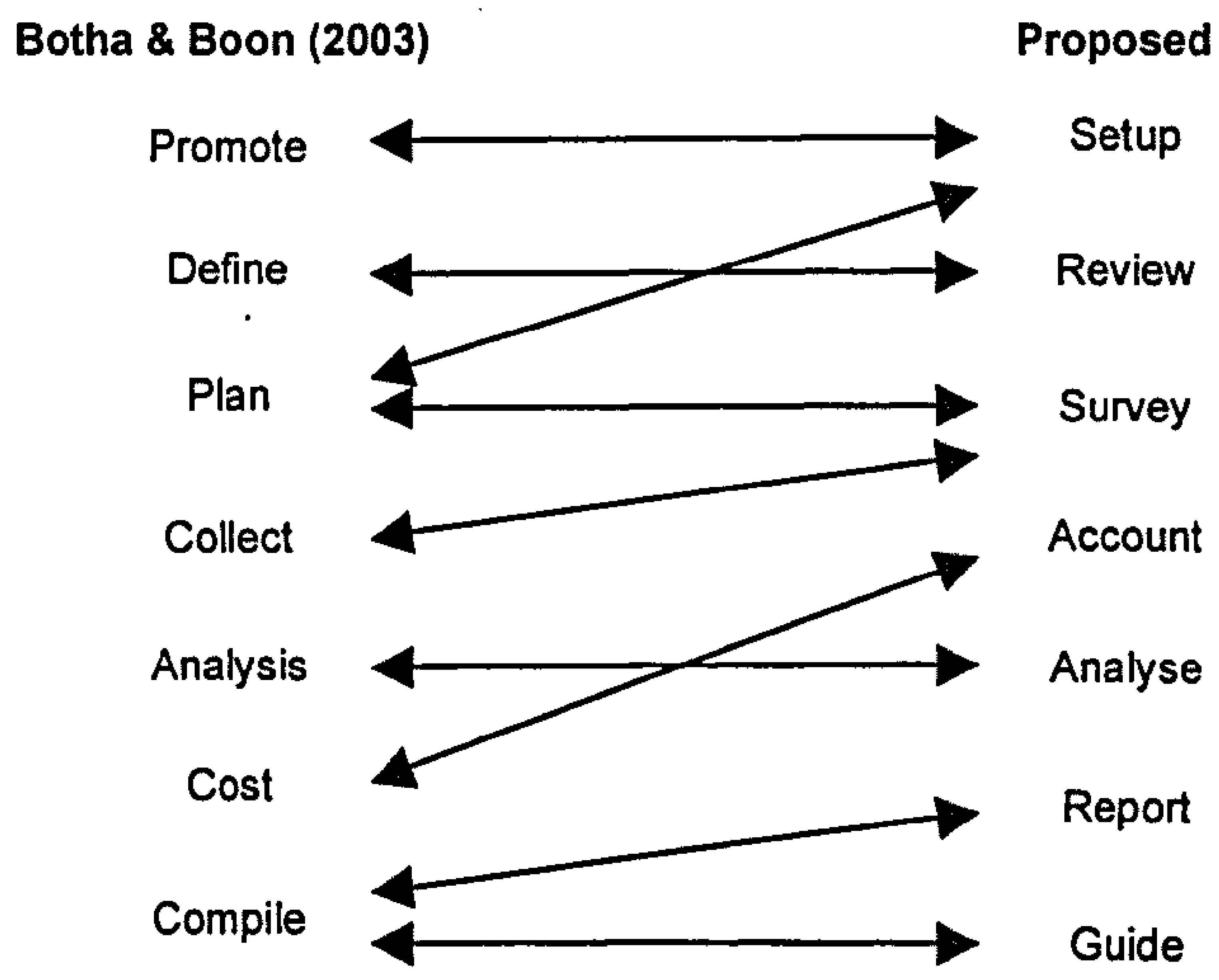
The first step was to compile a single master list/model of IA stages from each of the respective four IA methodologies (Burk & Horton, 1988; Orna, 1990; Buchanan & Gibb, 1998; Henzcel, 2001). The master list was compiled firstly, through identification and listing of each of the discrete stages/tasks offered by each respective approach, and secondly, through grouping of identical activity, and removal of any duplication (a bottom-up mapping exercise). The final step was consideration of additional stages/tasks, which may be required but were not found within existing methods, which was completed partially through cross mapping to both Dalton (1999) and Botha & Boon's (2003) models, and partially through author consideration of additional desirable steps. No additional stages/tasks were identified which did not already exist in an existing IA model. However, it was anticipated that this would be revisited upon completion of the case studies and usability trials.

The output of this exercise was a high level, generic, methodological model against which each of the individual IA methodologies could then be mapped for comparative analysis. The seven identified stages were as follows:

- **Setup**: project planning, preparation of business case, endorsement, organisational communication etc.
- **Review**: strategic analysis (internal and external), organisational (cultural) analysis etc.
- **Survey**: survey of information users, identification and inventory of information resources, mapping of information flow etc.
- **Account**: cost, business benefit and/or value of information resources
- **Analyse**: analysis of findings
- **Report**: production and dissemination of IA findings and recommendations
- **Guide**: implementation of recommendations, organisational information management strategy and/or policy development, and establishment of the IA as a cyclical process

These stages were then compared and contrasted with Botha & Boon's (2003) hybrid model as illustrated in figure 4.1 below.

Figure 4.1. Identifying an IA methodological baseline



It can be seen from Figure 4.1 (see page 176) that the models are quite similar. However, there are some notable variations:

- Botha & Boon's 'plan' stage is split across 'setup' and 'survey'. Both Buchanan & Gibb (1998) and Henczel (2001) include initial planning stages associated with overall setup, and later planning stages associated with preparation for data gathering (in what is referred to here as the 'survey' stage).
- Botha & Boons 'cost' stage becomes 'account' and comes before 'analyse'. Account is preferred as a term as it has broader meaning than cost, acknowledging the different approaches to this phase by the respective authors (see Sections 4.3-6). 'Account' is placed before 'analyse' acknowledging Buchanan & Gibb's (1998) sequence of IA tasks, which logically recognises that all required data (including cost benefit etc.) must be gathered prior to final analysis.
- Botha & Boons 'compile' stage is split across 'report' and 'guide'. This acknowledges that Orna (1990), Buchanan & Gibb (1998), and Henzcel (2001) all have individual stages/steps for both production of the information report and ongoing activity such as strategy and policy development, and establishing cyclical IA based reviews.

In consideration of these variations and the fact that the author's model has been mapped against all four IA methodologies in scope for this study, the author used this model for comparing and contrasting relative comprehensiveness.

The key IA methodologies were then mapped to this baseline, as illustrated in Table 4.1 (see page 176). Comparative analysis (approximate) now illustrates the relative comprehensiveness of each of the respective IA methods against the baseline. Burk & Horton's (1988) approach can be seen to be focused on core IA tasks, lacking stages for initial setup, strategic and organisational review, and post-audit policy and/or strategy development. Buchanan & Gibb (1998) lack an initial setup stage. Orna (1999) and Henzcel (2001) can be seen to be very similar, with only minor variation between (for example, Orna [1999] conducts a preliminary review prior to setup in order to guide the latter).

Table 4.1. A relative comparison of IA Methodologies

<table>
<tr><th></th><th>Setup</th><th>Review</th><th>Survey</th><th>Analyse</th><th>Account</th><th>Report</th><th>Guide</th></tr>
<tr><td>Burk & Horton (1988)</td><td></td><td></td><td>1</td><td>3</td><td>2</td><td>4</td><td></td></tr>
<tr><td>Orna (1999)</td><td>2 - 4</td><td>1</td><td>5</td><td>6</td><td colspan="2">7</td><td>8 - 10</td></tr>
<tr><td>Buchanan & Gibb (1998)</td><td></td><td>1</td><td>2</td><td>3</td><td>4</td><td colspan="2">5</td></tr>
<tr><td>Henczel (2001)</td><td>1</td><td colspan="2">2</td><td colspan="2">3 - 4</td><td>5</td><td>6 - 7</td></tr>
</table>

note. Sections 4.3-6 provide individual stage names as per the respective stage numbers above.

However, the author believes that the true value of Table 4.1 is not the comparison of the above methodologies, but the generic methodological baseline which has been identified from this comparison, for this provides a method to assess completeness of approach not just when adopting any one of the above methodologies, but also when considering an individual or tailored approach. The comparison is of limited further value because it is only an approximate mapping at a high level, which does not fully consider or review how well each of these methodologies approach each of these generic stages. This is why applicability and usability is also considered.

4.7.2. Applicability

Applicability refers to the ability to meet individual requirements. Two criteria are proposed to measure applicability:

- Application: the ability of the method to address each of the elements of the IA (e.g. strategic, process, resource)
- Scope: the ability of the method to be scoped to organisational requirements

Application

In Section 3.5 (see pages 102-104) it was proposed that there are four elements and three perspectives to the role and scope of an IA. Elements were derived from Earl's (2000) information strategy taxonomy and are: information management, information technology, information systems, and information content. They provide the auditor with the flexibility to focus on discrete types of information resources dependent upon organisational requirements. Perspectives provide a second dimension, allowing the information audit to be scoped not just according to information resource type(s), but also by one or more desired organisational views. These dimensions of IA role and scope came together as the scope matrix illustrated in Figure 4.2 (see page 178).

Figure 4.2 also illustrates the respective capability (approximate) of each IA methodology to address each of these elements and perspectives. Burk & Horton (1998) can be seen to have the narrowest application of the four methods, capable of addressing each of the four elements but only from the 'resource' perspective. Buchanan & Gibb (1998), Orna (1999), and Henzcel (2001) all have identical application: capable of addressing all four elements from both a strategic and resource perspective.

Figure 4.2. IA Application

	Information Management	Information Technology	Information Systems	Information Content
Strategic	○ △ ⬡	○ △ ⬡	○ △ ⬡	○ △ ⬡
Process				
Resource	□ ○ △ ⬡	□ ○ △ ⬡	□ ○ △ ⬡	□ ○ △ ⬡

Key: Burk & Horton (1998) □ Buchanan & Gibb (1998) ○
Orna (1999) △ Henczel (2001) ⬡

The lack of process application capability is the key observation from this exercise, a gap shared by all four methods. While Buchanan & Gibb (1998), Orna (1999) and Henzcel (2001) all include the mapping of information flow within their respective methodologies (which, to a degree, draws parallels with process modelling), none explicitly include process modelling as a task or activity (Buchanan & Gibb [1998] do discuss process, and suggest process modelling as an alternative approach to organisational modelling, but overall their methodology is acknowledged [by themselves] as being functional in nature). Burk & Horton (1988) do not even include information flow, being primarily based on the relationship from information resource to organisational structure.

This is a key omission as the process perspective transcends the limitations of a relatively static functional view by focusing not on organisational structure, but on the dynamic relationship between information resources, information flow, and business tasks and activity (Gibb, Buchanan, and Shah, 2006). Further, the process models potentially generated by this perspective provide significant opportunity for achieving synergy and integration with related activity, such as information system architecture, and the early stages of information systems analysis and design, particularly if similar modelling conventions are adopted (see Section 3.4.3, pages 100-102). This is key to extending the future value of the IA.

Scope

Scope refers to the ability to tailor the method to individual organisational requirements. It is proposed that there are four interrelated elements to the scope of an IA (the elements are derived from the Open Group classification of scope utilised for information system architecture development [Open Group, 2002]):

- **Organisational scope:** defines the organisational coverage. There are two basic approaches: vertical division by business sector or unit, and horizontal division by business process. Constraints and/or business priority may dictate that a segmented approach be more appropriate than a holistic one.
- **Domain scope**: domains are the IM subsets, which should be addressed as part of the overall audit (e.g. business process, information technology, information systems, information content [discussed in Sections 3.4-5]). Again, practical constraints may dictate the adoption of a segmented approach.
- **Vertical scope**: defines the depth and detail to be captured and documented by the audit. It is often impractical to attempt to complete a detailed audit at the first attempt; consequently, it may be more prudent to begin in a top-down manner, gradually building up the level of detail captured over successive iterations.
- **Time horizon**: defines the timelines to be met. The IA may need to be planned in stages, to align to business plans and/or respond to dynamically evolving markets and services.

Scope is more difficult to objectively assess as this has less to do with the methodological aspects of the respective IA approach, and more to do with the client requirement, and associated project management considerations. However, limitations aside, it could be argued that those methods which include an explicit setup stage and provide guidelines on scope go some way to addressing this requirement. Returning to Table 4.1 (see page 176), it can be seen that both Orna (1999) and Henczel (2001) provide explicit setup stages, while Burk & Horton (1988) and Buchanan & Gibb (1998) do not. All authors to varying degrees discuss each of the elements of scope, but all lack practical guidelines.

A second equally important measure of the ability to manage scope are the overall recommendations and guidance provided by the author of the respective methodology. For example, Henzcel (1991) states that "The scope of an initial (or 1st generation) information audit should definitely be the entire organisation". Henzcel also states that this could be preceded by a pilot project of a selected business unit (by type of information or operational or functional level), but this is regarded as preparation for a comprehensive IA rather than as an exercise in itself. As an absolute rule, the author considers this is an unrealistic goal, particularly when consideration is given to complex corporate and/or federated organisational structures (it is almost always desirable to audit an entire organisation, but it is not always practical, and not always necessary as the focus or priority may be individual business units or processes). The remaining authors do not make this statement, but it could be argued that, due to the lack of guidance on this point, the implicit assumption made by the reader would be that the entire organisation would be in scope.

In conclusion, while Orna (1999) and Henzcel (2001) both provide stages for setting scope and planning, none of the methods provide exemplary guidance on setting and managing scope. It could be argued that much of this guidance falls within the realms of project management and consequently out with the scope of an IA methodology, but practical guidance and procedures for managing application and scope are a serious omission, particularly given the previously discussed concerns over the potential scale and complexity of the IA.

4.7.3. Usability

Usability can be defined as follows:

- The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.[2]
- The extent to which an item is ...convenient and practical in use.[3]
- The effort needed for use, and for individual assessment of such use.[4]

Three definitions are provided as they each convey important elements of usability. User satisfaction, it can be argued, is at the heart of usability typically measured by how effectively and efficiently user requirements are met, and, importantly, through ease of use. An initial source of information regarding how well these elements are met by the respective IA methodologies are case studies from the field, which are discussed in the next section.

Empirical evidence

As previously highlighted by the author as part of the rationale for this research (see Section 1.1.3, page 4), and noted by Botha & Boon (2003), there is a general lack of available information audit case studies, which have explicitly

[2] ISO 9241-11
[3] www.projectauditors.com/Dictionary/U.html
[4] www.sei.cmu.edu/opensystems/glossary.html

tested methods as part of their respective audits. However, not withstanding this shortcoming, the available case studies are discussed in the following sections with methodological evidence discussed in more depth where available. Where no explicit methodology is provided, the key steps taken are highlighted to identify the overall approach adopted. The author acknowledges that both Orna (1990) and Henzcel include case studies with their respective methodologies, but the cases provided are more akin to examples of application, with no methodological critique or consideration of usability. Further, usability cannot be tested by the author/developer, but requires application by external party (Open Group, 2003). It is therefore deemed more useful to identify and discuss case studies from the field.

Lubbe & Boon (1992) conducted an IA of Vista University. The overall objective had a strong information resource management orientation with Lubbe & Boon adopting Burk & Horton's (1988) methodology. The main survey tools were selected interviews with senior managers followed by questionnaire to staff. Findings are presented in overview, but no critique of the methodology is provided.

Booth & Haines (1993) conducted an IA of a UK Regional Health Authority. The overall objective was "to develop and implement a new information management policy to ensure the availability of appropriate resources, organisational structures and training to meet the information requirements of the Regional Health Authority corporate program". Booth & Haines do not explicitly state that Orna's (1990) approach was followed, but Orna was involved in the process (as a guest speaker at an initial conference where the IA was launched) and was consulted at later stages. The methodology adopted is only discussed at a high level, but reference to information flow modelling, information policy oriented final goals, and a final report which included a balance sheet all suggest that Orna's (1990) methodology was followed. Booth & Haines discuss findings and benefits of the IA, but unfortunately provide no critique nor reflection on use of the methodology.

Dubois (1995) conducted a pilot IA of an organisation. The overall aim was a cost benefit analysis focused on information resources and services identified in the organisation's existing resource database (acknowledged as a narrow focus justified by the pilot status of the IA). Dubois does not refer to any particular IA methodology but instead identifies five key phases that he followed: planning, survey, blueprint of situation, report, and establishment of regular monitoring mechanisms. Each are discussed in high-level overview. The main data gathering tool is a questionnaire with a focus on identification and cost benefit analysis of information resources. The final output is a report and set of recommendations. Due to the high level nature of the discussion it is difficult to map Dubois's approach to any other IA methodology; however it could be argued that, due to its focus on IR identification and cost benefit analysis, and the lack of any strategic analysis or information flow steps, it shares a similar approach and purpose as Burk & Horton (1988). Dubois presents the findings of the IA, but provides no critique nor reflection on the methodological process.

Haynes (1995) makes reference to two case studies, one a technical department of a financial institution, and the other a commercial research company, but both are discussed at a very superficial overview level. Haynes provides a summary of his own IA methodology, which could be described as a hybrid approach as it combines elements of both Burk & Horton (1988) and Orna (1990), both of which are cited. However, no practical discussion of the case studies or critique of the methodology is provided.

Theakston (1998) conducted an IA of National Westminster Bank Learning Resource Centres. The overall objective was to "carry out a survey of stock, services, and performance". Findings are discussed, but there is only minimal discussion of the approach adopted with no reference to any particular IA methodology.

Soy & Bustelo (1999) conducted an IA of GDS Grup de Serveis SA, a Spanish financial services company. The objective was to establish a corporate information policy. Soy & Bustelo refer to Burk & Horton (1988), Orna (1990), and Buchanan & Gibb (1998) but do not identify any one approach, stating that they "borrow the terminology used in more complicated methodologies applicable in large organisations" but not specifying what they borrow nor from whom. Their main data gathering approach was a questionnaire distributed to all staff, followed by selective interviews with key personnel. Information resources, services and information flow were all identified and evaluated suggesting an approach similar to the recommendations of both Orna (1990) and Buchanan & Gibb (1998). The final output was a report, which was to serve as the basis of establishment of an information policy. No critique of their methodological approach was discussed.

Lamoral (2001) conducted an IA at the Institute for Commercial Forestry Research, South Africa. The aim was to "gather and critically evaluate information on all aspects of information and knowledge provision at the ICFR". Reference is made to Burk & Horton (1988), Orna (1990), and Buchanan & Gibb (1998) with Lamoral stating the adopted approach was based on Orna; however the focus of the IA would appear to have been identification and evaluation of IRs with no information flow mapping or modelling (characteristic of an Orna based approach), or adoption of Orna's terminology for stages and output. The overall approach was based on questionnaires followed by structured in-depth interviews with selected personnel. The final output was a report and set of recommendations that were to be used as the basis for development of an information policy. Organisational findings are presented but there is no critique of the adopted IA method.

Garrat & Du Toit (2003) conducted an IA of a South African law firm library. The overall objective was to determine and demonstrate the value of library and information services in the light of recent outsourcing of library services. Garrat & Du Toit refer to Burk & Horton (1988), Orna (1990), and Buchanan & Gibb (1998), but do not identify nor map to any specific IA methodology and only provide a high level overview of the approach taken, which involved observation, interviews, and questionnaires (including an online survey of the wider library community via the South African Organisation of Law Libraries). The final output was a report summarising findings. Garrat & Du Toit provide no critque nor reflection on their methodological process.

Langley, Seabrooks, and Ryder (2003) conducted an IA at the Miller Brewing Company. The aim was to identify "what information is necessary to support the business operations, what information people currently use, where people obtain this information and any gaps". They refer to "combined methodologies" but do not elaborate on this. They adopted a survey-oriented approach based on questionnaire followed by short follow-up interviews with a focus on establishing an inventory of IRs and mapping information flows. Reference is made to Henczel (2001) but it is not clear if this was the IA methodology adopted. Organisational findings are discussed but there is no critique of the IA methodological process adopted.

Guenther (2004) discusses utilising the IA as a precursor to intranet development as part of overall web site management at University of Virginia Health System Web Center, but does not provide an actual case study. Guenther summarises Henczel's (2001) IA methodology but does not explicitly state whether or not this is the methodology adopted. No practical experience is discussed.

Jones (2004) conducted an IA at Hobart City Council, Tasmania. The aim was to "develop a culture where all information is recorded, managed and organised, where management systems are transparent and accountable and knowledge is freely shared across organisational barriers". The IA brief was to "conduct an IA to establish how information was being collected, used, managed and distributed in the council". Reference is made to both Orna (1990) and Henczel (2001) with Henczel's approach adopted. A pilot IA, with a questionnaire as the main method of data collection, was conducted focused on the area of risk management. Organisational findings are presented but there is no critique nor reflection on the adopted IA methodology.

Tali & Mnjama (2004) conducted an IA at the South African Development Community Secretariat. The aim was to "identify the information needs, information flows and processes and IRs within the SADC Secretariat in order to improve the management of information within the organisation". They refer to Buchanan & Gibb (1998), but do not explicitly map to any single IA methodology. The approach adopted was survey oriented based on questionnaires, semi-structured interviews, and personal observation. Organisational findings are presented but there is no critique of the IA process.

Wood (2005) conducted an IA of St Helena Hospice Millie Hare library. The overall objective was to ensure the library was providing an effective and efficient service. Wood does not refer to any specific IA methodology and only provides a very high level overview of the approach taken, which was a questionnaire based survey of staff, patients and their family members, supplemented by selected follow-up interviews. Wood described her approach as service oriented, focused on information service awareness, access, and usage. The key benefits of the IA were summarised as increased awareness of available services, identification of user needs, and identification of gaps in service provision. The final output was a report summarising findings. Wood provides no critique nor reflection on the methodological process.

In summary, of the identified and limited case studies, the majority (Dubois, 1995; Haynes, 1995; Theakston, 1998; Soy & Bustelo, 1999; Langley et al 2003; Garrat & Du Toit, 2003; Guenther, 2004; Tali & Mujama, 2004; Wood, 2005) do not make reference to a specific adopted IA methodology, while those that do (Lubbe & Boon, 1992; Booth & Haines, 1993; Lamoral, 2001; Jones, 2005) make only brief mention and provide no methodological critique nor feedback on usability. All four IA methods reviewed in depth for the purposes of this study (Burk & Horton, 1988; Orna, 1990; Buchanan & Gibb, 1998; Henczel, 2001) would appear to receive equal attention with no one method distinguishing itself as the 'preferred approach' of auditors.

A further notable observation from this review of existing case studies is that it would appear that the preferred approach to information auditing is to adopt a 'hybrid' approach based upon and referring to established IA methods, but predominantly built around standard everyday research tools such as questionnaires and interviews. This 'simplified' approach may be further evidence (see Section 1.1.1, pages 4-5) that existing IA methods are too complex and/or are not readily adoptable (for example, Soy & Bustelo [1999] refer to 'complicated methodologies'). However, this is difficult to gauge, as the majority of cases simply do not provide enough methodological detail.

In consideration of the lack of empirical evidence regarding usability of IA methods, the challenge for the author was how usability could be considered prior to testing in the field (the empirical component of this study, now considered to be of even greater value given the lack of existing empirical evidence noted above). Completeness and applicability, as discussed in the previous sections, both significantly influence usability, but two further aspects, more explicitly focused on the user experience are proposed by the author. These are the skills required of the auditor to conduct the IA, and the level of tools support provided by the respective authors.

Skills requirement

The first consideration when discussing the skills requirement is who might the intended user be? All authors, not surprisingly, pitch their respective methodology to information professionals. Notably, Buchanan & Gibb (1998) recommend that their approach be led by a 'senior' information professional, a distinction not made by the other authors; however, Buchanan & Gibb do not specify any specific skills to denote this seniority. No one specifies audit experience as a prerequisite of the auditor role with both Orna and Henzcel pitching their approach to the first time auditor (Burk & Horton and Buchanan & Gibb do not discuss this). A further related consideration is whether the auditor should be internal or external: both Orna and Henczel promote internal resourcing (although Henczel does recommend external help with Data Analysis), while Burk & Horton and Buchanan & Gibb are both neutral on this point, each identifying the relative strengths and weaknesses of internal versus external.

All authors acknowledge that a multidisciplinary approach is required to conduct an IA, and that the skill set required is considerable, drawing from several disciplines beyond the natural boundaries of most information professionals. For example (Buchanan & Gibb, 1998):

- Project Management
- Strategic Analysis
- Systems Analysis
- Statistics

- Accountancy

Of course, some of these can be shared across a team; but the requirement remains considerable, particularly for the primary auditor (Buchanan & Gibb (1998) argued that it was highly probable that an information professional embarking on an audit would lack one or more of these required skills and developed their own methodology and the associated toolset partially to address this problem).

With regard to the specific skills required, these vary dependent upon methodology. The basic information skills requirement is broadly similar across all four methods; however, the more specialised skill requirements are not, largely dictated by individual approaches to the *review* and *account* stages of the IA (see Figure 4.1, page 174). These key variances are as follows:

- Buchanan & Gibb include in-depth strategic analysis steps and a formal accounting stage.
- Orna also includes a degree of strategic analysis but with the emphasis more on organisational analysis (structure, management philosophy etc.). Orna also includes an accounting stage, but in contrast to Buchanan & Gibb's formal approach, focuses on simple cost/value ratios based upon the Burk & Horton approach.
- Henzcel's approach to the initial review stage is broadly similar to Orna's, but notably, Henzel has no account stage.
- Burk & Horton have no strategic or organisational analysis steps, and use simple cost/value ratios rather than formal accounting methods for the account stage.

In summary, Buchanan & Gibb's IA methodology requires the broadest skillset from the auditor, drawing extensively from both strategic management and accountancy disciplines. Orna is next, but adopting a simpler, less in-depth approach. Both Henzcel and Burk & Horton demand the narrowest skillset of the auditor, but this is largely due to the complete omission of individual steps/stages, rather than a pragmatic approach.

Tools support

Closely related to the skills required are the tools and techniques which are provided in support of the IA. Similar to the skills requirement, the tools and techniques required to support the IA process are broad ranging, covering (but not limited to) strategic and organisational analysis, data gathering and analysis, information flow/process modelling, systems analysis, cost/value accounting, and reporting and presentation skills. The following sections discuss the tools support provided by each of the respective IA methodologies.

When introduced, InfoMap was the most comprehensive method available to identify and define an organisation's information resources. From a tools support perspective, the methodology provided an extremely useful template for IRE capture (referred to as an 'inventory data form'), identifying and detailing all the required data fields necessary to build an inventory of IRs. The methodology also included tables and weightings for determining cost/value focused on value with reference to recommended methods for costing which Burk & Horton acknowledged as a problematic area (discussed in Section 4.3.1, page 125). However while the IRE template has proven useful, and been adopted/refined by both Orna (1990) and Buchanan & Gibb (1998), the rating methods for assessing and ranking IRE values were described as unclear by Buchanan & Gibb (1998). Notably, InfoMap was also supported by InfoMapper software, a database application designed to provide a purpose built inventory system for population utilising the InfoMap IA methodology. However, Barclay and Oppenheim (1994), in a trial conducted at Trainload Coal, concluded that the software was inflexible, cumbersome and of limited value with both the authors and the participating organisation concluding that it would have been simpler to have adapted an existing COTS database application to capture IRE data.

One further toolset limitation with Burk & Horton relates directly to the comprehensiveness of the methodology. As previously noted, the methodology focuses on identification of an organisation's IREs and associated information mapping, with no stages included for organisational analysis and strategy and/or policy development. This has previously (see Section 4.3.2, page 134) been highlighted as a methodological limitation, particularly with regard to organisational analysis. The implications for toolset support are simple: if the scope/comprehensiveness of the methodology is narrow then so too will be the corresponding tools and techniques which are provided or suggested to support the methodology.

Although providing a more comprehensive approach, toolset limitations have also been identified with Orna's (1990) methodology. Nickerson (1991) and Buchanan & Gibb (1998) both highlighted the need for a more comprehensive set of tools and techniques to support each of the stages of the methodology with Buchanan & Gibb drawing particular attention to a lack of tools and techniques to support the initial stage involving organisational analysis. For example, during the initial investigation (stage one) an organisational analysis is carried out that requires an in-depth investigation of the organisations objectives, structure, and culture. Orna (1990) emphasises the importance of this stage:

> ...if we don't fully understand what it (the organisation) thinks it is in business for, we risk misinterpreting what we find at later stages, assigning inappropriate values to information resources, and choosing information

solutions that are so bad a match that they harm its interests rather than furthering them.

However, to carry out the initial investigation requires a number of key research skills (e.g. interview technique, qualitative data analysis, organisational analysis tools to identify the organisation's mission, environment, structure, and culture etc.) which would have benefited from supporting tools and techniques (Nickerson, 1991).

Buchanan & Gibb's (1998) IA methodology was in part a response to the toolset limitations noted above in both Burk & Horton (1988) and Orna's (1990) approaches. The methodology provides a complete, step-by-step process supported by a comprehensive IA tool-kit based on proven tools and techniques drawn predominantly from business and management science disciplines. Buchanan & Gibb's (1998) approach was to detail the purpose and tasks for each IA stage, and provide reference to appropriate tools and techniques which could be utilised to complete the stage (rather than detailed guidance/examples). In this way, tools support is evident for all stages of their IA methodology. Notably, the methodology also provides a meta model for mapping the relationship from business strategy to information strategy to information resources (subsequently adopted by Henzcel [2001]), and identified three established methods from accounting which could be applied to the problematic area of costing/valuing information resources. However, as noted previously (see Section 4.5, pages 155-156) there are concerns associated with the Buchanan & Gibb approach, two of which have toolset implications. Buchanan & Gibb (1998) themselves noted that there may be practical difficulties in modelling relationships between business objectives, critical success factors, tasks, and information resources, due to the complex many-to-many relationships. Also, although process modelling is identified as a recommended technique, the methodology is predominantly task-oriented and hierarchical in nature, and provides no process modelling guidance or tool support.

Henzcel's (2001) approach is similar to both Orna (1990) and Buchanan & Gibb (2001), drawing extensively on both. Unfortunately, similar to Orna's (1990) methodology, Henzcel's methodology has been criticised for lacking practical guidance in several key stages, as Webster (2001) noted:

> At times it is too vague and evades detail by claiming much depends on each organisation's culture.

As previously discussed (see Section 4.6.2, pages 165-167) and briefly recapped here, there is limited guidance for key steps such as organisational analysis and information flow modelling. The selection criteria used as part of 'develop strategies', 'formulate recommendations', and 'develop action plans' lacks detail on weightings and scales, essential to their use. Henzcel only briefly mentions process and provides no guidelines. Information flow can be considered a form of process representation, but Henzcel's examples are based upon organisational structure, which is contrary to the cross-functional characteristics of a process. Buchanan & Gibb's (1998) information resource database approach is adopted, but Henczel does not address Buchanan & Gibb's own concerns regarding the potential complexity of this approach. Finally, allocation of costs to information resources is briefly mentioned as a further step during the data analysis stage, but there is no explicit stage/step, discussion, or guidelines.

In summary, Burk & Horton (1988) provide useful templates for capturing and inventorying IREs, but the limited scope and applicability of their methodology also limits the extensiveness of the toolset. Both Orna (1990) and Henzcel (2001) provide more complete methodologies, but lack practical tools and techniques for several key stages/steps. Of the more complete methodologies, Buchanan & Gibb (1998) provide the most comprehensive tools support, with tools and techniques listed and recommended for each of the stages and respective steps; however this may be more appropriately referred to as 'tools guidance', given that the authors provide a framework of existing tools and techniques which can be utilised for IA purposes, rather than detailed examples and instruction. There are also potential problematic areas concerning modelling of complex relationships, and the methodology lacks tools/techniques for process modelling. Neither of these problems are unique to Buchanan & Gibb (1998), but they do highlight gaps and areas for further development.

4.8. Summary

This chapter provided an in-depth review and critique of IA methodologies. Early origins were discussed before identification of the key popular approaches (Burk & Horton, 1988; Buchanan & Gibb, 1998; Orna, 1999; Henzcel, 2001). Each of these methods were then individually discussed and critiqued before a detailed comparison was conducted to highlight the relative completeness, applicability, and usability of each. This comparison can be summarised as follows:

- **Comprehensiveness:** The key IA methodologies were mapped to a methodological baseline, which illustrated relative comprehensiveness of respective approaches (see Table 4.1, page 176). Burk & Horton's (1988) approach was shown to be focused on core IA tasks, lacking stages for initial setup, strategic and organisational review, and post-audit policy and/or strategy development. Buchanan & Gibb's (1998) approach lacks an initial setup stage but is otherwise similar to both Orna (1999) and Henzcel (2001). Orna and Henzcel are very similar, with only minor variation between.

  Burk & Horton (1988) adopt a now largely discounted bottom-up approach, while Buchanan & Gibb (1998), Orna (1999), and Henczel (2001) are all top-down approaches.

- **Application:** Buchanan & Gibb (1998), Orna (1999), and Henzcel (2001) all provide for both *strategic* and *resource* application, with Buchanan & Gibb providing the most in-depth strategic application. Burk & Horton has the narrowest application of the four methods, focused solely on *resource*. All four methods have limited *process* application. Orna and Henzcel do promote an information flow based approach, which it could be argued is similar to a process based approach, but processes are not discussed in any depth, while organisational structures are. Buchanan & Gibb also adopt an information flow based approach, and also discuss and suggest process modelling, but their overall approach is predominantly functional in nature. Burk & Horton is based solely upon organisational structure.

Orna and Henczel both provide steps for setting scope and planning, but limited practical guidance. Buchanan & Gibb and Burk & Horton provide no explicit step.

- **Usability:** Buchanan & Gibb (1998) provide the most comprehensive IA toolset, with tools and techniques listed and recommended for each of the stages and respective steps, but the method also requires the broadest range of skills, drawing extensively from both strategic management and accountancy disciplines. Both Orna (1990) and Henzcel (2001) lack practical tools and techniques for several steps, but adopt a simpler, less in-depth approach, requiring a narrower skillset. Burk & Horton (1988) provide useful templates and have the narrowest skillset of all four, but the limited scope and applicability of the method largely negates these benefits.

  Orna and Henczel both pitch their approaches to internal information professionals conducting an IA for the first time which, it could be argued, provides a more realistic approach than Buchanan & Gibb, who recommend that the IA be led by an experienced auditor.

From the above review it is proposed that Buchanan & Gibb (1998) provide a suitable methodological basis for *a generic and universally applicable information audit framework* (see Section 1.2, page 9). The methodology provides a relatively comprehensive approach, has application equal to its peers, and perhaps most notably, is supported by a comprehensive toolset. Botha & Boon (2003), in their own comparison of IA methodologies in pursuit of a basis for a standardised IA methodology, also noted the suitability of the Buchanan & Gibb's (1998) methodology, concluding:

> According to Robertson's (1994) statement, the standardised methodology envisioned by him is not supposed to limit organisations in the execution of information audits, but rather guide them in terms of elements to investigate and tasks to include in the performance of such an audit – the methodology as proposed by Buchanan & Gibb (1998) would therefore be acceptable.

Buchanan & Gibb (1998) was consequently adopted as the IA methodology for the empirical component of this research. However, as previously noted, there were some areas of potential concern associated with this methodology (see Section 4.5.2, pages 155-156). Although noted as potential rather than actual concerns, some consideration was given to how these might be mitigated for prior to implementation and/or tested for actuality during implementation. These concerns and the corresponding solutions or measures were as follows:

- Concerns regarding potential complexity related to the depth and breadth of the approach would be managed by careful and pragmatic scope management, which would be facilitated by the use of the proposed IA scope matrix (see Figure 3.16, page 104), and corresponding tailoring of the methodology.
- Concerns regarding synthesis between stages would be managed through careful selection and application of tools and techniques, which were capable of, or adaptable to, an integrated approach. This would be one of the evaluation measures regarding suitability and usability of the recommended toolset associated with this methodology.
- Concerns regarding the modelling of relationships between business objectives, critical success factors, tasks, and information resources, would

be tested rather than mitigated for as a process, meta-model, and toolset is provided as part of the methodology.

- Process modelling would be incorporated and tested as part of the case studies, subject to appropriate organisational requirement. Process modelling is identified as a potential technique within the methodology so does not represent a major departure from the toolset, however, there is a requirement to identify and test an appropriate modelling technique/methodology which can serve the purposes of the IA. It is proposed that the modelling technique is based on a simple input-output model similar to Orna's (1990) information flow approach and UML, DFD, and IDEF (see Section 3.5.2, page 109), and that Ould's (1995) methodology is adopted to provide a step-by-step modelling process, if required (see Section 3.5.2, page 110).

Section three: Case studies

Chapters Five, Six and Seven within this section present and discuss the empirical, case study based component of this research, which tested the Buchanan & Gibb (1998) IA methodology. These case studies are presented in two stages: firstly, two audits conducted by the researcher primarily for the purposes of methodological (IA) testing (see Chapters Five and Six); and secondly, three usability trials conducted by independent party under observation by the researcher (see Chapter Seven).

It should be reiterated that organisations consented to findings being utilised for research purposes under the agreement that sensitive or confidential material would be withheld, that organisation specific information or findings identified or generated by the IA would be used selectively for illustrative purposes only (and within the research context), and that the complete final audit report would remain the confidential property of the participating organisation. Staff within participating organisations were invited to participate without obligation and privacy was established through anonymity of responses.

It should also be reiterated that the scope of each IA was dictated not by the auditor but by the brief provided by the participating organisation, with the IA then tailored accordingly. While this removed the opportunity to establish a controlled test case it ensured that the IA met the requirements of the participating organisation and maintained confidence in test results by removing the opportunity for the auditor to scope the IA to suit the methodology, rather than to the requirements of the participating organisation. Individual briefs are discussed for each respective IA, prior to discussion of proceedings and findings.

For a more detailed discussion of the research methodology, which framed these case studies, please refer to Chapter Two.

Chapter Five: Case study One

The following section discusses, in some depth, the first of the two case studies conducted to trial the IA methodology.

5.1. Organisational overview, client brief, and methodological scope

The participating organisation was the University of Strathclyde, Department of Design, Manufacturing & Engineering Management.

5.1.1. Organisational overview

The University of Strathclyde was founded (1796) in Scotland as a place of useful learning, to make higher education available to all, and to combine excellence with relevance. The University mission statement was defined as to:

- Contribute to the advancement of the knowledge society, to social cohesion and to the quality of life in Scotland, and in the wider national and global community;
- Generate, through excellence in research and scholarship, new ideas, knowledge and skills to create opportunities for individuals and society;
- Provide high-quality education to all of its students, regardless of background, inspiring them to develop to the full their abilities, and creating outstanding professional and creative people;
- Offer the opportunities for all staff to develop their full potential, and contribute fully to the achievement of the University's Vision.

The University of Strathclyde aspires to be a dynamic top-ranking European University dedicated to excellence through its core mission of promoting useful learning. Information resources are managed at the University level by the Information Resources Directorate (IRD), which encompasses three major service areas of the University: Library Services, Information Technology Services, and Learning Services. By bringing together information resources and the services needed to deliver them, the Directorate seeks to enable the best use of Communications and Information Technology in support of the University's work. At the time of the audit, the IRD was considering ways in which it could help individual departments to better manage their information resources.

The department of Design, Manufacturing & Engineering Management (DMEM) conducts broad-based education and research of relevance to the needs of manufacturing industries. DMEM is primarily concerned with 'product realisation', from design through manufacture with research interests ranging through production and process technologies, information technologies, design methodologies, strategic management and performance improvement. The Department prides itself on the relevance of its work, its high standards and its high levels of care for its students. At the time of the survey, the Department consisted of 17 academic staff, 3 academic related staff, 11 technician staff, and 6 secretarial staff. DMEM facilities included manufacturing laboratories, precision machining, CNC, metal forming and metrology, manufacturing systems, electronic assembly and robotic cells, design studios and design-and-make laboratories. There were also a variety of computer laboratories, ranging from networked PCs with manufacturing software packages to sophisticated graphics workstations running CAD/CAM software. There were over 300 undergraduate students, approximately 40 postgraduate students, and a further 50 researchers, either engaged on funded research projects or studying for a PhD. At the time of the audit, the DMEM HOD had approached IRD for guidance on information management following a number of unspecified information related problems with internal processes.

5.1.2. IA brief

IRD, when approached by the auditor, were willing to trial the Buchanan & Gibb IA methodology as a potential method for assisting individual University departments with the management of their information resources. Given DMEM were already in discussion with IRD, it seemed appropriate for IRD to use DMEM as a pilot exercise. The auditor consulted with both parties and defined their respective briefs as follows.

IRD IA objectives

- To pilot the information audit methodology in order to test its suitability as a method for University Departments to identify, evaluate, and manage their information resources.
- To evaluate information management within a University Department as part of the overarching IRD information strategy development process.

DMEM IA objectives

DMEM IA objectives were initially stated by the DMEM Head of Department (HOD) as:

- To improve the efficiency, effectiveness and visibility of information handling.
- To improve response time to information needs and demands.
- To understand and plan for any training and other staff development needs.

Follow on meetings between the auditor and the HOD discussed and expanded upon these objectives, utilising the IA scope matrix and walking through the corresponding stages of the IA. The HOD initially stated that he wanted to know what his information resources were, how effective information flows were within the department, and what was required to improve information flow. However, when discussing this requirement further, the HOD indicated that he would also like to conduct a strategic review of the department's goals and objectives as part of the identify and analyse stages, and would like to involve staff as much as possible in this process (he was concerned that the department might lack shared direction). Consequently, what might have initially been considered a resource oriented IA was, after more in-depth discussion facilitated by the IA scope matrix, a strategic oriented IA (which, when strategy cannot be taken as a pre-given, is considered by the researcher/auditor a natural and logical first step to provide direction and context for process or resource oriented IAs). With regard to elements within scope (e.g. the second IM, IS, IT, IC dimension of the scope matrix), it was agreed that management, systems, and content were within scope (from a strategic orientation), but that technology could be largely taken as a given (apart from local hardware) unless issues were identified related to the other three elements (this was deemed appropriate as in this case, majority of technology [network infrastructure etc.) was provided by a central university service outwith DMEM and considered satisfactory by the HOD regardless). The HOD also stated that he did not require costing of resources. The resulting scope matrix for this IA is illustrated in Figure 5.1 below.

Figure 5.1. DMEM IA Scope[1]

	Information Management	**Information Systems**	**Information Content**	**Information Technology**
Strategic				
Process				
Resource				

[1] Shading denotes scope with lighter shade denoting extended scope.

One further important requirement, which emerged from these initial discussions, was for the IA to be completed across the summer recess, which limited the total duration to no more than twelve weeks. The reason for this time restriction was twofold: firstly, to gain maximum access to teaching staff; and secondly, to complete the IA before the general distraction of a new academic year, which impacted all staff.

5.1.3. The IA Methodology

Given the DMEM objectives as discussed above, the IA methodology was tailored (high level – detailed tailoring is discussed in Section 5.2) to DMEM requirements and the limited time-scale as illustrated in Figure 5.2 below. This aligns with Buchanan & Gibb's (1998) original intention, that stages could be tailored and/or removed to suit individual requirements. The notable change is the removal of the account stage.

Figure 5.2. DMEM IA Methodology[2]

1	2	3	4	5
Promote	Identify	Analyse	Account	Synthesise

It was deemed appropriate, given the requirements stipulated by the HOD (to involve staff in the strategic review), to establish a working group to participate in a series of workshops facilitated by the auditor. These ran through stages two to five on a weekly basis (11 two hour sessions), and were supplemented by interviews with further members of staff during stage three (analyse). It was also deemed acceptable to include process modelling as it was felt by the auditor that this could be incorporated as part of both strategic analysis and information flow modelling and would assist in modelling and analysis of activity across departmental functions (being to the benefit of auditor and participating organisation). It was considered ambitious

[2] Shading denoted stages applied.

to attempt detailed modelling of all DMEM processes within the allotted timeframe therefore prioritisation of processes was agreed and anticipated. Each of the stages illustrated in Figure 5.2 (page 204) are discussed in more depth in the sections which follow (including lower level tailoring).

5.2. DMEM IA

The following sections discuss the stages and steps of the IA with example output illustrating activity and deliverables.

5.2.1. Promote

According to Buchanan & Gibb (1998) there are three steps to this stage: firstly, conference or seminar to communicate the purpose of the IA to staff; secondly, communiqué to staff from sponsor encouraging cooperation; and thirdly, preliminary organisational survey by auditor. Largely due to the previously noted time constraints, this IA bypassed step one and went straight to step two, which it was felt could substitute for step one to a large degree (discussed below). Step three occurred as per the guidelines.

In line with Buchanan & Gibb's (1998) recommendations, the HOD (as sponsor) sent out a *passport letter*, via email, to all DMEM staff introducing the auditor, but also outlining the purpose and benefits of the IA, and providing a high level summary of the planned schedule (effectively combining steps one and two by providing much of the information that would have been communicated by step one). The HOD also stated that he was looking for representative volunteers to become members of the working group. The list of volunteers was checked by the HOD and auditor to ensure that the group would have members representing the various stakeholders and information user groups, which were broadly summarised as: systems support, administrative support, teaching, and research. Volunteers were then approached by the auditor, who then explained the process and commitment required, allowing participants to withdraw if required. The resulting four participants, by departmental role, were as follows:

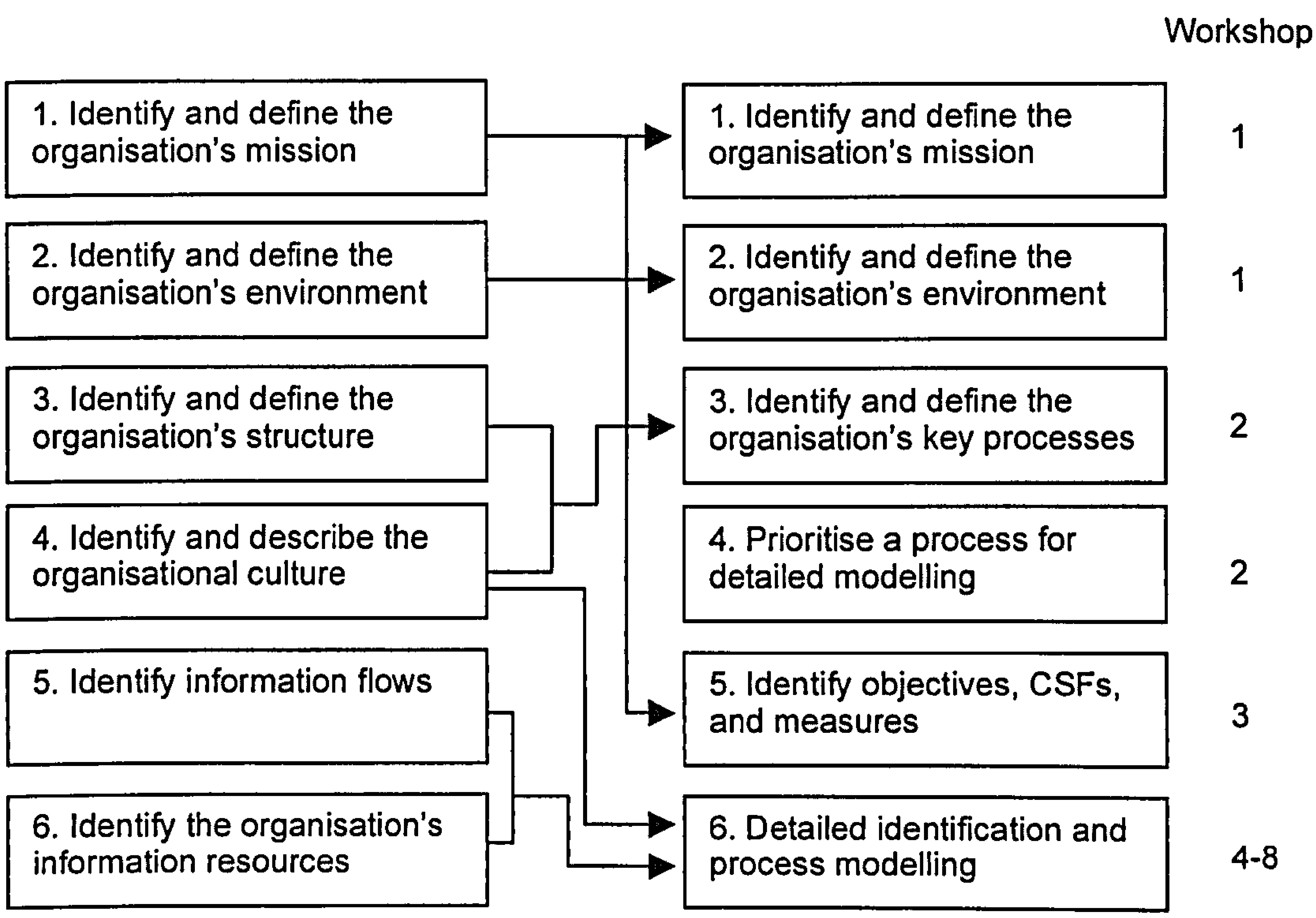
- Professor (primarily representing research, but also teaching)
- Head of system support (system support)
- Senior Lecturer (primarily representing teaching, but also research)
- Senior Secretary (representing administrative support)

The initial meetings with potential working group members, supplemented by early discussions with the HOD, acted as the *preliminary survey* step of this stage (step three). The purpose of this step was to allow the auditor to make a preliminary assessment of the level of awareness and value of information among staff, key to establishing appropriate levels of communication and IA structure/approach. The preliminary survey showed that staff were aware of the importance of information, but not familiar with information management practice. Preliminary observations also suggested poor organisational cohesion (the department appeared to work in small, very loosely coupled groups), and disparate procedures (briefly alluded to by administrative staff and noted for further investigation). The IA communication plan was also agreed during this stage. Minutes would be kept and circulated for all workshops (sent to the working group, but available to all staff), a weekly email from the auditor would summarise weekly activity and would be sent to all staff, and a seminar was planned to follow production of the final report (which would also be available to all staff).

5.2.2. Identify

There are six steps to this stage of the Buchanan & Gibb (1998) methodology: definition of mission, environmental analysis, definition of organisational structure, cultural analysis, identification of general information flow, and lastly, identification of information resources. According to Buchanan & Gibb's (1998) recommendations, step three of this stage is where process modelling can substitute for more traditional functional/structural frameworks; consequently, this was the stage of the IA where process modelling was incorporated by the auditor. To facilitate process modelling and associated prioritisation there were some minor refinement and restructuring of steps within this stage. Step one was split into two stages: mission was identified but objectives, CSFs and measures were identified later as these focused on the prioritised process (which would not be identified until a later step). Step two proceeded as normal. Steps three and four were combined as part of initial high-level process modelling, but four was split with force field analysis occurring later (again to focus on the prioritised process). Steps five and six proceeded as normal but were combined as part of the workshop structure. These minor adaptations are illustrated in Figure 5.3 below.

Figure 5.3. DMEM adapted Identify stage



This stage was a combination of workshops and interviews facilitated and conducted by the auditor. For each workshop participants were provided with the minutes of the previous workshop and advance instructions for the next workshop (see Appendix 2). The third column in Figure 5.3 (see page 207) illustrates in which workshops the IA steps occurred.

Identify and define the organisations mission

A thorough understanding of DMEM's mission was essential in order to assign appropriate values and priorities to information resources, and to provide strategic direction for the next stages. Buchanan & Gibb (1998) recommend Abell's (1980) business definition framework, Synnott's (1987) interpretation of portfolio analysis, and Pellow & Wilson's (1993) CSF approach.

Abell (1980) proposes that an organisation should define its business in terms of three dimensions: customer groups, customer needs, and technology/distinctive competencies. To use the framework to its full potential an organisation should firstly define its industry sector before defining its particular business. The resulting business definition is then measured according to: scope, product differentiation, and competitor differentiation. Finally, the business can be strategically categorised as either: focused, differentiated, or undifferentiated. The main purpose of Abell's framework is to define the business in general terms prior to further analysis. As such, each step was walked through and discussed in the workshop. Key definitions from this step are summarised as follows:

- *industry sector* was broadly defined as engineering.
- *customer groups* were defined as government (funding councils), students/parents, and employers.
- *customer needs* were defined as teaching and learning within the fields of design, manufacturing, and engineering management;

- *competencies* (research interests) were defined as production and process technologies, information technology, design methods, strategic management and performance improvement.
- *scope* was defined as broad in relation to competitors, research interests differentiated, and engineering management as the key differentiator (though not exclusively) from competitors.

The next step was to begin considering DMEM's mission statement. This was not defined by this step as it was already in existence. Instead the statement was discussed as to whether or not any refinement was required; however, none was felt to be required. The DMEM mission statement was:

> To produce high calibre graduates in design, manufacture and engineering management, through the best available standards of education, founded on a base of excellence in theory and practice of the subject, and advancement of knowledge through research.

Overall, Abell (1980) proved highly effective as a tool to discuss DMEM business definition, ensuring that all workshop participants had a shared understanding of exactly what this business was (and providing them with a clear and agreed sense of mission and direction, which would guide follow on steps). Hill & Jones (1992) suggest that the natural next step is to then consider whether future activity should remain natural extensions of the original business or become diversified. A recommended approach is portfolio analysis, which is also recommended by Buchanan & Gibb (1998); however portfolio analysis was not conducted during this IA as this tool is considered more applicable to organisational portfolios than relatively narrower departmental portfolios (Synott, 1987), and although it could have been argued that some benefit is possible (for example, reviewing the department's teaching portfolio) the six step process, which includes more complex and time consuming steps such as profitability analysis and return on capital, would not have been achievable within the time constraints of this particular IA.

The final tool recommended by Buchanan & Gibb (1998) during this step, Pellow & Wilson's (1993) CSF approach, was utilised during step five of this stage once a prioritised process had been identified (see pages 214-216).

Identify and define the organisations environment

As per Buchanan & Gibb (1998) guidelines, PEST analysis was utilised to initiate this step. PEST analysis was conducted as a group discussion largely as a precursor to more in-depth competitive forces analysis (with a degree of overlap). The key political, economic, social, and technological influences (PEST) were identified as government, employers, students, and the Internet respectively. Notably, three key trends were highlighted by this discussion: that DMEM faced increasing competition both domestically and globally, that private funding was increasing and government funding decreasing, and that buyers (students/sponsors) were increasingly requiring flexible modes of delivery.

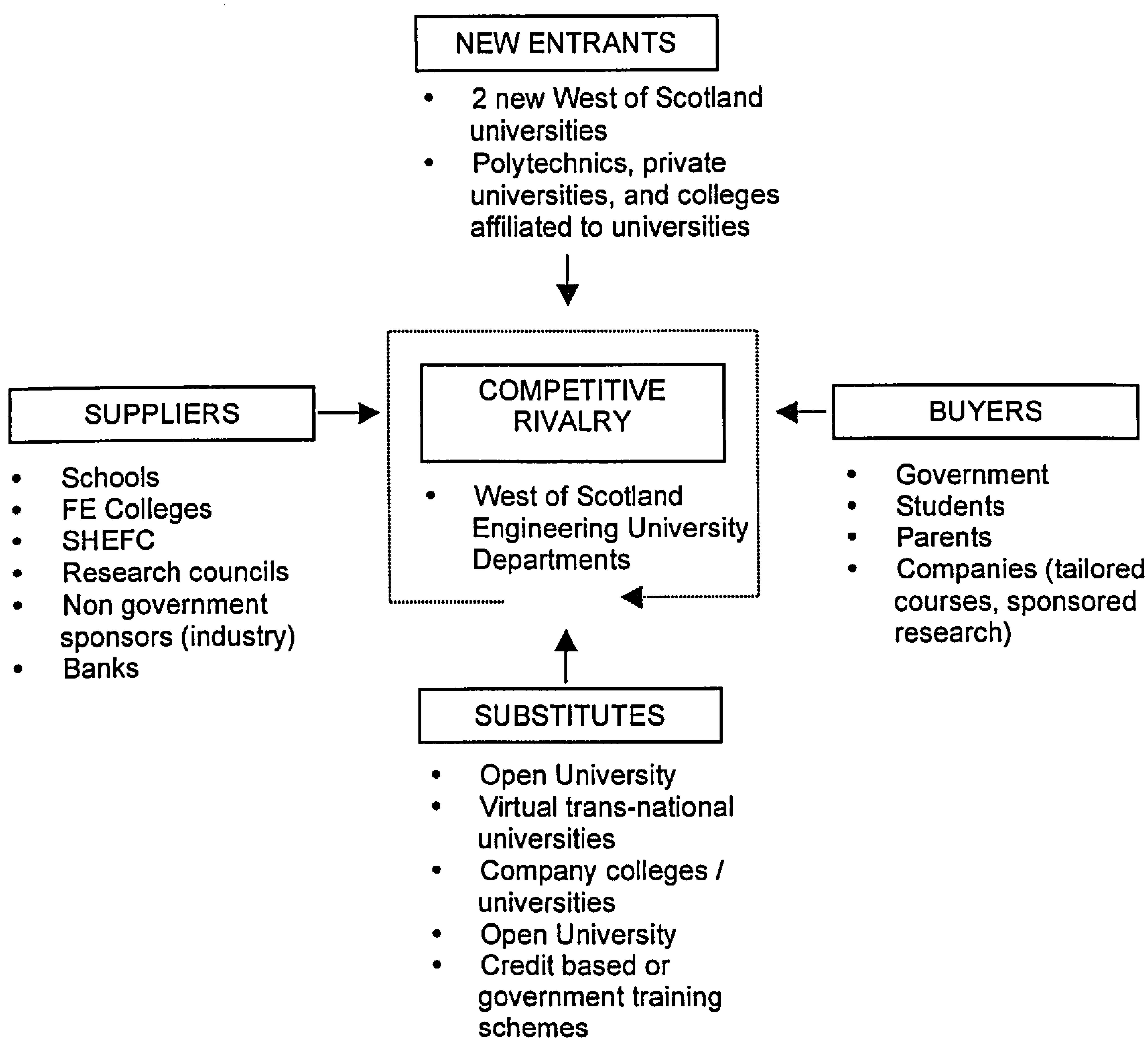
Also as per Buchanan & Gibb (1998) guidelines, Porter's (1980) model was utilised during this step to identify and consider the competitive environmental forces affecting the Department. According to Porter, there are five competitive forces: new entrants, substitutes, suppliers, buyers, and competitive rivalry. Workshop participants were provided with an overview of Porter's model (see Appendix Two) in advance of the workshop and asked to give prior consideration to:

- What are the key forces at work in the University environment?
- Is it likely that the forces will change, and if so how?
- What can be done to influence these forces?

- What information resources does DMEM require to influence these forces?
- Are some markets more attractive than others?

The model was then gradually built up through whiteboard-based group discussion in the workshop with minutes discussed and verified at the following workshop. The completed model is illustrated in Figure 5.4 below.

Figure 5.4. DMEM competitive forces



With regard to the applicability and usability of the tools recommended by Buchanan & Gibb (1998) for this step, PEST analysis proved to be a useful tool to initiate structured environmental analysis. The key trends highlighted by PEST provided participants with a clear sense of purpose overall, and added impetus to the follow on analysis of DMEM's competitive position.

Porter's (1980) model was also successfully utilised to identify competitive position and the environmental forces affecting this position. Overall, environmental analysis provided direction for later setting and/or refinement of DMEM objectives (step five of this IA stage). Both tools facilitated group discussion.

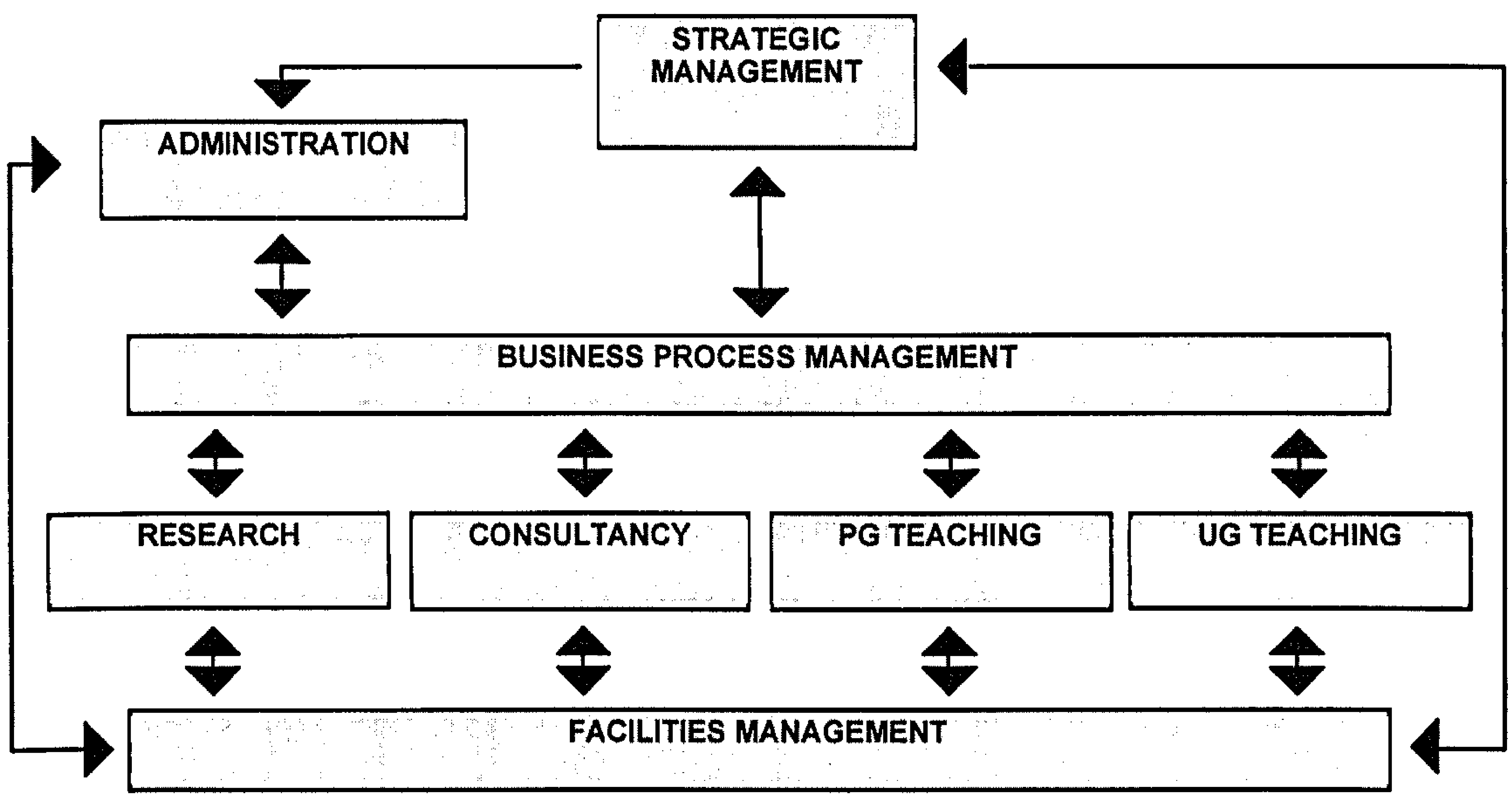
Identify and define the organisation's key processes

The purpose of this step was to develop a high level process map of the organisation to illustrate, quite simply, what it does to achieve its mission. In contrast to the more traditional task-orientated *functional* charts the process model focuses on business *processes*. This first step was to identify a suitable tool. Buchanan & Gibb (1998) make reference to the process recommendations of Hammer & Champy (1994), but neither Buchanan & Gibb nor Hammer & Champy provide explicit process modelling guidelines. As a consequence, Ould's (1995) STRIM modelling process was adopted (see Section 3.5.2, page 110).

Step one of Ould's (1995) process (determining objectives) was satisfied by the output of the preceding IA steps and by the IA brief; consequently this stage began at step two (establish an overall picture to provide a high level perspective). Workshop participants were provided with a definition of process as part of the pre-workshop instructions (see Appendix 2) and asked to consider in advance "what are the key things (activities) we do?". During the workshop, processes were identified through a structured whiteboard-based discussion led by the auditor. The initial step was a brainstorming exercise where tasks/activities where identified and written on individual post-it notes and then placed on the whiteboard. Each task/activity was then discussed as a group and either identified as a discreet activity or grouped with other tasks as part of a discreet activity. As per Ould's instructions, the focus was on identifying key activities at a high level. The resulting process model is illustrated in Figure 5.5 below.

The remaining steps of Ould's (1995) process were completed during steps five and six of this stage of the IA, once a process had been prioritised for detailed modelling.

Figure 5.5. Example: *Map DMEM key processes*



Prioritise a process for detailed modelling

The purpose of this step was to prioritise a key process for detailed modelling and analysis. It was considered both impractical and unrealistic to attempt to tackle all DMEM key processes at once (particularly given the twelve week time constraint). Consequently, it was recommended that a key process be identified for this IA, with the possibility of one or more follow on exercises for the remaining processes, either as a continuation of the IA, or conducted internally.

In prioritising a key process there were three important considerations:

- **Strategic impact**: the current and potential contribution of each key process towards achieving the organisation's mission (e.g. core value-adding processes versus support processes [see Section 3.5.2, page 108]).
- **Resource consumption**: the resources consumed or utilised by each key process (e.g. do the resource requirements or utilisation of resources give cause for concern).
- **Required investment**: the time, cost, and management commitment required to model each key process (e.g. start big or small?).

The prioritised process was *undergraduate teaching*. As well as being a core process of the department, a number of problems had already been identified by workshop participants in previous sessions. These problems were summarised as follows:

- Competition from other Universities.
- Scheduling of classes and associated room bookings.
- Meeting deadlines (cyclical).
- Too much paperwork distributed to students (referred to as "handout junkies").
- Poor departmental communication (in all directions).
- Volume of information.
- A lack of formal processes and procedures for key tasks and activities, leading to duplication and disparity.

Identify Objectives, Critical Success Factors and measures

According to Buchanan & Gibb (1998), the purpose of this step is to identify the objectives, critical success factors and performance measures, which in this case, were for the prioritised process. This IA step was initiated in workshop three but was completed by participants in their own time between workshops (during a recess when the auditor was conducting interviews with process owners outwith the group [discussed later]).

DMEM objectives for the undergraduate teaching process were defined through group discussion as:

- Provide a course portfolio reflecting the dynamic requirements of stakeholders
- Provide excellence in the delivery of teaching and learning
- Ensure effective and efficient deployment of resources
- Ensure effective marketing of, and recruitment to, courses.

It is important to note that the above objectives were at the time, considered *proposed* objectives, which would be later confirmed through wider departmental consultation. Once objectives were identified the next step was to identify associated critical success factors (CSFs), which are those factors upon which each objective is fundamentally dependent for its success. Pellow & Wilson's (1993) CSF approach was utilised during this step. The first step was to identify the CSFs for each objective, which once more utilised the technique of brainstorming. Pellow and Wilson recommend attempting to maintain a manageable list of approximately 6-8 for each objective. CSFs were identified through brainstorming for each associated objective. Once identified each CSF is checked (through group discussion of relative importance to associated objective) to ensure that it is genuinely necessary and that the final list is sufficient to ensure the objective's success. Once completed, there existed a list of CSFs for each of the four undergraduate teaching objectives. Table 5.1 (see page 216) provides an example for the *provide a course portfolio taking account of the dynamic and diverse requirements of stakeholders* objective, illustrating the CSFs which were identified, and the associated measures.

Table 5.1. Example: *Identify Objectives, Critical Success Factors & Performance measures*

Objective: Provide a course portfolio taking account of the dynamic and diverse requirements of stakeholders.	
CSF	**Measure**
FUNDING	SHEFC, GRANTS, SPONSORSHIP, STUDENTSHIPS
INDUSTRIAL LINKS	SPONSORSHIP, PLACEMENTS, PROJECTS, EMPLOYMENT, STUDENT PRIZES
COURSE RELEVANCE	STUDENT FEEDBACK, QUALITY SYSTEMS MANAGEMENT, FREQUENCY OF COURSE REVIEWS, EMPLOYMENT FIGURES
GRADUATE EMPLOYMENT	EMPLOYMENT FIGURES, GRADUATE TRACKING (ALUMNI)
PROFESSIONAL ACCREDITATION	APPROPRIATE ACCREDITATION BODIES, COMPETITORS
MARKET KNOWLEDGE	APPLICATIONS, STUDENT FEEDBACK, COMPETITIVE ANALYSIS, MARKET SURVEYS
COURSE RANGE & LEVEL	APPLICATIONS, STUDENT RANGE, COMPETITORS, STUDENT FEEDBACK, GRADUATE EMPLOYMENT, ENTRY STANDARDS

With regard to the applicability and usability of the tools recommended by Buchanan & Gibb (1998) for this step, Pellow & Wilson's (1993) CSF approach provided logical guidelines rather than prescriptive approach, which encouraged a pragmatic approach. For this step of the IA, the lack of a prescriptive approach was not considered a problem as identifying objectives, related success factors and associated measures was found to be a readily understood task.

Detailed identification and process modelling

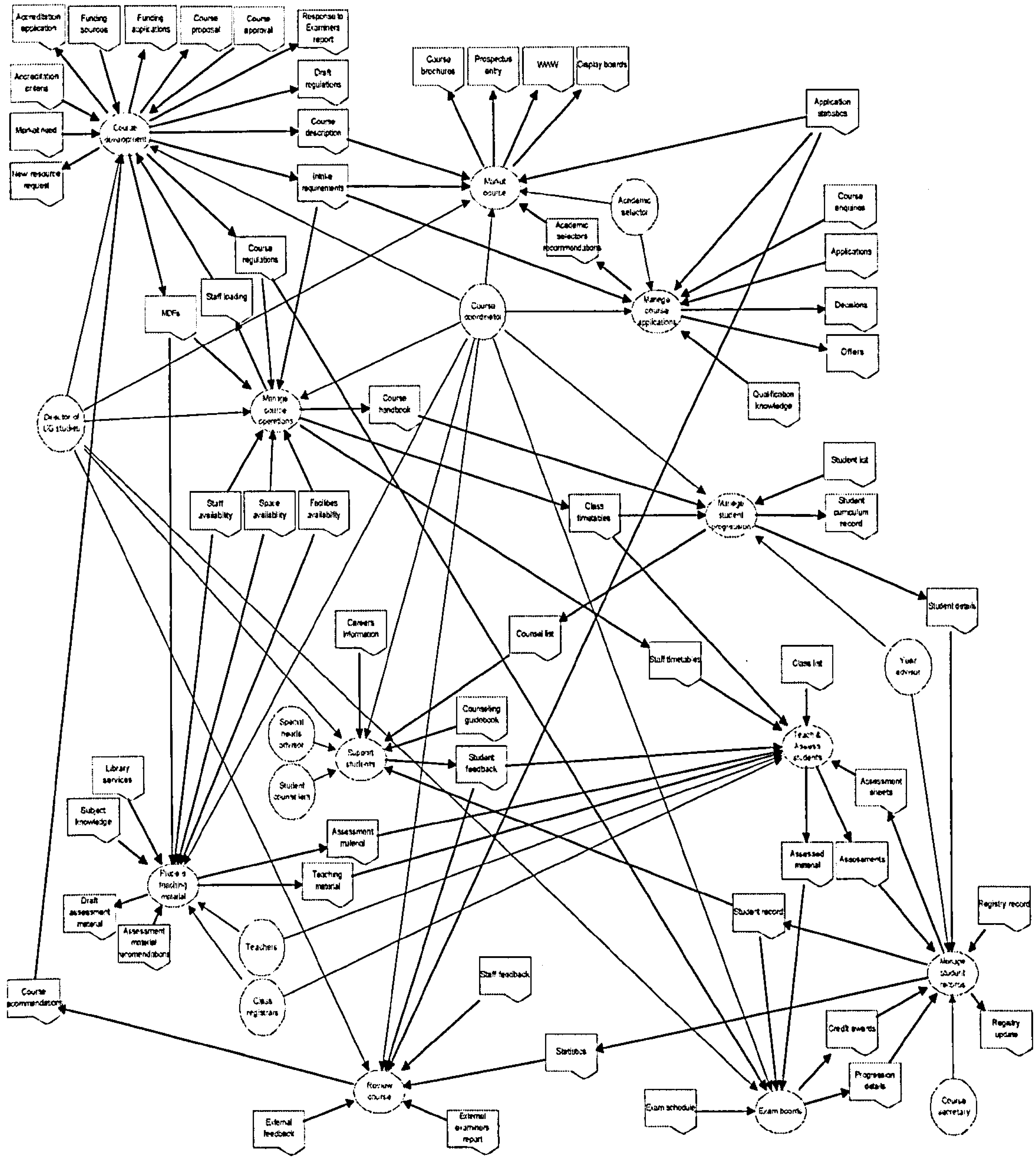
This step combines (for workshop purposes) steps five (identify information flows) and six (identify information resources) of the identify stage of Buchanan & Gibbs (1998) methodology (see Figure 5.3, page 207).

The undergraduate teaching process model was developed gradually in an iterative manner over the course of four workshops. This followed steps two to seven of Ould's (1995) process repeating step two for the prioritised process. Key processes were identified initially as a list and then gradually linked together to illustrate process flow through identification of respective inputs and outputs. The overall picture (process model) was developed and refined in four stages: identification of processes, identification of linkages between processes, identification of key inputs and outputs, identification of process owners. Information flow was captured as part of this modelling process in a manner similar to Orna's (1990) flow-based approach through the identification of key information inputs and outputs (which were then investigated and mapped in greater detail later [see Figure 5.7, page 225]). The process model was modelled using ICL Processwise Workbench software, which provided an object orientated simulation tool for process modelling and analysis. The application provided functionality to:

- Model existing business processes, to identify critical areas in a process and examine possible problem areas such as information bottlenecks, resource issues and high cost activities (by activity costing).
- Simulate new processes and evaluate them before implementation through scenario based modelling.

For the purposes of this IA, the focus was on modelling of existing processes. The resulting process model is illustrated in Figure 5.6 (see page 218).

Figure 5.6. Example: *Model the prioritised process (UG teaching)*



There are three classes of objects illustrated in Figure 5.6 above:

- Processes: a process is *an organised series of associated activities* that takes one or more inputs (materials, labour, information etc.) and produces a pre-specified output (product, service, knowledge etc.) as part of DMEM's value chain.

- Objects: the *key inputs or outputs* of each process. For the purposes of this exercise the objects were the key information resources associated with each process. This represented the preliminary inventory of information resources. These groupings were then later broken down into their constituent parts as more detailed information flow diagrams (see Figure 5.7, page 225).
- Owners: the members of *staff who own or perform* the related process.

It is important to note that the process model for this IA focused on *key* processes, objects, and owners associated with UG teaching (and the relationships between). As a continuation, this model could be developed further through exploded models illustrating the sub-processes of each higher level process (process decomposition); however this was deemed an optional follow on exercise not central to the immediate goals of this IA.

Next, detailed descriptions were developed for each UG teaching process, which provided a further verification step and, more importantly, key supporting information (a continuation of step four of Ould's [1995] process). Workshop participants were each allocated processes according to respective departmental role/background, and asked to:

1. Define the purpose/function of the process.
2. Identify the key activities performed as part of this process.
3. Identify any problems associated with this process.

To facilitate this step a simple template/worksheet was designed by the author (not provided by Buchanan & Gibb [1998] nor Ould [1990]) for capturing this information. Instructions and worksheets (see Appendix 2) were provided and completed by participants prior to the workshop and then discussed and finalised at the workshop. Table 5.2 (page 220) provides an example for the course development process.

Table 5.2. Example: *Process description*

Process: Course Development
Purpose/function of this process.
1. To develop a full specification of a course from market need and statement of goals, to class descriptors and regulations, within identified constraints (e.g. resources). 2. To modify the design of an existing course following output of a review, or modifications to market need, or course constraints.
Key activities (or sub-processes) performed as part of this process.
• Identify and evaluate opportunities and market.
• Define objectives.
• Propose course structure.
• Develop detailed course design.
• Produce course specification and regulations.
• Approve through Dept., AAC, Board, Senate, O&R.
• Schedule preparation and implementation.
• Seek inputs from industry, Dept. staff, other collaborating or affected Depts.
Problems/difficulties associated with this process.
• Takes a long time.
• Delivery not directly followed by resources. Initial delivery consumes resources until later arrival of funding.
• Obtaining industry partners.
• Staff time.
• Complex interactions with other courses.
• Uncertainty of market assessment.
• Development is not monitored at module level.

With regard to review of the tools utilised for this final step of the identify stage, the introduction of Ould (1995) provided a logical step-by-step approach to process modelling, which proved straightforward to follow and incorporate into the IA[3]. Similar to previous tools (for example, Pellow & Wilson [1993]) the approach is more guide than prescriptive methodology, but the outlined steps encouraged a logical and structured approach to process modelling and encouraged validation and verification of process

[3] It should be noted that the final step of Ould's (1995) process (respond to the analysis as per the objectives) did not occur at this point as it would have been process specific (occurring prior to the analysis stage of the IA). Consequently this occurred as part of the final analysis and synthesise stages.

models with a wider group of stakeholders. The process description template which was produced to support this step was not provided by Buchanan & Gibb (1998) but this was a straightforward enough tool to develop.

5.2.3. Analyse

There are four steps to this stage of the Buchanan & Gibb (1998) methodology: evaluation of information resources; production of detailed information flow diagrams; production of the preliminary report; and formulation of action plans. The purpose of this stage is to collate and evaluate the findings of the previous stages focusing on the relationship between highlighted information problems and the achievement of the identified objectives. The analyse steps were completed through auditor survey of process owners, workshops nine to eleven with the working group, and by the auditor individually.

Evaluate the information resources

This step discussed and evaluated the process model and associated descriptions with a wider group of identified process owners, and identified the Department's information resources based upon the preliminary inventory from the preceding stage (producing the more detailed inventory as per Buchanan & Gibb [1998] guidelines). Participants were sought by role as identified on the process model (nine roles were identified in total for undergraduate teaching [see Figure 5.6, page 218]) and were invited to participate without obligation via the DMEM HOD who requested volunteer participants. In total, nine participants took part, one for each role.

Participants were provided with a briefing paper in advance, which included a copy of the UG process model, the selected process descriptions associated with their role, and information worksheets for each process, created by the auditor based upon simple tabular design (see Appendix 3). Two interviews were conducted with each participant: the first to evaluate and discuss the process model and associated descriptions (steps five and six of Ould's [1995] process: Interview individuals to define the process in detail; review, revise and validate models through feedback sessions); the second to identify and evaluate associated information resources and flow. The first lasted one hour, the second two hours. Participants were encouraged to begin these exercises prior to the interviews (via instructions on the briefing paper).

Participants accepted the undergraduate teaching process model and associated descriptions with no major points of feedback or correction[4], but it was noted by the auditor during the interviews that the model itself was not immediately understandable with participants requiring explanation and orientation. The problem appeared to be caused by the many-to-many relationships, which introduced a degree of complexity to the illustration and made navigation difficult.

The second round of interviews focused upon the identification of key information resources, which revealed what information was required and generated by the Department, who generated it, who used it, how they used it, and what problems they were experiencing. Participants assigned a value on a scale of 1 to 5 to each identified information resource according to its relative strategic importance or contribution to the process. The scale adopted was as follows (Buchanan, 1995):

---

[4] Following these interviews the intention of the auditor was to return to the working group to discuss updates to the process model and descriptions based upon the feedback from the interview participants (relating to step seven of Ould's [1995] process: analyse the models). However, given that interview participants accepted the process models and descriptions this step became a relatively routine exercise, which occurred via email rather than workshop (although time was also provided at the beginning of the next workshop to discuss).

5: critical to the process.

4: provides significant benefits or adds value to the process.

3: contributes directly to the process but is not essential.

2: provides indirect or minor support to the process.

1: not presently used or has no perceived benefits.

The information resources identified constituted the detailed inventory, which was captured in tabular format and provided the basis for more detailed information flow modelling (the next step). The noted problems from these interviews were listed and provided to the working group for discussion at the next workshop, which was devoted to the identification and evaluation of information problems. This was conducted as a whiteboard based exercise where problems were discussed and verified, and where possible, grouped. Final output was a list of key information problems, summarised as:

- Complex and disparate information systems (e.g. *manage student records* sub-process systems include: Registry MIS, three disparate DMEM course systems [based on MS Access or AmiPro]).
- Duplicated effort, unnecessary data entry, and inefficient data processing e.g. high error rates (curriculum records, credit awards), multiple formats/systems (student records), time consuming maintenance (staff timetable/loading schedule), limited analysis capability (application numbers, student performance, Registry MIS), delivery delays (application statistics report, class list).
- No formal policy statement, procedures, or operational guidelines for the management of information resources e.g. updating, security, file management, procurement, utilisation, DMEM WWW, quality mgmt. etc.
- Paper culture. Poor utilisation of IT, disparate information systems, and a lack of procedures and guidelines were preserving a paper culture within the Department across all UG processes.

- Lack of standardisation including several ad hoc or informal processes e.g. staff availability, market research (*market course*), competitive analysis (*review course*) etc.
- Knowledge gaps e.g. market knowledge (no market research carried out as part of the *market course* process due to a lack of formal procedures and no identified information sources/services), graduate knowledge (no formal graduate tracking/research carried out as part of the *review course* or *course development* processes due to a lack of formal procedures and no identified information sources/services), DMEM resources (limited knowledge of available information resources and how to access them).

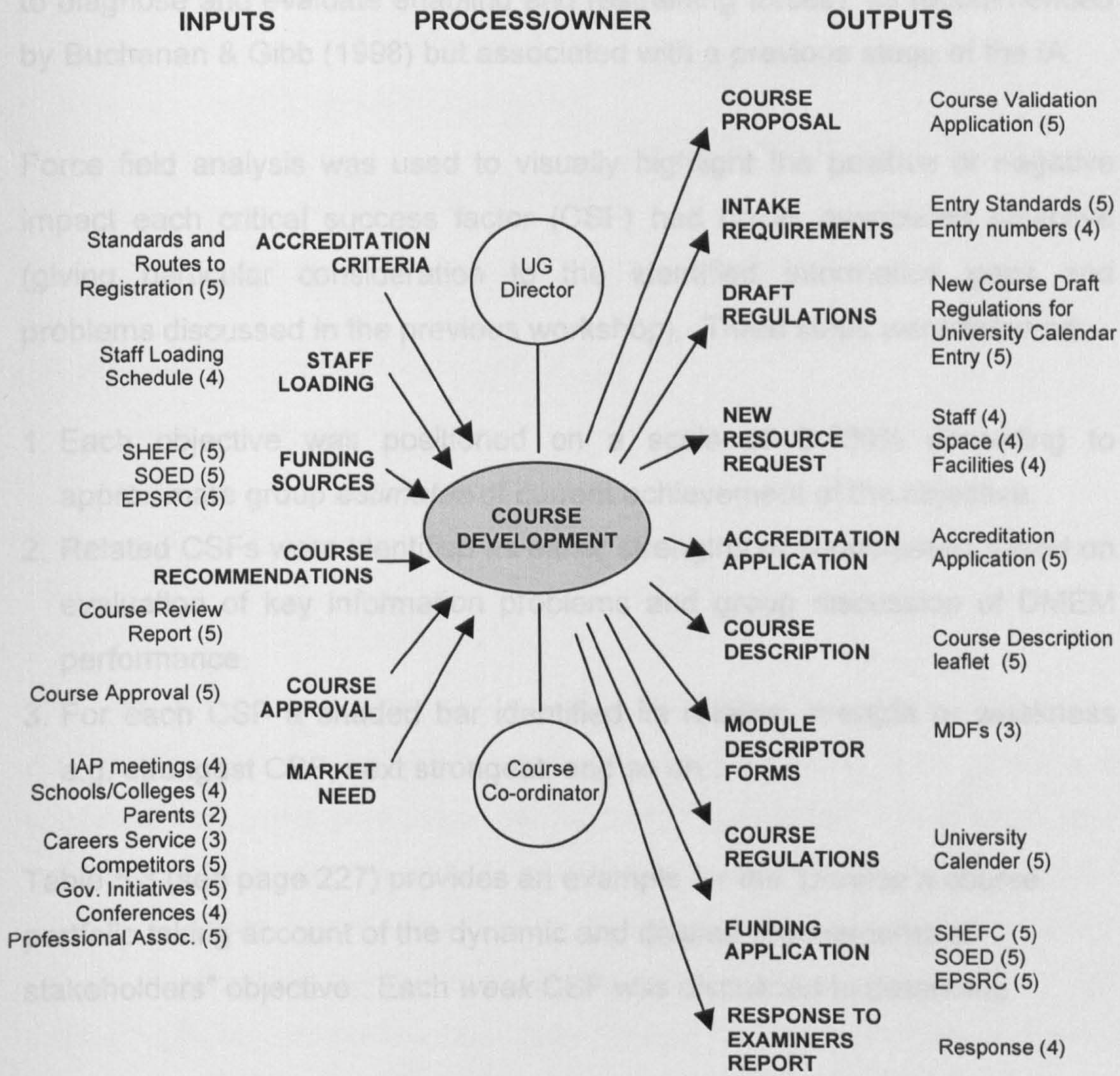
Produce the detailed information flow diagrams

The process model (see Figure 5.6, page 218) illustrated high-level information flow but until information resources were identified this was only a preliminary picture as it lacked detail. Detailed information flow diagrams were developed by the auditor based upon simple input/output models similar to Orna's (1990) flow based approach, as per Buchanan & Gibb's (1998) recommendations. Figure 5.7 (see page 225) provides an example for the course development sub-process of UG teaching. It includes the arithmetic means of the values assigned to information resources in the previous stage by interview participants. Analysis of information flow made it possible to evaluate information use, information requirements, and gaps in information provision (e.g. missing information highlighted by process owners). For example, information gaps were identified with both *market course* (lack of market knowledge) and *review course* (lack of student employment knowledge).

Produce the preliminary report

The preliminary report constituted the findings of the previous stages and steps. Buchanan & Gibb (1998) describe this as a summary account of the information audit process, findings, recommendations and general areas of concern. The only deviation from this description was that no recommendations were included in the preliminary report as this was considered premature. The preliminary report is not provided as per the confidentiality agreement.

Figure 5.7. Example: *Map Information Flow*



Formulate action plans

This step was completed in workshops ten and eleven (see Appendix 2). The purpose of this step was to identify and define action plans to improve problematic situations. Buchanan & Gibb (1998) refer to Checkland & Schole's (1990) soft systems methodology as a method to deal with complex, unstructured, or poorly defined situations, but this was not adopted by the auditor firstly because it was felt that, through the previous stages the problem had been well documented and defined; and secondly, that after extensive process modelling the working group would not have welcomed another modelling exercise. Instead force field analysis was adopted (used to diagnose and evaluate enabling and restraining forces), as recommended by Buchanan & Gibb (1998) but associated with a previous stage of the IA.

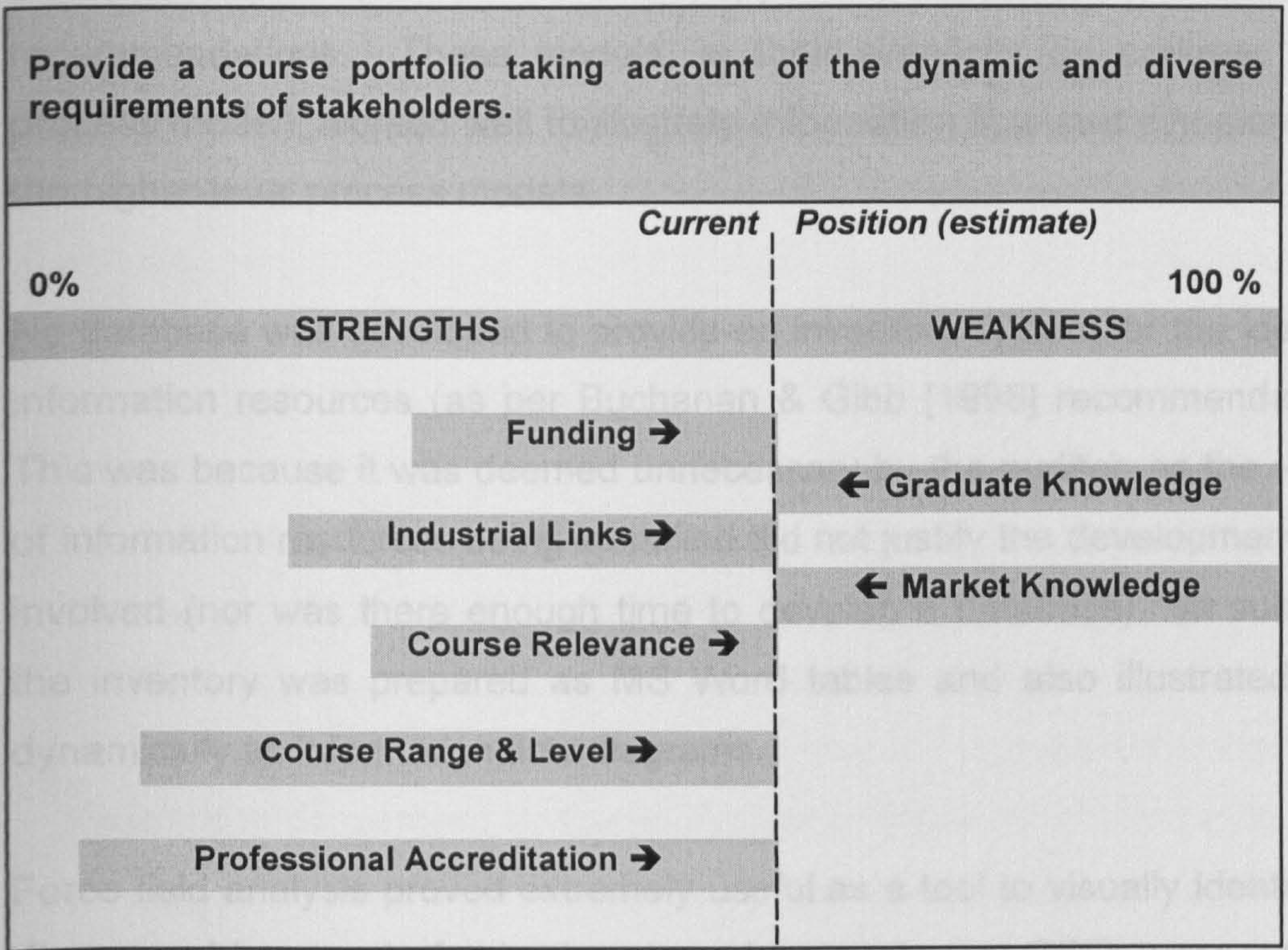
Force field analysis was used to visually highlight the positive or negative impact each critical success factor (CSF) had on its associated objective (giving particular consideration to the identified information gaps and problems discussed in the previous workshop). Three steps were followed:

1. Each objective was positioned on a scale of 0-100% according to approximate group *estimates* of current achievement of the objective.
2. Related CSFs were identified as either strengths or weaknesses based on evaluation of key information problems and group discussion of DMEM performance.
3. For each CSF a shaded bar identified its relative strength or weakness e.g. strongest CSF, next strongest, and so on...

Table 5.3 (see page 227) provides an example for the "provide a course portfolio taking account of the dynamic and diverse requirements of stakeholders" objective. Each *weak* CSF was discussed to determine:

- Why it is a weakness (refer to the identified key problems).
- How important an influence it is on the objective (identify priority).
- What action was required.

Table 5.3 Example: *Use of force field analysis*



The output of this step was recorded for incorporation in the final synthesise stage.

With regard to review of the tools utilised for this stage, a key observation was that the process model produced was overly complex. The auditor had concerns during the workshops as the model developed, which were later confirmed with the survey participants, who when viewing the model required time to orientate themselves due to the complex relationships illustrated. These relationships were introduced by the modelling software as a by-product of its object oriented simulation capability, which meant that many-to-many relationships were shown on all illustrations. With hindsight a simpler flow-based model would have been more appropriate for these interviews (particularly given that the simulation capability of the software was not required for this IA). However, the process model was successful none the less in identifying key processes and illustrating high-level information flow.

More detailed information flow was captured via simple input/output models similar to Orna's (1990) flow based approach, as per Buchanan & Gibb recommendations. These models, in their simplicity (in contrast to the process model), worked well to illustrate information flow and complemented the higher-level process models.

No database was developed to provide an inventory system for the identified information resources (as per Buchanan & Gibb [1998] recommendations). This was because it was deemed unnecessary by the auditor, as the volume of information resources being identified did not justify the development effort involved (nor was there enough time to develop a database). In substitute the inventory was prepared as MS Word tables and also illustrated more dynamically as information flow diagrams.

Force field analysis proved extremely useful as a tool to visually identify and discuss achievement of objectives based upon whether CSFs were regarded as strengths or weaknesses. Similar to the information flow models; its main strength was its visual simplicity, which helped to focus and direct discussion.

5.2.4. Account

As previously discussed, no account stage was conducted as dictated by the DMEM brief (see Section 5.1.2, page 202). However value was assigned through a previous step (see page 223), which provided a degree of measurement.

5.2.5. Synthesise

There are two steps to this stage of the Buchanan & Gibb (1998) methodology: production of the information audit report and, if specified by the client brief, production of an information strategy. The overall purpose of this stage is to report on the complete process and to synthesise findings and recommendations for strategic direction. The draft final report was supplied to the working group and discussed at the final workshop, which included the key recommendations, which formed the basis of the departments' information strategy. Both draft report and key recommendations were accepted by the working group. The key recommendations are summarised as follows:

- **Information Policy**: DMEM should establish an information policy to cover: data management, procurement, security, procedures, utilisation, WWW standards, IT training/basic skills etc. This should include policy review cycles and should align with overarching IRD policy. A priority should be the establishment of an information policy for market knowledge and graduate knowledge (two significant knowledge gaps within DMEM).
- **Process Improvement Projects**: Further project(s) should be established to explore possible process improvements for UG teaching and to model the other *key* processes identified (as illustrated in Figure 5.5, page 213).
- **Relational Database Management System**: systems analysis should be undertaken to rationalise and manage the identified disparate database and information systems. A RDMS is a possible solution to several of the highlighted information problems (e.g. duplicated effort, unnecessary data entry, and inefficient data processing).
- **Intranet/Content Management**: again, it was recommended that systems analysis be undertaken. An intranet/content management would address problems of resource availability, staff availability, knowledge sharing, communication, and the existing paper culture (a DMEM intranet would make information available electronically).

A significant part of this IA was concerned with strategic analysis to ensure that the management and utilisation of information resources matched objectives. The key outputs of this particular IA (beyond the report) could be summarised as follows:

- **Strategic analysis**: a statement of key objectives, critical success factors, and performance measures for undergraduate teaching including the identification of strengths and weaknesses.
- **UG Process model**: illustrated workflow, critical areas, information resource utilisation, and potential problem areas caused by poor communication or co-ordination across the boundaries of conventional department functions.
- **Information flow diagrams**: illustrated what key information resources are required and generated by DMEM, who generates them, who uses them, how they use them, and what problems they have.

5.3. Observations and reflection

With regard to the methodological process, the Buchanan & Gibb (1998) IA methodology and toolset was successfully trialled proving to be both usable and tailor-able. In summary:

- The IA scope matrix was successfully introduced as a scoping tool.
- *Promote* was completed as per Buchanan & Gibb (1998) guidelines with minor tailoring (steps one and two combined). All recommended tools were utilised.
- *Identify* was tailored to incorporate process modelling and the prioritisation of a process for more detailed investigation. Of the recommended tools, Abell (1980), Porter (1980), Pellow & Wilson (1993), and PEST analysis were successfully utilised during the initial strategic analysis steps; however, it was discovered that a tool was lacking for process modelling and therefore Ould's (1995) STRIM modelling process was identified and adopted. This was found to be a suitable IA tool, particularly in combination with information flow modelling based on Orna's (1990) flow-based approach (one of Buchanan & Gibb's recommendations). In support of this step a process description template was also developed and successfully trialled. No database was

developed for the IR inventory as the development effort was felt to outweigh the benefits (inventory was collated as simple tables and primarily illustrated within the information flow diagrams [with no adverse impact]).

- *Analyse* was completed as per guidelines. Ould (1995) and Orna (1990) were also utilised during this stage (as a follow on from the previous stage) for more indepth process and information flow modelling, which substituted for Checkland & Schole's (1990) soft system methodology. Adapted Force field analysis based upon Lewin (1947) was utilised for action planning (again one of Buchanan & Gibb's recommendations).
- *Account* was not in scope for this IA as per the client brief, however value was assigned to IRs through previous steps.
- *Synthesise* was completed as per guidelines with final output being the IA report and set of strategic recommendations.

The IA was completed on schedule within the allocated twelve-week period. Four members of DMEM staff participated in the workshops and a further nine in interviews. In total, twenty-two attended the post audit seminar. This represented approximately 120 hours (15 days) for the auditor, and 174 hours (22 days) for the department (not including the seminar).

Overall, the DMEM IA "experience" was extremely positive. A post audit discussion session was held with the working group and the HOD (both as part of the group and individually later), which explored participation and perceived value of IA output. The working group unanimously agreed that they had found the experience highly worthwhile with the HOD, who was moving on to another institution to become principal, stating that he would most likely conduct an IA at his next organisation if similar problems to those found within DMEM were encountered. A further encouraging sign was that the IA findings were immediately presented and discussed at a special meeting of the entire DMEM staff with the explicit intention of planning how to implement recommendations.

More specifically, the strengths of the DMEM IA, as stated by participants, were as follows:

- Staff benefited from the facilitated workshop approach. The structured top-down approach (and tools/techniques adopted) was simple to follow, greatly increased participant understanding of DMEM goals and resulting requirements, and helped illustrate the role of effective information management.
- Through the working group, wider interviews and regular communications, staff felt involved at all stages
- The short timeframe facilitated quick results, and limited the impact on staff. Focusing on a prioritised process also shortened the project duration, and demonstrated maximum value by focusing on the area of greatest immediate impact.

Participants mentioned only one negative, which was that the UG process model was overly complex, particularly the many-to-many relationships (see Figure 5.6, page 218).

The auditor's own observations/experience as the auditor supported the positive feedback received from participants, and further added to the criticism of the modelled process: the UG process model was not only overly complex and detailed for the purposes of the IA, but was modelled at the expense of other processes. Consequently, a methodological consideration for the next IA case studies was to focus less on detailed step-by-step process modelling, and a little more on gathering a more comprehensive organisational picture of processes (at a lower level for each key process than illustrated in Figure 5.5 (see page 213] illustrating key steps and input/output for each process, but not as detailed as Figure 5.6 (see page 218), which attempts to illustrate all relationships).

The next chapter presents and discusses the second case study.

Chapter Six: Case study Two

The following chapter discusses the second of the two case studies conducted to trial the IA methodology.

6.1. Organisational overview, client brief, and methodological scope

The participating organisation was the Scottish Arts Council (SAC).

6.1.1. Organisational overview

The SAC is a non-departmental, independent Government Body, whose role is to:

- develop and improve the knowledge, understanding and practice of the arts;
- increase the availability of the arts to the public;
- advise and co-operate with the departments of government, local authorities, other Arts Councils and other bodies and individuals.

At the time of the audit, SAC had 90 staff located at two Edinburgh premises within close proximity of one another.

6.1.2. IA Brief

SAC had previously undertaken an organisational review led by external consultants from Delloite & Touche, initiated and sponsored by the Scottish Executive. At the time of the information audit, SAC was initiating a change management programme based on the recommendations arising from this review. These recommendations were summarised by the SAC Director as four key objectives:

- Become more transparent and accountable
- Reduce time to process applications
- Streamline evaluation and approval processes
- Improve communication between stakeholders

Delloite & Touche had also been critical of the SAC core grant management system (GSM) and had identified, at a high level, several problems with the management and processing of information. These highlighted problems, in combination with the recommendations of the review, several of which had underlying information management implications, led the Director to the conclusion that SAC would benefit from an information audit as a precursor to the development of an information strategy.

SAC objectives

The primary objective of the IA was to facilitate achievement of the change management objectives, and to further investigate the information system problems highlighted by Delloite & Touche. SAC business strategy was to be taken as a given, as outlined in the SAC Corporate Strategy document; however, given the identified process problems and the "streamlining" objective, it was agreed that SAC processes and associated information systems should form the background to the study prior to more detailed analysis of information usage and flow.

SAC IA objectives were consequently summarised as:

- To improve the efficiency and effectiveness of information processing.
- To improve organisational communication.
- To provide a high-level functional review of SAC information systems and applications, with a view to improving internal processes.

Similar to case study one, the sponsor (in this case the SAC Director) stated that he did not require information resources to be costed. The SAC Director also wished the IA to be completed within eight weeks to minimise disruption to the now underway change programme (and expressed reluctance to commit staff to a series of workshops, which he felt would be too time consuming). A key deliverable was seen to be a set of strategic recommendations, which would be incorporated into the change programme.

In consideration of the brief, this IA was regarded as being primarily *process orientated with a resource element (focused on how well current information systems support SAC processes).* It could be argued that, due to the requirement for a set of strategic recommendations, that there was a strategic element; but given that strategy was to be taken as a given with no strategic analysis in scope for this IA, it was felt by the auditor that these strategic recommendations would be more accurately illustrated as output of the process and resource elements. The resulting scope matrix for this IA is illustrated in Figure 6.1 below.

Figure 6.1. SAC IA Scope[1]

	Information Management	Information Systems	Information Content	Information Technology
Strategic				
Process				
Resource				

6.1.3. The IA Methodology

The Buchanan & Gibb (1998) IA methodology was tailored (high level) to SAC requirements and the limited time-scale as illustrated in Figure 6.2 (see page 236).

[1] Shading denotes scope.

In-depth interviews followed by survey were deemed most appropriate to the brief and objectives, and are discussed in more depth in the sections which follow.

Figure 6.2. SAC IA Methodology[2]

1	2	3	4	5
Promote	Identify	Analyse	Account	Synthesise

It should be noted that for this IA the auditor elected to identify and describe, rather than model, processes and associated information flow. The reasons for this were twofold: firstly, to be able to identify and gather information on all SAC processes within the previously noted time constraints (and without the benefit of workshops); and secondly, to explore further methods of gathering comprehensive process information without the potential complexity of detailed modelling (as experienced in case study one [see Section 5.3]). This was not considered a limitation as process models were not specified as part of the SAC brief and empirical evidence from the previous case study (see Section 5.3.) suggested that detailed process descriptions could substitute for process models.

6.2. SAC IA

The following sections discuss the stages and steps of the IA with example output illustrating activity and deliverables.

6.2.1. Promote

Similar to case study one (see Section 5.2.1, page 205), step one (promote the benefits of the IA via conference or seminars) was bypassed with the IA

[2] Shading denoted stages applied.

beginning at step two. The reasons for this were threefold: firstly, this would have delayed the start date and/or significantly impacted the eight week schedule; secondly, the sponsor had already requested that staff input, from a time perspective, was kept to the necessary minimum (and a post IA seminar was already planned); and thirdly, this step had been bypassed in the previous IA with no adverse impact.

Once more, and in line with Buchanan & Gibb's (1998) recommendations for step two of this stage, the sponsor (in this case, the SAC Director) was requested to send out a *passport letter*, via email, to all staff, introducing the auditor, outlining the purpose and benefits of the IA (substituting for the bypassed step one), and providing a high level summary of the schedule of activity. The Director also stated that he was looking for representative volunteers to participate in a series of interviews. The list of volunteers was checked by the Director and auditor to ensure that the group would have members representing the various SAC stakeholders and information user groups. Volunteers were then approached by the auditor, who explained the process and commitment required, again allowing participants to withdraw if required. The 15 participants, by role, were as follows:

- Chairman
- Director
- Head of Strategic Development
- Head of Arts & International
- Head of Finance
- Head of Funding & Resources
- Head of IT Services
- Human Resources personnel (3)
- System Support Officers (2)
- Grant Administration personnel (3)

It should be noted that interviews varied according to role and area of investigation with three groupings in total: initial interviews with senior executive management to identify SAC processes (Chairman, Director); more in-depth follow on interviews with department heads, human resource personnel, system support personnel, and grant administration personnel to discuss process-related information use, requirements and issues; and information systems specific interviews with the head of finance (responsible for the main Grant Management System [GMS]) and the head of IT services. The nature of these interviews (and the associated questions) are discussed in the sections which follow (see Appendix 5 for copies of interview notes).

The initial brief meetings with potential interviewees to explain the IA process, supplemented by early discussions with the Director, again acted as the *preliminary survey* step of this stage (similar to case study one [see Section 5.2.1, page 205]). The preliminary survey found staff frustrated with information flow, organisational communication, and ICT provision. These initial findings supported concerns raised within the initial brief from the SAC Director.

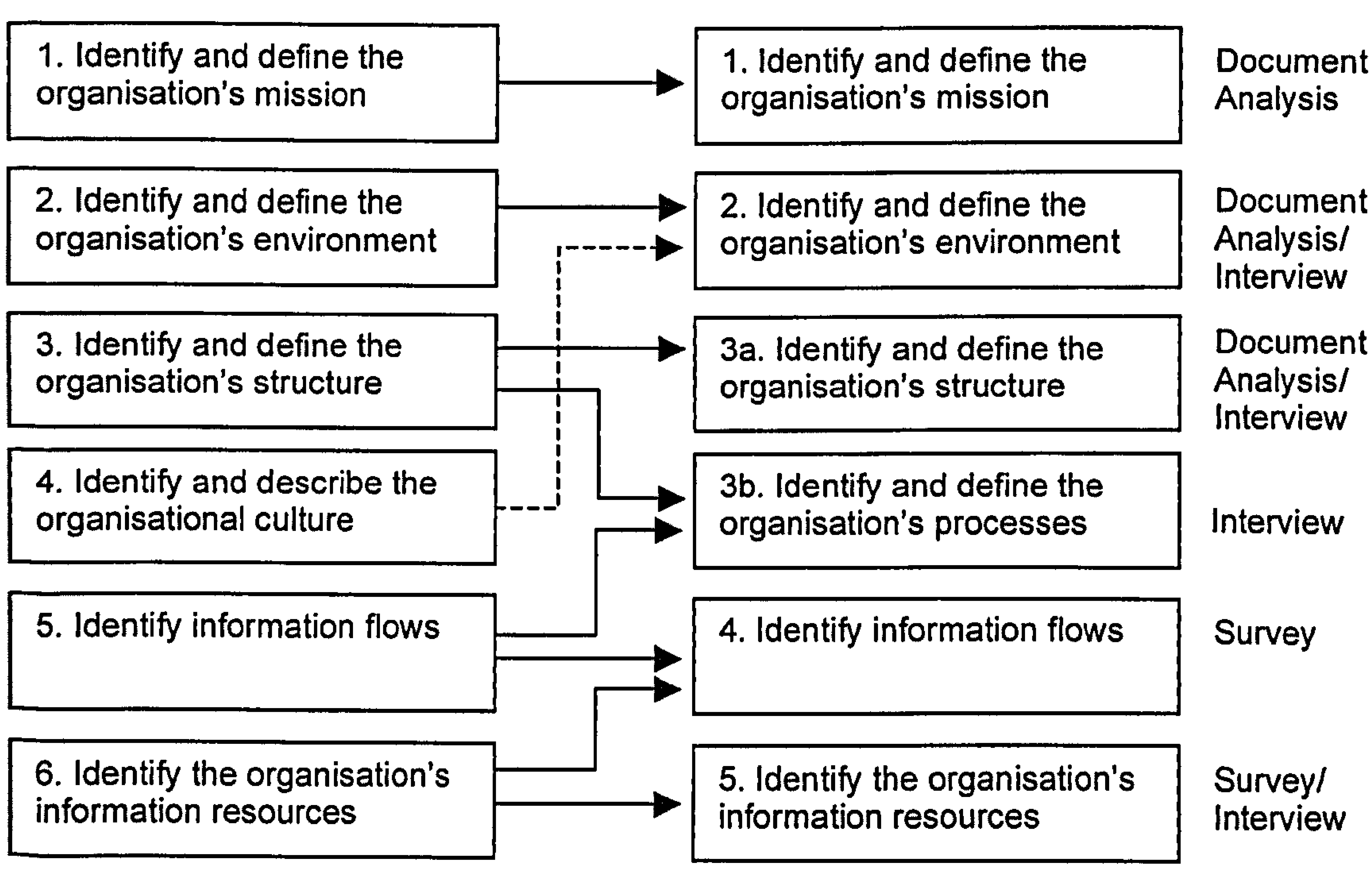
Finally, the IA communication plan was also agreed during this stage. A weekly email from the auditor would summarise weekly activity and would be sent to the Director for onward circulation, and a seminar was planned to follow production of the final report (primarily for senior management). The final report would be made available to all SAC staff.

6.2.2. Identify

In accordance with the brief which removed the requirement for strategic analysis, and to facilitate process modelling and the inclusion of a survey of information use (in order to gain wider access to staff), there were some minor refinement and restructuring of the six steps within this stage (definition of mission, environmental analysis, definition of organisational structure, cultural analysis, identification of general information flow, and identification of information resources).

Step one was limited to document analysis as per the brief. Step two was also limited to document analysis (again as per the brief), but further information was also gathered during the interviews. Step three occurred as two sub-steps: firstly the basic organisational structure was identified; and secondly, processes were identified. Step four did not occur as a formal step, but a degree of stakeholder analysis occurred naturally as part of the earlier definition of environment step. Step five was split with flow identified as part of the identification and definition of processes step, and then further explored as part of the survey of information use. Step six occurred as normal but was focused upon information systems and applications (as per the brief). These minor adaptations are illustrated in Figure 6.3 below.

Figure 6.3. SAC adapted Identify stage



This stage was a combination of document analysis, interviews, and survey (as illustrated by the third column of Figure 6.3, page 239).

Identify and define the organisations mission

As per the brief, SAC business strategy was to be taken as a given with no strategic analysis required. Consequently, this step was completed primarily through key document analysis, which confirmed mission to provide a framework for the IA (e.g. overarching strategic direction). Buchanan & Gibb (1998) themselves acknowledge, that where knowledge already exists, steps may be bypassed:

> Organisations may find that they already possess the knowledge to satisfy some of these steps. For example, they may already have a mission statement with clearly identified objectives; if this is the case they will be able to skip the relevant steps.

SAC business strategy was articulated in its corporate plan 2002-2007. The strategy is designed to reflect the National Culture Strategy and has as its key aims and objectives:

- To celebrate artistic excellence by:
  - encouraging excellence and innovation;
  - investing in artists and creative environments;
  - sustaining and developing a strong arts community.
- To improve the quality of life for all by:
  - strengthening communities through the arts;
  - improving geographical spread of the arts;
  - developing links between arts and education;
  - promoting the importance of the arts in social and economic policy;
  - championing attendance and participation.

- To provide leadership in the arts for Scotland by:
    - making the Scottish Arts Council more responsive to the needs of the arts and society;
    - increasing openness and accountability;
    - promoting understanding of the role of the arts in society;
    - stimulating investment in the arts.

There are also individual art form strategies for crafts, dance, drama, literature, music and visual arts; and a disability strategy and cultural diversity policy.

With regard to tools recommended by Buchanan & Gibb (1998) none were utilised for this stage, as they were not required (replaced by document analysis).

Identify and define the organisations environment

As this step is essentially an extension of the strategic analysis occurring in step one of Buchanan & Gibbs (1998) methodology, it was streamlined accordingly. This information was largely gathered through preliminary interviews/discussion and document analysis.

SAC reports to the Scottish Executive via the Scottish Parliament Education, Culture and Sport Committee. It has two main funding streams: exchequer funding from the Scottish Executive, and lottery funding from the Department of Culture, Media and Sport in London. Funds are effectively held in stewardship by SAC to support the various art forms, and to provide the organisational infrastructure.

Four main external stakeholder groups were identified:

- Government agencies: Scottish Parliament, Scottish Executive, Department of Culture, Media and Sport, Audit Scotland.
- Customers: Local authorities, artistic organisations and artists.
- Consumers: tourists, citizens and audiences.
- Related organisations: Arts and culture agencies, corporate sponsors, tourist boards, the media.

Again, none of the tools recommended by Buchanan & Gibb (1998) were utilised, as they were not required for this streamlined step.

Identify and define the organisations structure

As previously noted, this is the step where process modelling can substitute for functional/structural frameworks (Buchanan & Gibb, 1998); however, while this IA was of a process orientation the organisational structure was identified during key document analysis and was incorporated for completeness. Consequently, this step became two: firstly, identification of the organisation's structure; and secondly, identification of the organisation's processes (and demonstrating that both could be completed rather than either or).

With regard to structure, SAC activities are delivered through two complementary structures: the council and committee structure, and the functional structure. The council and committee structure (see Figure 6.4, page 243) plays an important role in channelling external advice on funding decisions and policy directions and is key to the effective stewardship and allocation of monies allocated to SAC.

Figure 6.4 SAC Council and Committee structure

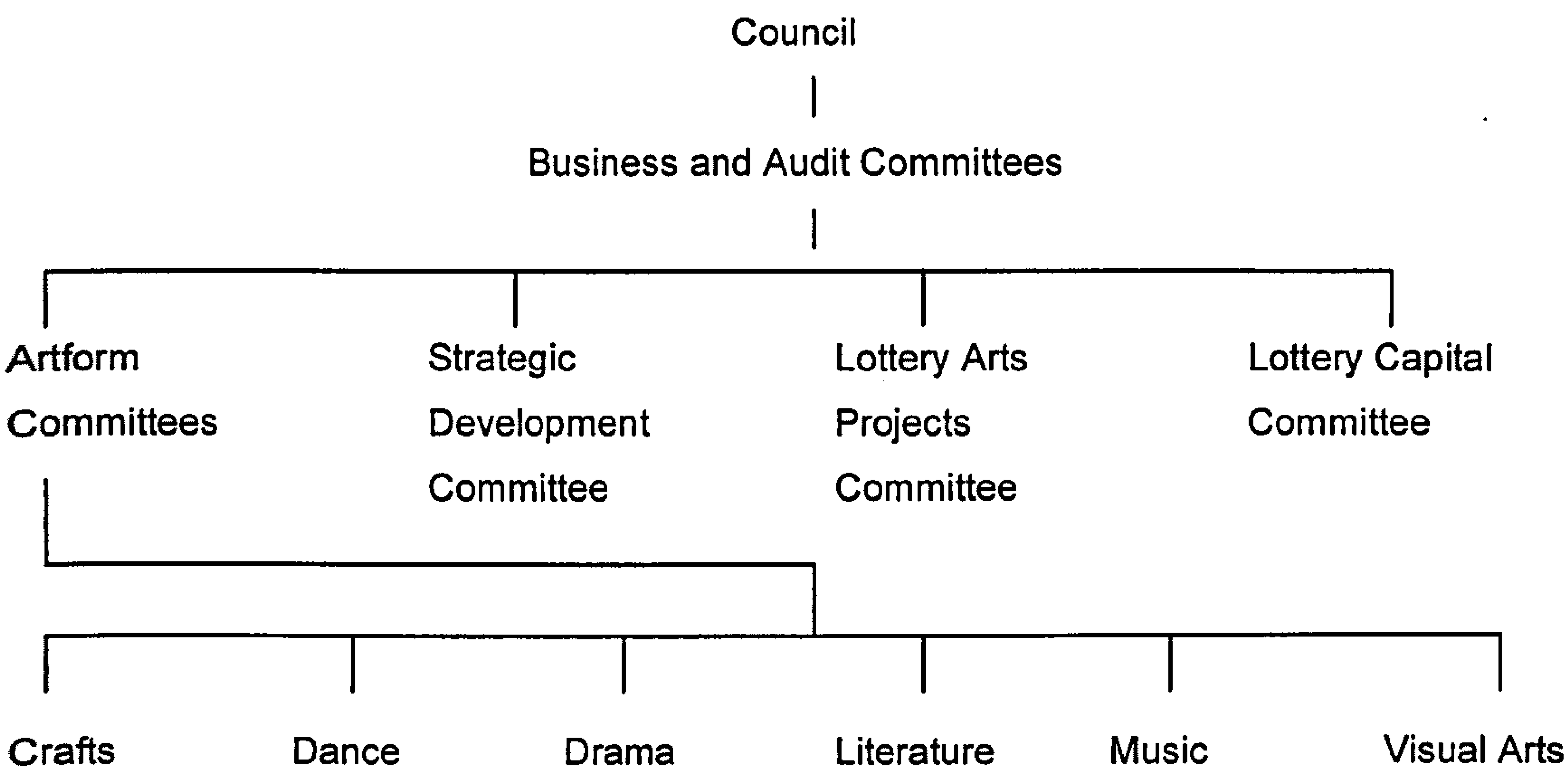
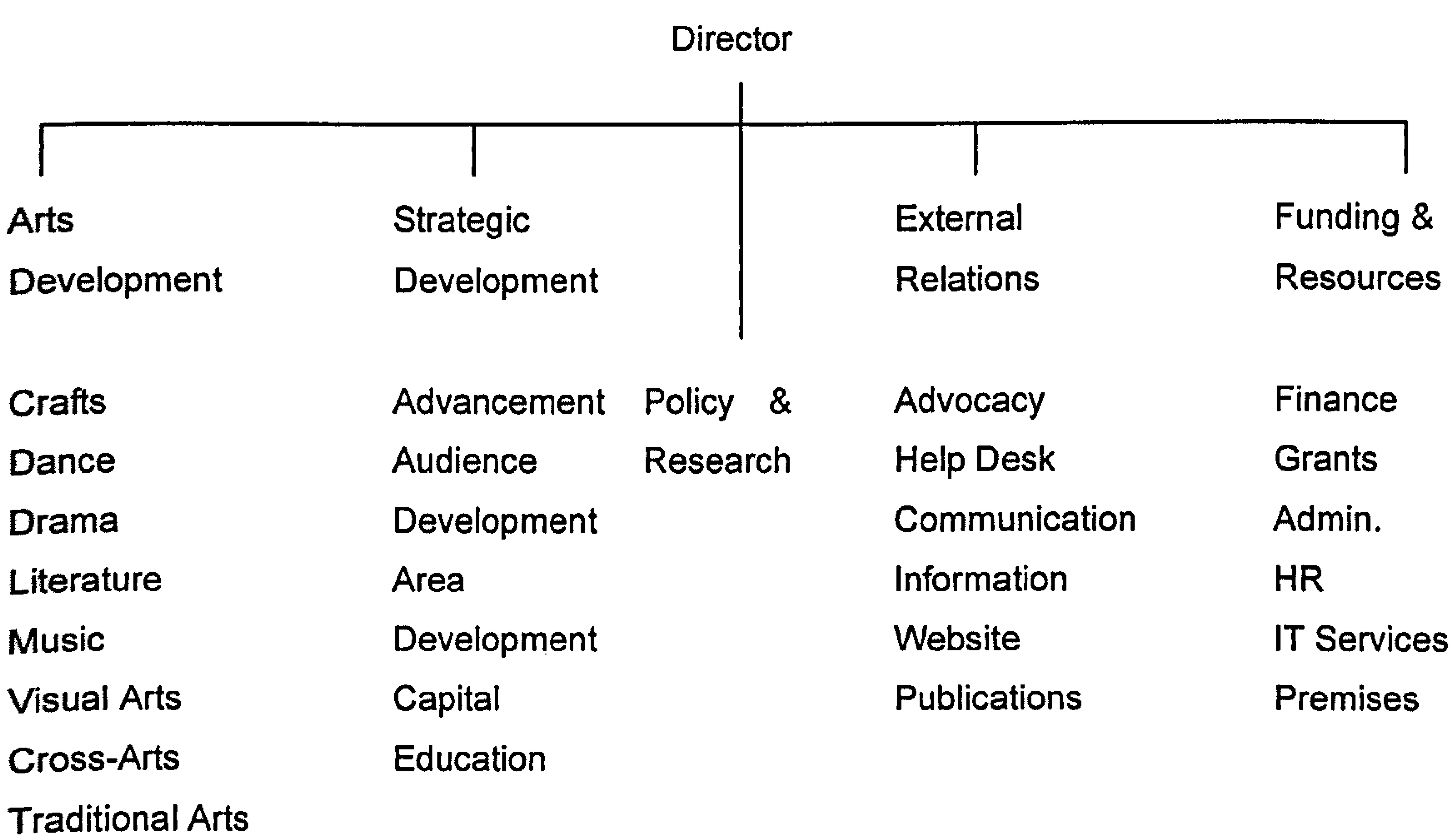


Figure 6.5 SAC Functional Structure



The functional structure is concerned with implementing and administering funding decisions agreed by the various committees, and for developing strategies which reflect issues raised by council and/or the committees. At the time of audit, this structure had only recently been re-organised into four key groups as illustrated in Figure 6.5 (see page 243).

Given this recent reorganisation, SAC organisational structure could, at the time of the IA, be considered as in transition.

Identify and define the organisations processes

Similar to case study one (see Section 5.2.2, page 212) Ould's (1995) framework for process modelling was followed for this step; however, as previously noted, processes were identified and described rather than modelled, firstly, to accommodate the IA brief and associated constraints, and secondly, based on empirical observations from the previous case study (see Section 5.3, page 232), to explore further capturing detailed process information without the complexity of detailed modelling, which would have been impractical regardless, given the time constraints. The first step of Ould's (1995) methodology (determine modelling objectives to provide overall scope, direction and purpose) was provided by the brief (see Section 6.1.2, pages 233-235), consequently this stage of the IA took up the process modelling methodology at step two (establish an overall picture to provide a high level perspective), which was combined with step three (interview senior personnel to verify objectives, discuss and refine the high level perspective, and identify suitable representative personnel to provide a more detailed perspective).

Processes were identified through initial interviews with SAC senior management (Chairman and Director), and then follow up verification with the wider pool of interviewees, which also provided the more detailed descriptions (discussed later in this section). Given the exploratory nature of these initial interviews (and the focus on identification), they were based upon one exploratory and open question: what are the main activities conducted within SAC? These were captured as a list and then discussed for overall completeness.

Once identified, processes were then categorised by the author (following the interviews) according to Ould's (1995) classification:

- Core processes (for servicing external customers through fulfilling orders, manufacturing, insurance policy processing, etc.,)
- Support processes (for servicing internal customers and providing administrative back-up for core processes, e,g. managing finances, purchasing, data processing)
- Management processes (for planning, organising and overseeing the enterprise).

Classification facilitated better understanding of organisational role and the associated value assigned (e.g. core processes vs. support processes). The identified SAC processes, including their respective classifications were as follows:

- Administering arts funding applications (core)
- Administering arts grants (core)
- Developing artform and arts strategies (core)
- Performing advocacy for the arts (core)
- Disseminating information on the arts (core)
- Servicing customer enquiries on the arts (core)
- Performing audits and compliance (management)
- Developing corporate strategy (management)
- Managing estates (support)
- Managing financial resources (support)
- Managing human resources (support)
- Managing information resources (support)
- Performing research (support)

- Providing secretarial support (support)

The next step was to conduct more formal and in-depth interviews with the main group of interviewees (three human resource personnel [group interview], three grant administration personnel [group interview], two system support personnel [group interview], and three department heads [individual interviews]). Interviews were semi-structured open-ended discussions based upon the following seven questions:

1. What do you do?
2. What information do you use, and need, in your job?
3. What information do you produce?
4. Are there any barriers to obtaining and sharing this information?
5. What systems/applications do you use?
6. Is there any functionality you would like?
7. How might your job be made easier from an information perspective?

Two further information systems specific interviews were also conducted. The first with the Head of Finance to discuss the core management information system (the Head of Finance was the system owner) and the second with the Head of IT Services to discuss overarching IS strategy. The questions and notes for these system specific interviews can be found in Appendix Five.

Prior to conducting these interviews, interviewees were provided with the list of processes identified through the initial interviews (Chairman, Director) and asked to comment on accuracy and completeness. All processes were verified. As part of this step interviewees were also asked to identify the processes with which they primarily associated themselves.

Opinions and issues gathered during the interviews were then mapped to the previously identified processes with which they were most associated, rather than simply to the functional units from which the interviewees were nominated. Further information was captured and subsequently documented according to: description of process, inputs, outputs, and issues raised. Table 6.1 below provides an example for the *administering arts grants* process. The template used was an evolution of the one developed for case study one (see Table 5.2, page 219), capturing more descriptive information than its predecessor in lieu of detailed process modelling (including the addition of input and output fields for identifying information flow). Notably, the template also captured the process cycle or sub-processes of the process, which would facilitate later process modelling if required; and also provided much of the descriptive content[3] required for use case descriptions providing synergy/integration to systems analysis and design.

Table 6.1. Example: Process Description

ADMINISTERING ARTS GRANTS
Description of process Administration of the grants process, from pre-application guidelines through to decisions, and concluding with post evaluation. As follows: 1. Funding allocated to budgets (national level) 2. Schemes/Funds setup 3. Guidelines & Application Forms created/updated 4. Applications received 5. Applications processed 6. Decision made 7. Funded projects monitored (staged dependent upon payment process and the specified intervals) [1] 8. Final post evaluation [1]monitoring of project activity for lottery funded organisations (more detailed requirements than SE): compliance to grant conditions, spend against budget, partnership agreements etc. Grants Admin are the default group for measurement/tracking of compliance, but more qualitative measurement is left to the respective Art Streams. Grant Admin are currently midway (Jun02-Apr03) through a change management programme based on the recommendations of Delloite & Touche. Main objectives were described as to: • Become more transparent and accountable • Reduce time to process applications • Streamline evaluation and approval processes

[3] Process description being similar to use case scenario description

• Improve communication between stakeholders
Inputs The application process (applications received, applications processed, decision made) is the main source of information. Each application contains several attachments, providing key company information concerning the applicant (repeated for repeat applications). Officer assessments are then attached, which are reviewed to confirm assessments have been properly handled and documented. Assessments are then passed on to an SAC Committee for a decision (there is an intention to allow officers to make the decisions in the future, with SAC committees focused more on policy).
Outputs • Assessment Reports • List of Applicants for consideration • List of decisions made • List of monitored projects and current status • Monitoring reports for SAC Committee (Summary) • Progress Reports (Full) Guidelines for reporting progress/compliance are provided with the letter of offer, which includes the main headings for the final report (to be completed by the funded organisation). Completed reports (typically 6-20 pages + attachments), are distributed by Grant Admin to the relevant departments but very little feedback is received (they feel there is too much detail). Grant Admin admit to being unsure if these reports are going to the correct individuals, and are unsure of how they are filed (all as hard copy).
Issue: Monitoring funded projects was described as difficult for the following reasons: • Organisations do not readily provide the necessary information (even under threat of withheld funds [the threat typically comes too late]) • Organisations lack the skills to measure themselves, particularly objectively • Organisations are uncomfortable with the process of being evaluated Estimated that, due to the problems listed above, 25% of monitored organisations are not fully assessed. ***Issue:*** A significant gap concerning the monitoring of funded bodies (particularly high risk/investment lottery funded projects) was the lack of organisational information (eg. Overall health, performance, budget, leadership etc. which would provide early indicators of problems/risks), and the timeliness of communication. ***Issue:*** There is a the lack of collective cross-art stream analysis of evaluations – a significant problem when requests for information/statistics are made by the Scottish Executive (typically met after 2-3 days manual searching, retrieval, and compilation). This gap also makes it impossible to do any trend analysis. ***Issue:*** Data is collected in an audit form about the outcomes of the project. The project has to be audited in terms of its success and its compliance with conditions of the grant. Although the audit form is collected for every grant not all the data is used. ***Issue:*** The key issues for GMS/LMS are accessibility and reliability. There is no system documentation and manipulation of the data can be a problem. The ability to interrogate datasets is limited. In general there needs to be more representative and flexible management reporting facilities.

Issue: It was not known whether data could be exported to, for instance, Excel for further manipulation and so a calculator is a commonly used tool.

Issue: There is an audit dimension to the GMS/LMS which means that old records cannot be deleted/updated. The GMS/LMS has limited functionality and is focused on managing the history of a grant and generating offer letters, etc. Problems have also been encountered with the conversion of documents into a downloadable format.

Issue: The GMS/LMS is dependent on one individual and presents problems in terms of business continuity.

Issue: Data cleaning will be needed to provide a consistent database.

Issue: There needs to be an awareness that information is part of a larger architecture than just transactions associated with grants. GMS was designed for the management and audit of transactions and is not suitable for enquiry work or strategy development.

Issue: More could be done on re-investment of experience based on evaluation of projects. There is some information collected on for instance audience figures but there are no PKIs and CSFs.

Issue: GMS/LMS has a problem in that geographical location is defined by where the applicant is rather than by where the project might be. GMS/LMS is therefore not accurate for e.g. analysis by which regions have benefited. The Cities of Glasgow and Edinburgh are listed as core organisations as that is who the cheque is paid to which makes detailed analysis by venue impossible.

Issue: There is no manual for GMS/LMS and the developer is not helpful.

Issue: GMS/LMS does not have mandatory fields and essential elements such as telephone and post code are not always there. This means that geographical analysis is inaccurate.

Issue: There are problems regarding the integrity of data: the GMS/LMS can appear to give incorrect data and some figures have been described by others as "deeply flawed". There are hidden projects and the true figures on investment may be incorrect as a result. The system is not used to its full potential –for instance audience figures are not included. Objectives (i.e. policy themes) need to be coded.

Issue: There are severe business continuity problems regarding the GMS and LMS.

Issue: Book-keeping functions do not appear able to quickly generate the summary information on finances that is requested by SE. SAC must accept that their independence in terms of decision-making does not mean that they are not required to report in a timely fashion to satisfy audit and accountability dimensions.

This IA step combined steps four to six of Ould's (1995) methodology (interview groups as part of facilitated modelling sessions, which identify and explore process goals, procedures, roles, resource usage, and information flow; interview individuals to define the process in detail; and review, revise, and validate models through feedback sessions). As previously noted, no modelling occurred, but processes were verified and key information captured during the interviews. Ould's (1995) methodology proved amenable to this adaptation.

Identify information flows

Information flow was identified as part of the previous step (through identification of inputs and outputs as part of process description [see Table 6.1, page 247]), with further supplementary information gathered as part of the survey of information use, which is discussed next.

For the information survey element, a questionnaire (see Appendix 6) was distributed to all members of staff (initially piloted among a small group of staff, then distributed to all staff as an email attachment in MS Excel format). The questionnaire focused on the following aspects of user role and information use:

1. Work area
2. Main responsibility
3. Other important activities
4. Distribution of activity (talking to people, using a computer, handling paper)
5. Contacts
6. Importance of sources of information
7. Accessibility of sources of information
8. Frequency and usefulness with which information is received via various mediums/channels.
9. Frequency and usefulness with which information is sent via various mediums/channels.
10. The level of difficulty experienced when receiving or sending information via various mediums/channels.

11. Key barriers when using or sharing information
12. Usefulness of current systems for sharing information.
13. IT access requirements
14. Quality and usability of SAC information
15. Awareness of SAC information related policy and procedures

Respondents could complete the questionnaire on screen and return via email, or print it out and return via internal post. 38 of the 90 questionnaires distributed were completed and returned (a 42% response rate). By SAC department, returns were as follows:

- Funding & Resources 12
- Arts Development 10
- Strategic Development 7
- External Relations 5
- Directors Office 4

While a higher response rate to the survey would have been desirable, the data collated during this stage of the IA nonetheless provided a valuable organisational profile of information use within SAC[4]. Notable key findings from the survey included:

- *Advising* was identified as a key activity that the majority of respondents undertook in their respective roles.
- Respondents spent almost half of their working day using a computer. The remainder of their time is spent equally between talking to people and handling paper.
- 56.8% of information sent out is from external sources.
- 70.3% of information received is from internal sources.

[4] Reduced and analysed according to category as denoted by the questions (see page 250)

- Aside from SAC colleagues, respondents are most frequently in contact with arts organisations, artists, funding bodies and government representatives.
- Arts organisations are a valuable source of information but are not considered readily accessible by respondents.
- Over 80% of respondents encounter serious internal barriers when using or sharing information, and over 60% meet with external barriers. Key barriers faced are: inaccurate/out of date information; lack of time; poor internal communication.
- Internal public folders are not considered useful.
- Respondents feel particularly strongly that SAC information is not focused on relevant materials, is not readily identifiable in terms of its author, or of the required quality.
- Email is a highly utilised method of communication, but difficulties are experienced with properly targeting email.
- Respondents believe that they will require remote access to IT in the future.

The above findings contributed to later analysis (see Section 6.2.3, page 254).

Identify the organisations information resources

This step occurred as per Buchanan & Gibb (1998) guidelines but, as per the brief, was focused upon information systems and applications. The application portfolio was identified via the general interviews and further verified through the information systems specific interviews with the head of finance (responsible for the main Grant Management System [GMS]) and the head of IT services. Application use by department was also captured and mapped during this step (gathered via the interviews). This mapping is illustrated in Table 6.2 (see page 253).

Table 6.2 below identified Funding & Resources as the major SAC application user. Common applications used across all departments were predominately desktop applications with the notable exception of GMS/LMS, the core grant management system. There was a surprising lack of use of the internet browser MS Internet Explorer, which was highlighted by staff as an issue (lack of desktop access). Significant concerns were also raised concerning GMS/LMS, which were later defined in greater detail (see Table 6.4, page 257).

Table 6.2. The SAC Application Portfolio[5]

	Arts Dev. (6)	Strategic Development	External Relations	Funding & Resources	Directorate
MS Office					
MS Outlook					
MS Windows					
MacAfee					
MS Internet Explorer					
Netscape					
GMS/LMS (MS SQL)					
MapInfo					
PS Financials					
ALBACS					
SAGE Payroll					
MS EmPower					
SHL GDM					
SHL OPQ					
SHL CCDM					
MS NT4					
Inoculate IT					

[5] Shading denotes use of application.

6.2.3. Analyse

In brief, the four steps to this stage are (Buchanan & Gibb, 1998):

1. Evaluate the information resources
2. Produce the detailed information flow diagram.
3. Produce the preliminary report.
4. Formulate action plans.

For the SAC audit, information flow was captured as part of the process descriptions, the analysis of which naturally preceded the evaluation of information resources, as process provides valuable context, and respects the top-down nature of the Buchanan & Gibb (1998) approach. A variation from Buchanan & Gibb's original methodology was that no preliminary report was produced, purely due to time constraints (but key findings were verified during this stage [discussed later]). It is also important to note that although a degree of quantitative data was provided by the structured survey, this stage predominantly involved qualitative data analysis. Miles and Huberman (1994) identify three major phases to qualitative data analysis: data reduction, data display, and conclusion drawing and verification, which were incorporated into this stage as follows (Buchanan & Gibb [1998] do not provide reference to any tools and techniques for qualitative data analysis).

Data reduction

According to Miles and Huberman (1994), data reduction is "the process of selecting, focusing, simplifying, abstracting, and transforming the data that appear in written up field notes or transcriptions." In this stage, data is meaningfully reduced or reconfigured for manageability, and made intelligible in terms of the issues and/or requirements being addressed. Data was reduced according to the following categories:

- Dissemination of Information (Internal)
- Dissemination of Information (External)
- Information Management and Organisation
- Information Acquisition
- Research and Query Handling
- Funding
- Organisational Issues
- ICT

The above categories were not provided by Buchanan & Gibb (1998) but were developed for the purposes of this audit. They are derived from definition of IA purpose and objectives (see Section 3.2.3, pages 69-70), which provides direction for what should be investigated and analysed for the purposes of an IA[6]. Data was then reduced through association and compression.

Data display

In the next stage of qualitative data analysis, data display provides "an organized, compressed assembly of information that permits conclusion drawing..." (Miles and Huberman, 1994). A data display can be extracted or extended text, an illustration, chart, or matrix; that provide a method to extrapolate and illustrate systematic patterns and interrelationships. Higher order categories or themes may also emerge during the process of data display that go beyond those first discovered during the initial process of data reduction.

Each category was presented in tabular textual format as illustrated in Table 6.3 (see page 256). The only exception was ICT, which was further broken down into several sub-categories (the recommendations presented in Table

[6] It should be noted however that 'research and query handling' and 'funding' are both organisation specific arising through noted organisational concerns and priorities.

6.3 were not completed until the next stage but are presented here for illustrative purposes).

Table 6.3. Example: qualitative data display I

1. Dissemination of Information (Internal)	
Issues	**Requirements**
• Too much e-mail is distributed on a scatter-gun basis. • E-mail is often distributed without guidance on how it should be handled. • People are unaware of certain key developments (both internal and external). • Different versions of documents can exist. • Director requires key figures to be pushed to desktop. • Content and structure of intranet and web-site needs to be agreed.	• Better targeting of e-mail. • E-mail etiquette. • Understanding of costs to receiver need to be demonstrated. • Online alerts • Automatic posting of new documents and proposals on intranet. • Key statistics on applications, grants, overall financial position, etc. • Comprehensive coverage and commitment of departments.
Recommendations: 1. Corporate information policy document required which, inter alia, defines how e-mail should be used, and establishes clear accountability and ownership of information. 2. An intranet should be established as a matter of priority. 3. An e-bulletin or news area should be a feature of the intranet where key developments could be announced. 4. An EIS should be considered which extracts figures from underlying systems. 5. Web content should include: corporate information, artform information, policy information, news information, jobs information. key external links, funding information, publications and administrative documents, plus facilities to register, provide contact information, and complete applications forms and audit forms online. 6. The intranet should have similar coverage (but including documents for internal circulation only) plus access to underlying systems.	

The further ICT sub-categories identified were:

1. Internet
2. GMS/LMS
3. Client Management
4. Decision Support
5. Organisational Communication
6. Document Management
7. Network Administration
8. IT Training

Again, tables were used to display the issues and associated requirements for each of these categories (for an example, see Table 6.4 below).

Table 6.4. Example: qualitative data display II

8.2 GMS/LMS	
Issues	**Requirements**
• Supported by a sole operator. • No Technical or User documentation. • Business continuity: rebuild, support, IPR ownership. • SAC user group disbanded. • Contact history not available in LMS. • Interface "not user-friendly". • No help function. • Only one SAC knowledgeable user. • Legacy gaps/data problems. • No mandatory fields in GMS (gaps in postcodes & telephone numbers compound geographical analysis problems). • Problematic interface between	• Geographical analysis. • Cross-referencing capability (Music & Social Inclusion, comparison of regional applications by artform etc.). • Indexing by: Funded organisation, Venue, Recipient, Artform, Policy directive etc. • Information on funded projects. • Venues Db. • Reminder/forward planner feature for payments due with automatic reminder and letter generator. • Case Load analysis by Artform officer. • Online electronic remittance for

GMS/LMS and MS Word (Officers Assessment Report process). Process to generate Officers Report in LMS four-step, complex, and error prone. • The ways of producing information are inconsistent and multiple and can often produce inaccurate and wildly differing results, up to £5m out in some cases. • Described as currently quicker to source information manually, than to "trawl through the system". • General user dissatisfaction due to: poor support; system relied on to do things it was not designed to do, as no other system exists; lack of awareness of existing functionality (primarily finance related). • Audit dimension disallows deletion of old records – a particular issue with contact details. • Data restructuring required for geographical analysis (to distinguish between physical and actual location). • Book-keeping functions limited, particularly for SE requests. • Report generation limited to MS Word Format ,which then has to be amended manually to transfer to spreadsheet form for analysis.	payments made. • More flexible management reporting facilities, including the ability to interrogate datasets. • Ability to export data (MS Excel etc.)

Recommendations:

1. Decision to be reached on whether or not to continue with current vendor before beginning preparatory work for version two. Then;
2. Conduct a complete functional review of GMS/LMS with a re-established user group. Review should follow standard software review/design process (Business Analysis-Conceptual & Logical Design/Functional Specification) prior to RFT. A strong recommendation is to remove non-grant process related functional requirements

(contacts, research, statistical analysis, venues), which can exist as separate databases within an overall relational management system (see Functional Blueprint). Separation would satisfy both logical and performance requirements prior to the establishment of an online grant application process.

Conclusion drawing and verification

The final stage of qualitative data analysis involves stepping back to consider what the conclusions mean and to assess the implications of findings (Miles and Huberman, 1994). Verification, which is integrally linked to conclusion drawing, involves revisiting the data as many times as necessary to cross-check or verify these emergent conclusions. Tables 6.3 (see page 256) and 6.4 (see page 258) illustrate complete data displays, which include the recommendations reached as part of this stage. The complete tables (completed for all categories and sub-categories) then provide a useful verification tool for both the categories and the respective recommendations. As previously noted no preliminary report was produced during this stage but the complete set of tables were discussed with a representative selection of participants, including the SAC Director (substituting for one of the key purposes of the preliminary report e.g. confirmation of findings).

6.2.4. Account

As previously noted, no account stage was conducted, as specified by the SAC Director as part of the IA brief.

6.2.5. Synthesise

The key outputs of the SAC IA are summarised as follows:

1. Identification of key organisational processes, including descriptions and classification

2. Process-based description and analysis of information flow
3. Information systems inventory and analysis
4. Detailed action plans
5. Information strategy recommendations

The detailed action plans were compiled from the individual recommendations for each of the identified categories (see Table 6.4 [page 257] for an example). These recommendations were then further extrapolated and categorised according to Earl's (2000) taxonomy of information strategy components and the corresponding IA scope matrix to provide the basis of the SAC information strategy.

Based upon the findings of the IA, the SAC information strategy recommendations were as follows:

- **Information Management**
    - Create an enhanced information service
    - Develop a corporate information policy
    - Define information processes and accountability
    - Create a Chief Information Officer (CIO) role at senior management level
- **Information Content**
    - Specify an information architecture to organise and navigate information
    - Enhance research and monitoring of the external arts environment and make accessible to staff and stakeholders
    - Define information flows and processes integral to core and peripheral functions
- **Information System**
    - Regardless of vendor considerations, Version Two of GMS/LMS should focus solely on grants management. Two new related database components are required to support

critical SAC data requirements: one to manage contacts, and one to hold statistical data for detailed analysis, decision support, and responding to Scottish Executive and Parliamentary requests.
    - Create mechanism for completing grant applications and audit forms online (including SAC website upgraded to an extranet)
    - Develop a content/document management system
    - Establish a single contacts application accessible to all.
- **Information Technology**
    - Systems should be implemented which facilitate browser-based intranet access to extract information from underlying systems.
    - Create a central intranet, accessible to all, based on clear ownership and accountability for documents.
    - Establish an extranet.
    - Create an electronic log form on the intranet

By doing this, SAC were provided with both high-level strategic direction and immediately actionable, lower level recommendations (action plans).

6.3. Observations and reflection

The overall SAC IA experience could once more be described as positive (similar to case study one). Participants appeared comfortable with the process, and welcomed the opportunity to consider ways in which to improve organisational processes and the management of information. In the post-report seminar, which was provided for the senior management team (the majority of which had participated in the interviews), there were two notable points of feedback:

- Staff expressed confidence in the methodological process undertaken to conduct the IA, considering it to be both understandable and comprehensive.

- Staff appreciated the two levels of recommendations, and the use of Earl's taxonomy to structure and simplify the information strategy.

The only negative aspect was the 42% return rate for the questionnaire. This is, of course, a common problem with questionnaires; but was a disappointment nonetheless, particularly considering that this was an internal questionnaire, which the SAC Director himself had asked staff to complete and return. One problem which may have contributed to poor returns was the short timeframe in which each of the stages of the IA had to be completed in, which provided only two weeks for questionnaires to be completed and returned. While this, on paper, would appear sufficient for completion of a fifteen-question questionnaire, it does not allow enough time for reminders and delayed returns due to unforeseen circumstances or absence etc. Fortunately the questionnaire was in addition to the interviews rather than the sole investigative technique (highlighting the importance, and benefits, of multiple lines of investigation).

With regard to the methodological process, the Buchanan & Gibb (1998) IA methodology and toolset once more proved to be both usable and tailor-able. In summary:

- The IA scope matrix once again facilitated effective IA scoping.
- *Promote* was once more tailored (steps one and two combined) suggesting that this could become adopted practice in future audits.
- *Identify* was once again tailored to incorporate process modelling (again based on Ould, 1995); however, processes were described rather than modelled for this IA. The shift from in-depth process modelling to capturing process descriptions for all organisational processes worked well and would be recommended in future IAs. The only exception would be where participating organisations include requirements in their brief which call for process modelling; for example, resolving specific process-related problems, automating manual processes etc. The templates

developed during this IA also worked particularly well, notably those for process description (see Table 6.1, page 247) and information resources (Table 6.4, page 257). In particular, the process description template captured information of direct relevance to use case descriptions as popularly utilised for systems analysis and design.

- Of the tools recommended by Buchanan & Gibb (1998) for the Identify stage, none were utilised as strategic and organisational analysis was limited to document analysis as per the client brief. Information use was to be primarily identified through in-depth interview and structured survey. In practice, the interviews provided an opportunity to identify and explore processes in more depth, while the structured survey provided more detailed data regarding information use, flow, and importance.
- No database was developed for the IR inventory as the development effort was once more felt to outweigh the benefits (with inventory again collated as simple tables). This would suggest that a database is not always necessary (dependent upon individual circumstances).
- *Analyse* was completed as per guidelines with a degree of minor tailoring (information flow descriptions rather than models; findings discussed rather than presented as a preliminary report), which proved pragmatic and efficient. The stage once more involved predominantly qualitative data analysis reflecting the nature of the IA. Again, a three stage model of qualitative data analysis based upon Miles & Huberman (1994) was adopted and is recommended by the author.
- *Account* did not occur as per the client brief.
- *Synthesise* occurred as per guidelines with final output being the IA report and a set of strategic recommendations. One final point from the author's perspective (and with the benefit of hindsight) is that, given the extent of the recommendations, they might have benefited from prioritisation, but this could be considered a follow on project management step outwith the scope of the IA.

Finally, the IA was completed on schedule within the allocated eight-week period. Fifteen members of SAC staff participated in interviews and a further thirty-two completed the questionnaire. In total, eighteen attended the post audit seminar. This represented approximately 96 hours (12 days) for the auditor, and 46 hours (5.75 days) for the department (not including the seminar). The notable observation is the significantly reduced resource requirement (from 22 days to 5.75 days) for the participating organisation where interviews replaced workshops (and strategic analysis was out of scope). The time saving for the auditor was less dramatic (from 15 days to 12) as some workshop savings were offset by the need to prepare for and conduct several interviews.

The next chapter presents and discusses the interim methodological findings from this and the previous IA case study.

Chapter Seven. Interim Findings and considerations for usability trials

The purpose of the previous two case studies was to (further[1]) test methodological *comprehensive* and *applicability* of the Buchanan & Gibb (1998) IA methodology, and to initially consider *usability* prior to the usability trials (for definition of these three measures see Section 4.7, page 168). Notable findings follow: firstly, those related to scope setting, followed by those relating to the respective stages of the methodology.

7.1 Scope setting

One of the first notable findings relates to the introduced IA scope matrix (see Figure 3.16, page 104), which was developed to assist with the challenges of IA scope setting and to ensure correct IA application. The matrix has been found to be effective in facilitating the identification of priorities and associated boundaries, and in so doing, has also assisted with the management of complexity, a key concern previously raised (Buchanan & Gibb, 1998).

For case study one, use of the matrix assisted the author in identifying that what was initially thought to be a resource oriented IA was in fact required to be of a strategic orientation. Confirmation of this key requirement occurred during the initial IA walkthrough when explaining each of the IA orientations to the client (see Section 5.1.2, pages 202-203). For study two, the matrix assisted in confirming that, while strategic recommendations were sought as part of final output, no strategic analysis was to be undertaken, and that the priority was in fact process and associated systems (see Section 6.1.2, pages 233-235). In both instances, the matrix not only established priority and boundary, but also provided direction for tailoring of the IA methodology.

[1] The first *static* test occurred during methodology selection (see Section 4.7, pages 168-194)

Case study two also demonstrated that traceability from initial scope to final output can be achieved when recommendations are structured according to the four IA elements as derived from Earl's (2000) taxonomy. The IA scope matrix is consequently recommended for IA scope setting and management. To facilitate use (particularly for the initial usability trials) it should be supported by summary descriptions of the three orientations (see Section 3.5, pages 105-112) and four elements (see Section 3.3.2, pages 78-80).

7.2 The Buchanan & Gibb (1998) methodology

7.2.1 Promote

Step one of the *promote* stage (promote the benefits of the IA through conference or series of seminars) was found to be not essential to the IA process in both studies. In both instances this step did not occur largely due to time constraints. Instead, the passport letter issued to staff in step two not only introduced the author and planned IA schedule, but also (and firstly) outlined the purpose and benefits of the IA, and in so doing, communicated much of the purpose of step one. Step one could consequently be considered as being a 'nice-to-have' step rather than an essential precursor to the IA, with step two substituting. While it is always desirable to hold face-to-face briefing sessions, it is also useful to have a pragmatic alternative where time or logistics dictate another approach is required. These case studies have demonstrated that this is possible.

Overall, the *promote* stage facilitated and encouraged high user involvement from the outset, which can be further increased (during later stages) by adopting two complementary methods of data capture; for example, workshops with selected representatives followed by interviews and/or questionnaires with a wider group of staff. The *promote* stage, as per Buchanan & Gibb (1998) guidelines, is considered critical to IA success by the author.

7.2.2 Identify

In both studies, this stage was modified slightly according to client brief and orientation. For study one, which was of a strategic orientation, all steps occurred, with some minor adaptation to facilitate process modelling and the later prioritisation of a single process for more detailed modelling (see Figure 5.3, page 207). For study two, which was primarily process oriented with a resource element, a similar degree of adaptation occurred (see Figure 6.3, page 239) for similar purposes. The findings of a methodological nature for each step (respective to each study) are discussed below.

Step one (identify and define the organisations mission) was conducted formally for study one but was streamlined to key document analysis for study two (as dictated by the client brief). For study one, Abell (1990) was effectively utilised to define the business of the participating organisation and within the workshop setting, to ensure participants had shared understanding of mission and direction. Of the remaining recommended tools for this step, Synott (1987) was not utilised as this was felt to be more applicable to an organisational IA rather than a departmental IA. Pellow & Wilson (1993) was utilised, but not until step five (to focus on a prioritised process) where it was found to provide a logical step-by-step approach to identifying key success factors. No tools were utilised for study two as this step did not formally occur; however, it is notable to highlight that key document analysis was highly effective during this step providing valuable organisational background information (see Section 6.2.2, pages 240-244) and context to later steps, validating Buchanan & Gibb's (1998) own recommendations (where mission is already defined).

Step two (identify and define the organisations environment) again occurred formally for study one, but again as key document analysis for study two. For study one, both PEST analysis and Porter's (1980) model of competitive forces were utilised. PEST was found to be particularly effective as a high-level environmental analysis tool, and acted as a natural precursor to more in-depth competitive forces analysis (Porter, 1990), which provided strategic understanding and direction for later steps. Both tools facilitated group discussion and in a workshop setting could be adopted for this benefit alone. Notably for study two, while this was conducted largely as key document analysis, questions were asked by the author during preliminary interviews (which were occurring almost in parallel) to supplement this as information regarding environmental and competitive forces was not as well defined within documents (as opposed to definition of mission and business direction). This information was not within key documents most probably due to its sensitive or confidential nature. It is anticipated that this would be similar in most organisational circumstances; consequently it is recommended that where this step occurs as key document analysis, some contingency is allowed for possible follow up with key stakeholders.

Step three (identify and define the organisations structure) is the point according to Buchanan & Gibb (1998), where process models can substitute for more traditional hierarchical models. However, although process modelling is identified as a recommended approach by Buchanan & Gibb (1998), no tool is provided nor recommended (a notable toolset limitation). Ould's (1995) STRIM process modelling methodology was found to be suitable for IA purposes as it provided a logical step-by-step approach to modelling of both processes and associated information flow (discussed in the next step). However, the detailed process modelling convention adopted in support of STRIM (not provided by STRIM) for study one was found to be overly complex and is a notable finding to highlight. The high level model (see Figure 5.5, page 212) was immediately understandable and usable by both author and participants, but the more detailed model (see Figure 5.6, page 218) of the prioritised process was not, with participants commenting that there were too many relationships illustrated making it overly complex to understand and follow (in terms of workflow). This overly complex model was largely dictated by the object-oriented modelling software, which illustrated all relationships, but also could be attributed to overly ambitious modelling by the author during the first trial.

A more successful element of this initial process modelling exercise was the creation of the process description template by the author (see Table 5.2, page 220), which was found to be an extremely useful tool for defining each process and capturing more descriptive supporting information (again, no such template was provided by Ould [1995]). This template was later refined for study two (see Table 6.1, page 247) and was found to be an effective alternative to modelling processes (demonstrating that it is not always necessary to model processes as process descriptions can suffice, dependent upon organisational requirement). Notably, the process description template could also be utilised to form the basis of use case descriptions.

The final notable point from this process modelling step is that it became apparent that care must be taken when process modelling, as it was found to be a time consuming step requiring access to many stakeholders. Where modelling is necessary, prioritisation (as adopted for study one) is a recommended pragmatic approach where there are multiple processes to consider. Where modelling is not absolutely necessary, study two has demonstrated that process descriptions provide an alternative approach, which is valid in its own right but could also be used to cover more processes within the same timeframe.

Step four (identify and describe the organisational culture) does not necessarily have to be an explicit step, as in both studies, this occurred as part of other activity. Buchanan & Gibb (1998) recommend stakeholder analysis (Grundy, 1993) and force field analysis (Lewin, 1947). For study one, step four did not formally occur, but stakeholder analysis occurred as part of the group discussions during the initial process modelling step, and force field analysis was effectively utilised during the final *analysis* stage for action planning. For study two, neither tools were utilised with organisational values, attitudes, and beliefs becoming self evident through the various discussions and exercises (particularly feedback on organisational policy and enabling and restraining forces). The notable finding is that step four can be pragmatically incorporated into adjacent steps with the benefit of streamlining the overall *identify* stage a little, if and when appropriate.

Step five (identify information flows) occurred for both studies. Buchanan & Gibb (1998) recommend a flow-based approach similar to Orna (1990). In practice (for study one), initial information flow was captured by default as part of process modelling (as inputs/outputs), and was later modelled in more detail as individual information flow diagrams for each respective sub-process (discussed later). Where no process modelling occurred (e.g. study two) information flow was captured as part of the detailed process descriptions through completion of the input/output fields (see Table 6.1, page 247). These could then be used as the basis for separate information flow diagrams (and use cases), if required. Both respective approaches provided opportunity for synergy and simplification of IA steps and are consequently recommended for future audits.

Step six (identify the organisations information resources) occurred as per Buchanan & Gibb (1998) guidelines, but notably, in both instances no database was developed for the resource inventory as the development effort was felt to outweigh the benefits (particularly given the noted time constraints for both IA's). In both instances, details were captured as simple MS Word tables although with hindsight MS Excel would have probably been more appropriate (although no issues were experienced with MS Word there is more inherent flexibility and functionality offered by MS Excel). Use of either a database or spreadsheet would be dependent upon individual circumstances. In both studies, information resources were initially identified in the preceding steps then identified or explored in more detail through interview (study one) or questionnaire based survey (study two). Each approach worked for the purposes of the respective audits, with final choice down to individual circumstances and preference. However, it should be noted that no template existed for this step with one having to be developed by the author (see Appendix 3).

On a final note regarding the *identify* stage, both studies demonstrated that each of the steps of the *identify* stage are valid, but that while they may have been previously considered a linear sequential process[2], it is in fact possible to conduct several in parallel and/or combination. This demonstrates an inherent flexibility within the methodology.

7.2.3 Analyse

In both studies this stage occurred as per Buchanan & Gibb (1998) guidelines with the notable exception of step three (discussed below).

Step one (evaluate information resources), for both studies, involved a wider survey of information users within the participating organisations to explore strategic importance and utility of the identified information resources, and to identify any associated problems. For study one, this was accomplished through interviews with a representative sample of information users, while for study two a questionnaire was distributed to all staff. Both approaches were found to be appropriate to the circumstances and goals of the respective audits with no notable observations beyond those normally associated with interviews versus questionnaires. With regard to tools, Buchanan & Gibb (1998) recommend McFarland & McKenney's (1984) strategic grid, but this was not used in either instance as it was deemed more appropriate to IT portfolio analysis within a workshop setting, which was not deemed necessary for either IA. Buchanan's (1995) information resource value scale (see Table 3.4, page 112), which was introduced by the author, was found to be useful, providing a simple scale for measuring importance

---

[2] Buchanan & Gibb (1998) provide no direction on this point.

and utility. Consequently, the value scale is recommended for future audits. The sets of questions developed for these case studies should also provide useful sample sets for future audits, as these are not provided by Buchanan & Gibb (1998).

Step two (produce detailed information flow diagrams) occurred for study one as per Buchanan & Gibb (1998) guidelines with simple input/output diagrams developed from the process models supplemented by additional information resource details gathered during the preceding step. A notable point is that the use of Buchanan's (1995) information resource value scale provided values (arithmetic mean) for each identified information resource, which is a notable progression on previous information flow diagrams (and strengthens the case for inclusion of this tool in any future revised methodology). Information flow diagrams were not produced for study two largely dictated by the brief; however these could have been produced directly from the process descriptions, although values would not be available.

Step three (produce preliminary report) occurred for study one but not for study two. This step proved to be a routine exercise with initial findings presented for sponsor and key stakeholder feedback prior to final report (for study one). A preliminary report was not produced for study two due to time pressures, but a summary of key findings was discussed with the sponsor, which under the circumstances provided an alternative approach.

Step four (formulate action plans) was simplified in both instances, as the recommended tool (Checkland & Scholes [1990] soft systems methodology) was considered unnecessary as a well defined picture of organisational structure, processes and information flow now existed in both instances. It is likely that, in future audits, process modelling and associated analysis would substitute for soft systems methodology, particularly where a top-down approach is adopted (as prescribed by Buchanan & Gibb [1998]). For study one, Lewin's (1947) force field analysis was successfully utilised to formulate action plans through visual mapping of the previously identified strengths and weaknesses. In a workshop setting this proved highly effective. For study two, which had no workshops or working group assigned, analysis occurred through a process of qualitative data analysis, conducted by the author, observing a three stage process of data reduction, data display, and conclusion drawing and verification (Miles & Huberman, 1994). Buchanan & Gibb (1998) do not provide reference and/or guidance in this area; consequently Miles & Huberman (or similar) is recommended.

7.2.4 Account

The *account* stage is untested, as neither sponsor required cost analysis of information resources and/or services. This is unfortunate, particularly in consideration of the usability trials, as cost and value have previously been highlighted as a potentially complex and problematic step (Buchanan & Gibb, 1998). This stage would be closely observed if organisations participating in the trials required the account stage to be completed as part of their respective briefs (however, evidence suggests it may not).

7.2.5 Synthesise

For both studies this stage occurred as per Buchanan & Gibb (1998) guidelines with final output being the IA report and a set of strategic recommendations. Notably, for study two recommendations were extrapolated and categorised according to Earl's (2000) taxonomy of information strategy, which correspond to the four elements of the IA scope matrix. In so doing this provided structure to recommendations and traceability back to original scope. The IA scope matrix taxonomy is consequently recommended for future audits.

7.3 Summary

Interim findings from the previous two case studies have found the Buchanan & Gibb (1998) IA methodology to be, in the main, methodologically complete, applicable and tailor-able to organisational requirements, and usable (discussed further in Chapter 9). Summary interim findings and considerations for the usability trials are as follows:

- The IA scope matrix has been successfully trialled. To facilitate further more widespread use it should be supported by summary descriptions of the three orientations and four elements.
- The *promote* stage can be streamlined with steps one and two combined.
- It is possible to conduct several of the *identify* steps in parallel and/or combination.
- A notable toolset gap is the lack of a process modelling method and supporting tool/templates. Ould's (1995) STRIM methodology is recommended as a suitable tool for process modelling (should process be within scope). Process descriptions are a valid alternative to modelling dependent upon circumstances and constraints, and could also be utilised to form the basis of use case descriptions if required. Process and information flow modelling and analysis can substitute for SSM as this provides a valid alternative 'rich' picture of the organisation.
- A database may not always be required for the resource inventory.
- A further notable toolset limitation is a lack of qualitative data analysis instruction. Miles & Huberman's (1994) three-stage process of data reduction, data display, and conclusion drawing and verification is a recommended addition to the IA toolset (for the *analysis* stage).
- Traceability from initial scope to final output can be achieved when recommendations are structured according to the IA scope matrix as derived from Earl's (2000) information strategy taxonomy.

The next chapter presents and discusses the findings of the three usability trials, which more fully test and consider *usability*.

Chapter Eight: Usability Trials

The following sections present and discuss the three usability trials conducted to further test the IA methodology.

In contrast to the previous two case studies, which discussed methodological considerations in some depth, the following three trials focus on usability of the methodology. A summary IA methodological overview is provided for each trial for the purposes of context and background, but the focus of the discussion is on the user experience. The three auditors who participated in the trials had no previous practical audit experience but they had all completed postgraduate studies in information management and were consequently familiar with IA methodologies and associated tools and techniques (via the taught curriculum). Two of the three auditors were employees of the participating organisations, both employed in information management roles.

The research methodology underpinning these three usability trials (primarily based on observation and post-audit semi-structured interview) is discussed in Chapter Two (see Section 2.2.3.3, pages 33-38).

8.1. Usability Trial One: The British Council

The British Council (BC) was founded in 1934 as a voluntary association to foster overseas educational and cultural relations (in 1940 it was established on a permanent basis with the award of a royal charter). BC is a registered charity and non-departmental public body. Approximately one third of BC funding is received from the Foreign and Commonwealth Office (FCO) as annual grant-in-aid, a further third from providing educational services (e.g. English language courses, hosting examinations), and the remainder from managing programmes for the UK government (e.g. Chevening Scholarships) and the European Union (e.g. Socrates Exchange Programme).

The BC works in seven subject areas: arts, education and training (including sport), English language teaching, governance, information, science and health. The BC is represented in 217 cities in 110 countries, and currently manages 95 international development contracts in 97 of those countries, to the value of £250 million.

Within the UK, BC headquarters are split between Manchester and London, supported by three country offices for Northern Ireland (Belfast), Wales (Cardiff,) and Scotland (Edinburgh); and a further fifteen regional offices distributed throughout the UK.

8.1.1. IA brief and Methodological overview

BC had recently completed a small, high-level knowledge audit, as a precursor to the development of a knowledge strategy, which had highlighted several key information requirements, which were not being adequately met (according to participating BC staff). These information requirements were: staff contact information, project and events information, global products and services information, UK services information, new initiatives information, brand identity updates, corporate policy and standards. In parallel with the knowledge audit, BC was also initiating a process reengineering project to look at new ways of developing new products and services (a key objective as part of *Strategy 2010*), with the dual goals of promoting greater reuse of existing products/services from the global portfolio, and reaching markets faster with new products/services (provisionally titled the *commissioning process*). The findings of the knowledge audit highlighted shortcomings in BC's management of information, which had serious implications for the success of this new process, so more detailed investigation of information flow and requirements was called for. The appointed BC sponsor for the proposed IA was the Director, Knowledge Management; who provided the following IA brief (Kassenova, 2005):

> To analyse the British Council information needs and current information support for the new products and services development process, ...and provide a set of recommendations to improve current information flow and use of information resources, tools, and systems. This will enable better information provision for people involved in the commissioning process in the near future.

In the initial meeting with the sponsor, the auditor walked through the Buchanan & Gibb (1998) methodology explaining the purpose of each stage and the respective steps involved, and introduced and utilised the IA scope matrix to establish scope (explaining each of the orientations to the sponsor). The sponsor confirmed that he wished the IA to focus on the product and service development process, and to identify and evaluate associated information resources. The sponsor viewed the IA as a follow on activity from the knowledge audit, which had included strategic analysis; consequently, the sponsor felt there was no need for this activity as part of the IA *identify* stage. The sponsor did not require the *account* stage either. The final output was to be the information report for the prioritised process.

The sponsor was reluctant to precede the IA with a seminar, feeling it unnecessary and time consuming.

The summary for the adopted IA methodology is illustrated in Figure 8.1. The IA could be described as having a *process* orientation with elements of *resource* orientation.

Figure 8.1. BC IA Methodology[1]

1	2	3	4	5
Promote	**Identify**	**Analyse**	**Account**	**Synthesise**

With regard to author observation, the auditor appeared to experience no major problems or challenges with this initial meeting. The walkthrough of the IA methodology provided structure to initial discussion and effectively preceded the scoping exercise by allowing the auditor to fully familiarise the sponsor with IA purpose and scope (prior to considering orientation). The observer noted some initial nervousness on the part of the auditor, which could be put down to being the first meeting and/or due to the presence of the observer, but the auditor seemed to relax as the meeting progressed. The auditor later commented that she was nervous initially due to having not conducted an IA previously and also commented that the presence of the author as observer had not contributed to this, but had in fact been of some reassurance. The auditor further commented that the structured walkthrough of the IA methodology had put her more at ease as she found herself discussing a familiar subject. The IA scope matrix was also found to facilitate structured discussion. Overall, both contributed to auditor confidence. The overall approach taken by the auditor (e.g. the process orientation), in

[1] Shading denotes stages of the methodology applied as per the brief.

consideration of the BC brief, which highlighted process concerns, was considered appropriate by the author.

Promote

Two further meetings were held between the sponsor and auditor during this stage to discuss staff participation and to draft the passport letter. The sponsor identified four BC units, which together constituted the main stakeholders and users for the product and service development process, from which interviewees/participants were invited to participate. These groups were: Knowledge & Information Services, Education & Training Group, Governance, and the recently established Commissioning Group. In total, twenty representatives were selected from across the four groups to take part in the IA.

The sponsor indicated a preference for individual interviews over workshops, as this was considered easier to manage from a BC resource management perspective. Prior to the auditor inviting participation, the sponsor circulated an email to all staff as the *passport letter*, which introduced the auditor and explained the purpose of the IA.

A preliminary survey was carried out by the auditor through initial meetings with the sponsor and one representative from each of the four participating groups. Initial findings supported the information management shortcomings highlighted by the knowledge audit report, particularly a lack of readily accessible information regarding existing BC products and service (highlighted). It was agreed during this stage that the participants in the preliminary survey would also form a working group that would periodically convene to contribute to proceedings.

With regard to usability observations for this stage, the auditor appeared to progress well through throughout. With regard to tools utilised, the passport letter was utilised (the only tool recommended by Buchanan & Gibb [1998] for this stage).

Identify

As per the BC brief, strategic analysis was not undertaken for this particular IA, which streamlined steps 1-4 (see Section 4.5.1, pages 147-151) to desktop research to provide the auditor with organisational understanding and background information (similar to case study two [see Section 6.2.2, page 239]). The BC intranet site provided the basis for this desktop research, supplemented by key internal reports made available to the auditor via the sponsor. These reports included: *BC Strategy 2010*, *BC Information 2010*, the *Knowledge Audit report*, and the *Commissioning Process Pilot Evaluation* report (which included a proposed *commissioning* process). As part of these steps the auditor identified and verified BC mission and strategy. The BC mission was identified as to (British Council, 2005):

> Connect people worldwide with learning opportunities and creative ideas from the UK and build lasting relationships between the UK and other countries.

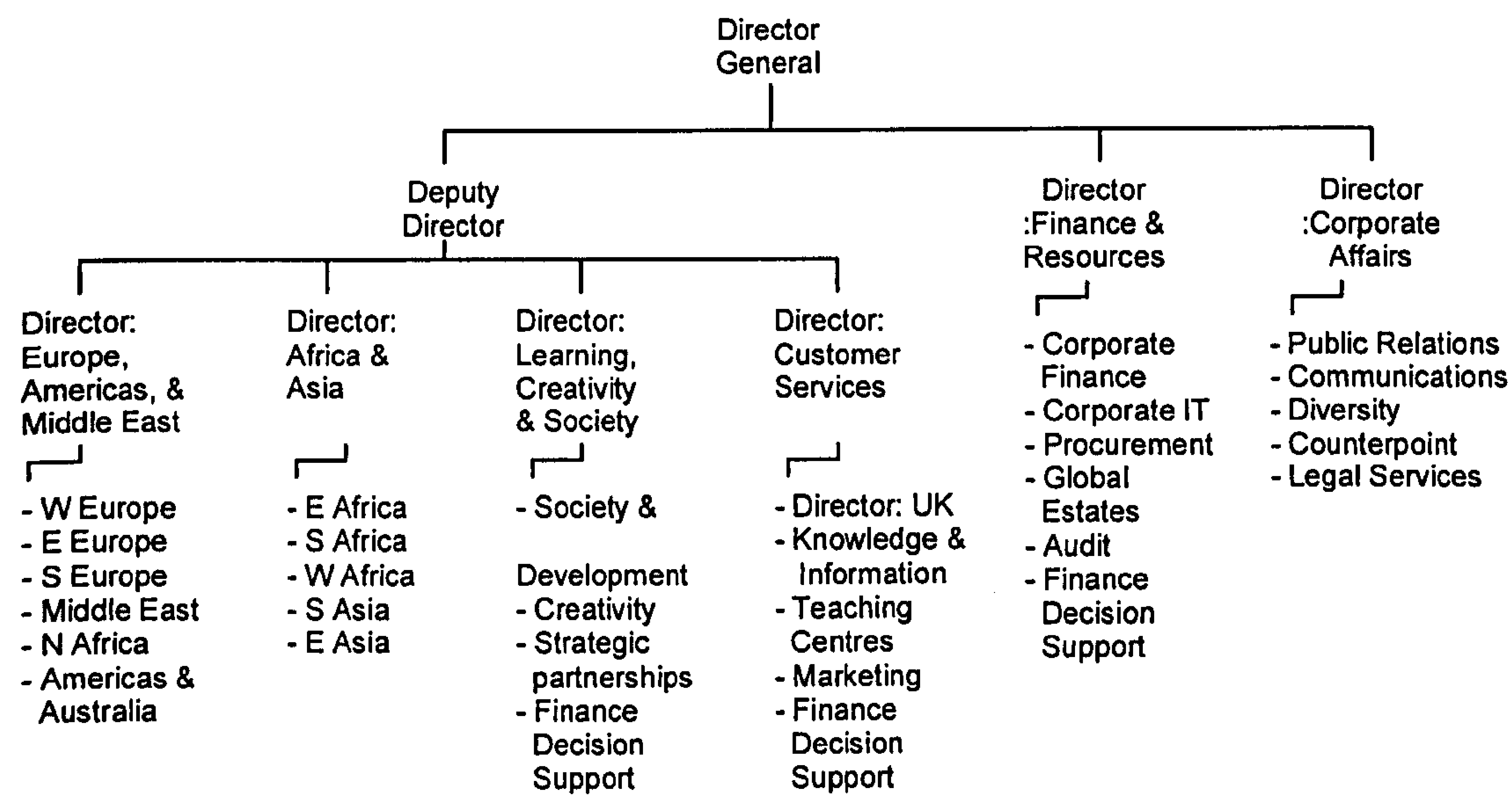
BC *Strategy 2010* (British Council, 2005) was defined as focusing on three main areas:

1. Reaching millions more people and serving them better.
2. Releasing the creativity and potential of our people.
3. Being clear about our outcomes.

The auditor also identified the high level organisational structure during these combined steps, which is illustrated in Figure 8.2 (see page 281).

Step five of this stage (identify information flow) was where the auditor incorporated process modelling[2] (focused on the product and services development process as per the BC brief), which then included information flow as part of process identification and modelling (and also the final IA step of information resource identification). The auditor's approach to process modelling was based on STRIM (Ould, 1995) as taught during her previous postgraduate studies.

Figure 8.2. The British Council Organisational Structure (British Council, 2005)



Data was gathered through semi-structured interviews based on six questions. Questions varied slightly dependent upon role/responsibility of the participant (e.g. head of department vs. system support). Questions were:

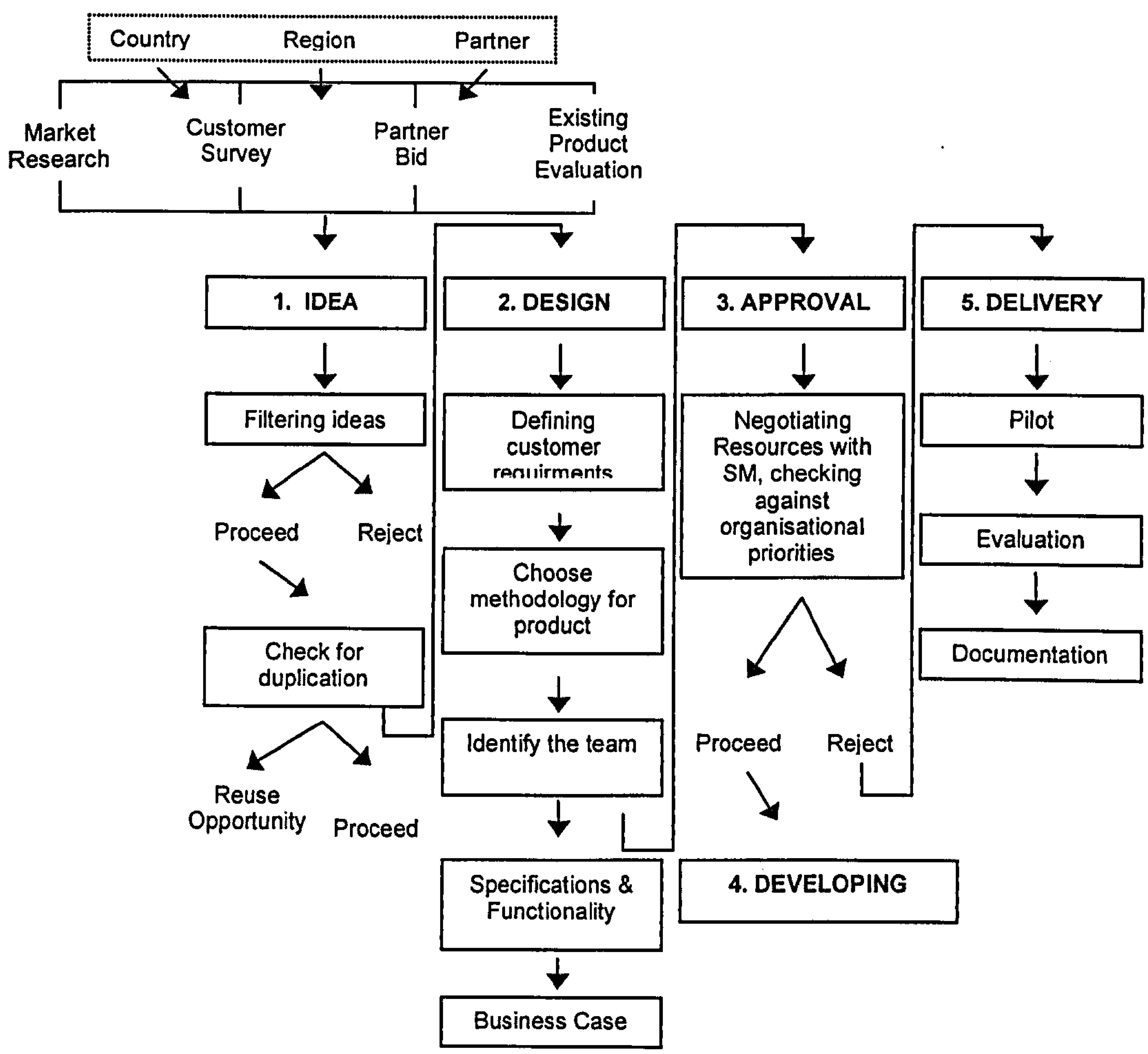
- What are the key stages and steps of the product and services development process?
- What information is necessary to support different stages?
- What are the information flows and interactions within the process?

[2] Process modelling is a recommended tool for step three but given that steps 1-4 were desktop analysis it was valid to introduce this at this point.

- What information resources are currently used?
- What are the problems?
- How could information provision be improved?

As part of this process the auditor identified a five-stage product and service development process, which was modelled, distributed to participants for verification and/or feedback, and then discussed with the working group. Some minor refinement of terminology occurred but otherwise the model remained the same (see Figure 8.3 below) as initially captured. Narrative-based process descriptions supported the model, describing what occurred at each respective stage.

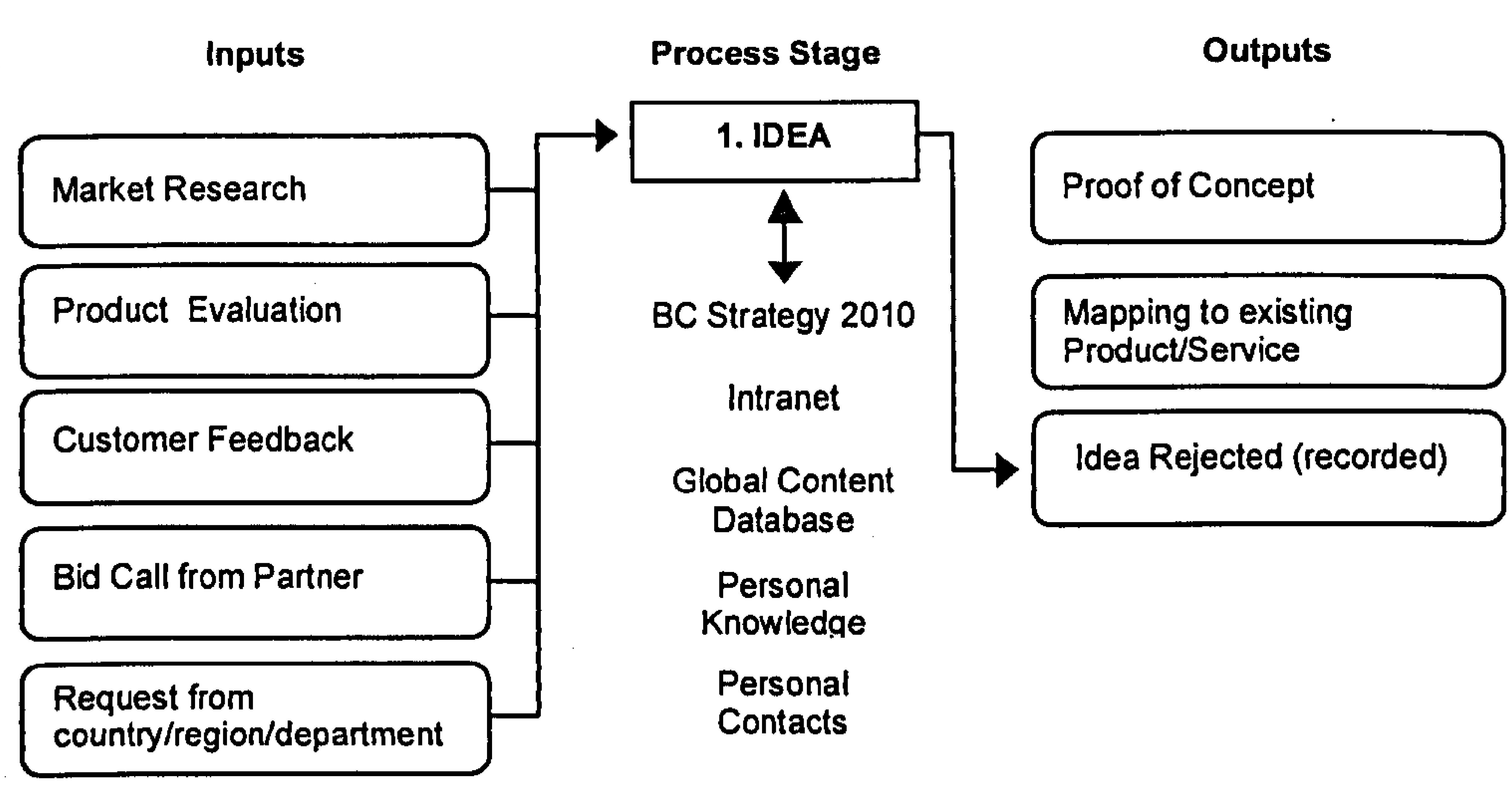
Figure 8.3. Example: Identifying BC Processes (Kassenova, 2005)



The process modelled in Figure 8.3 above reflected the current process for product/service development, which could then be compared to the proposed *commissioning* process, facilitating gap analysis (current to desired state) if required. The auditor later commented that she had felt (correctly) that it was important to identify current processes (as opposed to planned processes) in order to be able to also identify information flow and key information resources.

The auditor then mapped information flow based upon the process model. Figure 8.4 below provides an example information flow diagram for stage one of the *product and service development* process (information flow was identified and modelled for each of the respective stages by the auditor). The auditor adopted a simple input/process/output model (as per Buchanan & Gibb [1998] guidelines), which identified and illustrated key information resources for each stage of the prioritised process, facilitating further exploration of information requirements and issues. For example, Figure 8.4 illustrated a dependency on the use of personal knowledge and contacts during the filtering and consideration of product/service ideas, which supported evidence from the preliminary investigation regarding lack of readily accessible information regarding products and services.

Figure 8.4. Example: Identifying information flow (Kassenova, 2005)



Twenty-five information-related issues/problems were also identified and associated with product and service development during this stage.

In terms of author observations during this stage, the initial desktop research undertaken by the auditor could be seen to provide valuable context and organisational understanding, and highlighted the importance of undertaking this step when no strategic analysis is part of the remit.

The auditor appeared to find the interview process difficult, seeking some guidance regarding preparation, questions, and interview technique[3]. The auditor also appeared to have similar problems with process modelling, again seeking guidance and direction.

A further notable observation during this stage was that there was limited evaluation of the value of identified information resources by the auditor. This step was omitted by the auditor as the data captured for this task was largely incomplete (via the interviews, and included on the questionnaire). The auditor planned to ask interviewees to identify information resources and then assign corresponding values according to Buchanan & Gibb's (1998) scale of importance to the task/process with which the IR was associated with, however in practice, this task proved difficult for the auditor as it involved capturing and structuring large amounts of data within a single interview. The auditor was advised to break this into two steps by the author and as outlined by Buchanan & Gibb (1998), but attempted to complete this as a single step in consideration of time constraints and to minimise trips to participants (geographically dispersed across the UK). The resulting failure could be put down to over ambitious scheduling due to lack of experience.

[3] In this and future instances during the usability trials where auditors asked for guidance and direction the author, in the dual role of supervisor and observer, would direct the auditor to suitable instructional material and examples, but not contribute/participate in their preparation or application.

With regard to the key tools and techniques utilised for this stage, those associated with steps 1-4 were not utilised as these steps were not within scope, process modelling occurred but a tool had to be sourced by the auditor (STRIM) as none is provided by Buchanan & Gibb (1998), and information flow was modelled similar to Orna (1999) as recommended. A small database application was also developed by the auditor to capture and log information resource data, but was not used, as the more structured *inventory* element of this IA was relatively minor compared to the data collected via the semi-structured interviews, which required more qualitative analysis and management as follows.

Analyse

Qualitative data analysis was conducted similar to Miles & Huberman's (1994) three-stage approach of data reduction, data display, and conclusion drawing and verification (an approach the auditor would be familiar with from their postgraduate studies). As illustrated and discussed above, data was initially captured and structured by the identified process stage, then further refined as information flow diagrams, and supported by textual process descriptions (techniques adopted/developed and then trialled in the previous two case studies). Recommendations were reached through analysis of the implications arising from the twenty-five identified issues/problems, which were discussed and verified with the BC working group. The final set of recommendations (twenty-six in total) were classified under one of the following three categories (Kassenova, 2005):

- Organisational issues
- Information support of the products and services development process
- Information resource management improvements

Table 8.1 (see page 286) provides example recommendations for *information support of the products and services development process.*

In terms of observation the auditor appeared to proceed without incident or problem during this stage. With regards to adoption of recommended tools and techniques the auditor adopted a streamlined approach to this stage focused on qualitative analysis of emergent issues. Neither McFarlan & McKenney (1984) nor Checkland & Schole (1990) was used, but this was valid as, firstly, strategic analysis was not within scope and secondly, the adopted process modelling approach and subsequent analysis substituted for soft systems methodology.

Table 8.1. Example: BC IA recommendations (Kassenova, 2005)

Information support of the products and services development process	
1.	Full and up-to-date information about products, services and events, with clear contact points/responsibility for the development and implementation teams, with access to financial information about for previously delivered products and services via the BC Financial and Business System (FABS).
2.	Product/service information available by country/region with both summary and detailed information.
3.	Standard templates for product/service development.
4.	Information toolkit providing central (intranet) access to key resources (e.g. DFID, DFES, EU), process information, and templates (once developed).
5.	Contacts information to include: areas of expertise and professional interest; list of approved researchers, consultants, suppliers (by area), including history of previous engagements with BC.
6.	Market research service/information to support product/service development.
7.	Enhance FABS to allow input of proof of concept information prior to approval point (to provide a historical reference point).

Synthesise

The IA report was structured as follows: executive summary, BC brief, background information, findings, and recommendations. The key outputs of the BC IA were:

1. BC product and service development process model and sub-process descriptions.
2. Process-based information flow models, including issue analysis.
3. Identification of key information resources.
4. Identification of information issues and requirements.
5. Recommendations.

The report was circulated to interview participants via the BC Sponsor and made more widely available via the BC intranet site. The auditor also presented findings at a monthly BC *knowledge-sharing* meeting, which was made available to a wider audience via videoconferencing.

In terms of author observation during this stage, the auditor appeared to proceed through the final IA stage without incident or problem.

8.1.2. Post audit interview

Selection of the Buchanan & Gibb (1998) methodology by the auditor was based on the perceived flexibility of approach and incorporation of comprehensive tools and techniques to support each of the IA stages and tasks. The auditor commented (Kassenova, 2005):

> The analysis of the key information audit methodologies, i.e. a general overview of different approaches with in-depth analysis of Burk & Horton (1988), Orna (1999), Henczel (2001), and Buchanan & Gibb (1998) methodologies; helped the author to consider different possible approaches to conducting an information audit, and to choose one appropriate to British Council needs. Based on this analysis Buchanan & Gibb's methodology was chosen, due to its flexibility and an innovative approach to using multi-disciplinary tools and techniques.

However, the auditor then found the process of becoming familiar with the various tools and techniques, ironically initially considered as a strength, in practice a difficult and time consuming task. The auditor commented (Kassenova, 2005):

> I would recommend Buchanan & Gibb to expand the level of details in which the methodology is written, as currently it is a summarised version and not easy to use, especially for people new to the information audit. All key stages would benefit from templates, examples and case studies to support and explain how to use them... This would help the users of the methodology to make an informed choice of the methods by matching tools and techniques recommended to needs and requirements.

As part of this discussion, the auditor highlighted a particular need for further guidance regarding interview preparation, process modelling, and qualitative data analysis, which supports the authors own observations during this trial.

With regard to overall experience, the auditor found the experience of conducting an IA challenging, providing comment on the level of skill required (Kassenova, 2005):

> According to personal experience, the author agrees with Buchanan & Gibb (1998), that special skills are required of the information auditor, and not any information professional (as proposed by Orna [1999] and Henczel [2001] can do it. This is also one of the constraints, as the Buchanan & Gibb (1998) methodology requires a wide range of skills.

In summary, for this auditor, the methodological strengths of Buchanan & Gibb (1998) were also its greatest methodological weaknesses.

8.2. Usability Trial Two: The University of Strathclyde Office of Marketing & Communication

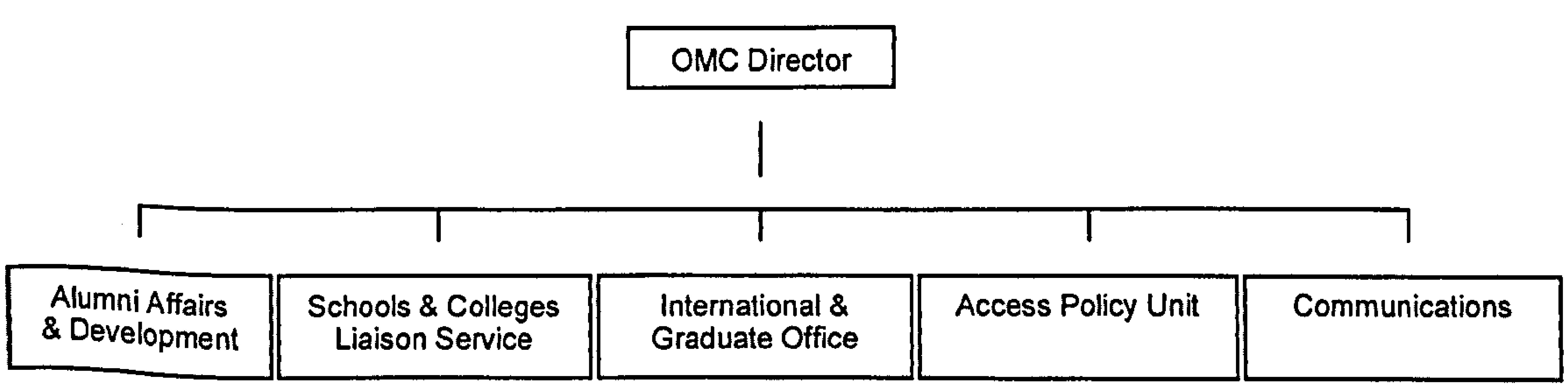
The University of Strathclyde was founded (1796) in Scotland as a place of useful learning, to make higher education available to all, and to combine excellence with relevance.

The University Office of Marketing & Communication (OMC) was established July 2004 as as a result of recommendations arising from a 2003 University-wide marketing review, which called for increased synergy and more coordinated effort in marketing initiatives. OMC brought together five existing University units: Alumni Affairs & Development, Communications Office, International & Graduate Office, Schools & Colleges Liaison Service, and the Access Policy Unit. Its primary purpose is to develop and deliver a marketing strategy that supports the attainment of the University's strategic mission (see Section 5.1.1, page 200).

OMC is responsible for the local and international recruitment of students, alumni relationship management, managing scholarships, fundraising, and aspects of public relations relating to the University's image and identity.

The OMC Director reports to the Vice Principal. At the time of the audit, there were 49 members of staff across the five OMC units (see Figure 8.5 below). Each unit retained its existing head of department, each of which now reported to the OMC Director.

Figure 8.5. The Office of Marketing & Communication



8.2.1. IA brief and Methodological overview

Similar to the first usability trial, the auditor began with an initial meeting with the sponsor to walk through the Buchanan & Gibb (1998) methodology and to establish scope (utilising the IA scope matrix).

Given that OMC had only recently been established at the time of IA, it is perhaps not surprising that the OMC Director was primarily focused on issues of integration, most notably to create synergy across individual units and to improve organisational communication and information flow. In the initial meeting with the Director a top-down process oriented approach was agreed as most appropriate, including mapping of information flow for core processes. The Director felt this should take priority over detailed information resource inventory and analysis, and did not feel the need for the account stage. The summary for the adopted IA methodology is illustrated in Figure 8.6 below.

Figure 8.6. OMC IA Methodology[4]

1	2	3	4	5
Promote	**Identify**	**Analyse**	**Account**	**Synthesise**

The Director acknowledged the importance of the *promote* stage adding that he wished to involve staff as much as possible in the IA. The primary means of investigation established by the auditor was in-depth interviews, supplemented with a follow-up questionnaire, and including analysis of key OMC documents (Alumni Affairs Annual Report, PRISM, GOALS newsletter etc.).

[4] Shading denotes stages of the methodology applied as per the brief.

In terms of observation the auditor conducted the walkthrough and scope setting without problem; however the author believed OMC would have benefited from both a strategic and process orientation (the IA included some desktop strategic analysis, but had a stronger process orientation). Strategic analysis and/or review would have facilitated a shared strategic vision across all OMC units, and provided a detailed framework for follow on process and information flow modelling and analysis. This failure to scope the IA properly could be put down to the inexperience of the auditor, who allowed herself to be initially led by the OMC Director, who believed strategy could be taken "as a given".

Given the OMC Director's stated goal of involving staff as much as possible, and taking into account the department's recently merged status, the author also believed that this particular IA would have benefited from a series of workshops, similar to the approach taken with case study one (see 5.1.3, page 204); however, the auditor later commented that they were not comfortable with organising and facilitating workshop sessions due to lack of experience, preferring interviews instead. This was a valid consideration.

Promote

Follow on meetings (three) from the initial briefing session between the auditor and the OMC Director acted as the preliminary survey *step of this stage and also incorporated some of the initial steps of the identify stage* (discussed later).

As part of this stage the Director wrote and circulated a *passport letter*, which introduced the auditor, explained the purpose of the IA, and encouraged participation. Interviewees were invited to participate by the Director, with guidance from the auditor who stressed the importance of adequate representation. The head of each unit was to be interviewed, followed by individual interviews with two members of staff from each unit (16 interviews in total).

In terms of observation, this stage proceeded without incident; however, a preliminary survey based solely on discussions with the OMC Director was not ideal. Ideally, brief initial meetings should also have been held with a cross-section of the interview participants. In post audit interview the auditor commented that they had not considered this at the time, but with hindsight now realised that wider preliminary consultation would have been of some benefit to gain a wider understanding and orientation.

With regard to tools utilised, the passport letter was utilised (the only tool recommended by Buchanan & Gibb [1998] for this stage).

Identify

The first four steps of this stage (identify the organisation's mission, environment, structure, and organisational culture) were completed by the auditor as part of of the initial meetings with the OMC Director, which began as part of the previous *promote* stage (the primary purpose was to provide background as strategic analysis was not within scope of this audit).

The OMC mission was described as:

> To bring an integrated and professional approach to marketing and communications, so that strategies are coordinated across the University and messages are consistent and mutually reinforcing.

OMC strategic objectives were defined as:

1. The promotion of the brand identity of the University
2. The effective recruitment of students

3. The retention of the relationships among the Alumni and external customers of the University.

The output of these steps provided valuable context for the interviews, which constituted the main research tool for this stage. The interview questions, which primarily focused on role, process, and information flow (reflecting the OMC IA brief), were as follows (Roussakis, 2005):

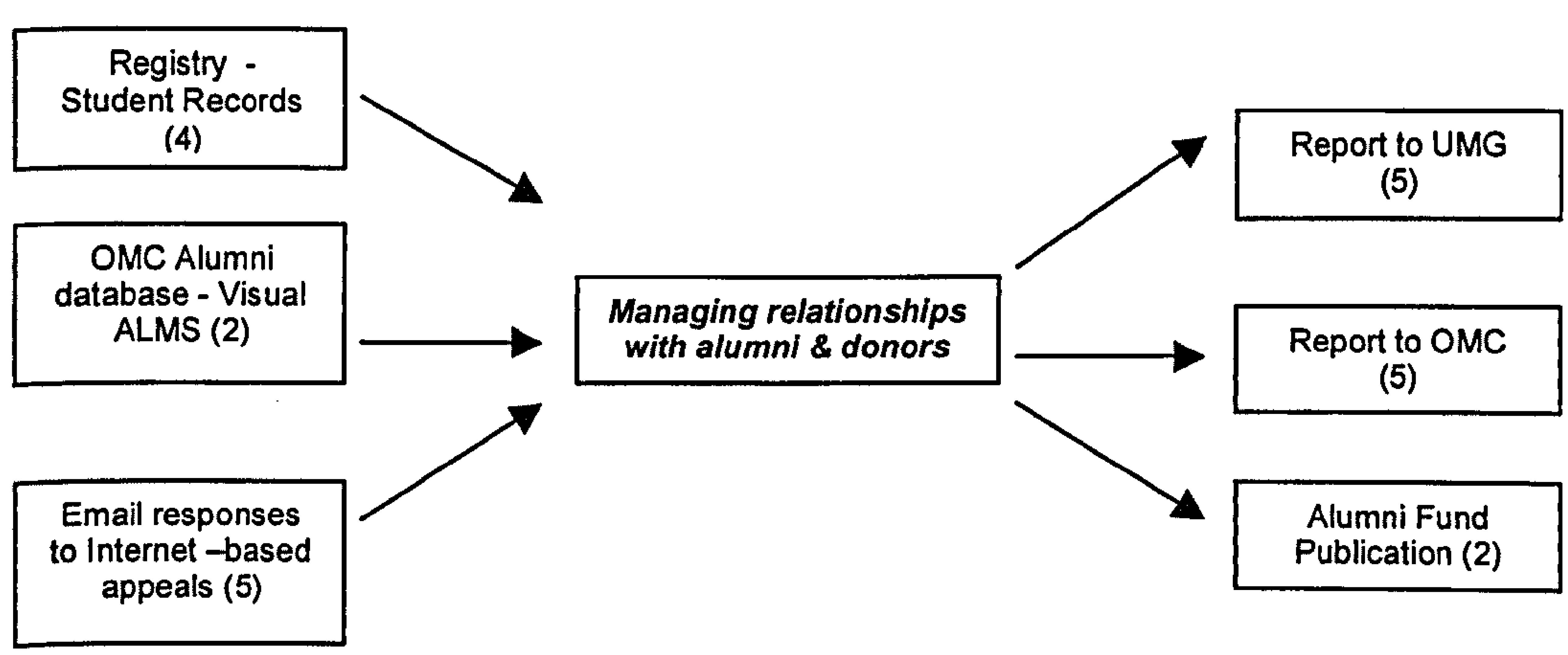
1. What do you do in your office?
2. What are the main processes of your department?
3. Can you identify their inputs and outputs?
4. Who are your customers; and how do you interact with them?
5. Is there any interaction with the other departments?
6. What applications do you use?
7. What information do you use in your role?
8. Is there any information you require that is not directly available to you?
9. Are you satisfied with the amount of information provided to you?
10. How could information flow be improved?

The auditor identified 8 OMC processes during the interviews, which were classified according to Ould (1995). The auditor elected to describe rather than model processes, with process data structured according to process input, output, and associated issues. Key information resources were also identified and then mapped to their associated process (as simple information flow diagrams).

Once in draft form findings were circulated to interview participants for feedback. This verification step also asked participants to assign values (according to Buchanan & Gibb, 1998) to the identified information resources. The auditor then updated the information flow diagrams to incorporate the mean values for the respective information resources. An example completed information flow diagram can be seen in Figure 8.7 (see below).

In terms of observation during this stage, the auditor appeared comfortable with the interview process and identifying information flow, information resources, and associated issues; but appeared to consider process identification and modelling more difficult, seeking guidance and direction before embarking on this step. The auditor ultimately elected to describe rather than model processes (which fortunately was sufficient for this particular IA given the focus was on communication and information flow between processes rather than the processes themselves). In later discussion the auditor commented that she was worried about the potential complexity of the task as it initially seemed vast in scope (something that STRIM [Ould, 1995] addresses through structured top-down decomposition of processes).

Figure 8.7. Example: Identify OMC Information Flow (Roussakis, 2005)



With regard to the key tools and techniques utilised for this stage, those associated with steps 1-4 were not utilised as these steps were not within scope. Information flow was successfully modelled similar to Orna (1999) as recommended by Buchanan & Gibb (1998). The auditor captured information resources in a MS Excel spreadsheet rather than creating a purpose built database application. No disadvantage was experienced with this approach, while the main advantage was the significant reduction in application development time.

Analyse

Qualitative data analysis was once more (similar to trial one [see Section 8.1.1, page 285) conducted according to Miles & Huberman's (1994) three-stage approach of data reduction, data display, and conclusion drawing and verification. Data was captured and structured by identified OMC processes, which were then presented as information flow diagrams, supported by textual process descriptions. Recommendations were reached through analysis of the implications of findings, which were discussed and verified through discussion with the OMC Director (which was a substitution for the submission of a preliminary report).

In terms of observation the auditor appeared to proceed without incident or problem during this stage. With regards to adoption of recommended tools and techniques, once more the auditor adopted a streamlined approach (similar to trial one) to this stage focused on qualitative analysis of emergent issues. Neither McFarlan & McKenney (1984) nor Checkland & Schole (1990) were used, but this was valid as, firstly, strategic analysis was not within scope and secondly, the adopted information flow modelling and subsequent analysis substituted for soft systems methodology in this instance.

Account

This stage was not conducted according to the OMC brief.

Synthesise

The IA report was structured as follows: executive summary, scope and objectives of the IA, background information, findings, recommendations, and further actions. The key outputs of the OMC IA were:

- OMC process model and process descriptions.
- Process-based information flow models, including issue analysis.
- Identification and valuation of key information resources.
- Recommendations.

The OMC IA recommendations were (Roussakis, 2005):

- Clearer information promoting the services of OMC should be made available University-wide. In particular, the OMC website should provide more complete descriptions of services.
- A standard reporting format is required to be used across all five OMC units. Alumni Affairs and Communication should report quarterly so as to better monitor and communicate progress; the remaining units can continue reporting annually as they follow the academic year.
- Consideration should be given to establishing an internal weekly briefing channel for HODs to keep staff aware of events and/or developments.
- Academic faculties must provide lists of courses offered a minimum of six months prior to start of term for the Communications unit to update publications. The OMC should relay and reinforce this requirement.
- The Access Policy Unit must work closer with Careers Services to track progress of students post-graduation.
- Alumni Affairs & Development and the International & Graduate Office should be required to share information on overseas student profiles.

The report was circulated to all members of staff via the OMC Director. No information strategy was produced as per the brief.

With regard to observation, this stage proceeded without incident or notable observation.

8.2.2. Post audit interview

The auditor, when selecting an appropriate IA methodology to adopt, felt that the main strength of Buchanan & Gibb (1998) over both Orna (1999) and Henzcel (2001), was the clear objectives for each stage supported by guidelines for selecting appropriate tools and techniques. The auditor was also complementary of the structured step-by-step approach, but also commented that both Henzcel and Orna were very similar in approach, so this was considered of secondary importance.

The auditor found both the process identification and information flow modelling steps extremely valuable to the IA process, commenting (Roussakis, 2005):

> The process model proposed for the investigation of the information resources proved to be significant in the application of the IA to the OMC department... The information flow diagrams identified immediately the information resources and the respective issues.

An important point of feedback from the auditor related to the lack of an account stage. The auditor felt that without the account stage, evaluations of information resources were heavily reliant on valuations made during verification of process descriptions and information flow models, and that these were then limited to subjective valuation, which has obvious shortcoming. The difficulty with attempting to identify objectively the value of information resources was compounded by the limited strategic analysis conducted, which made it difficult to map information resources back to strategic goals and objectives and to then assign corresponding strategic value. This feedback highlights a limitation to adopting a predominately *process* oriented approach where strategic input is limited and, as a consequence, there is limited information to guide later analysis and evaluation (it is also reasonable to assume that a similar problem would be encountered with a predominately *resource* oriented approach).

A shortcoming of the IA methodology highlighted by the auditor was the limited information on tools and techniques for each stage due to there being no support/information available beyond the original journal publication. The auditor felt that she experienced a steep uphill learning curve, particularly researching, adapting, and applying the various recommended tools and techniques required for each stage/step of the IA methodology. The auditor commented (Roussakis, 2005):

> The significance of the (Buchanan & Gibb, 1998) methodology is the initiation of tools and techniques to be followed during the stages of the IA process. The auditor feels the need to remark that it would have been more useful during the whole process if there were information concerning the use of the tools and benefit of using them, in the IA process... It is strongly believed that... for the benefit of the IA process (there is) publication of further research, including analytic descriptions of tools and techniques. If this occurs, then the author believes that the methodology can provide a standard approach to information auditing.

However, in terms of overall use of the Buchanan & Gibb (1998) IA methodology, the auditor's concluding comments were positive (Roussakis, 2005):

> To conclude, the integrated strategic approach was the ideal methodology to support the requirements of OMC. The initialisation of the process model gives directions to the auditor on what to look for inside the organisation. Moreover, the introduction of the tools and

techniques provide the auditor with an understanding on how to use the information acquired.

8.3. Usability Trial Three: MacFarlanes Legal Firm

Macfarlanes is a UK legal firm, based in the City of London. The firm's main areas of legal practice are broadly defined under the four main headings of : corporate; property; litigation and dispute resolution; and private client.

With regard to their overarching values, MLF believe they distinguish themselves from their competitors by an emphasis on client service, and a reputation for quality, which rivals that of the largest firms in the City. They believe they are widely recognised as one of a handful of high quality, independent law firms in the UK.

At the time of the audit, there were 260 lawyers, 62 of which were partners, and 50 of which were trainees. There was a total staff of 475 distributed across the respective legal and administrative divisions.

8.3.1. IA brief and Methodological overview

MLF has an extensive library service consisting of one main library unit and four satellite units, providing specialist services/support for each of the respective legal departments (see Figure 8.9, page 303). There are five full time members of staff to manage the library service. The IA was proposed by the library service as a method to conduct a general review of services and information flow. This was initiated for best practice and improvement purposes rather than as a response to any perceived service issues or feedback from the legal departments. The IA sponsor was the MLF legal partner responsible for professional support.

In initial briefing sessions with the sponsor, the auditor walked through the Buchanan & Gibb (1998) methodology explaining the purpose of each stage and the respective steps involved, and used the IA scope matrix to set scope. The sponsor confirmed that he wished the IA to focus on the library service, and to identify and evaluate associated information resources. The sponsor felt there was no need for strategic analysis as part of the IA *identify* stage, or for costing of information resources and/or associated services, which consequently removed the need for the *account* stage. The final output would be the information report for the library service. There was no MLF requirement for an information strategy (output two of the *synthesise* stage of the IA). One further requirement was for the IA to be completed in six weeks for the report to be available for the next meeting of the Board.

The summary for the adopted IA methodology is illustrated in Figure 8.9 below.

Figure 8.9. MLF IA Methodology[5]

1	2	3	4	5
Promote	**Identify**	**Analyse**	**Account**	**Synthesise**

The MLF IA does not neatly fit into any of the proposed IA orientations of strategic, process, or resource. There are elements of a *process* orientation due to the focus on library services, and elements of *resource* orientation naturally associated with this; but the IA, according to the MLF brief, is strongly focused on use and value of existing information services from a customer perspective, which significantly streamlines and focuses the investigation. It is therefore valid to consider this approach as being a hybrid of both process and resource orientations.

With regard to observations for this stage, the auditor proceeded through the walkthrough and scope setting without incident. Although scope was perhaps a little narrow it would be unfair to blame this on the auditor as this was largely dictated by the participating organisation.

5 Shading denotes stages of the methodology applied as per the brief.

Promote

The initial briefing sessions between auditor and sponsor were also utilised to finalise IA scope and participation. The sponsor confirmed that the entire organisation was in scope with participation desired from across all groups of library service user. The sponsor indicated a preference for individual interviews over workshops, as this was considered easier to manage from a MLF resource and cost management perspective. To ensure a representative sample, thirty-three representatives were selected from across MLF to participate in semi-structured interviews. By role these were partners, assistants, trainees, and paralegal secretaries. It was also agreed that an online (MLF intranet) structured questionnaire would be developed for wider (all 260 legal staff) participation and feedback.

Prior to engagement, the sponsor circulated an email to all staff as the *passport letter*, which introduced the auditor and explained the purpose of the IA.

A preliminary survey was also carried out during this stage by the auditor through the initial meetings with the sponsor, and informal discussions with both library staff and users (each satellite unit was visited as part of this step). This confirmed that there were no issues or concerns driving the IA with users appearing generally satisfied with levels of service.

With regard to observation, this stage proceeded without incident or notable observation. Once more steps one and two were successfully combined (and simplified) as the passport letter.

Identify

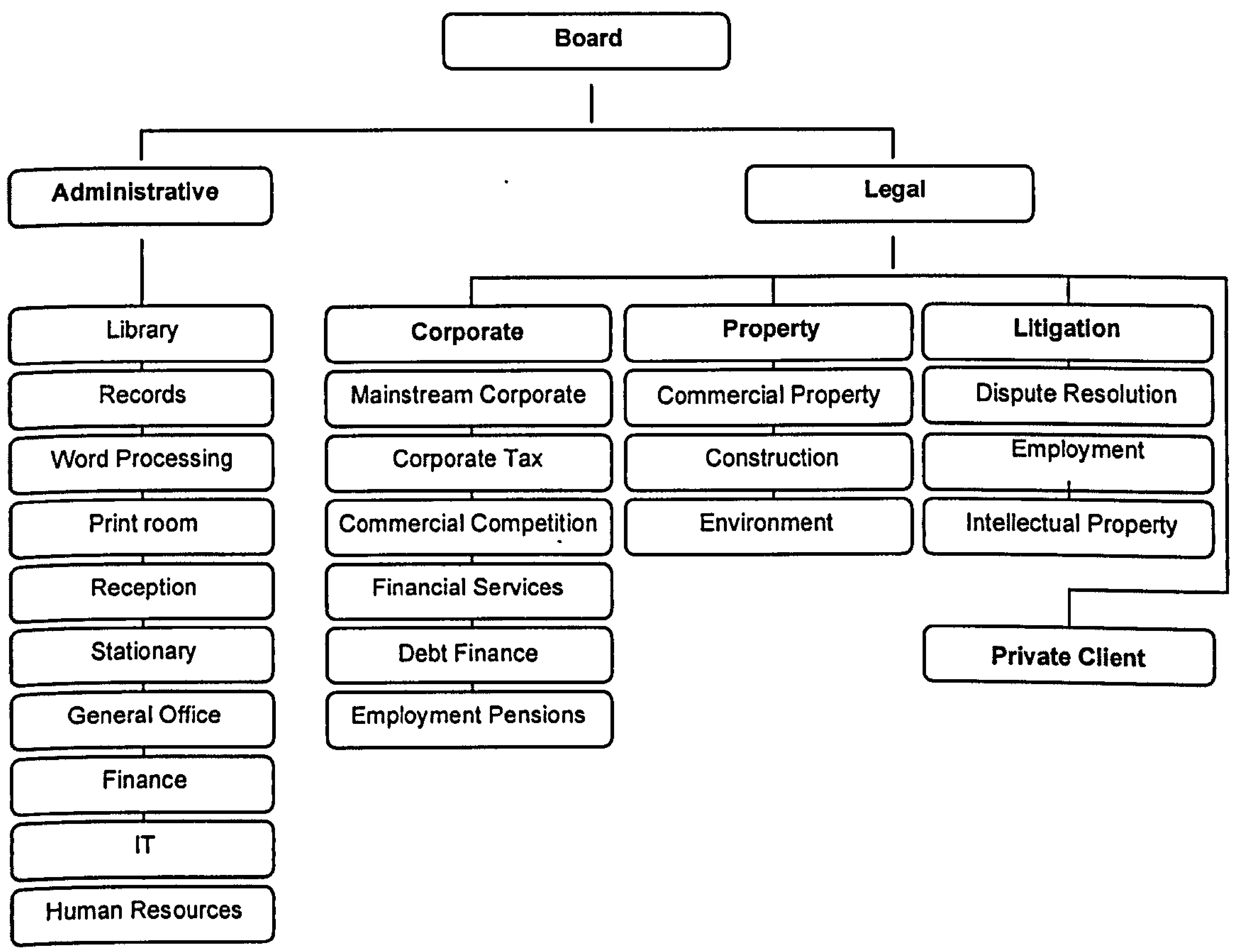
As per the MLF brief, strategic analysis was not undertaken for this particular IA, which once again streamlined steps 1-4 (similar to the previous trials) to desktop research to provide the auditor with valuable organisational understanding and background information. The MLF intranet site provided the basis for this desktop research, supplemented by key internal reports made available to the auditor via the sponsor.

MLFs' mission was defined as to provide (MacFarlanes, 2005):

- access to the best legal advice in all situations and jurisdictions by having the flexibility to choose the right law firm; and
- seamless and efficient service.

The organisational structure was identified as illustrated in Figure 8.9 below.

Figure 8.9. Identify Organisational Structure (Martin, 2005)



Library services were identified and verified by the auditor through an initial group meeting with library staff. These services were as follows:

- Current awareness bulletins
- Selective dissemination of information (SDI)
- Subscription services
- Online catalogue
- Enquiry desk
- Periodical circulation
- Main library collection
- Satellite library collection

The interview questions for the semi-structured interviews were as follows:

- What do you do?
- How long do you spend reading daily (or otherwise) current awareness bulletins, on average?
- Do you feel the time spent reading current awareness bulletins is worthwhile?
- How often do you request further information based on something outlined in a bulletin?
- Do you feel the press scanning service provides sufficient coverage?
- How often do you consult/utilise the following: PSL, Library, KH, Subscription Services?
- How often do you contribute to the firm's information resources, and how?
- For what type of enquiry are you likely to consult your PSL rather than the library, and why?
- For what type of enquiry are you likely to consult the library rather than your PSL, and why?
- How often do you use the library enquiry desk service, on average?
- For what reason are you most likely to make an enquiry to the library enquiry desk service?

- When you put a request to the library enquiry desk, in what format do you prefer to receive the resulting information?
- Do you use the online library catalogue?
- How extensive do you find the main library collection to be?
- How extensive to you find your respective satellite library collection to be?
- How efficient do you find the practice of periodical circulation?
- Are there any periodicals to which the library does not currently subscribe but that you believe should?

The online questionnaire asked the same questions, but with closed answers structured by Likert scale, with staff also asked to rank use and value for each of the identified information services. All thirty-three interviews were successfully completed. 39% of legal staff completed the online questionnaire, a total of 101 staff from the 260 invited to participate.

The interview and online questionnaire, as per the MLF brief, focused on the identified library services. This provided the auditor with a profile of service usage and associated value (in graphical and tabular format). The auditor captured information resources in a MS Excel spreadsheet rather than creating a purpose built database application. Again (similar to the previous trials), no disadvantage was experienced with this approach, while the main advantage was the significant reduction in application development time (and subsequent skill-set required).

With regard to observations for this stage, the IA was very "service" oriented and focused, with no information flow diagrams and limited identification of information resources out with those identified as library services. The auditor seemed comfortable with identifying library services, but not with "process-thinking". Although the IA was service-oriented, it would have benefited from some process oriented exploration as this would have provided further valuable analysis of functions, information requirements and flow. The identified core services would also have benefited from supporting service descriptions (similar to process descriptions).

Thirty-three interviews supported by an online questionnaire was very thorough, but perhaps too extensive (particularly given that MLF set a six week timeframe). The auditor appeared to be pressured by time as a result (although noted as more project management than IA methodology consideration).

Analyse

Qualitative data analysis was once more conducted according to Miles & Huberman's (1994) three-stage approach of data reduction, data display, and conclusion drawing and verification. Data was captured and structured by identified MLF library services. MS Excel was utilised to record and analyse findings.

After analysis, the auditor noted that the majority of the library services were considered satisfactory by users; however, five key issues were identified:

- A large number of fee-earners did not feel that the content of the daily library bulletins was specific enough to their own group
- The corporate tax department responses indicated dissatisfaction with their bulletin, which was theoretically tailored specifically for their department
- Contributions to the library catalogue from individual departments were not common practice
- By far the majority of fee-earners did not make use of the online library catalogue, and this is due, in a high number of cases, to fee-earners being unaware of its existence and capabilities, or untrained in its use.
- A disproportionately high number of litigation fee-earners were not satisfied with the main library collection.

Recommendations were reached through analysis of the implications of the above findings.

With regards to adoption of recommended tools and techniques during this stage, the auditor adopted a streamlined approach focused on qualitative analysis of emergent issues associated with the identified services and associated information resources. Neither McFarlan & McKenney (1984) nor Checkland & Schole (1990) were used (recommended tools). In the author's opinion Checkland & Schole's soft system approach could have been considered by the auditor to provide more holistic analysis of services. When queried later on this point the auditor commented that by this stage of the audit they had felt pressured by time (as previously noted, the audit was to be completed in six weeks). This confirmed author observation of this stage.

Account

This stage was not conducted according to the MLF brief.

Synthesise

The IA report was structured as follows: executive summary, scope and objectives of the IA, background information, findings, recommendations, and further actions. The key outputs of the MLF IA could be summarised as:

- List of core library services
- Service analysis and evaluation
- Recommendations

Recommendations are summarised as follows:

1. Further tailor bulletins to user requirements.
2. Review delivery format of bulletins.

3. Include periodical supplements within SDI.
4. Clarify and communicate respective roles of PSL's and the Library.
5. Encourages contributions to the library from legal departments
6. Provide dedicated collection point for trainees.
7. Publicise/promote the online catalogue. Provide staff training.
8. Publicise/promote the library enquiry desk. Add contact details to MDS and intranet.
9. Provide regular reminder to legal staff to circulate journals.

The report was circulated to interview participants via the BC Sponsor and made more widely available via the BC intranet site. Findings were well received, with MLF planning to follow up with a second IA looking more broadly at information flow and systems.

With regard to observations, this stage proceeded without incident, however recommendations were of a general nature and there was limited supporting material. Once more the auditor commented that she had felt pressured throughout by the six week timeline and that as a result, she had prioritised the identification and evaluation of services and associated information resources. Again this is a notable finding, but perhaps more in relation to planning than IA methodology (although highlighting the need for guidance in support of the IA).

8.3.2. Post audit interview

Buchanan & Gibb (1998) was selected as the chosen IA methodology based on the extensive toolkit of proven tools and techniques provided. The auditor commented (Martin, 2005):

> The provision of a "toolkit" sets this methodology apart from the others. In spite of the project planning responsibilities left to the auditor, Buchanan & Gibb (1998) make suggestions as to how to carry out each

stage of the IA. The auditor is directed towards published methodologies for each stage, such as Porter's model of competitive forces and Glazer's model of information asset management. Whilst these are merely suggestions, and, as stated above, are not step by step guides to how the audit must be done, they do at least provide a starting point for the auditor to gain sufficient knowledge of the concepts involved. Whether or not the auditor chooses to use the recommended techniques, he can be confident that each one suggested has been developed and published in its own right, and not a subsection of a larger methodology. This in itself permits a deeper understanding of each phase, its possibilities and its boundaries. This aspect of the Buchanan & Gibb (1998) methodology exactly suits one requirement of this project, in that the auditor requires as much explanation as possible for each stage and its elements.

However, the auditor also highlighted a time consuming learning curve associated with researching, adapting, and applying the recommended business tools and techniques required for each stage/step of the IA methodology. The auditor commented (Martin, 2005):

> Were Buchanan & Gibb able to outline each of these external models within the text of their own methodology, and how best to tailor it for the information audit rather than for the more specific situations for which they were designed, this would result in a more self-contained methodology. This would, in turn, make the extra reading an option rather than a requirement, and permit the more time-constrained auditor the option of a more comprehensive audit.

The auditor concluded (Martin, 2005):

> The main problem encountered with the Buchanan & Gibb methodology in this case was the amount of external reading required to perform the

steps suggested by the authors. Were Buchanan & Gibb to incorporate adapted versions of the models that other authors have created into their methodology, the auditor would, in the event of a time constrained project, have all the information they require in one text. The auditor would not, therefore, have to adapt models himself which were not originally created with the information audit in mind.

8.4. Summary

The three usability trials were all successfully completed with Buchanan & Gibb (1998) the chosen methodology in all three instances, with the methodology selected, according to auditor feedback, based upon the logical structuring of stages, and the provision of the toolkit. Key findings associated with the actual trials are summarised below.

With regard to scope setting, the IA scope matrix was found to be useful to establish scope/orientation in all three audits and to facilitate structured discussion (in combination with a walkthrough of the methodology). However, although the matrix was found to be useful, only one of the audits was properly scoped in the opinion of the author (trial one), with the other two being too narrowly scoped (trial two would have benefited from being both process/strategy oriented rather than just process, and trial three, although supposed to be both process and resource, was in fact more narrowly focused on services and associated information resources). All three audits also suffered from over ambitious scheduling either in their entirety or across individual stages within. While these issues could be considered part of a natural learning curve well recognised within project planning disciplines they nonetheless indicate that detailed guidance regarding audit planning would be of benefit to support the IA methodology.

With regard to overall methodological approach, all three audits followed a similar streamlined approach:

- Promote: steps 1-2 combined, 3 occurring as normal
- Identify: steps 1-4 conducted as desktop research (appropriate to briefs which did not include strategic analysis), process models and/or descriptions combined with information flow models (apart from trial three), and information resources catalogued in tabular or spreadsheet form rather than database form. In all three instances the semi-structured

interview was the main method of data capture supplemented by questionnaire.

- Analyse: combined as three stage qualitative data analysis with process and information flow models substituting for soft systems methodology.
- Account: not required
- Synthesise: step 1 occurring but not 2 (no information strategy required)

These streamlined, and simplified approaches align with previous IA case studies from the field, which adopted similar approaches (see Section 4.7.3, page 187). This suggests that in several instances Buchanan & Gibb (1998) would not need to be adopted in its methodological entirety as evidence suggests that the majority of audits tend to be focused on the identification of information resources and flow at the operational rather than strategic level (however it still remains important to frame these streamlined approaches within a comprehensive methodology which promotes a top-down organisational approach [to provide context and value], which can be achieved through desktop analysis as conducted during the trials). The streamlined approaches adopted for these trials demonstrate that the Buchanan & Gibb (1998) methodology can be tailored and streamlined to purpose as originally intended. Flexibility to remove stages not relevant to the brief was highlighted by the auditors as a key strength of the methodology.

With regard to the toolkit, a lack of instructional depth was highlighted by the auditors as a key weakness of the methodology with a call for summary overviews, templates, and examples in support of the various tools and techniques. In particular, further direction and guidance is required for conducting interviews, process modelling, and data analysis as direction is limited for these three key methods and auditors were observed to experience various difficulties with these methods. As a minimum the methodology requires inclusion and/or reference to a process modelling approach such as STRIM (Ould, 1995), as process modelling was found to be a useful and key part of the IA toolkit.

In conclusion it is noted that several of the key findings from these usability trials, perhaps not surprisingly, relate to auditor experience. As previously noted (see section 4.7.3, page 188), Buchanan & Gibb (1998) differ from both Orna (1999) and Henzcel (2001), in that they recommend that, ideally, the IA be led be a senior information professional (in consideration of the broad skill set required of the auditor). The evidence from these trials lends support to Buchanan & Gibb's recommendation, and suggests that, where this is not the case (and a highly likely scenario given the scarcity of auditors), a first time auditor would benefit from the guidance and support of an experienced auditor or senior information manager. It is also reasonable to assume, given that the auditor experienced difficulties with tools and techniques, that these problems would be heightened by the use of a methodology with a less comprehensive toolset such as Orna or Henzcel (see Section 4.7.3, pages 190-194). On a final note regarding this point, it could also be argued that these challenges are simply part of a natural learning curve for first time auditors, and that given that all three audits were successfully completed and well received by the participating organisations, this could be consider a project management rather than a methodological challenge.

In summary, the three trials have demonstrated that Buchanan & Gibb (1998) is usable, but that it would benefit from some further refinement to assist first time auditors (for a summary of these recommended revisions, see Table 10.1, page 339).

The following chapter considers these and the previous case study findings in relation to the overall objectives of this research.

Chapter Nine: Discussion

The following chapter discusses the key findings from this study, structured according to achievement of research objectives and associated research questions (see Section 1.2, pages 9-10). This builds on and summarises key findings from earlier discussion in previous chapters, most notably Section 3.6 (pages 113-115), Section 4.8 (pages 195-198), Chapter 7 (pages 265-274) and Chapter 8 (pages 275-313).

9.1. Research objective one: To identify and/or develop a generic and universally applicable IA framework.

The research questions (see Section 1.2, page 9) associated with this objective were as follows:

- What is the purpose and scope of the information audit?
- What should be the core methodological components/elements of a generic, and universally applicable information audit?

Each of the above questions are discussed in turn below.

9.1.1. What is the purpose and scope of the IA?

With regard to *purpose*, the original definition utilised for this study (see Section 1.1, page 69) was Buchanan & Gibb' (1998), which emphasised the strategic role of the IA. The author found this definition still applicable, but in consideration of the key relationships between the IA and information systems development (particularly information systems architecture) identified as part of this research (see Section 9.2.1, page 321), the author proposed a revised definition which retained strategic purpose, but also make explicit the relationship to information systems development.

This expanded definition had implications for *scope*. The author proposed that Earl's (2000) information strategy *taxonomy (see Figure* 3.8, page 78) could be used to manage and direct information audit scope, as it provided a logical (and universally acknowledged) breakdown of information strategy components (but adapted with information content replacing information resource), could be mapped directly to enterprise architecture frameworks [see Figure 3.15, page 100]), and complemented the above expanded definition of IA purpose. The author also proposed a second dimension to scope, which could be used in conjunction with Earl's taxonomy, allowing the IA to be scoped not just according to information strategy component, but also by stakeholder requirement and organisational orientation and/or priority. This additional IA dimension was defined as *perspectives*, which consisted of three sub-categories: *strategic*, *process*, and *resource*. The resulting two-dimensional IA scope matrix is illustrated in Figure 3.16 (see page 104).

9.1.2. What should be the core methodological components/elements of a generic, and universally applicable IA?

One of the first problems faced when considering a universal approach was that there is no standard, agreed methodological approach, but instead a variety of academic and proprietary methods, some comprehensive, some no more than unpopulated frameworks (Buchanan & Gibb, 1998). This made it extremely difficult to determine what the generic steps of an IA should be, and to then be able to review the completeness of existing methods (with a view to being able to select a suitable approach for universal adoption).

Through a comparison of the respective stages/steps of four commonly cited IA methodologies (Burk & Horton, Orna, Buchanan & Gibb, and Henzcel), seven IA stages/steps were identified by the author, which formed a methodological *baseline* (see Section 4.7.1, pages 168-175).

The common IA stages/steps were identified as:

- Setup: project planning, preparation of business case, endorsement, organisational communication etc.
- Review: strategic analysis (internal and external), organisational (cultural) analysis etc.

- Survey: survey of information users, identification and inventory of information resources, mapping of information flow etc.
- Account: cost of information resources
- Analyse: analysis of findings
- Report: production and dissemination of IA findings and recommendations
- Guide: organisational information management policy development

The four IA methodologies were then mapped to this baseline. Comparative analysis illustrated the relative comprehensiveness of each of the respective IA methods. Burk & Horton's (1988) approach was shown to be focused on core IA tasks, lacking stages for initial setup, strategic and organisational review, and post-audit policy and/or strategy development. Buchanan & Gibb (1998) was shown to lack an initial setup stage. Orna (1999) and Henzcel (2001) were shown to be very similar, with only minor variation between.

Each IA method was also critiqued according to *applicability* and *usability*[1].

With regard to applicability, which considered each IA method's ability to adopt the proposed *strategic*, *process*, and *resource* perspectives, Buchanan & Gibb (1998), Orna (1990), and Henzcel (2001) were shown to have both *strategic* and *resource* orientation, with Buchanan & Gibb providing the most in-depth *strategic* capability. Burk & Horton was shown to have the narrowest orientation of the four methods, focused solely on *resource*.

It was also demonstrated by this comparison that all four methods have limited *process* orientation. As previously noted (see Section 4.8, page 195-196), Orna and Henzcel do promote an information flow based approach, which is similar to

---

[1] Conducted here as a *static test* (as part of the literature review) prior to *dynamic tests* conducted as case studies and usability trials.

a process orientation, but processes are not discussed in any depth, while organisational structures are. Buchanan & Gibb identify process modelling as an alternative approach, but the methodology would appear to be oriented to organisational structure. Burk & Horton are based solely on organisational structure.

With regard to *usability* (see Section 4.8, page 196), Buchanan & Gibb (1998) was identified as providing the most comprehensive IA toolset, but the method was also identified as potentially requiring the broadest range of skills. Both Orna (1990) and Henzcel (2001) were shown to lack practical tools and techniques for several steps, but adopt a simpler approach, requiring a narrower skillset. Burk & Horton (1988) provide useful templates and have the narrowest skillset of all four, but the limited scope and applicability of the method largely negated these benefits.

In terms of achievement of research objective one, Buchanan & Gibb (1998) was found to be a suitable methodological basis for *a generic and universally applicable information audit framework.* Although the author had some concerns regarding the complexity of the approach (see Section 4.8, page 197) the method closely matched the developed IA methodological baseline, was found to provide the most complete methodology of the four reviewed with application equal to its peers, and most significantly, the most comprehensive toolset.

The above conclusion would appear to be supported by both Botha & Boon (2003) and Alexopoulos & Theodoulidis (2003) who have both recently commented on Buchanan & Gibb's (1998) potential suitability for universal application. It is therefore the author's opinion that objective one has been achieved, with the basis[2] for a generic and universally applicable IA framework successfully identified.

2 Acknowledging the proposed methodological refinements and additions to the methodology arising from the field tests (for these recommendations see Section 10.2.1, pages 338-342).

9.2. Research objective two: To identify and explicitly map key relationships to information system development processes, in order to identify and demonstrate the potential extended value of the information audit.

The research question (see Section 1.2, page 9) associated with this objective was: what is the relationship of the information audit to evolving information systems development processes, including information system architecture? This is discussed as follows.

9.2.1. What is the relationship of the information audit to evolving information systems development processes, including information system architecture?

A historical problem with IA application was the ambiguous linkage to related ICT development processes, which made it difficult to incorporate the IA into established operational practice and to demonstrate business benefit (see Section 1.1, page 5). While the link between the information audit and information strategy has been formally acknowledged and incorporated into previous IA methodologies (most notably Orna, 1990 and Buchanan & Gibb, 1998), the link from audit to information systems development and information system architecture had not.

The TOGAF Architectural Development method was shown to map to and extend Earl's (2000) taxonomy (see Figure 3.15, page 100), bridging the gap between information strategy and information system architecture by providing a development framework. The Zachman (1992) Information System Architecture framework was shown to provide a framework for the required architectural representations. To extend the value and benefit derived from the IA, the author proposed that alignment and reuse should be sought wherever possible between the outputs of the IA and the inputs to information systems architectural development. In an ideal scenario, the information system architecture would be driven and guided by information strategy, with both facilitated by the output of the information audit. At the high level, this would be accomplished by formal IA adoption of Earl's (2000) taxonomy (via the proposed IA scope matrix), allowing the IA to naturally integrate. At the more detailed level, synchronicity between inputs/outputs is required. It is proposed that the output of an information audit would map (approximately) to the top two rows of the Zachman Framework: Scope and Business Model; and contribute to the application architecture component of the system model (see Table 3.3, page 101).

Absolute matching of input/output could be sought through detailed specification of IA tasks and standardised output across the respective frameworks/methodologies, but it is proposed that general mapping would suffice in most IA instances, with the benefit of not overly extending or complicating the IA and/or architectural process (several of these inputs can be immediately identified from the outputs of the case studies, for example, process descriptions and models, data models, and business goals). However, as an area of further research, explicitly mapping respective inputs and outputs to each other would be a valuable further exercise, and is noted as such (see Section 10.2.1, page 342).

With regard to achievement of objective two, this research has identified and mapped a direct relationship from information audit to information system architecture made explicit through aligned terminology (see Figure 3.15, page 100) and high level mapping of respective input and output (see Table 3.3, page 101). It is therefore the author's opinion that objective two has been achieved, with a direct relationship from IA to information systems development defined and mapped.

9.3. Research objective three: To test the usability of the information audit framework.

This section discusses the findings of the empirical component of this research: firstly, methodological testing through two case studies; and secondly, three usability trials. The research questions (see Section 1.2, page 9) associated with this objective were as follows:

- How should the IA be tailored to individual organisational circumstances and goals?
- How should IA scope be managed?
- How usable is the information audit framework?

Each of these questions are discussed in turn below.

9.3.1. How should the IA be tailored to individual organisational circumstances and goals?

A highlighted problem with IA methodologies was managing their complexity and adapting them to individual organisational requirements (see Section 1.1, page 4). Burk & Horton (1988), Orna (1990), Buchanan & Gibb (1998) and Henzcel (2000) all briefly discuss tailoring, but there is limited guidance. For example, Buchanan & Gibb (1998) only provide the following comment in their methodology:

> ... the methodology is intended to be wide-ranging and of general applicability but it is recognised that organisations may need to make compromises, may wish to use a sub-set of steps, or may need to enhance or tailor it to their specific requirements.

Consequently, this research also looked at how to tailor the IA methodology.

For each of the case studies and usability trials, the method of tailoring the Buchanan & Gibb (1998) IA methodology for each participating organisation was to match organisational requirements to IA stages, and to select appropriate tools and techniques through consideration of issues to be explored, information entities to be identified and modelled, and organisational preferences and/or constraints. In each case, this tailoring step was completed via a structured walkthrough of the IA methodology between sponsor and auditor (with the auditor explaining the purpose of each stage and the respective steps involved facilitated by the existing descriptions of purpose for each stage).

Tailoring of the Buchanan & Gibb (1998) methodology proved to be a straightforward task with neither the author nor the auditors conducting the usability trials noting any problems. The methodology was found to be extremely flexible in this respect, allowing the author/auditors to tailor it to individual requirements, as illustrated in Figure 9.1 (see page 321).

Case study one (see Section 5.1.3, page 204) streamlined the *promote* stage, completed the next two stages in their entirety, omitted the *account* stage, and produced an IA report but no information strategy; case study two (see Section 6.1.3, pages 235-236) also streamlined the first stage, completed the next two stages in their entirety, and omitted the *account* stage, but produced an IA report and information strategy; the three usability trials (see Section 8.1.1 [pages 276-278], Section 8.2.1 [pages 290-291], and Section 8.3.1 [pages 300-301 respectively) all followed a similar approach where *promote* was streamlined, *identify* was streamlined as no strategic analysis was required by any of the participating organisations, *analyse* was completed in full, *account* omitted, and a IA report produced but no information strategy produced. The dominant tools/techniques for data gathering in all cases were interviews and questionnaires, which aligns with the findings from previous published case studies (see Section 4.7.3, page 187).

Figure 9.1. Tailoring the IA Methodology[3]

	1 Promote	2 Identify	3 Analyse	4 Account	5 Synthesise
Case Study 1					
Case Study 2					
Usability Trial 1					
Usability Trial 2					
Usability Trial 3					

A notable observation was that none of the participating organisations felt the need for the *account* stage. While it would have been good to have trialled the methodology in its entirety at least once, it would have been poor practice to have influenced and/or manipulated the requirements of the participating organisations. There were two key reasons for the removal of this stage in each of the studies/trials: firstly, the participating organisations considered cost to be managed through their existing accounting practice and did not see a need for further information or procedures; secondly, each of the audits conducted for this research were subject to tight timelines (avg. eight weeks), and the *account* stage is potentially one of the most time-consuming (and specialist), which, given the lack of value attached to this stage, also contributed to it being removed. The lack of importance attached to the *account* stage by participating organisations is a notable finding, warranting further, more extensive research. Of the existing IA case studies identified and reviewed as part of this research

[3] Shading denotes stages completed for each case study and usability trials as per their respective briefs

(see Section 4.7.3, pages 181-188) only one included cost steps (Dubois [1995] conducted cost benefit analysis of identified information resources); consequently, there would appear to be a need for more empirical research in this area (see Section 10.2.2, page 343). While this research has not been extensive enough to be conclusive, the evidence gathered thus far does suggest that the *account* stage may not be required in the future.

Another notable observation was that only one of the five audits produced an information strategy (case study two). However, this was not due to any lack of appreciation of the benefits of an information strategy by the participating organisations, but simply due to the fact that the four audits which did not produce an information strategy were conducted at a department rather than organisational level. Given that an information strategy is an organisation wide initiative (Earl, 2000; Orna 2004) it would have been counter productive to develop one at a departmental level. What is notable however is that for the organisations which participated, none had an existing information strategy in place. Again, this is an interesting topic for further research (see Section 10.2.2, page 344). Of the other existing IA case studies identified and reviewed as part of the literature review for this research (see Section 4.7.3, pages 181-188) none produced an information strategy, although two did produce an information policy (Booth & Haines, 1993; Soy & Bustelo, 1999) which does share a close relationship with information strategy (see Section 3.3.1, page 75).

9.3.2. How should IA scope be managed?

The developed IA scope matrix (see Figure 3.16, page 104) was found to be extremely useful for establishing and managing IA scope. The case studies and follow-on usability trials demonstrated that *perspectives*, when combined with Earl's (2000) adapted taxonomy elements (IT, IM, IS, IC), allowed each IA to be tailored to individual organisational requirements and provided with a particular focus and priority, which helped with the management of scope, the management of which had been noted as a historical problem (see Section 1.1.1, page 4). The additional scope dimension provided by the three IA perspectives was found to be extremely useful when tailoring the methodology as it helped the auditor to understand and focus the scope of the audit (e.g. strategic, process, or resource oriented); and secondly, to identify appropriate tools and techniques to select for each of the stages (e.g. strategic analysis tools and/or process modelling tools).

Case study one (see Figure 5.1, page 203) adopted a predominantly strategic perspective with a degree of process. Case study two (see Figure 6.1, page 235) adopted a process perspective with a degree of resource. Usability trial one (see Section 8.1.1, page 278) adopted a process perspective; while trials two and three (see Section 8.2.1, pages 290-291 and Section 8.3.1, page 301 respectively) were both predominantly process with a resource element. None adopted a predominantly resource perspective (although resource featured in three of the five cases), but the author believes that this was simply due to the requirements and focus of the participating organisations rather than challenging the validity of resource as the third perspective.

The case studies demonstrated that it is unlikely that one orientation would ever be adopted in isolation (as there is some dependency: for example, conducting a resource view without strategic or process input would lack organisational context or direction), but highly likely that two would be used in combination, but with one receiving particular attention over another (as demonstrated by four of the five audits conducted for this study).

9.3.3. How usable is the information audit framework?

This question was explored in two stages[4]: firstly, methodological testing through two case studies; and secondly, three usability trials.

Stage one methodological testing

In stage one, the Buchanan & Gibb (1998) IA methodology proved to be both complete and usable. For both case studies, feedback from the participating organisations was extremely positive, with participants expressing confidence in the methodological process undertaken to conduct the IA, considering it to be both understandable and comprehensive (see Section 5.3, page 231 and Section 6.3, pages 261-262 respectively.). The only negative point received was for the first study, where participants felt that the modelling of the prioritised process was too complex.

The author's own observations/experience as auditor supported the positive feedback received from participants, and further added to the criticism of the approach to process modelling: the process model was not only overly complex and detailed for the purposes of the IA, but was modelled at the expense of other processes. Consequently, case study two focused less on detailed step-by-step process modelling, and a little more on gathering a more comprehensive organisational picture of all core processes. The shift from in-depth process modelling to capturing process descriptions for all organisational processes worked well and would be recommended in future audits. The only exception would be where participating organisations include requirements in their brief which call for process modelling; for example, resolving specific process-related

[4] Although as previously noted (see Section 9.1.2, page 318) a degree of static testing occurred as part of the prior document-based review of IA methods.

problems, automating manual processes etc. Other notable findings from the stage one case studies were:

- The top-down methodological approach provided valuable context for organisational analysis and investigation. The process view proved particularly valuable, encouraging user involvement by focusing on readily understandable aspects of day-to-day work, and providing an organisational roadmap of information flow and associated issues and requirements. It was not always necessary to model processes as process descriptions sufficed in some instances, but this was dependent upon organisational requirements, so in future instances could be considered on a case-by-case basis.
- The promote stage facilitated high user involvement, which was facilitated further by adopting two complementary methods of data capture for the identify stage; for example, workshops with selected representatives followed by interviews and/or questionnaires with a wider group of staff.
- Earl's (2000) taxonomy was effectively used as a structure for both the information audit report and the information strategy.

No major concerns or methodological failings were identified during the methodological testing; however, there were a number of key considerations for the follow-on usability trials:

- A notable toolset gap was the lack of a process modelling method and supporting tool/templates. Ould's (1995) STRIM methodology was consequently recommended as a suitable tool for process modelling (should process be within scope). Process descriptions were also identified as a valid alternative to modelling dependent upon circumstances and constraints.
- Process and information flow modelling and analysis can substitute for soft systems methodology as this provides a valid alternative "rich" picture of the organisation.

- A database may not always be required for the resource inventory.
- A further notable toolset limitation is the lack of instruction regarding qualitative data analysis. Miles & Huberman's (1994) three-stage process of data reduction, data display, and conclusion drawing and verification is a recommended addition to the IA toolset (for the analysis stage).
- The account stage remained unproven, and is a potentially complex stage.

Stage two usability trials

The second stage usability trails were all successfully completed. In all three instances, initial selection of the Buchanan & Gibb (1998) methodology by the auditors was based on perceived flexibility of approach and incorporation of comprehensive tools and techniques to support each of the IA stages. In practice, all three auditors found the methodology to be both usable and flexible. However, all three auditors were also unanimous regarding their main point of feedback, that the Buchanan & Gibb methodology would benefit from further instructional depth, particularly with regard to the tools and techniques (largely due to the methodology appearing within a journal article and not a more extensive handbook). The auditors highlighted a particular need for further guidance regarding: strategic analysis; interview preparation; process modelling; and qualitative data analysis.

The author's own observations of the usability trials were categorised according to two criteria: those relating to the overall approach taken by the auditor (e.g. application of the IA methodology), and those relating to the resulting user experience.

With regard to the overall approach (in relation to the client brief), the approaches taken for usability trial one (see Section 8.1.1, pages 276-278) and three (see Section 8.3.1, pages 300-301) were appropriate, but the approach for trial two (see Section 8.2.1, pages 290-291) could have been improved upon in the author's opinion. While some preliminary strategic analysis was undertaken for usability trial two, the author believes that this audit would have benefited from both a strategic and process orientation (the audit included some desktop strategic analysis, but had a strong process orientation). This failure to properly scope the IA was primarily due to the inexperience of the auditor, who allowed themselves to be initially led by the sponsor, who believed strategy could be taken "as a given".

In all three instances, there were areas were the auditors did not gather enough information. For usability trial one, there was very limited evaluation of the value of identified information resources. For usability trial two, a preliminary survey based solely on discussions with the sponsor was not ideal (initial meetings should have been held with a cross-section of the interview participants to gather further background information). Usability trial three was very "service" oriented and focused, with no information flow diagrams and limited identification of information resources. For all three audits, the recommendations contained within the final information audit reports were, in the main, of a general nature, with limited structure and no action plans. Again this could be put down to the relative inexperience of the auditors, who did not gather enough in-depth information to produce more detailed recommendations.

With regard to observations of the user experience, it became apparent that there was a time consuming, and at times steep, learning curve for each of the auditors, particularly researching, adapting, and applying the recommended tools and techniques required for each stage/step of the Buchanan & Gibb (1998) IA methodology. All three auditors also found the process identification and modelling steps difficult, with all three requiring some guidance to complete. One auditor also found the interview process difficult, requiring some guidance regarding preparation, questions, and interview technique.

The key findings of the usability trial were that the main strengths of the Buchanan & Gibb (1998) methodology are the logical structuring of stages, provision of the toolkit, and the flexibility to remove stages not relevant to the brief; and that the main weakness of the methodology was its lack of instructional depth.

Further instructional depth could be provided, but it should be noted that, given that the recommended tools are almost all proven and existing methods, authoritative instruction does already exist. One of the original intentions of the Buchanan & Gibb (1998) methodology was to provide a reference toolset of existing methods/tools from which the auditor could draw. It is the author's opinion that this goal still has merit as it avoids unnecessary repetition and by linking methods/tools to the IA rather than embedding them allows natural evolution of individual methods to be incorporated without necessarily having to update the overarching IA framework. A further benefit is that by directing the auditor to the body of knowledge for individual methods and tools they will have access to a much wider selection of resources and materials than they would if contained within a single IA methodology. However, it is acknowledged that the Buchanan & Gibb (1998) methodology would benefit from supporting examples to provide IA context for each method/tool and is consequently a key recommendation (see Section 10.2.2, page 342).

The findings of these usability trials also reopened the debate regarding who should conduct an information audit and what experience is required. One auditor commented (Kassenova, 2005):

> According to personal experience, the author agrees with Buchanan & Gibb (1998), that special skills are required of the information auditor, and not any information professional (as proposed by Orna [1999] and Henczel

[2001]) can do it. This is also one of the constraints, as the (Buchanan & Gibb) methodology requires a wide range of skills.

From the evidence of these usability trials, the author believes that the original argument put forward by Buchanan & Gibb (1998) still holds true, that the IA should ideally be led or supported by a senior information professional. While each of the usability trial participants conducted successful audits which were all well received by their respective participating organisations, the trials demonstrated that first time auditors would benefit from the support and guidance of a senior colleague during the natural transition from student to *practitioner* (e.g. from theory to practice). General training in research methods has also been identified as being of *potential benefit*[5].

With regard to achievement of objective three the author believes this to have been successfully achieved, with the results of the five studies demonstrating that the Buchanan & Gibb methodology is usable, but not yet entirely suitable for universal adoption. Based on user feedback, the stages and steps of the methodology are satisfactory, but universal adoption would require the provision of a more substantial toolset including IA specific templates, and some further depth of instruction (see Section 8.4, page 312). The author proposes that the various tools and templates either identified or developed as part of this research will fulfil this requirement, and these are discussed in more depth as part of final recommendations (see Section 10.2.1, pages 338-342).

---

[5] It should be reiterated that all three auditors had training in both IA methods and research methods as part of their previous postgraduate studies.

9.4. Summary

This research has identified Buchanan & Gibb (1998) as a suitable methodological basis for *a generic and universally applicable information audit framework* with the methodology being shown to closely match the developed IA methodological baseline, and to provide the most complete methodology of the four reviewed with application equal to its peers, and most significantly, the most comprehensive toolset.

This research has also *identified and explicitly mapped a direct relationship from information audit to information system development processes* made explicit through aligned terminology from information strategy to information systems development (see Figure 3.15, page 100), and high level mapping of respective input and output from information audit framework to information systems architecture framework (see Table 3.3, page 101).

This research has also demonstrated *usability of the information audit framework*, with the Buchanan & Gibb (1998) methodology found to be usable but requiring some refinement of stages/steps, and benefiting from some further instructional depth and tools/template support. The IA scope matrix was found to be extremely useful for establishing and managing IA scope.

In summary, all three research objectives have been successfully achieved. The next chapter presents the final recommendations arising from this research.

Chapter Ten: Conclusion

The following presents the conclusions and recommendations of this research. The author also notes research limitations and reflects on the overall research experience.

10.1. Contribution to the field

10.1.1. A revised IA definition

This research proposes a revised information audit definition (see Section 3.6, page 113), which notably, makes explicit the relationship of the information audit to information systems development, highlighting extended value. The proposed revised definition is as follows:

> The purpose of the information audit is to provide a holistic approach to identifying, evaluating, and managing an organisation's information resources and information flow, in order to ensure effective and efficient organisational information systems. The IA provides both strategic and operational direction, and contributes directly to information system development.

10.1.2. An IA Scope Matrix

A two dimensional information audit scope matrix has been developed. The first dimension based upon Earl's (2000) information strategy taxonomy, the second based upon a new concept of scope, referred to as IA *perspectives*, which consists of three sub-categories: *strategic*, *process*, and *resource*. The resulting two-dimensional 'scope matrix' is illustrated in Figure 10.1 (page 333).

It has been demonstrated by this research that the benefits of IA perspectives are that, in combination with Earl's (2000) adapted taxonomy, they allow the IA to be tailored to individual organisational requirements and provided with a particular orientation and priority (as demonstrated by the five case studies). This helps with the management of scope, the management of which was noted as a historical problem (Buchanan & Gibb, 1998; DiMattia & Blumenstein, 2000;

Botha & Boon, 2003 [see Section 1.1.1, page 4]) during the rationale for this research.

Figure 10.1. Information Audit Scope Matrix

	Information Management	Information Technology	Information Systems	Information Content
Strategic				
Process				
Resource				

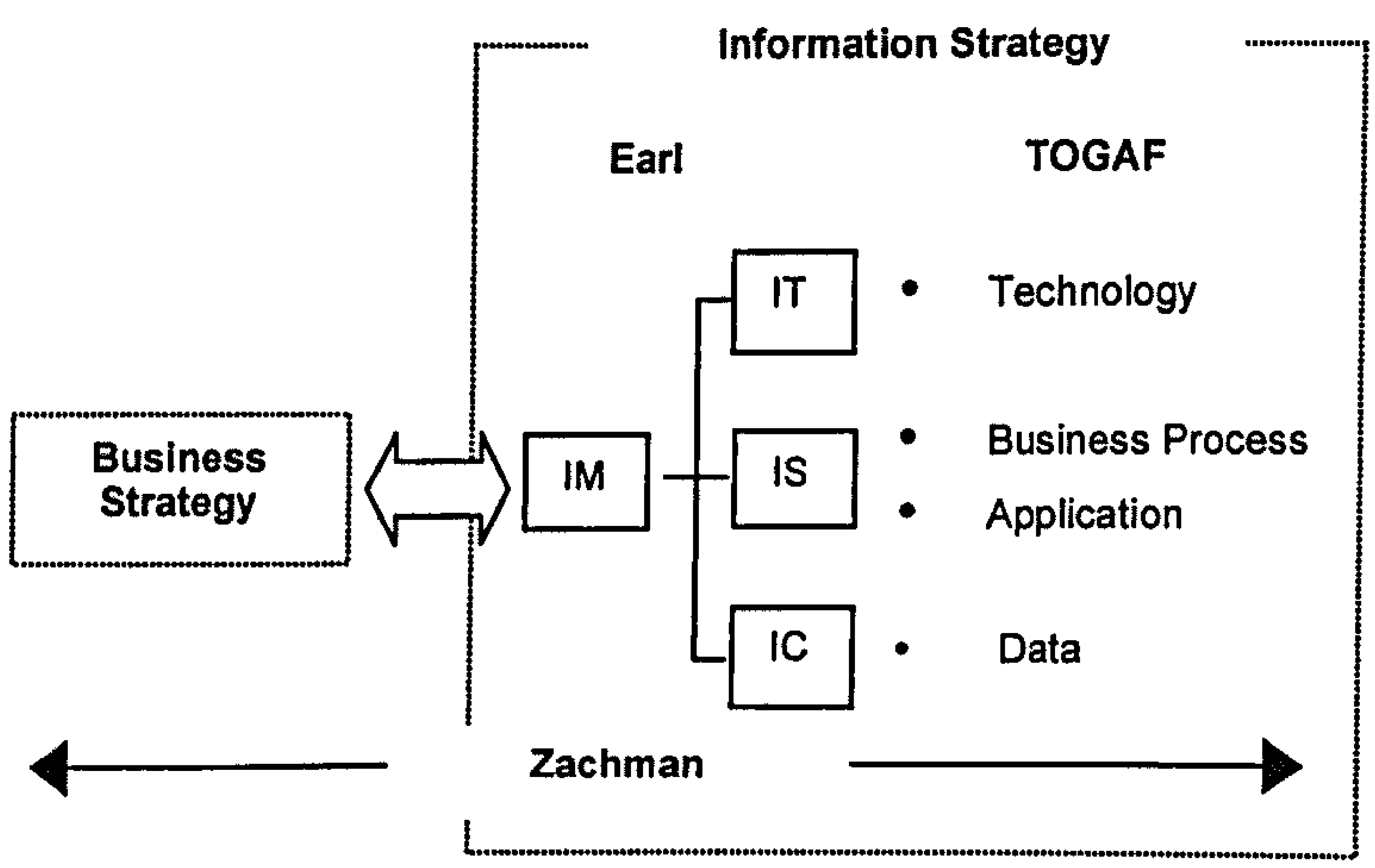
The scope matrix was found to be an extremely useful tool when tailoring the methodology as it helped the auditor to understand and focus the scope of the audit; and secondly, to identify appropriate tools and techniques to select for each of the stages.

10.1.3. IA integration with information systems architecture

This research has mapped a direct methodological relationship from the information audit to information systems architecture development via Earl's information strategy taxonomy (see Figure 10.2, page 334). The TOGAF Architectural Development Method has been shown to map to and extend Earl's (2000) taxonomy, bridging the gap between information strategy and information system architecture by providing a development methodology. The Zachman (1992) Information System Architecture framework has also been shown to map directly to this taxonomy providing a breakdown of architectural views or orientations (similar to IA perspectives).

The author proposed that to extend the value and benefit derived from the IA, alignment and reuse should be sought wherever possible between the outputs of the IA and the inputs to information systems architectural development. In an ideal scenario, the information system architecture would be driven and guided by information strategy, with both facilitated by the output of the information audit. At the high level, this would be accomplished immediately by formal IA adoption of Earl's (2000) taxonomy, allowing the IA to naturally integrate. However, at the more detailed level, synchronicity between inputs/outputs is required, which was deemed out-with the scope of this research.

Figure 10.2. Earl, TOGAF & Zachman



The immediate value of figure 10.2 is in illustrating the relationship between the outputs of the IA, and the inputs to the architectural development process (in response to problem statement three [see Section 1.1.1, page 5).

10.1.4. An IA methodological baseline

This research has developed an IA methodological baseline, which provides a method to assess completeness of approach when adopting a specific IA methodology.

Seven baseline IA stages/steps have been identified:

- **Setup**: project planning, preparation of business case, endorsement, organisational communication etc.
- **Review**: strategic analysis (internal and external), organisational (cultural) analysis etc.
- **Survey**: survey of information users, identification and inventory of information resources, mapping of information flow etc.
- **Account**: cost of information resources
- **Analyse**: analysis of findings
- **Report**: production and dissemination of IA findings and recommendations
- **Guide**: organisational information management policy development, implementation of recommendations, and establishment of the IA as a cyclical process

The baseline could also be used as a framework guide when considering an individual or tailored approach to the audit.

10.1.5. A process-based approach to the modelling of information flow

In the view of the author, this is a key IA omission identified by this research as the process perspective transcends the limitations of a relatively static functional view by focusing not on organisational structure, but on the dynamic relationship between information resources, information flow, and business tasks and activity (Gibb, Buchanan, and Shah, 2006). Further, the process models potentially generated by this perspective provide significant opportunity for achieving synergy and integration with related activity, such as information system architecture, and the early stages of information systems analysis and design, particularly if similar modelling conventions are adopted (such as UML and

BPMN). This synergy is considered by the author to be key to extending the future value of the IA.

This study demonstrated the suitability of Ould's (1995) process modelling process as part of the IA framework, demonstrated and further developed a simple process-based information flow modelling technique (see Figure 5.7, page 224), and developed and demonstrated a process description template (see Table 6.1, page 247). This approach to process modelling and mapping has already been further utilised within a framework for business continuity management (Gibb & Buchanan, 2006).

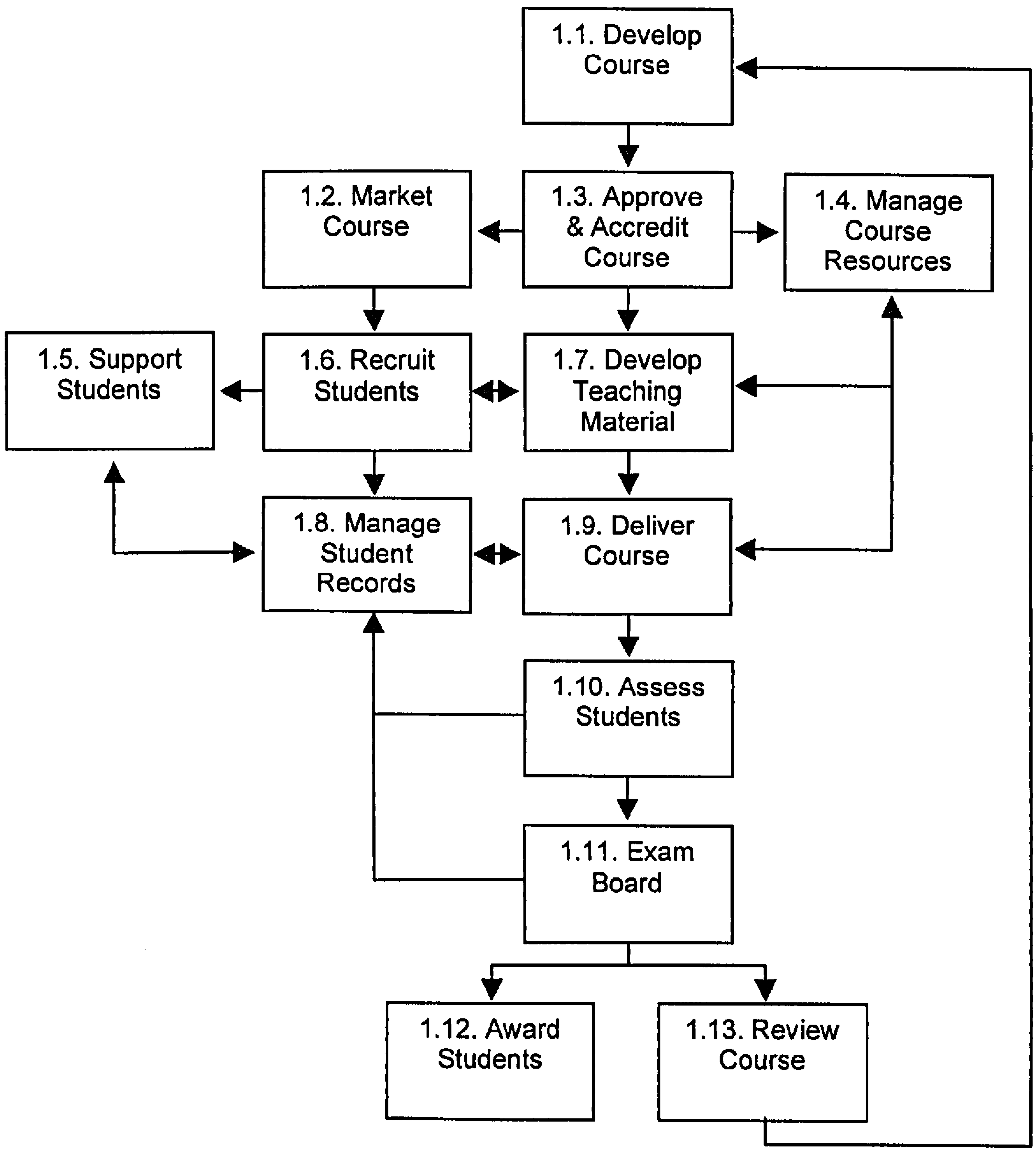
The initial process models were overly complex (see Figure 5.6, page 218) but a simpler approach is recommended in future as demonstrated in Figure 10.3 (see page 336), which demonstrates how the original complex process model from case study one could be simplified.

10.1.6. A basis for a generic and universal information audit framework

Buchanan & Gibb (1998) has been identified as a suitable methodological basis for *a generic and universally applicable information audit framework* (research objective one [see Section 1.2, page 9]). Although there are some concerns regarding the complexity of the approach and some toolset limitations to be considered; the method has been shown to provide a relatively comprehensive methodology, to have application at least equal to its peers, and perhaps most notably, is supported by the most comprehensive toolset. This finding is supported by Botha & Boon (2003), who in their own comparison of IA methodologies in pursuit of a basis for a standardised IA methodology also arrived at Buchanan & Gibb (1998) as a suitable methodology, and also by Alexopoulos & Theodoulidis (2003).

However, from the case studies and usability trials a number of refinements are proposed to the Buchanan & Gibb (1998) methodology and are discussed in Section 10.3.1 (see page 343).

Figure 10.3. A process flow model (UG teaching)



10.2. Research limitations

There are some limitations to this research, which should be reiterated prior to discussion of the key recommendations arising from this research. These limitations are as follows:

- This research would have benefited from further case studies, but a degree of pragmatism had to be applied by the researcher in consideration of time, logistical, and resource constraints. However, five studies nonetheless allowed the framework to be tested under a variety of conditions, and facilitated the identification of trends, patterns and dominant themes. It should also be noted that five studies is also substantially more than previous research and can from this perspective, be considered positively.
- The five studies could not be considered true repeat applications in the strictest terms as circumstances, requirements, and scope of the IA varied according to participating organisation, making each study uniquely different. A retest of the method with the same organisation would also have been unreliable as the organisation's belief state and systems would have altered/evolved as a result of the first IA. Consequently, analysis of the five studies focused on the identification of general trends, patterns, and themes, rather than the correlation of repeatable measurements. However, this is not necessarily of major concern in a study of a qualitative nature such as this.
- Of the five studies, only one was from the private sector, with the remaining four from the public sector. As a consequence there is limited representation from organisations operating in a commercial environment. This was not ideal, but occurred based solely on availability of organisations to participate. A recommendation for further studies would hopefully incorporate further private sector organisations.
- The account stage was not tested as it was not required by any of the participating organisations. While it would have been good to have trialled the

methodology in its entirety at least once during this study, it would have been poor practice to have attempted to influence and/or manipulate the requirements of the participating organisations. However, this means that the Buchanan & Gibb (1998) methodology has not yet been tested in its entirety. The recommendation would be for further research in this area.

- It is reasonable to assume that there may have been a degree of bias within this study due to the author of this study also being the co-author of the Buchanan & Gibb (1998) IA methodology. While all steps were taken to remove the possibility of any bias, further methodological testing by independent parties would be highly desirable.
- A limitation when considering usability was a lack of empirical evidence as previously noted by Botha & Boon (see Section 1.1.1, page 4) and verified by this author (see Section 4.7.3, pages 181-188). This limited the opportunity to conduct empirical verification of results. Again this can only be corrected through further testing and/or application of the methodology.

10.3. Recommendations

There are a number of key recommendations arising from this research calling for further refinement of the Buchanan & Gibb (1998) methodology and further research in the area of information management and the information audit. These are noted as follows.

10.3.1. A revised Buchanan & Gibb methodology

A number of refinements to the Buchanan & Gibb methodology are proposed as summarised in Table 10.1 (see page 344) and discussed as follows.

The methodology would benefit from the inclusion of an initial *setup* stage prior to the *promote* stage, to identify the client IA requirement and to establish associated IA scope. This new stage would be supported by the IA methodological baseline (both the generic and Buchanan & Gibb specific models) and the IA scope matrix developed as part of this research.

The *promote* stage remains largely as is with only one minor modification: the passport letter technique associated with step two should also be associated with step one to indicate that these first two steps of this stage can be merged together under certain circumstances. This occurred for all five studies undertaken as part of this research, but it is the author's opinion that it would be premature based solely on this research to suggest that these steps could be explicitly merged into one without further audits under a wider variety of circumstances (for example, it is highly likely that very large-scale organisational audits would benefit greatly from step one).

Table 10.1. A revised Buchanan & Gibb methodology[1]

STAGE	STEP	TOOL/TECHNIQUE
Setup	***1. Structured Walkthrough***	***IA methodology baseline (a structured walkthrough)***
	2. Set scope	***IA Scope Matrix***
Promote	1. Promote the benefits of the information audit	Conference Seminar ***Passport letter (when combined with step two of this stage)***
	2. Foster co-operation throughout the organisation	Passport letter
	3. Carry out a preliminary survey	Walk-around
Identify	1. Identify and define the organisation's mission	Business definition framework Portfolio analysis CSF analysis
	2. Identify and define the organisation's environment	PEST analysis Model of competitive forces
	3. Identify and define the organisation's ~~structure~~ ***processes***	***STRIM (Ould, 1995)*** ~~Mintzberg (1988)~~ Orna (1990) ***Process description template*** ***Process flow model***
	4. Identify and describe the organisational culture	***Mintzberg (1988)*** Stakeholder analysis Force field analysis
	5. Identify information flows	Orna (1990) ***Input/output model***
	6. Identify the organisation's information resources	Database

[1] New stages and/or steps are highlighted in bold italic while removed stages, steps, tools are strikethroughs

		Information resource template
Analyse	1. Evaluate the information resources	Strategic importance measure Strategic IT/IS grid Problem analysis ***Buchanan's (1995) IR value scale***
	2. Produce the detailed information flow diagram	***STRIM*** ***Information flow model***
	3. Produce the preliminary report	***Earl's (2000) adapted IS taxonomy***
	4. Formulate action plans	~~Soft systems methodology~~ ***Force field analysis***
Account	1. Account	ABC OBS Glazier's model (1993)
Synthesise	1. The information audit report	***Earls (2000) adapted IS taxonomy***
	2. The information strategy	***IA scope matrix*** ***Earl's (2000) adapted IS taxonomy*** ***Orna (2004)***

There are some minor changes proposed to the *identify* stage, largely to further incorporate process modelling. Steps one and two remain unchanged, but it is recommended that 'process' replace 'structure' in the title of step three. As part of this refinement of step three it is proposed that Mintzberg's (1988) method for the analysis of organisational structure could be associated with step four as it is a suitable method for identifying the strategy/structure fit of an organisation, which could be associated with organisational culture (step four of this stage). The revised process focus of step three would be supported by the STRIM methodology, and the process flow model (see Figure 10.3, page 340) and process description template (see Table 6.1, page 247) developed as part of this research. Step five of this stage remains unchanged but emphasis is now placed on identifying inputs/outputs as part of previous process modelling steps to support the later development of information flow models (see Section 5.2.2, page 217). Step six also remains unchanged but is now supported by the developed information resource template (see Appendix 4). Finally with regard to this stage it should be reiterated that there are noted reservations regarding the need for a database to inventory information resources (see Section 7.2.1, page 270), but it is the author's opinion that a database remains a legitimate optional tool and should consequently remain within the toolset.

For the *analyse* stage step one remains unchanged but Buchanan's (1995) IR value scale (see Section 5.2.3, page 222) is explicitly added to the toolset. Step two also remains unchanged but is now supported by the latter steps of STRIM and the proposed information flow model (see Figure 5.7, page 224). Step three remains unchanged with Earl's (2000) IS taxonomy added to the toolset to provide report structure. For step four it is proposed that soft systems methodology be removed from the toolset as a 'rich' process-based picture can now be developed during the preceding steps utilising STRIM, as demonstrated and discussed in case study one (see Section 5.2.3, page 225). It is proposed that force field analysis be identified as an option during this step (as well as for step four of the identify stage) as it was successfully utilised for this step in case study one (see Section 5.2.3, page 225). More general and universal data analysis methods and tools are also recommended to support this stage, which dependent upon scale and scope of the audit will be either quantitative and/or qualitative methods and tools. A qualitative approach to data reduction and analysis based upon Miles and Huberman (1994) was successfully utilised for case study two and is consequently recommended.

The *account* stage remains unchanged as it remains untested, but evidence from the five case studies suggests that this stage might not be required; however it would be premature based solely on this research to make a final decision on this point. Consequently a key recommendation is for further research in this area (see Section 10.3.3.3, page 346).

The two steps of the final *synthesise* stage remain unchanged but the IA scope matrix and the associated information strategy taxonomy of Earl (2000) are added to the toolset to ensure that the report and/or strategy is directly traceable to IA scope and structured accordingly. Orna (2004) is also added as an appropriate additional source of guidance and structure.

The above changes proposed to the Buchanan & Gibb (1998) methodology are considered evolutionary rather than revolutionary, with the original methodology remaining largely intact and individual steps supported with further tools and/or techniques.

10.3.2. IA instruction

The Buchanan & Gibb (1998) IA methodology would benefit from supporting examples to provide IA context for each method/tool. The most obvious and immediate solution is to make available both the templates developed during this research, and example output from a selection of the audits conducted. The usability trials identified (see Section 8.4, page 312) a particular need for additional instruction in the following areas: interviewing, process modelling, and qualitative data analysis. Conducting interviews would be assisted by examples of the approach taken (see Section 5.2.2, page 221 and Section 6.2.2, page 244) and lists of example questions utilised (see Sections 3.51[page 107], 3.5.2 [page 110], 3.5.3 [page 112], and Section 6.2.2 [page 246]). Process modelling would be assisted by adoption of STRIM (see Section 3.5.2, page 110), use of the process description template (see Table 6.1, page 247), and the approach to process modelling (see Figure 5.5 [page 212] and Figure 10.3 [page 336]). Qualitative data analysis would be assisted by adoption of an approach similar to Miles & Huberman (1994) as demonstrated for case study two (see Section 6.2.3, pages 254-259) supported by the data display templates developed as part of this study (see Table 6.3 [page 256] and Table 6.4 [page 257]) and the existing recommended tools and techniques (see Table 10.1, page 339).

10.3.3. Further research

There are five recommendations for further research.

10.3.3.1. Synchronicity between inputs/outputs

This study identified and mapped a methodological relationship from information strategy to information system architecture, with the information audit integrated within (see Figure 10.2, page 334). Explicitly mapping the respective inputs and outputs between each of these models would be a valuable exercise, as this would extend the value of the information audit, and provide explicit integration from information strategy to enterprise (system) architecture. Several of these common inputs/outputs have been identified by this study through mapping the output of stages of the information audit methodology to elements of the Zachman Enterprise Architecture Framework (see Table 3.4, page 101). The recommendation is for this to be continued with appropriate revisions to the Buchanan & Gibb (1998) methodology. The goal would be for information audit output (for example, business process and data models) to be direct input to enterprise architecture and system development. This requires the adoption of similar modelling conventions and terminology.

10.3.3.2. Further case studies

Further testing of the Buchanan & Gibb (1998) methodology would be good to validate/verify the findings of this study (and to test any refined methodology based on the above recommendations). It would be particularly good for this to be conducted independently (i.e not by the co-author of the original methodology), and for more organisations from the private sector to participate. Testing of Burk & Horton (1988), Orna (1990, 1999), and Henczel (2001) is also highly desirable. This would further test findings of this research and in more general terms contribute to the overall body of knowledge in this field, which is currently limited (see Section 1.1, page 4 and Section 4.7.3, pages 181-188).

10.3.3.3. Account/Cost: is this required?

The lack of importance attached to the account stage by the participating organisations is a notable finding, which can only be resolved through further, more extensive research. Of the existing IA case studies identified and reviewed as part of the literature review (see Section 4.7.3, pages 181-188) only one included cost steps (Dubois [1995] conducted cost benefit analysis of identified information resources); consequently, there would appear to be a need for more applied research in this area. While this research has not been extensive enough to be conclusive, the evidence gathered thus far does suggest that the account stage may not be required in the future.

10.3.3.4. Information strategy: theory versus practice

Another notable observation was that only one of the five audits produced an information strategy (case study two). This was not due to any lack of appreciation of the benefits of an information strategy by the participating organisations, but simply due to the fact that the four audits which did not produce an information strategy were conducted at a department, rather than organisational level. Given that an information strategy is an organisation wide initiative (Earl, 2000; Orna 2004) it would have been counter productive to develop one at a departmental level. What is notable, however, is that for the organisations which participated, none had an existing information strategy in place. This finding supports problem statement five within the original rationale for this research (see Section 1.1.2, page 7): that there is limited evidence of the existence of information strategy within organisations. Further, of the existing IA case studies identified and reviewed as part of the literature review (see Section 4.7.3, pages 181-188) none produced an information strategy, although two did produce an information policy. This lack of evidence regarding the existence of information strategy is an interesting theory versus practice topic for further research.

10.3.3.5. Benchmarking Information Management

As previously noted, organisations have differing requirements and needs; however, at the highest level they all share a common goal when considering an information audit: to assess how well they manage their information resources. Given this commonality, an interesting area for further research would be to explore the possibility of identifying a core set of information management processes and/or practices which could be used as a set of measures to guide standardised and bench-marketable information auditing. The process framework might be similar in approach to the Capability Maturity Model Integration (CMMI) established by the Software Engineering Institute for software engineering processes.

10.4. Reflection

The anticipated learning outcomes of this research were:

- Identification of the appropriate methodological steps, goals and outcomes of a generic information audit methodology;
- Awareness of the organisational scope (both depth and breadth) of the information audit;
- Understanding of the practical steps and procedures required to successfully complete an information audit;
- Understanding of the relationship of the information audit to related ICT management disciplines and development processes.

The author believes the above outcomes have all been realised as part of the achievement of overall research objectives (as discussed in chapter nine and summarised in Section 9.4, page 333). From a reflective point of view, realising these learning outcomes has been both interesting and educational, deeply extending my understanding of information auditing, and strengthening and extending my research skills.

References

Abell, D.F. (1980) *Defining the business: the starting point of strategic planning.* Englewood Cliffs, NJ: Prentice Hall.

Alexopoulos, E. and Theodoulidis, B. (2003) The generic information business model. *The International Journal of Information Management* (23), pp. 323-336.

Apps, I. (2002) Are you prepared for disaster? Is your data really protected?" *Information Management & Technology*, November/December 2002, pp. 244–245.

Audit Commission. (1990) Preparing an information technology strategy: making IT happen. *The Audit Commission for Local Authorities in England and Wales Management Papers* (7) February 1990. pp.1-6.

Badenoch, D., Reid, C., Burton, P., Gibb, F. and Oppenheim, C. (1994) The value of information. In: Feeney, M. and Grieves, M. (eds). The value and impact of information. East Grinstead: Bowker-Saur, 1994, pp. 9-78.

Barclay, K. and Oppenheim, C. (1994) An evaluation of InfoMapper software at Trainload Coal. *Aslib Proceedings* 46(2), pp. 31-42.

Barker, R. L. (1990) *Information audits: designing a methodology with reference to the R & D division of a pharmaceutical company.* Department of Information Studies, Occasional Publications Series No. 8. Sheffield: University of Sheffield. p.5-14., p.27-34.

Bell, J. (1999) *Doing your Research Project* (3rd edn) Buckingham: Open University Press.

Best, D. (1985) Information mapping: a technique to assist the introduction of information technology in organisations, in, Cronin, B. (eds). *Information management: from strategies to action*. London: Aslib, 1985. p.75-94, p.82-94.

Best, D.P. ed. (1996) *The fourth resource: information and its management.* Aldershot: Aslib Gower.

Beynon-Davies, P. (2002) *Information systems: an introduction to informatics in organisations*. Hampshire: Palgrave.

Bird, J. (1997) *The reuters guide to good information strategy*. London: Reuters Limited.

Boisot, M. (1987) Information and Organisations: The Manager as Anthropologist. London: Fontana

Boisot, M. (1988) Knowledge Assets: securing competitive advantage in the information economy. Oxford: OUP

Booth, A. & Haines, M. (1993) Information audit: whose line is it anyway? *Health Libraries Review* 1993, 10, pp.224-232.

Botha, H. & Boon, J.A. (2003) The information audit: principles and guidelines. *Library Review* 53(1) p23-38.

Buchanan, S. (1995) *The information audit: an integrated strategic approach.* Unpublished MSc Dissertation. The University of Strathclyde.

Buchanan, S. & Gibb, F. (1998) The information audit: an integrated strategic approach. *The International Journal of Information Management* 18 (1), p.29-47.

Buchanan, S. & Gibb, F. (2007) The information audit: role and scope. *The International Journal of Information Management* (27), p.159-172.

Buchanan, S. & Gibb, F. (2008a) The information audit: methodology selection. *The International Journal of Information Management*, in press.

Buchanan, S. & Gibb, F. (2008b) The information audit: theory versus practice. *The International Journal of Information Management, in press.*

Buchanan, S. (2003) *Systems Development*. The University of Strathclyde Graduate School of Informatics.

Buchanan, S. (2004) *Enterprise Architecture*. The University of Strathclyde Graduate School of Informatics.

Burk, C.F. & Horton, F.W. (1988) *InfoMap: a complete guide to discovering corporate information resources*. Englewood Cliffs, N.J.: Prentice Hall.

Carlisle, D.K. (2005) Resource review: conducting an information audit. *Information Management Journal* 39(2), pp.68-69.

CCTA. (1990) *Managing information as a resource*. London: HMSO.

CCTA. (1994) *Standards and IS strategy*. London: HMSO.

CCTA. (1994) *Policies and IS strategies*. London: HMSO.

Champy, J. (2002) *X-engineering the corporation: reinvent your business in the digital age*. London: Hodder & Stoughton.

Checkland, P. and Scholes, J. (1990) *Soft systems methodology in action*. Chichester: John Wiley & Sons Ltd.

Chillarege R. (2002) The Marriage of Business Dynamics and Software Engineering. *IEEE Software*, November/December 2002, pp.43-49.

Chowdhury, G.G., Burton, P., McMenemy, D., and Poulter, A. (2008) *Librarianship: an introduction*. London: Facet Publishing.

Cronin, B. (1985) Synoptic rationality: an unattainable goal?, in, Cronin, B. (eds). *Information management: from strategies to action*. London: Aslib, 1985. p.7-8.

Dalton, P. (1999) Investigating information auditing. *Library & Information Research News* 23(74) 1999, p.45-50.

Davenport, T.H. (1997) *Information ecology*. Oxford: Oxford University Press.

Davenport, T.H. (2000) in Marchand, D.A., Davenport, T.H., and Dickson, T. eds (2000) *Mastering Information Management*. London: Financial Times Prentice Hall, pp.5-9.

Davis, G.B. & Hamilton, S. (1993) *Managing information: how information systems impact organisational strategy*. Illinois: Business One Irwin, 1993. p.22.

Denscombe, M. (2003) *The good research guide*. Maidenhead: Open University Press, DiMattia, S.S. & Blumenstein, L. (2000) In search of the information audit: essential tool or cumbersome process? *Library Journal* March 1, 2000, p48-50.

Dubois, C.P.R. (1995) The information audit: its contribution to decision making. Library *Management* 16(7), pp. 20-24.

Dubois E. and Pohl K. (2003) RE 02: A Major Step toward a Mature Requirements Engineering Community. *IEEE Software* 20 (1), p14-15.

Du Toit, A. (1998) Information Management in South African Manufacturing Enterprises. *International Journal of Information Management* 18(3), p205-213.

Dutta A. (2003) Managing IT with Systems Thinking. *Computer* 36 (3), pp.96-97.

Ellis, D., Barker, R., Potter, S. & Pridgeon, C. (1993) Information audits, communication audits, and information mapping: a review and survey. *International Journal of Information Management* 13 (2), p.134-151.

Elvin E. and Davies A. (2002) Challenging the learning failure of IT systems development practice. *British Computer Society Review 2002: Computing in the 21st Century*, pp.53-55

Earl, M.J. (1989) *Management strategies for information technology*. London: Prentice Hall.

Earl, M.J. (1996) *Information management: the organizational dimension*. Oxford: Oxford University Press.

Earl, M.J. (2000) in Marchand, D.A., Davenport, T.H., and Dickson, T. eds (2000) *Mastering Information Management*. London: Financial Times Prentice Hall, p.16-22.

Elvin E. and Davies A. (2002) Challenging the learning failure of IT systems development practice. *British Computer Society Review 2002: Computing in the 21st Century*, pp.53-55

Feather, J. and Sturges, P. (eds) (1997) *International Encyclopedia of Information and Library Science*. Routledge.

Garratt, O. and Du Toit, A. (2002) Accountability and demonstration of the value of information serices in South African law firms. *Aslib Proceedings* 55(3), pp.130-137.

Ghauri, P., and Gronhaug, K. (2002) *Research Methods in Business Studies: A Practical Guide* (2nd ed.), Harlow, FT Prentice Hall.

Ghauri, P., & Gronhaug, K. (2005) *Research methods in business studies*. Essex: FT Prentice Hall,

Gibb, F. (2005) *Information systems*. The University of Strathclyde Business School.

Gibb, F., Buchanan, S., and Shah, S. (2006) An integrated approach to process and service management. *International Journal of Information Management* (26) p44-58.

Gibb, F. and Buchanan, S. (2006) A framework for business continuity management. *International Journal of Information Management* (26) p128-141.

Gill, J., and Johnson, P. (1997) *Research Methods for Managers* (2nd edn), London: Paul Chapman.

Gillman, P.L. (1985) An analytical approach to information management. *The Electronic Library* 3 (1), p.56-60.

Glazier, R. (1993) Measuring the value of information. *IBM Systems Journal*, 1993, 32(1).

Gorman, G.E. and Corbitt, B.J. (2002) Core competencies in information management education. *New Library World* 103 (1182/1183), p436-445.

Gruber, T. (1983) The operational audit: an integrated approach. Internal auditor 40 (4), p.39-41.

Grundy, T. (1993) *Implementing strategic change: a practical guide for business.* London: Kogan Page.

Guenther. K. (2004) Conducting an information audit on your intranet. *Online* 28 (5) pp 46.

Hammer, M. and Champy, J. (1994) *Re-engineering the corporation: a manifesto for business revolution.* London: Nicholas Brealey Publishing.

Hamilton, S. (1987) *A communication audit handbook: helping organisations communicate.* London: Pitman.

Hawley Committee (1995) *Information as an asset.* London: KPMG IMPACT.

Haynes, D. (1995) Business process reengineering and information audits. *Managing Information* 2 (6), p.30-32.

Henczel, S. (2000) The information audit as a first step towards effective knowledge management: an opportunity for the special librarian. *INSPEL 34* (2000) pp.210-226.

Henczel, S. (2001) *The information audit: a practical guide.* London: K.G.Saur.

Henderson, H.L. (1980) Cost effective information provision and the role for the information audit. *Information Management* 1 (4), p.7-9.

Joint Information Systems Committee (1995) *Guidelines for developing an information strategy.* Bristol: Pheon Press Ltd.

Johnson, G. and Scholes, K. (1993) *Exploring corporate strategy: text and cases.* 3rd ed. Englewood Cliffs, NJ: Prentice Hall.

Jones, H. (2005) Risking knowledge management: an information audit of risk management activities within the Hobart City Council. *Library Management* 26 (6/7) 2005. p397-407.

Juristo N. et al. (2002) Is the European Industry Moving toward Solving Requirements Engineering Problems? *IEEE Software*, 19 (6), p70-76.

Kan, S. H. (2003) *Metrics and Models in Software Quality Engineering* (2nd edn) Boston: Addison Wesley.

Kassenova, A. (2005). *Information Audit at the British Council.* Unpublished MSc dissertaion, University of Strathclyde.

Hammer, M. & Champy, J. (1994) *Reengineering the corporation: a manifesto for business revolution.* London: Nicholas Brealey Publishing.

Hawley Committee (1995) *Information as an asset: the board agenda.* London: KPMG IMPACT.

Hill, C. W. R. & Jones, G. R. (1992) *Strategic management: an integrated approach.* Boston: Houghton Mifflen.

Lamoral, D. (2001) An evaluation of information provision at the Institute for Commercial Forestry Research, South Africa: the findings of an information audit. *Journal of Librarianship and Information Science* 33 (4) 2001. p177-190.

Langley, E.A., Seabrooks, J., Ryder, D. (2003) *Information audit as a holistic approach: a case study.* Available at http://www.sla.org/division/dst/LangleySLA062003.pdf. Last accessed October 19, 2005.

Lewin, K. (1947) Frontiers in group dynamics: concepts, method, and reality in social science; social equilibria and social change. *Human relations* 1 (1) pp23-32.

Lubbe, W.F. & Boon, J.A. (1992) Information audit at a university. *South African Journal of Library and Information Science* 60 (4), pp.214-223.

Lyman, P. and Varian, H. R. (2003) 'How much information 2003?' *University of Berkeley, 2003.* Available at: http://www.sims.berkeley.edu/research/projects/how-much-info-2003/. Last accessed October 19, 2005.

Marchand, D.A. & Horton, F.W. (1986) *Infotrends: profiting from your information resources*. New York: Wiley.

Marchand, D.A., Kettinger, W.J., and Rollins, J.D. (2001) *Information orientation: the link to business performance*. Oxford: Oxford University Press.

Marchand, D.A. ed. (2000) *Competing with information.* Chichester: John Wiley & Sons Ltd.

Marchand, D.A. and Davenport, D.H. ed. (2000) *Mastering information management.* London: Financial Times Prentice Hall.

Martin, E. (2005). *Information Audit at MacFarlanes Law Firm*. Unpublished MSc dissertation, University of Strathclyde.

Massey, J. (1995) Vital assets. *Information Age*, June 1995. p.25-33.

McFarlan, F.W. (1984) Information technology changes the way you compete. Harvard Business Review, May-June, 1984.

McGovern F. (2002) Managing Software Projects with Business-Based Requirements. *IT Pro*, 4 (5), p18-23.

Middleton, M. (2002) *Information management: a consolidation of operations analysis and strategy*. Wagga Wagga: Charles Sturt University.

Miles, M.B, and Huberman, A.M. (1994). *Qualitative Data Analysis,* 2nd Ed. Newbury Park, CA: Sage.

Mintzberg, H. (1988) The structuring of organisations, in, Quinn, J.B., Mintzberg, H., & James, R.M. (eds.). The strategy process: concepts, contexts, and cases. New York: Prentice Hall.

Nickerson, G. (1991) Book review: Practical information polices: how to manage information flows in organisations. *Database* 14 (6), p.86.

OECD. (1998). Meeting of the Industry Committee at Ministerial level – scoreboard of indicators.

Open Group (2002) *ADM Introduction*. Available at: http://www.opengroup.org/architecture/togaf8-doc/

Open Group (2003) *Evaluating usability*. Available at: http://www.opengroup.org/openbrand/testing/testprocs/pd4.pdf

Orna, E. (1990) *Practical information policies: how to manage information flow in organisations*. Aldershot: Gower.

Orna, E. (1999) *Practical information policies* 2nd Ed. Aldershot: Gower.

Orna, E. (2004) *Information strategy in practice*. Aldershot: Gower.

Ould, M.A. (1995) *Business processes: modelling and analysis for re-engineering and improvement.* Chichester: John Wiley & Sons Ltd.

O'Rourke, C., Fishman, N., & Selkow, W. (2003) *Enterprise architecture using the zachman framework*. Boston: Thomson.

Patton, M.Q. (2002) *Qualatative Research and Evalaution Methods.* 3rd ed. CA: SAGE.

Tellis, W. (1997) *Application of a Case Study Methodology*, The Qaulatative Report, Volume 3, No. 3, p.1-14

Pellow, A. & Wilson, T.D. (1993) The management information requirements of heads of university departments: a critical success factors approach. Journal of Information Science 19 (6), p.425-437.

Peppard, J. (1993) *IT strategy for business.* London: Pitman.

Perks, C. and Beveridge, T. (2003) *Guide to enterprise architecture.* New York: Springer-Verlag.

Porter, M.E. (1980) Competitive strategy: techniques for analysing industries and competitors. New York: Free Press.

Pritchard, S. (2003) 'Data Assurance'. *Information Age Business Briefing: Enterprise Storage,* (42), pp23–24.

Quinn, A.V. (1979) The information audit: a new tool for the information manager. *Information Manager* 1 (4), p.18-19.

Remenyi, D., Williams, B., Money, A., and Swartz, E. (1998) *Doing research in business management: an introduction to process and method.* London: SAGE

Remenyi, D. (1993) *Information management case studies.* London: Pitman.

Reynolds, P.D. (1980) Management information audit. *Accountants Magazine* 84 (884), p.66-69.

Reid, C. (1994) Is information worth it? *Information Policy Briefings* (6). London: British Library.

Riley, R.H. (1976) The information audit. *Bulletin of the American Society for Information Science* 2 (5), p.24-25.

Robertson, G. (1994) The information audit: a broader perspective. *Managing Information* 1 (4), p.34-36.

Roussakis, C. (2005). *Information Audit at the Office of Marketing & Communication*. Unpublished MSc dissertation, University of Strathclyde.

Saunders, M., Lewis P., and Thornhill, A. (2003) *Research Methods for Business Students* (3rd ed.), Harlow, FT Prentice Hall.

Schwab, D.P. (2005) *Research methods for organizational studies.* London: Lawrence Erlbaum Associates

Soy, C. & Bustelo, C. (1999) A practical approach to information audit: case study. *Managing Information* 6 (9), p30-38

Synott, W.R. (1987) *The information weapon: winning customers and markets with technology*. New York: John Wiley & Sons.

Tali, M. & Mnjama, N. (2004) Information audit at the Southern African Development Community (SADC) Secretariat. *Library Management* 25 (4/5), p199-207.

Tapscott, D. (1993) *Paradigm shift: the new promise of information technology.* New York: McGraw-Hill, p.182.

Tellis, W. (1997) *Application of a Case Study Methodology*, The Qualitative Report, (3) 3, p.1-14

Tesch, R. (1990) *Qualitative Research: Analysis Types and Software Tools.* New York: Falmer.

Theakston, C. (1998) An information audit of National Westminster Bank UK's learning and resource centres. *International Journal of Information Management* 18 (5), p371-375.

Tonner, D. (2003) 'Scaling the data mountain'. *Information Age Business Briefing: Enterprise Storage*, (42), p8–9.

Tranfield, D. and Starkey, K. (1998) The nature, social organisation and promotion of management research: towards policy. *British Journal of Management*, 9, p341-353.

Turner R. (2003) Seven Pitfalls to Avoid in the Hunt for Best Practices. *IEEE Software*. 20 (1), p.67-69.

Turney, P.B.B. (1996) *Activity based costing: The performance breakthrough.* London: Kogan Page, 1996.

Underwood, P.G. (1994) Checking the net: a soft-systems approach to information auditing. *South African Journal of Library and Information Science* 62 (2), p.59-64.

Venkarraman, N. and Henderson, J.C. in Marchand, D.A., Davenport, T.H., and Dickson, T. eds (2000) *Mastering Information Management.* London: Financial Times Prentice Hall, p.283–289.

Vickers, P. (1985) Information management: selling a concept, in, Cronin, B. (eds*). Information management: from strategies to action*. London: Aslib.

Weber M. and Weisbrod. (2003) Requirements Engineeering in Automotive Development: Experiences and Challenges. *IEEE Software*, 20 (1), p.16-24.

Webster, M. (2001) A guide to information audits. *Information World Review* December 2001, p66.

Wood, A. (2005) St Helena Hospice information audit report executive summary. EAHIL Workshop, *Implementation of quality systems and certification of biomedical libraries conference*, Palermo June 23-25, 2005.

Wood, S. (2004) *Information auditing: a guide for information managers*. Available at: http://www.freepint.com/shop/report.

World Bank. (1998) World Bank Development Report.

Worlock, D.R. (1987) Implementing the information audit. *Aslib Proceedings* 39, p.255-260.

Young R.R. (2001) *Effective Requirements Practices*. Addison-Wesley: Boston.

Yin, R.K. (1984) *Case Study Research: Design and Methods*. Applied Social Research Methods Series, Volume 5. CA:SAGE