Development and Usage of Information Architecture: A Management Perspective

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Wolfson College, University of Oxford

Submitted in Partial Fulfilment of the

Degree of Doctor of Philosophy

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This thesis is dedicated to the memory of my parents.

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Abstract

Despite its emergence more than a decade ago, information architecture remains a problematic concept. A study of relevant literature suggests significant advocacy with inadequate supporting evidence on its existence, application or value. The available limited research evidence generally presents unsatisfactory information architecture experience. Notwithstanding the unresolved issues and reported unsatisfactory experience, information architecture continues to be referenced as an important information management issue. Hence this doctoral study sought to investigate it.

In the first stage, the study set out to clarify the position of information architecture via a large scale postal survey of 294 organisations. The survey found that information architecture is being used in association with IS planning, particularly in organisations which position IT as a strategic resource, but perceptions on its two conventional key components vary. While application architecture is viewed as being useful for IS planning, corporate data model is seen as being more relevant to data management and project implementation. Both models are regarded as tools facilitating integrated information systems development.

In the second stage of research, case studies on 6 large organisations were conducted to gain an in-depth understanding of successful information architecture practice. The investigation reaffirmed application architecture's position as an IS planning tool and cast further doubt on corporate data model's role not only in IS planning but also in IS practice as a whole. Business area/project data model was identified as the pragmatic high-level data model for both application/database development and data management. A major finding of the case studies was on business system architecture, a pictorial model depicting IT in its business setting. It is seen as being of value for integrating IS planning with strategy development and business planning - a tool for fusing IT with the business. The case studies concluded that the value and effectiveness of information architecture is dependent on the targeting of its components - business system architecture, application architecture and business area/project data model - in terms of tasks and recipients.

The case for a holistic approach to business/IS planning and implementation is currently being argued by a number of leading management and IS scholars. This thesis embraces the holistic approach and positions the (redefined) information architecture as a valuable tool in its implementation.

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Chapter 1: Introduction

- Research Issue
- Research Methodology
- Research Findings
- Outline of Thesis

The concept of Information Architecture (IA) has been well-known since IBM introduced Business Systems Planning (BSP) as a structured information systems planning methodology in the 70's (IBM,1981). In spite of its long existence, it has not been established that information architecture has been widely accepted in practice or that much value has been derived from it; it is an area lacking adequate research (Earl, 1989). Current views on information architecture (see Chapter 2) appear to be divided with much unsubstantiated claim and criticism. Nevertheless, there is evidence that the information architecture concept is perceived to be an important information management issue. It has consistently emerged as a top information management issue in recent IS surveys such as the 1989/1990 SIM/University of Minnesota survey (Niederman, et al., 1991), CSC/Index surveys from 1988 to 1992 (Boar, 1993, p. 32) and Datamation Annual IT Outlook (Moad, 1994). A topical issue suffering from a dearth of research clearly merits study. When the issue is also within the domain of interests of a practitioner-turned-researcher, it satisfies the requirements for a meaningful and worthwhile research by that individual. Information architecture as researched and presented in this thesis is such an issue.

Information architecture, in its current form and usage, is both a tool and a deliverable of IS planning (IBM, 1981; Martin, 1989, 1990a). As a tool, it facilitates the planning process. As a deliverable, IA serves as the blueprint for implementing the IS plan. The typical IA as generally reflected in the literature consists of an application architecture and a corporate data model (entity relationship diagram). The application architecture shows the major applications (existing and planned) and their relationship to one another in

terms of the data flows between them; it facilitates the development of integrated IT applications. The corporate data model depicts the organisation's business entities and their relationship to one another according to business rules; it enables the design and development of integrated databases. The IA as a whole is seen as a means of realising the organisation's integrated information systems goal. The details of technologies related to the integrated information systems are not shown in the IA but are instead depicted in the IT architecture.

1. Research Issue

Current research (Earl, 1990, 1993, 1994; Goodhue, et al., 1988, 1992a; Kim and Everest, 1994) and personal experience suggest that the development and usage of information architecture is not proceeding as smoothly as is implied in some of the literature, particularly in that originating from IT vendors, consultants and methodologists (IBM, 1981, 1992; Finkelstein, 1981, 1991; Martin, 1989, 1990a; Texas Instruments, 1989, 1991, 1992). It is not clear as to whether or not the development and usage of IA is widespread. Equally unclear is the general experience with IA. There seems to be some understanding on what IA represents but there is no clear consensus on what exactly it is, what form it takes, how it is developed or what its real uses and values are. The work of writers such as Davenport (1993, 1994), Henderson and Venkatraman (1989, 1993), Inmon and Caplan (1992), McGee and Prusak (1993) and Zachman (1987) coupled with emerging research evidence help to shed some light on IA and have provided a base for conducting this research.

While it was feasible to pursue the investigation into IA from a methodological perspective, it was decided that a management perspective would be more appropriate. The methodological aspects of IA have received and continue to receive the attention of researchers (Brancheau, et al., 1988; Everest and Kim, 1989; Goodhue, et al., 1988, 1992a; Hackathorn and Karimi, 1988; Karimi, 1988) and vendors and methodologists (Andersen Consulting, 1992; IBM, 1992, 1993; Inmon and Caplan, 1992; Martin, 1989, 1990a, 1990b; Texas Instruments, 1992; Zachman, 1987). The management aspect of IA

is however lacking adequate research; IA is often covered as part of IS planning or some other IS research (Allen, 1982; Earl, 1990, 1993). In this circumstance and as IA is perceived as an important information management issue, this research has been pursued from a management perspective. The objective has not been to develop a methodology or technique for IA development and usage but rather to understand these issues and position IA from an information management perspective. The research objectives have hence been defined as follows:

* To determine how widely information architecture is used (state) and what its generally perceived value is (status).

* To investigate the development and usage of information architecture and to suggest how these tasks may be efficiently and effectively carried out in efforts to leverage the planning and implementation of strategic IT applications.

2. Research Methodology

The research objectives were such that they required two separate but inter-linked research approaches. As the general position of IA was unclear, it was decided that the state and status of IA required to be investigated first. The extant literature on IA and IS planning provided the necessary foundation for conducting a large scale postal survey into the general usage and perception of IA. A structured questionnaire with 34 questions requiring mainly Likert-type scale responses was used. 294 completed questionnaires (32% response) from a cross section of industries provided an adequate sample size for conducting quantitative analysis and hypothesis testing. The findings of the survey while helping to clarify the general state and status of IA also served as a base for proceeding to the next phase of the research, the case studies.

Case studies of six large organisations were conducted in the second phase of the research. The organisations are major players in their respective industries - petroleum, water utility, motorcar manufacturing, insurance, retailing and rail transport. Five of them - Shell Expro, Thames Water, Rover Group, Allied Dunbar and Safeway Stores -

were selected because they were generally considered as exemplars of IA practice and/or IS planning. British Rail, though not satisfying this criteria, was chosen as the sixth case study in order to benefit from the organisation's recent experience in a major IA project which ended less than satisfactorily. These case studies involved in-depth, semi-structured interviews with, on the average, eight people in each organization. Those interviewed included the head of IT, senior IT executives, functional heads and senior managers. At least one board member in each organisation was interviewed to gain the necessary top management perspective on IA. The interviews followed a consistent set of guidelines based on a theoretical research model and concluded with the administration of a structured questionnaire on the organisation's IA experience. Documentation in the form of business plan, IS plan, systems documentation, IT manuals, minutes, internal surveys, company reports, appraisal forms, and literature in the public domain were examined to extract data relevant to the research. All the data gathered were qualitatively analysed, with particular attention being given to patterns existing in the case study sample.

3. Research Findings

At the core of the research is the basic hypothesis that information architecture is a valuable IS planning and implementation tool. The research findings support this hypothesis and offer propositions for effective IA practice.

The survey, reflecting the perceptions of mainly IT heads and managers, found usage of IA to be significant in medium and large organisations. The architecture was associated with IS planning, and was perceived as being of value to organisations which positioned IT as a strategic resource. Both application architecture and corporate data model, initially identified as key components of IA, were rated as valuable tools but for different purposes. The application architecture, though considered to be somewhat complex, was nonetheless perceived to be useful for communication with senior management on IT application matters. In the case of the corporate data model, it was not only perceived to be complex from a senior management perspective but was also regarded as being

irrelevant to them. It was however thought to be of relevance to application/database development and data management.

After relating the survey findings to relevant theories and other research (Goodhue, et al., 1988, 1992a, 1992b; Lederer and Sethi, 1988; etc.), it was concluded that information architecture is a useful IS planning tool which has potential for addressing some IS planning problems. However, IA's effectiveness and value is dependent on how its components are targeted, designed, developed and used. The value of data modelling is in implementation rather than planning of information systems. A project-level data model is a proven tool for IS project work and is also generally regarded as being adequate for data management tasks and integrated database development; this suggests that a corporate data model may be unnecessary. An application architecture is potentially a suitable tool for communication with senior management. In this regard, the model needs to be simple and reflect the essence of the IS plan's recommendations on IT applications. However a macro-level architecture may subsequently manifest itself as a less-useful implementation tool. These conflicting demands could be resolved by developing two-levels of application architecture - an overall model for senior management presentation and a detailed model for project implementation. These findings and propositions were expanded in the case studies.

Earl (1990, 1993, 1994) in his study of IS planning practices concludes that the 'organisational approach' is the most successful approach for the planning and implementation of IT applications. In the 'organisational approach', IS planning is integrated with business planning, and IT applications are developed and implemented as part of business projects. Earl identified the approach's major weaknesses as its relative softness and lack of rigour. This doctoral research, via evidence from six case studies, positions information architecture as a useful tool which addresses these weaknesses and facilitates the effective practice of holistic IS planning and implementation. The case studies found that an IA consisting of business system architecture, overall and detailed application architecture, and business area/project data models helps to vertically and

horizontally integrate the processes spanning from business/IS planning to project implementation. IA is complemented in these processes in matters of technology by the organisation's IT architecture.

In the holistic approach, a strategic initiative is not just a collection of functional proposals/plans but a cohesive whole in which contributions from key functions including IT are fused. The case studies suggest that business system architecture is an effective way to model this concept of holism; the architecture depicts the integration of strategic resources and other relevant factors for delivering a strategy. The model is developed jointly at the functional level by IT and other business functions for use by senior management in strategy development and business planning. Senior management involvement in IS planning is thus facilitated; they can view an IT initiative in the context of its business setting.

In addition to elucidating business system architecture, the case studies also offered evidence supporting the survey's propositions on application architecture and project data model. An overall application architecture is for providing senior management a macro-level perspective of the organisation's IT applications and their contributions to the business. The detailed application architecture is for use at the project level and serves to integrate IS planning with application development. The business area/project data model is developed as part of project scoping for use in application/database development tasks. Collectively, these data models are sufficient to meet the data modelling needs of data management and integrated database development, thereby making the corporate data model unnecessary. The case study organisations were practically unanimous in their rejection of corporate data modelling.

A core message delivered by the case studies is the need for multiple types of IA models each of which is specifically positioned and targeted. The models are inter-related but focus on distinct purposes and recipients. Senior management's requirements in relation to business/IS planning are best served by the pictorial business system architecture rather than detailed technical models. In contrast, models for project implementation such

as the business area/project data model need to be detailed and adhering to some syntax/standard for them to be of practical value to the application developers. A useful guide for deciding on the form and content of an IA model is to gauge its relevance and usefulness in relation to its targeted recipients and their behavioural/communication characteristics and expectations. Conceptually, the various IA models can be located on a continuum with 'syntactics, complexity, specification, detail, text and written presentation' at one end, and 'semantics, simplicity, clarification, macro issues, pictorial/graphic and verbal presentation' at the other end. Models meant for senior management usage are closer to the 'semantics' end while those for use by the project team are closer to the 'syntactics' end (Stamper, 1987).

4. Outline of Thesis

This thesis has been structured to present the research in the way it was conceived, developed and undertaken. At the outset of the research, it was not apparent as to what aspect of IA should form the focus. What was evident was that the fuzziness surrounding information architecture should be addressed before a decision was made on the target for in-depth research. Thus the literature search in the first stage of research was confined largely to the IS domain with focus on IA; this is reflected in Chapter 2. The literature enabled the development of broad research questions and provided the theoretical foundation for conducting a survey. The rationale for conducting a postal survey followed by case studies is discussed as part of research methodology design in Chapter 3. The survey into IA's state and status is presented in Chapter 4 wherein the hypotheses and exploratory research issues derived from the literature are discussed. Chapter 4 explains the survey process and documents the results of quantitative analysis and statistical tests. The chapter concludes with a discussion of the survey findings and propositions, paying particular attention to application architecture and corporate data model.

The survey results, considered in the light of relevant theories, provided direction for the in-depth investigation into IA. IS planning, strategy and business planning, management

behaviour and communication, and IT architecture emerged as key areas with direct bearing on the qualitative study. Chapter 5 presents the related literature and the theoretical research model developed from it. The chapter seeks to clarify and verify the theoretical model with regard to its positioning of IA as a complement to the 'organisational approach' form of IS planning. The theoretical model was used to conduct six case studies. Chapter 6, a large chapter, describes each of the six case studies in terms of the following items: company profile, IT function, strategy development and business planning, IS planning, business model, application architecture, high-level data model and IT architecture. The case study data is analysed qualitatively in Chapter 7. The chapter seeks to validate the theoretical model and show how IA helps to facilitate the effective practice of holistic IS planning and implementation (the essence of the 'organisational approach'). Chapter 8 clarifies key aspects of the framework for IA practice which emerged from the qualitative analysis. The chapter concludes with propositions on development and usage of IA models. Chapter 9, the last chapter, summarises the research findings and contributions to knowledge, and suggests the implication of these for IS research and practice.

Chapter 2: The Case for Research in Information Architecture

- What is Information Architecture?
- Information Systems Planning
- Development of Information Architecture
- Claims and Assertions About Information Architecture
- Criticisms of Information Architecture
- Research Evidence on Information Architecture
- Need for Research in Information Architecture
- Research Proposal

This chapter explains the rationale for the study in information architecture (IA) and discusses the issues to be investigated: *the position of information architecture and its development and usage as an IS planning tool and implementation blueprint.* What is presented is a summary of current practices, perceptions and arguments and reflections thereon. The chapter does not cover all the literature as it is felt this would make the chapter needlessly large and complex. Only material in relation to the objectives of the chapter and relevant to the first stage of field work, a postal survey, are included. Chapter 5 goes into greater depth on some the theoretical issues introduced here and covers additional material in relation to the second stage of field work, the case studies.

1. What is Information Architecture?

Information architecture is generally understood to be a high-level blueprint developed during IS planning for the purpose of implementing the resulting plan. This understanding reflects broad direction rather than clear definition. There is confusion and ambiguity as to what exactly constitutes an information architecture. Developments over the years have led to different interpretations of IA and the emergence of related concepts such as information systems architecture (see below). As noted by Earl (1989, p. 97), "there is hardly any accepted terminology and no universal definition of architecture".

Many variations may be found in the definition and interpretation of IA. A number of writers use IA synonymously with data architecture/corporate data model (Everest and Kim, 1989; Karimi, 1988; Martin, 1989, 1990a; Teng, et al., 1992). Kim and Everest (1994, p. 5) in a more recent paper observe that "the term, data architecture, seems to be easier to comprehend and communicate than the term, information architecture." Wetherbe and Davis (1983) interpret IA broadly to cover all of information systems planning, design and development. Laudon and Laudon (1994, p. 19) define IA as "the particular form that information technology takes in an organization to achieve selected goals or functions." IA is also used to refer to the set of policies and rules that govern an organisation's actual and planned usage of information technology (Allen and Boynton, 1991; McNurlin, 1988). IBM (1981, p. 68) defines IA as "the blueprint into which the current and future information systems development and eventual operational systems should fit". Brancheau et al. (1987, p. 1) consider an IA to be "a high-level map of the information requirements of an organisation. It is a personnel, organisation, and technology independent profile of the major information categories used within an enterprise."

Definition of Information Architecture and its Components

In this situation of differing definitions, it is necessary to establish the meaning of information architecture as used in this thesis. The definition provided below positions IA as a useful interface between a business plan and a technology plan:

> *Information Architecture is a set of high level models which complements the business plan in IT-related matters and serves as a tool for IS planning and a blueprint for IS plan implementation.*

An IA in line with the above definition has to have an application component and a data component. That would be the minimum required to serve the three functions stated. Such a definition of IA components is consistent with the thinking on information architecture of writers such as Earl (1989), Kim and Everest (1994), Nolan and Mulryan

(1987) and Zachman (1987). Allen (1982, p. 85) explicitly defines IA in terms of application architecture and data architecture. He argues that an effective IS blueprint must inform on: "(1) what the major data collections will be; (2) how they should be related, if at all; (3) what types of application systems will feed and draw on these collections; and finally, (4) how the applications systems will be related". A review of popular IS planning methodologies such as BSP (IBM, 1981) and Information Engineering (Martin, 1990a; Texas Instrument, 1991) shows that corporate data model and application architecture are common architectural deliverables in the practice of these methodologies. The core components of IA have hence been defined to include a corporate data model[1] and an application architecture. This definition of IA components is provisional. It facilitates the research into information architecture and will be validated in the course of this study.

A corporate data model (CDM) is a high level graphical model which shows the business entities relevant to an organisation and the relationships between these entities. (Figure 2.1 provides an example.) The entity-relationship diagram (ERD)[2] as proposed by Chen (1976) is effectively a CDM. The CDM is considered as essential for long-term and cost effective data management and database development (Martin, 1982, 1990a). While individual databases can be established and maintained without such a data model, these writers and others such as Towner (1989) argue that it may be difficult over the long term to expand and integrate databases without a CDM. They maintain that it provides the guidance needed to tap the full potential of a corporate-wide data management plan.

---

1 There are a number of terminologies and conventions used to define a data-oriented model of an organisation - entity relationship diagram/model, data architecture, enterprise data model, corporate data model, etc. There are subtle differences in convention and emphasis in the way some of these terms are used; e.g. entity relationship diagram tends to denote conventions adhering to those defined by Chen (1976, 1993). Essentially all refer to a graphical model which depicts an organisation's major business entities and their relationships. Hence, to avoid confusion, the term *corporate data model* has been chosen to cover all these terms. Strategic data model, which covers only entities and relationships relevant to strategic applications, is also embraced by the term but when there is a need to emphasise the strategic dimension of a strategic data model, this is explicitly done.

2 The ERD and CDM are essentially the same and differ more in convention than content or purpose. Some writers such as Inmon and Caplan (1992) prefer to use ERD while others such as Towner (1989) prefer the CDM term. The CDM term has been chosen in view of the field work involved in this research and the observation that IT professionals are more comfortable with the CDM term.

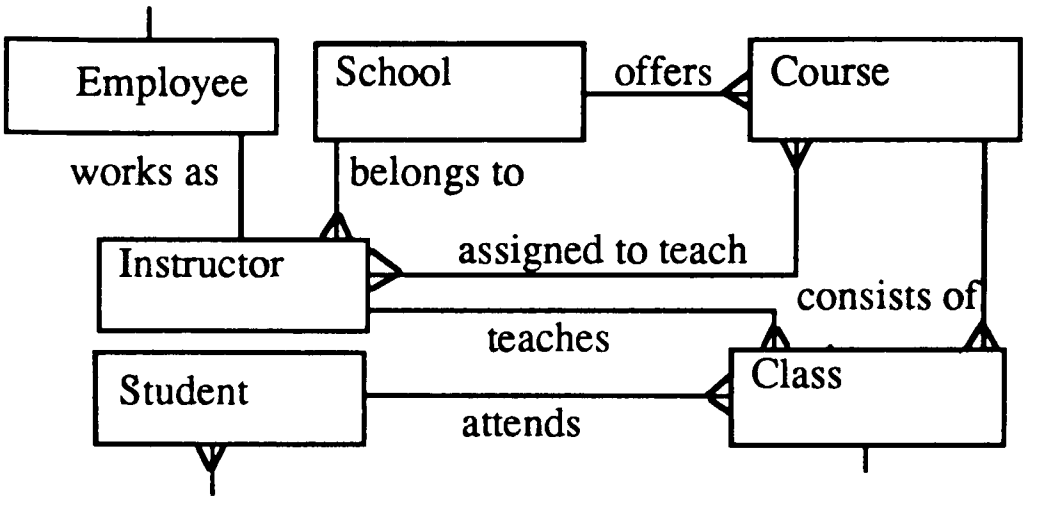


Figure 2.1: Part of a Corporate Data Model of a University

An application architecture (AA) is a graphical model showing the major applications which make up or will make up an organisation's integrated information system, and how these applications relate to each other in terms of the data flows between them. (Figure 2.2 provides an example.) "Applications become an element of architecture because organizations need a map or blueprint through which to plan development and anticipate the requirements of computing, communications and data." (Earl, 1989, p. 100). Moriarty (1990) maintains that the AA serves management communication needs during IS planning and later enables development of applications in an integrated manner.

Information Systems Architecture

Some writers use the terms information architecture and information systems architecture synonymously (Gage, 1991; Lesso, 1989, McNurlin, 1988; Osterle, 1990; Osterle, et al., 1993). This thesis, however, differentiates between these two terms: information systems architecture is made up of information architecture and IT architecture (see figure 2.3). The definition of IS architecture thus is in accordance with Zachman's (1987) IS architecture framework[3], a widely endorsed reference for architecture matters in IT (Everest and Kim, 1989; Hackathorn and Karimi, 1988; Inmon and Caplan, 1992; Von Halle, 1992; etc.). Zachman's framework presents a global view of IS planning and implementation in terms of three sets of hierarchically organised models covering data

3 Zachman's IS architecture framework is discussed in greater depth in Chapter 5.

(CDM and other data models), function (AA and other process models) and network (IT architecture and other technology models). The IS architecture model shown in figure 2.3 has been derived from Zachman's architectural concepts by marrying them with the architecture frameworks of Earl (1989) and Nolan and Mulryan (1987). Both these frameworks depict architecture in terms of "computing", "communications", "applications" and "data". Within the proposed IS architecture arrangement, IA and IT architecture are loosely coupled and influence each other.

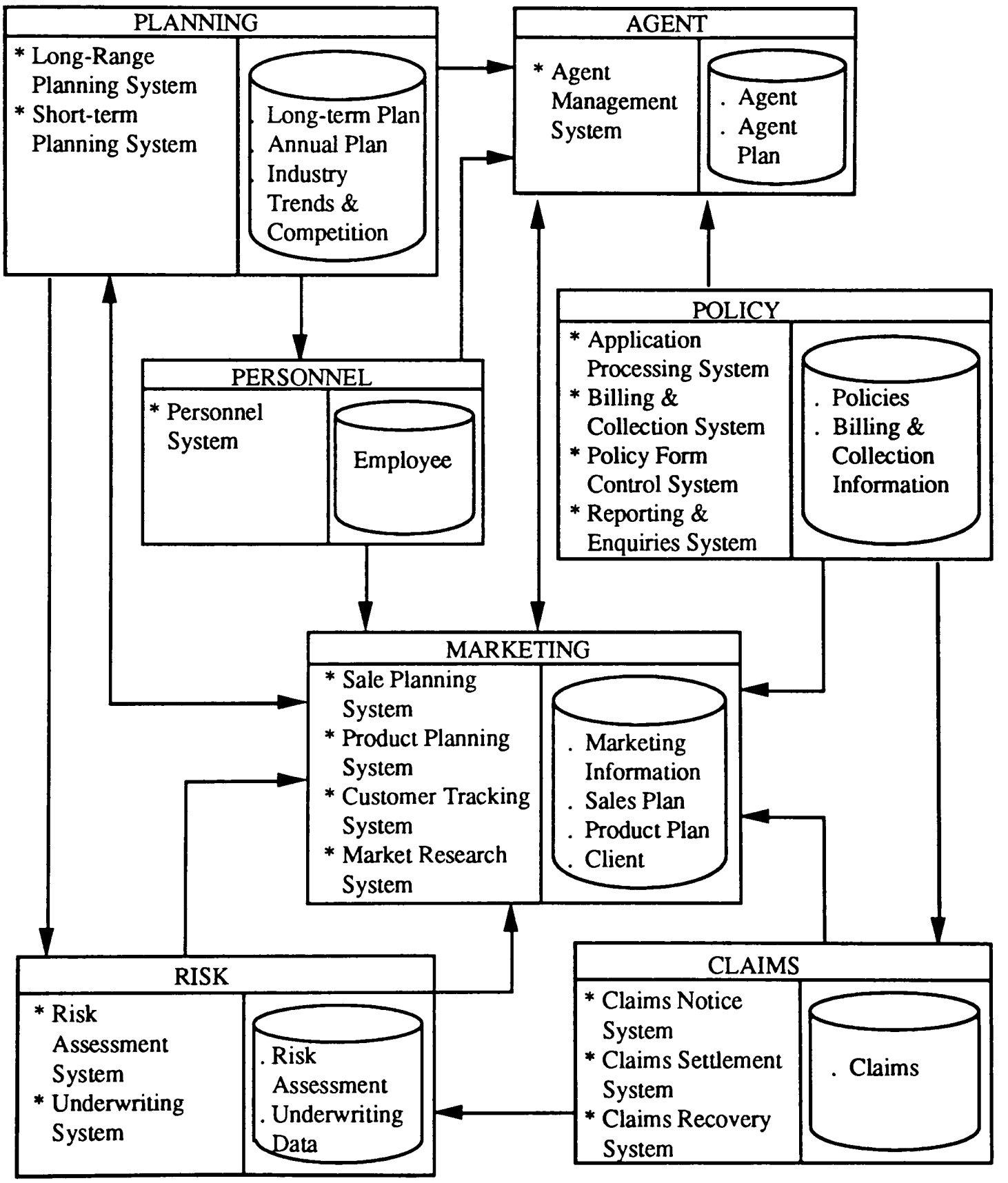


Figure 2.2: Application Architecture of an Insurance Company

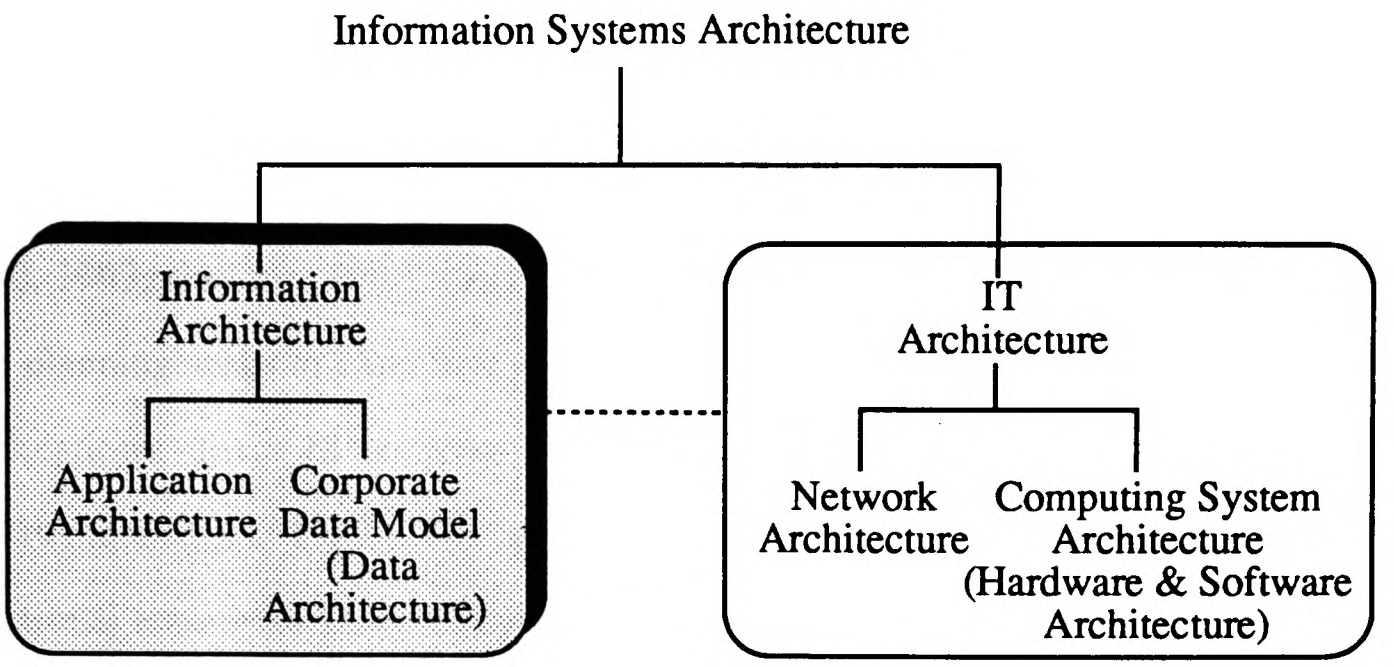


Figure 2.3: Information Architecture and Information Systems Architecture

An IT architecture[4] deals with the planning and implementation of a portfolio of necessary technologies for the effective and efficient development and operation of IT applications. The architecture consists of a computing system architecture (hardware and software architecture) and a network architecture (telecommunication network and related facilities for interlinking and interworking computing systems). At its root are technology principles and standards for building efficient and flexible computing systems and networks. The IT architecture facilitates implementation of new technologies and replacement/expansion/enhancement/retirement of old technologies. An effective IT architecture helps to ensure that the implementation and operation of strategic and essential applications is not impeded by technology limitations.

2. Information Systems Planning

The literature (e.g. Niederman, et al., 1991) and descriptions of popular IS planning methodologies (e.g. IBM, 1981) suggest that IS planning is the major source of information architecture. An IS planning[5] (ISP) exercise is an ongoing commitment to

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4 IT architecture is briefly discussed here to help in the positioning of information architecture in relation to it. It is discussed in greater depth in Chapter 5.

5 The term Information Systems Planning embraces Strategic IS Planning but is not exclusively confined to it. The term is thus also applicable to organisations such as public bodies which may not be concerned about planning of IS for strategic advantage. The term 'Strategic IS Planning' is used only when there is a need to specifically emphasise the strategic aspects of IS planning.

the explicit and systematic evaluation and determination of IT's contribution to the business. The ISP is typically driven by business requirements rather than technology; the problems of developing an IS plan otherwise have been well documented (Earl, 1990, 1993; Galliers, 1987, 1991a; Lederer and Mendelow, 1989; Ward, et al., 1992). The planning seeks to align investments in IT with business goals, identify strategic IT applications, direct IS resource management, and develop technology policies and architecture (Earl, 1989). The exercise is often conducted as a project by a multi-functional team with IT executives playing a key role. It is subsequently linked to the organisation's business planning cycle as an ongoing process. Collection of planning data is mainly via interviews with key executives and examination of the organisation's business documents/reports and systems documentation. The duration of the planning exercise is normally from one to five months depending on its scope and horizon (Galliers, 1987). An ISP exercise sometimes utilises the services of external consultants (Earl, 1990, 1993). The typical ISP's time horizon is from three to five years (Galliers, 1987; Lederer and Sethi, 1988; Premkumar and King, 1991).

The products stemming from IS planning are a mixture of hard and soft deliverables (Ward, et al., 1992): soft outputs relate to human factors, such as relationship, co-operation, commitment, awareness and motivation; hard deliverables are documents defining strategies and plans. An IS plan typically references the business plan, business strategy, organisational CSFs, key information needs, application portfolio, strategic/financial justification, information systems architecture, resource plan, information management strategy, and implementation plan (Atkinson, 1992; Osterle, et al., 1993; Ward, et al., 1992). Of these hard outputs, information architecture and IT architecture are considered to be two of the more significant deliverables particularly in major IS planning exercises (Allen, 1982; Boar, 1993; IBM, 1981, 1992; Kim and Everest, 1994; Lederer and Sethi, 1988, 1992; Martin, 1989, 1990a; Parker, et al., 1988; Zachman, 1987).

IS Planning Methodology

A formal ISP methodology is used by some organisations to carry out IS planning; examples of well-known formal ISP methodologies are Business Systems Planning (IBM, 1981), Information Engineering (Martin, 1989, 1990a, 1990b), and Method/1 (Andersen Consulting, 1992b, 1992c). There appears, however, to be a growing preference for customised methodologies (Earl, 1990, 1993; Lederer and Sethi, 1988, 1992; Premkumar and King, 1991). ISP methodologies are a hybrid of analysis/modelling techniques such as matrices, entity relationship diagramming/ conceptual data modelling, data flow diagramming and affinity analysis (IBM, 1981, 1992, Martin, 1989, 1990a). Business analysis techniques/frameworks such as Critical Success Factors (Bullen and Rockart, 1981; Rockart, 1979), Value Chain Analysis (Porter, 1985) and Competitive Forces (Porter, 1980) are being increasingly incorporated into IS planning practice to give it the required business alignment (Boar, 1993; Earl, 1988b, 1989; Galliers, 1991a; Henderson and Sifonis, 1988; ISS, 1992; Osterle, et al. 1993; Premkumar and King, 1991). (See figure 2.4 for an example). Selected information management frameworks such as Strategic Impact Grid (McFarlan, et al., 1983a), Strategic Opportunities Framework (Benjamin, et al., 1984) and Information Intensity Matrix (Porter and Millar, 1985) feature in current ISP approaches (Earl, 1988b, 1989; ISS, 1992; Ward, et. al., 1992).

Whether or not an IA is part of an IS plan is often determined by the ISP methodology employed. Some of the methodologies, such as Business Systems Planning (BSP) and Information Engineering, stipulate development of IA and define its nature and form. The emergence of Information Engineering as possibly the most popular formal methodology (Lederer and Sethi, 1988; Premkumar and King, 1991) is perhaps due to its explicit support of IA (Hackathorn and Karimi, 1988; Martin, 1989, 1990a). This can be inferred from Galliers' (1987) findings. In his study of IS planning practices in the UK and Australia, Galliers found that IS architecture was the sixth most important focus of IS

planning, and delivery of a framework/direction for information systems implementation was ranked as the second most important objective of IS planning.

IS Planning Process - An Example

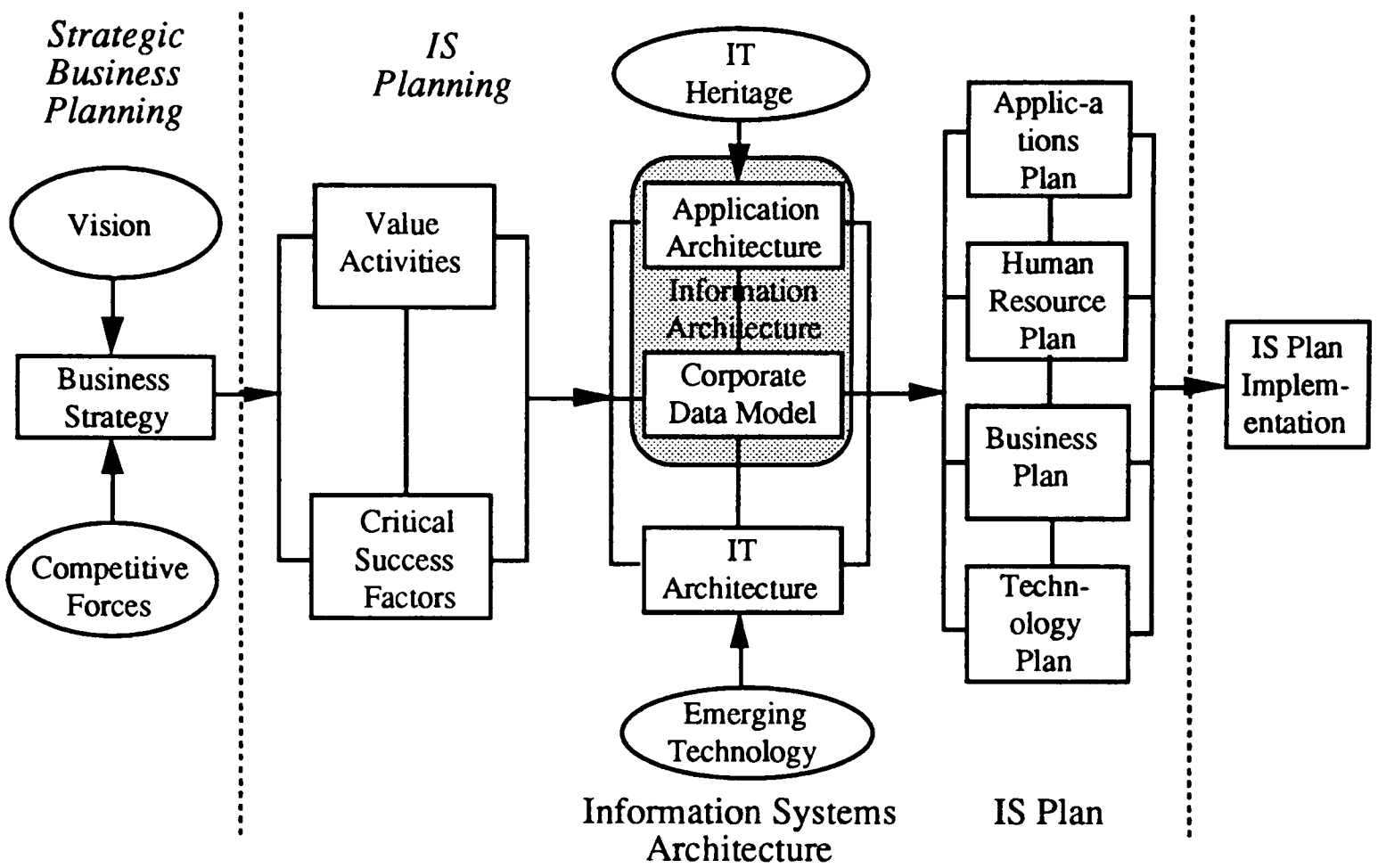


Figure 2.4: IS Planning Process - An Example (ISS, 1992)

Figure 2.4 shows an example of an IS planning process. The framework shown is that of an insurance company (ISS, 1992). It is based on the work of Henderson and Sifonis (1988). The planning process reflects current practices in IS planning as regards both business alignment and technology. The incorporation of Porter's (1980, 1985) competitive forces, generic business strategies and value chain analysis, and Rockart's (1979) CSF is a major factor in ensuring that the IS planning process gives due consideration to business issues. Application and technological issues are handled through development of the IS architecture. Business strategies/plan, CSFs, value activities and IS architecture contribute to development of the IS plan which is a set of documents comprising the applications plan, human resource plan, business plan and

technology plan. The IA and IT architecture contained within the IS plan are used in the implementation of the projects and recommendations of IS planning. The overall planning process is top-down in nature, being driven by business strategies and plans. It is bottom-up in matters related to IT heritage and legacy systems.

3. Development of Information Architecture

Information architecture is often developed as an integral part of IS planning. The IA development technique described below is a common one, featured in popular ISP methodologies such as BSP and Information Engineering (IBM, 1981; Martin, 1989, 1990a). It is presented here to provide an appreciation of the complexity of conventional IA development; please consult the references for a more comprehensive coverage of this issue. The description below does *not* seek to represent what this thesis considers to be an appropriate way to develop an IA.

Value Activity-Entity Matrix and CRUD Matrix

A prerequisite for developing an IA in the conventional way is a value activity-entity matrix. The matrix used to be defined in terms of functions/processes and data classes but recent developments in information management and strategic management have resulted in the replacement of functions/processes and data classes with value activities and business entities respectively (IBM, 1992; ISS, 1992; Martin, 1990a). This change leverages IA development with advances in value chain analysis (Porter, 1985) and entity modelling (Chen, 1976, 1993; Martin, 1989, 1990a).

Porter (1985, p. 38) defines value activities as "the physically and technologically distinct activities a firm performs". Value activities have different economics or high potential impact on differentiation, or represent a significant proportion of cost. He advocates identification of current and future value activities by isolating them in terms of their technological and strategic distinctness. Porter offers a generic value chain analysis framework to facilitate this task: five primary activities - inbound logistics, operations, outbound logistics, marketing and sales, and service (depicted in this order); four support

activities - firm infrastructure, human resource management, technology development, and procurement (layered in this order above the primary activities arrangement).

Martin (1990a, p. 461) defines an entity as "A person, thing or concept that has characteristics of interest to the enterprise. An entity is something about which we store data." Entities are identified through interviewing key informants on what the business is about, what it is likely to be according to the business plan, and what the objects of interest are. This effort is complemented by examining the company's business rules, documents, reports and documentation with focus on entities and attributes. Value activities are also used to identify and validate entities. The principle employed is that a value activity involves at least an input and an output, and the input or output is associated with at least one entity. The business entities identified in this manner are finalised after resolving any synonym or homonym in their names.

A value activity-entity matrix is constructed by arranging value activities and business entities along the two dimensions of a matrix (see figure 2.5). The matrix is completed by inserting the relationships between the entities and activities in terms of what an activity does to an entity from a data management perspective, i.e. whether an activity creates (C), reads (R), updates (U) or deletes (D) data on an entity. The matrix is referred to as a CRUD matrix, the word CRUD being an acronym of the four relationships. The matrix is claimed by Martin (1990a) and others to help business and IT executives in gaining a comprehensive understanding of the relationships between value activities and entities, and to pave the way for developing the application architecture.

Application Architecture Development

An application architecture is commonly developed in a structured manner by utilising a CRUD matrix. The matrix is first reorganised by rearranging and clustering the activities and entities in terms of their natural occurrence and relationships. Value activities are rearranged according to their logical sequence and lifecycle of the organisation's product.

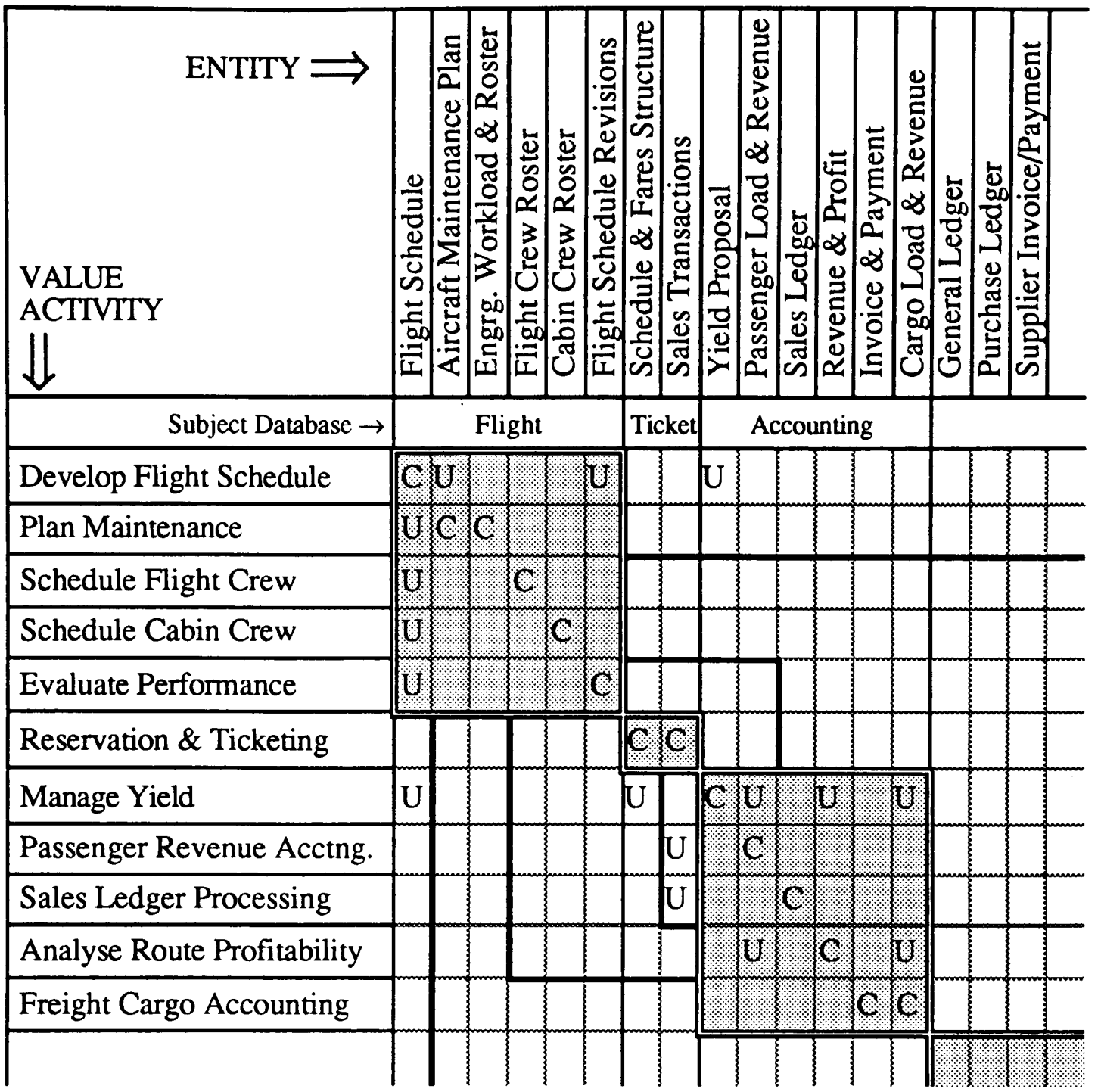


Figure 2.5: Value Activity-Entity Matrix of an Airline:
Clustering of Activities and Entities into Application Areas (ISS, 1992)

The activity-entity relationships are reclassified: a 'C' indicates that the associated value activity creates or updates/deletes data on the related entity; a 'U' indicates that the activity uses data on the associated entity but has no privilege to create or modify the entity's data.

Entities in the matrix are clustered together to form subject databases (see figure 2.5). This is done by performing affinity analysis (see Appendix 3: Glossary and Acronyms, and Martin, 1990a). Entities which have close affinity are clustered together into subject

databases. The subject database that is created/updated (indicated by 'Cs') by the first set of activities is moved towards the left of the matrix. Other subject databases are similarly shifted such that the order of entities along the horizontal dimension synchronises with the order of the value activities along the vertical dimension. The result is that the 'Cs' appear on a top-left-to-bottom-right diagonal. Such an arrangement helps in 'carving out' the application areas, as is illustrated in figure 2.5.

Each application area consists of a few inter-related value activities bonded together by a subject database for which they play the creator role. Sometimes more than one subject database may be associated with an application area. A subject database created/updated by an application area is accessed by other application areas (the 'Us' outside application area boundaries). This leads to a flow of data from one application area to another and creates inter-dependencies and inter-relationships between them. While these links between application areas are indicative of an integrated information system, too many or too much data flow is an indication of a potentially complex system with ensuing problems associated with systems development, maintenance and flexibility. The objective is to have minimum and loose coupling between application areas and high cohesion within each application area (Page Jones, 1988; Witt, 1992).

The emerging integrated application architecture can appear complex even with minimum coupling. The model is hence simplified by extracting and presenting only the application architecture model without the matrix. In such a form, it looks like a very-high level data flow diagram. To make the application architecture model more comprehensive and informative, component applications and associated subject databases are specified within the respective application areas. The status of each of these component applications (retain, revise/enhance/replace or newly develop) is indicated in the model. An application architecture developed in this manner is shown in figure 2.2 .

An application architecture can be developed in a less rigorous way from that described above. It is a bottom-up approach which assumes that applications have been identified by some other means; e.g. examination of the application portfolio in the light of industry

norms, developments in the IT industry, and IT-related initiatives by competitors, suppliers and associates. The identified applications are modelled graphically to show their inter-relationships in the form of data flows. The draft model is then refined through interactions with senior management and functional management.

The less rigorous approach may at times be required to complement the structured approach described earlier; for example, an IT application could emerge subsequent to an IS planning exercise. In such a situation, the application is phased into the rigorously developed application architecture in the manner described in the foregoing paragraph.

Corporate Data Model Development

Entity-relationship diagram is a popular technique for corporate data model (CDM) development but the full technique as specified by Chen (1976, 1993) need not be applied. A subset is more often used. The result is a CDM which, while appearing as a normal conceptual data model, contains the essence of an entity-relationship diagram. (See figure 2.1 for an example.) Such an approach helps in standardising an organisation's data modelling convention from the highest to the lowest levels (ISS, 1992). The CDM can be developed top-down, bottom-up or as a combination of the two approaches (Chen, 1993; Hayes and Nolan, 1974). The bottom-up approach uses the principle of multi-level abstraction; low-level entity-relationships are abstracted recursively into higher levels of entity-relationships and the final CDM. The top-down approach, described below, is the more common approach and is often prescribed in ISP methodologies (Inmon and Caplan, 1992; ISS, 1992; Martin, 1982, 1990a; Vesely, 1990).

A technique for identifying business entities has been described earlier. The next step in the development of the corporate data model is to make explicit the inter-relationships between the identified entities. This is commonly done by tapping the business knowledge of relevant people and examining the organisation's current and future business rules and policies. An entity-entity matrix is constructed and the relationships

between the entities are indicated in it. The entities and their relationships are modelled graphically using the entity-relationship diagramming technique. Entities are represented as rectangles, and where a relationship exists between a pair of entities, a line is drawn connecting their respective rectangles (see figure 2.1). The relationship is described next to the line. There is no direction indicated to show whether a relationship is determined from one particular entity or another. A relationship's cardinality is often reflected. The resulting diagram is presented to knowledgeable and interested parties for their comments and input. A number of iterations may thus be required before the corporate data model is ready for use.

4. Claims and Assertions About Information Architecture

As may be discerned from the preceding paragraphs, the typical IA development is demanding and requires considerable effort. Whether the resources and effort expended are worth the benefits is a major question regarding information architecture. A number of writers extol the benefits of IA while others are critical of it. Many of these claims and criticisms have not been adequately researched. The claims and criticisms are discussed below to build up the case for research in information architecture. They do *not* represent research findings at this stage of the thesis.

Business/IS Planning Tool

Information architecture, in particular the corporate data model, is seen by Chen (1976, 1993), Finkelstein (1981, 1991), Martin (1982, 1990a, 1990b), Sager (1990), Texas Instruments (1989) and others as a potential business/enterprise modelling tool. IBM (1981) regards information architecture both as a tool and a deliverable of IS planning. Rockart (1979) notes that an IA adds rigour and comprehensiveness to IS planning. McNurlin (1988), Vesely (1990) and Zachman (1987) suggest that an IA can serve in communications with management during IS planning. According to Teng, et al. (1992), an IA helps in relating business and organisational issues to IT applications. Everest and Kim (1989) and Lesso(1989) suggest that IA is of value in decision-making regarding

business needs and IT opportunities. Based on their experience, Nolan and Mulryan (1987) suggest usage of IA as a means for modelling an organisation's vision on application of IT. Allen and Boynton (1991) and Garland (1986) assert that the IA is a tool for IS plan implementation and for responding to changing business conditions during the implementation of the plan.

IS Framework

Everest and Kim (1989), via their investigation into the IA experiences of IT managers, maintain that the IA provides a framework for planning, implementing, operating and maintaining an organisation's total information system. They consider this holistic characteristic to be IA's most significant benefit. McNurlin (1988, p. 16) argues that with organisational information systems becoming more integrated and complex, the case for a holistic framework becomes compelling:

> "Once something becomes complex, an architecture is probably needed to define it. It is not necessary to have an architecture to build a log cabin. But it is necessary to build a skyscraper, because that building is complex. Like skyscrapers, corporate information systems have become so complex that they need an underlying architecture to tie them together - and to guide their future development."

IS Integration

Darnton and Giacoletto (1992) and Peterson (1992) view IA as being essential for effective IS integration. Buckelew (1985) asserts that the task of integrating information systems is difficult, the difficulty arising mainly from components that were never meant to work together. An IT-user may be initially satisfied with an application but can soon become frustrated with its inability to be adequately integrated with other applications. In pursuing this argument further, Buckelew (p. 295, p. 300) insists that:

> "Integration within each subsystem is no longer sufficient. Conscious decisions should be made on the degree of integration versus local option with both a short-

> and long-term view. ... IS must ensure, through the architectural guidelines, that today's application solution does not become tomorrow's system problem."

Project Management

It is common for an organisation to be engaged in a few systems development projects simultaneously. Wetherbe and Davis (1983) claim that these multiple projects can be co-ordinated and optimised with the aid of an IA. Giacoletto and Darnton (1989, p. 13) suggest that "One role of the Information Architecture is to ensure consistency between members and projects of virtual project teams". The typical project is not implemented in isolation but is part of a much larger organisational undertaking.

Application Development

Martin (1989,1990a), Niederman, et al. (1991) and Scheer (1989) argue that an information architecture offers the potential to serve as a basis for building a co-ordinated, responsive, long-lasting set of business applications. Allen (1982, p.77) sees in IA a potential tool for managing systems development. Lederer and Sethi (1992, p. 36) assert that unless an ISP delivers some form of IA, application development may not directly benefit from IS planning: "there may be nothing to implement." Inmon and Caplan (1992) maintain that stability in application is achieved when its development is based on IA. According to Hackathorn and Karimi (1988), application development tends to be unplanned, overlapping and disorganised without an IA. Osterle (1990) claims that an application derived from IA is less complex than an application developed without reference to an IA. Garland (1986) feels that systems developed under an overall architecture are likely to require less maintenance to meet evolving business needs.

Relevance to IT Architecture

Niederman, et al. (1991) note that an IA provides a base for planning and developing an IT architecture. Lesso (1989) suggests that with the aid of an IA, management can see how technical resources might be directed and what business impact that would have.

Brancheau, et al. (1987) argue that the IA, as a separate but integral part of an IS architecture, helps in reducing the dependence of systems defined by it upon specific hardware or software. Henderson and Venkatraman (1989) imply that, via its loose coupling with IT architecture, an IA remains relatively stable and is of value in directing IS implementation without being adversely affected by the rapid progress in technology.

Managing Change

Garland (1986) proposes IA as a tool for managing change in the IT function. Allen and Boynton (1991) insist that all major changes in IS "must come through a revamped IS architecture." Kanter and Miserendino (1987, p. 17) express this aspect of IA's usefulness thus:

> "What is needed is an architecture that can handle the complexities of today's business while having the built-in flexibility and expansibility to incorporate tomorrow's growth and new requirements."

Feeny (1993), in his study of ten IT directors, found that architecture and IT infrastructure were considered by them to be tools for maintaining the flexibility of information systems. Teng, et al. (1992) believe that IA is not only a tool for managing change but is also fundamental for business process reengineering. McNurlin (1988, p. 1, p. 8, p. 12) contends similarly:

> "Designing a system architecture is no longer just a technology issue. It now requires rethinking the business and its strategy. ... Rethinking the business and architecture planning go hand-in-hand. ... A number of companies we know are using an information systems architecture study as a means of getting management to rethink their business."

5. Criticisms on Information Architecture

Some of the above-mentioned claims are supported by research evidence. Many, however, need substantiation. A number of writers are challenging some of these claims and are pointing to problems and issues in IA development and usage.

Consumption of Significant Time and Resource

Davenport and Short (1990) and Moynihan (1990) argue that IA development is laborious and time-consuming. Rockart (1979) states that IBM's BSP methodology, in which IA development is central, requires many interviews, takes too long and often produces voluminous output without visible positive impact. Palmer (1991), an advocate of Information Engineering, may have noticed such situations too and hence recommends that IA development effort during IS planning should not exceed 40% of total effort.

Senior Management and Information Architecture

Martin (1982, 1990a) advocates development of IA as part of IS planning, and notes that it is not a trivial task. It involves development of detailed models and participation of functional executives and senior management via meetings and presentations. Moynihan (1990, p. 18), however, points out that senior management does not want IS planning to "get bogged down in detail, need endless meetings, involve too many people or fudge responsibility about who is responsible for what." Galliers (1987), via his investigation into IS planning practices, maintains that an IS planning exercise should not be so complex or technical that senior management is deterred from participating in it.

Need for Expertise in Methodology and Tools

Development of IA requires special expertise; this is evident from the books, manuals and reference guides on ISP methodologies which recommend IA development (Earl, 1989; IBM, 1981, 1989, 1992; Martin, 1989, 1990a, 1990b; Nolan and Mulryan, 1987). This can mean that additional personnel with IA skills will have to be included in

the ISP team. Alternatively, ISP team members will have to be trained in IA development and usage. The training will extend the duration of ISP further. Special tools (e.g. CASE tools) may have to be employed to ease development of IA models and matrices. Holeman (1988, p. 17) (an IT consultant), in his review of IS planning tools, maintains that "one factor that has contributed to the failure of many (ISP) projects has been the absence of an automated ISP tool."

Obsolescence of Information Architecture

While acknowledging the potential benefits of IA, Niederman, et al. (1991, p. 479) suggest that "the information architecture is difficult to capture, use, and maintain, due to both the breadth of information requirements and the changing nature of the business environment." Allen (1982, p. 86) expands on this issue and warns that :

> "Inflexible architectural decisions or grand designs from the past are a major impediment to change. Such rigidity creates painful problems because the requirements for new applications and data arise quickly. Business segments change rapidly ... many vital aspects of the organisation change faster than do information systems. ... But it takes several years to restructure the applications and data architecture of a business."

The typical IA is a static model which merely reflects information system requirements and situation perceived at an instance. Organisations are dynamic and changes are inevitable, but it is often the case that the IA is not updated when these changes occur; this is in spite of the yet-to-be-proven claim that CASE tools can facilitate IA development and maintenance (Martin, 1990a; Texas Instruments, 1989, 1991). The IA becomes obsolete, diminishes in value and is soon hastened to the shelf.

Failure of Information Architecture

An IA is not an end in itself but is a means for implementing the IS plan. Brancheau, et al. (1987) and Cecil and Goldstein (1990) feel that the IA has generally failed in this

regard. Brancheau, et al. point out that the typical IA is large, broad in scope, highly abstracted, cumbersome and complex. Gage (1991, p. 67) notes that too often architecture efforts delve into detail without delivering anything substantial but instead produce "volumes of documentation" which eventually end up "on a shelf somewhere to gather dust". Crescenzi (1988, p. 15) observes that "Most failed IS architectures were designed in detail". Heygate (1993, p. 83), an IT consultant from McKinsey, expresses his views on the failure of IA thus:

> "Probably the single greatest contributor to present disenchantment with IT delivery has been the appalling waste of money on huge data and application 'architecture' projects. Hundreds of millions of dollars have been spent on these massive undertakings on the strength of the usually unproven and certainly unquantified assumption that reorganizing a corporation's database will lead to competitive advantage. All too often, their complexity has led to a graveyard of project failures, from which even lavish further expenditure offers little promise of escape."

6. Research Evidence on Information Architecture

There has been a dearth of research in IA (Earl, 1989). It has received the attention of researchers only in the recent period, perhaps as a result of its emergence as a top information management issue. On the other hand, IA has continued to hold sway in the practitioner's world and there has been no lack of literature on IA in this domain (e.g. in Computerworld, Datamation, IS Analyzer and magazines/publications from IT vendors and consultants). The usage, benefits, problems and limitations attributed to IA in these publications tend to be based on perception, inference and anecdote rather than research per se. Thus it is not surprising that a number of the claims discussed above are being challenged by emerging research evidence. Some of this evidence has been mentioned in the discussion above. Three cases of research in particular provide notable evidence on the benefits, problems and characteristics of information architecture, and hence are briefly reviewed below.

Information Systems Planning in UK Companies (Earl, 1990, 1993)

As part of OXIIM's (Oxford Institute of Information Management, Templeton College) research in information management, Earl carried out a qualitative study of the IS planning experiences of 27 UK companies in 1988-89. All were large companies from a range of industries. Many were among the leaders in their respective industries. The companies had a range of ISP experience, from 1 to 20 years. Earl categorised the companies' IS planning practices into five approaches based on their focus. Of these, two[6] are relevant to information architecture:

* *Technological Approach* - It focuses on the development of architecture. An IA development technique, such as the one described above under Section 3, would be a central part of the approach.
* *Organisational Approach* - It emphasises the planning process and focuses on senior management's understanding and involvement. Planning decisions are made through continuous integration between the IT function and the organisation.

Earl concluded that the 'Organisational Approach'[7] was the most successful of the approaches, and that it was markedly superior to the architecture-oriented 'Technological Approach'. He noted that the 'Technological Approach' did have its strengths despite its lower ranking. IS planning success was generally *perceived* by the organisations as being more feasible via a 'Technological Approach': "perhaps ... it represents what respondents thought an IS planning methodology should look like." (Earl 1993, p.15). The approach provided rigour and structure, and facilitated usage of CASE tools. There

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6 The other three ISP approaches are:
Business Driven - business planning drives IS planning under the assumption that current business direction or plans are the only basis upon which IS plans can be built.
Method Driven - a formal ISP methodology drives IS planning; external consultants may be engaged to undertake the task.
Administrative Approach - resource planning and formal approval procedures supersede other planning considerations.

7 The Organisational Approach is discussed in greater depth in Chapter 5.

were defined deliverables in the form of blueprints for technology and application implementation.

As regards weaknesses, the 'Technological Approach' was the most demanding of the five approaches in matters of IS planning effort and resources. Earl also noted various other weaknesses. There was universal comment in his study on the length of time involved. Methods employed were overly complex and beyond the comprehension of users, and "perhaps beyond the needs of business". The planning received high profile but carried commensurate risks. Top management was initially committed to the ISP project but over time started to question it. "User managers reacted negatively to the complexity of the analysis and outputs and reported a tendency for technical dependencies to displace business priorities." (1993, p. 10) .This could be partially explained in that "business competitiveness is rarely the focus of the Technological Approach." (1993, p. 15). The approach factored requirements into smaller modules for implementation. This was thought to limit benefits, slow down implementation and impair cross-functional application development. Overall, aborting of architecture-centred IS planning was not uncommon.

In spite of these weaknesses, the 'Technological Approach' was ranked third after the 'Business-Driven Approach' as the most successful way to conduct IS planning. Though the 'Organisational Approach' was rated as the overall superior approach, some inherent problems in it were noted by Earl: difficulty in generating new themes, softness of methodology and general inability to deliver architecture. These are areas where the 'Technological Approach' is strongest; its weak areas are where the 'Organisational Approach' is superior (see Chapter 5). There appears to be potential for a symbiotic arrangement in the form of a hybrid 'Organisational-Technological Approach'. Earl suggests this combination as a possibility for IS planning practice and notes that some organisations are in the course of doing so.

Strategic Data Planning (Goodhue, et al., 1992a)

Strategic data planning, a form of Earl's 'Technological Approach' IS planning, was first introduced by Martin (1982). It focuses on defining an organisation's data and developing a data architecture to guide future systems development. Martin's (1989, 1990a, 1990b) formalised Information Engineering methodology advocates the practice of strategic data planning.

Goodhue, et al. (1992a) investigated the strategic data planning practices of nine large organisations in the US. Based on this investigation, Goodhue, et al. argue that the data-oriented approach is most appropriate when data integration is critical to the strategic goals of an organisation. Even in this situation, care is required in the practice of strategic data planning because of its inherent problems. Goodhue, et al. point out that strategic data planning is a time-consuming and complex process. They feel that the volume of detail involved can swamp creativity and obscure the larger strategic picture. Expectations from usage of the planning approach generally exceed realised outcomes, and often the positive outcomes are different from those intended. The researchers contend that strategic data planning is an inefficient IS planning approach when the primary goal is identifying high-payoff systems.

Goodhue, et al. further argue that strategic data planning may not be the best way to produce a data architecture. They point to the possibility of adopting and modifying appropriate corporate data models from other organisations as an effective and economic way to develop the required data architecture. In an earlier research, Goodhue, et al. (1988) also propose consideration of Pareto's "80/20" principle for data architecture development. They maintain that a less rigorous approach can deliver the necessary data architecture. It is unlikely to be perfect but neither is the model delivered by standard strategic data planning. Goodhue, et al. (1992a, p. 28) substantiate their latter contention by noting that the participants in their studies had expressed "uneasiness about the correctness of their architectures", and had complained that "the architectures are too

high-level to be useful in designing systems, or they contain errors that are only apparent when a more detailed analysis is conducted."

In conclusion, Goodhue, et al. (1992a, p. 27) suggest that:

> "Where data sharing is not absolutely critical, or the organisation is very large or very decentralised, an SDP [strategic data planning] may not be appropriate".

Building an IS Architecture (Kim and Everest, 1994)

Kim and Everest's recent paper supports the findings of Earl and Goodhue, et al. and helps to further clarify the validity of some of the claims and criticisms on information architecture. In order to get an indication on IS architecture experience in the industry, Kim and Everest conducted 20 monthly discussion sessions over 2 years with a panel of 22 senior IS managers from 15 organisations.

The IS managers' architecture experience was generally found to be unsatisfactory. Nevertheless the managers were enthusiastic about IS architecture, pointing out the potential benefits of a well-maintained architecture. They felt that an IS architecture could provide an integrated view of the information resources of an organisation. It could serve as a road map for planning detailed process and data modelling activities, and provide a basis for planning and prioritising databases and applications.

The major failure of IS architecture as seen by the IS managers was its unrealistic scope: it took too long to develop, involved too much detail and was governed by unrealistic expectations. The typical IS architecture was "stacks of paper documentation ... too conceptual, bulky, and inflexible to be of real use." (p. 9). The architecture's size prevented it from being updated regularly[8]. This consequently led to the IS architecture's obsolescence and abandonment. Development of IS architecture required significant human resource but adequate and appropriate manpower was not assigned to the project

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8 CASE was not mentioned. Nevertheless, noting the growing adoption of CASE tools (Orlikowski, 1993), it can be reasonably inferred that the adoption has generally not benefited IS architecture development and maintenance.

as it was not considered to be of high priority. User-departments were generally not interested in the project or its deliverables. Few functional managers were willing to spend their time or resources on a project of seemingly little relevance to them. There was a lack of continuity in the project at corporate and divisional levels. Top management commitment tended to be short-lived, leading to loss of support from them for usage of IS architecture in systems development.

7. The Need for Research in Information Architecture

The available research evidence presents a gloomy picture of IA. The evidence supports a number of the criticisms directed at it and suggests that IA is generally a failure, both as a tool and a deliverable of IS planning. Some of the research findings however do support a few claims such as IA's ability to incorporate rigour into IS planning and IA's potential in addressing emerging IT infrastructure and IS integration requirements. Nonetheless, some important IA issues remain uninvestigated. Existing research tends to focus on benefits and problems of IA and occasionally covers IA development as part of an investigation into ISP. Little work has been done on what constitutes a good IA and how it should be developed and used. A number of writers (Earl, 1989, 1990, 1993; Lederer and Sethi, 1988; McGee and Prusak, 1993; Teng, et al., 1992; and others) have taken cognisance of this situation and have called for more research in IA.

Information architecture's sustained position as a top information management issue (Boar, 1993, p. 32) is giving additional impetus for research in it. Benjamin and Blunt (1992) contend that organisations in general have not been able to satisfactorily integrate their information systems. Perhaps this state of IS integration underpins the recent interest in IA. IA is regarded as a potential tool to achieve IS integration, a highly ranked information management goal (Boar, 1993, p. 32; Gibson and Jackson, 1991; Goodhue, et al., 1992b). The importance of IA in this regard is expected to continue in the future when IT becomes fused with the business (Norton, 1987). Benjamin and Blunt (p.18) predict that IT applications will be planned and developed increasingly with the aid of IA. They state that:

> "Without an understandable information architecture, IT will be unable to bridge the gulf between the new technologies and the business's strategic directions."

Niederman, et al. (1991, p. 492, 491), in noting that "because of the magnitude of IT investments, the infrastructure issue will remain important in the years ahead", call for research in information architecture:

> "Rigorous examination of information architecture, for example, can (1) categorize and describe techniques for creating firm-wide information architectures; (2) clarify organizational circumstances in which an information architecture is of greatest value; (3) link initiation, development, and evaluation of information architecture to technology infrastructure requirements and to theoretical bases for predicting successful enterprise-wide application of IT."

8. Proposed Research

The fact that IA is a topical issue with potential implications but lacking adequate research (Earl, 1989; Kim and Everest, 1994; Lederer and Sethi, 1988; Niederman, et al., 1991) makes this doctoral study a potentially useful one to IS practitioners and researchers alike. This research is an effort in clarifying the position of IA and its development and usage from a management perspective. The objective of the research is to contribute to a better understanding of IA and how it can employed in efforts to fuse IT with the business in the pursuit of strategic advantage. The overall hypothesis at this stage of the research, based on the extant literature and personal experience, is as follows:

* *Information architecture is an information management tool of potential value in both IS planning and implementation. The general failure of IA arises from its improper form, structure and positioning. With correct targeting and appropriate design, an information architecture can contribute to business planning in technology matters and leverage IS planning and implementation efforts.*

With IS planning becoming more business oriented, the information architecture concept conceived during the data processing era has become dysfunctional. It needs to be reconceived to synchronise with the business thrust and happenings in information management in the current IT era (Earl, 1989). This research seeks to do that.

The research domain shown in figure 2.6 has emerged from a holistic consideration of the research hypothesis, IA claims and criticisms, research evidence, personal experience and observation, and predictions and history of IA. A research domain is generally regarded as necessary for effective investigation (Nunamaker, et al., 1991). In this research, it has served to guide the whole IA study. It has been used to progressively develop focused research models/domains specific to the issues being investigated at any one stage. (See figure 4.1 in chapter 4 and figure 5.1 in chapter 5.)

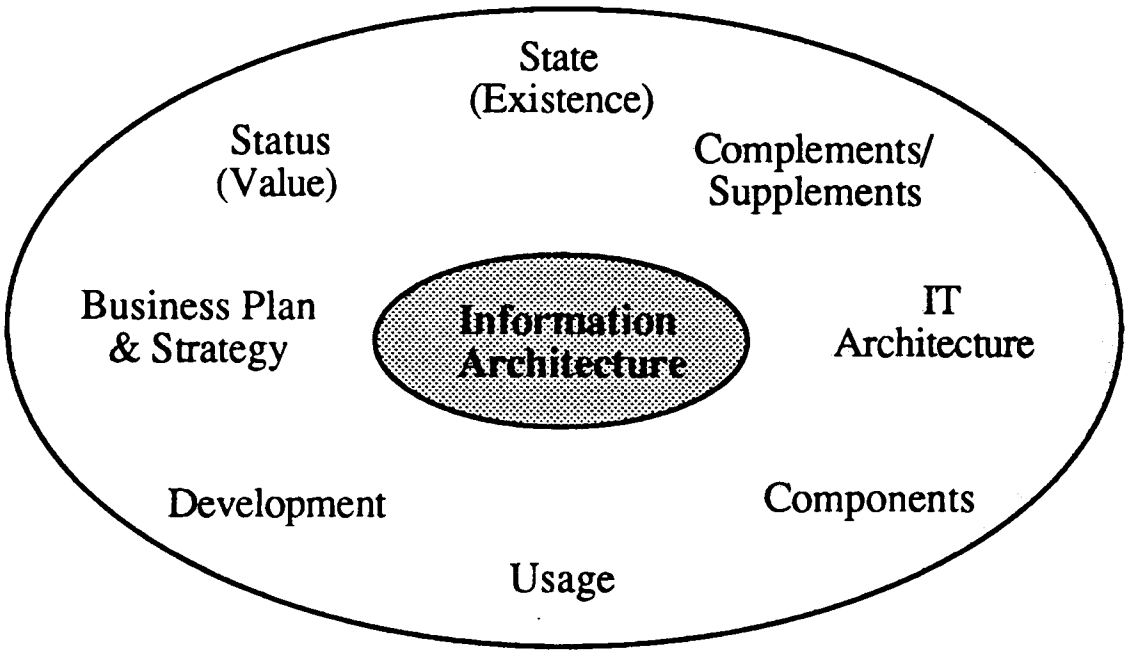


Figure 2.6: Major Elements in Overall Research Domain

There are many questions which could be investigated on information architecture. It is not feasible to investigate all possible questions even in a comprehensive doctoral research. Hence a subset[9], as guided by the overall research hypothesis and defined by

9 Some of the IA research issues not covered by this study are indicated in Chapter 9 under 'Implications for Further Research'.

the issues depicted in the research domain, was identified for the study. Underlying the formulation of this subset was the need for the study to be objective, complement/ supplement/support other studies wherever possible, be of value in clearing some of the fuzziness surrounding IA, provide some novel and original insights into IA, and make a clear contribution to research and practice of IA. The final set of questions which were formulated for investigation are listed below:

* State - How wide is the existence of IA? Is there any industry or type/size of organisation where it is more widely used?

* Status - What is the general perception of IA's value in the real world? Are there any variations in relation to industry or organisation type/size?

* Business and Strategy - What is the relationship of IA to strategy development, business planning and business modelling? Is there any relationship between IA and strategic use of IT? What is the association between IA and role of IT?

* Development - When, why, how frequently, how and by whom is IA developed? What tools/techniques/methodologies are used to develop IA? The impact of recent IT developments (e.g. CASE tools) on IA.

* Usage - When, why, how frequently, how and by whom is IA used? How does IA affect/contribute to information management, strategy development, business planning, IS planning, IS plan implementation and application development?

* Components - Are application architecture and corporate data model effective components of IA? What are the other components of IA? What are the characteristics, form, appearance and structure of IA's components? What are the differences and relationships between these components? What is the general perception on IA components? What are the purposes/benefits,

limitations/problems and relative strengths and weaknesses of each component? How and why is each component developed and used?

* IT architecture - What are the facts regarding IT architecture and its relationship to information architecture?

* Complements/Supplements - Is there any tool/technique/process which is a complement/supplement to IA?

These questions and the overall research hypothesis seek to provide a foundation for conducting the research into information architecture in a progressive manner.

9. Summary

This chapter has clarified the situation and basis for the research in information architecture. There is much uncertainty on what an information architecture is and what it realistically offers to information management. Many claims, some without supporting evidence, are being made about the benefits of IA. At the same time, IA is also the target of criticisms. The available research evidence on IA suggests that it is more of a failure than a success. Despite this situation, information architecture is currently a top information management issue. A topical issue with many unanswered questions and lacking adequate research warrants investigation. This research has hence sought to elucidate information architecture, and investigate and offer propositions with supporting evidence as to how it can be efficiently developed and effectively used.

The position of information architecture in the real world is still somewhat unclear. Hence before any in-depth investigation into IA is carried out, its state and status need to be clarified first. The evidence from this initial investigation can establish the basis and direction for further work. It will seek to crystallise the thinking and guide the in-depth investigation. The need to position the research in the real world at large has been given due consideration in the research methodology design, the subject of the next chapter.

Chapter 3: Research Methodology

- Research Methodology Typology
- Research Paradigms and Methods
- Methodology for Information Architecture Research
- Large Scale Postal Survey
- Case Studies

The last chapter developed the case for research in information architecture (IA) and identified the questions to be researched. It was established that there is much uncertainty regarding IA's general position in the real world. It emerged that the state and status of IA need to be clarified first before any in-depth investigation into IA's development and usage could be carried out meaningfully. This chapter describes the design of the research methodology used for this two-stage investigation. The usage of the research methodology and associated experience are discussed in chapters 4 and 6 where they are presented within the context of the actual research work carried out.

1. Research Methodology Typology

Bennett (1986, p. 7, p. 14) defines research as

> "a systematic, careful inquiry or examination to discover new information or relationships, and to expand/verify existing knowledge for some specified purpose."

He classifies research practice as theory-orientated and action-orientated. Theory-orientated research is pure basic research which is concerned with resolving, illuminating, or exemplifying a theoretical issue. It is concerned with developing new concepts and models, generating new knowledge, and enhancing understanding about the world. Action-orientated research is concerned more with providing information to serve current needs, solve existing problems or generate decision alternatives. Bennett argues that both forms of research are necessary. Without the development of new

concepts, new theories and new principles, little technological progress is possible. At the same time, a systematic attempt is also required in translating these sometimes highly theoretical and academic findings into relevant practical applications.

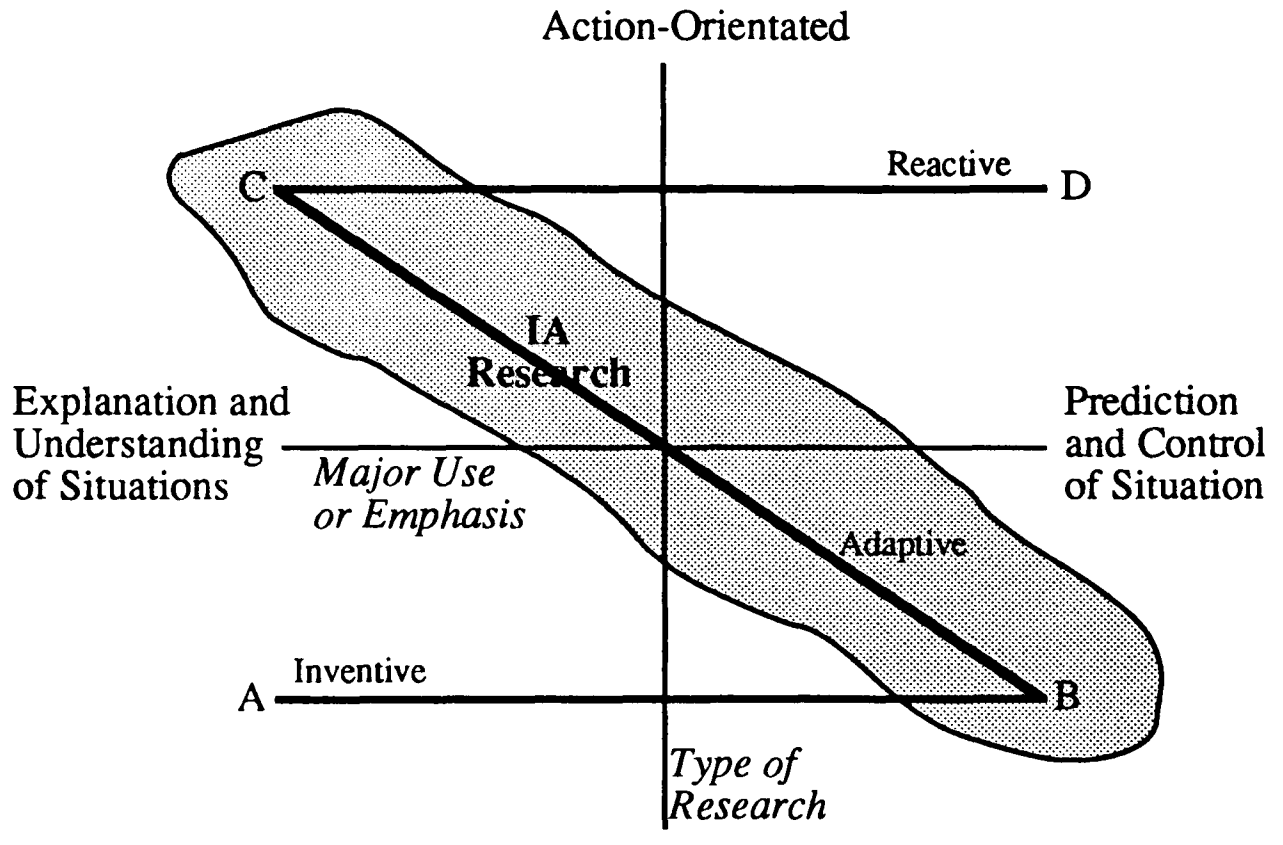


Figure 3.1: Types of Research and Their Use (Bennett, 1986)

There are three aspects to research - knowledge, action, and translation of knowledge to action. Bennett has modelled these aspects; see figure 3.1 . The vertical axis represents the two extreme forms of research while the horizontal axis indicates their main emphasis. Point A refers to explanation/understanding of the real world in terms of theory. Point B relates to predicting and controlling of events with reference to theory. A research conducted along A-B can be described as *inventive* since it is concerned with producing new theories and ideas and testing their validity. A research positioned along C-D aims at understanding real world problems and controlling/predicting their outcomes. It can be described as *reactive* as the concern is reacting to problems arising in ongoing situations. Bennett considers the common organisational problem solving to be of this type. He contends that managers engaged in such problem solving are not adequately supported by research in management (p. 19) "because either few or no new

methods or ideas have been developed in the inventive process A-B, or, if they have, little attempt has been made to translate them into useful, working principles i.e. the '*adaptive*' process B-C."

This research seeks to contribute to both theory and practice of information architecture. An *adaptive* type of research is needed to satisfy this objective (see figure 3.1). The research methodology was hence designed accordingly (see section 4 below). A review of relevant research paradigms and methods helps in the appreciation of the research methodology design.

2. Research Paradigms and Methods

Land (1985, 1992), Hirschheim (1985) and many others maintain that information systems are essentially social systems. This epistemological positioning of IS enables research efforts in information systems to benefit from established paradigms in social science research. Two paradigms in particular are relevant to the design of the IA research methodology: *positivism* and *phenomenology* (anti-positivism) (Bogdan and Taylor, 1975; Burrell and Morgan, 1979).

Positivism and Phenomenology

Positivism is based on the unity of the scientific method of enquiry, the search for human causal relationships, the belief in empiricism, the objective nature of science and its processes, and the logical and mathematical foundation of science (Hirschheim, 1985). It seeks an objective form of knowledge (laws, relationships, facts, etc.) which can be identified or tested by any researcher who follows the same route. The positivistic approach is practised in social science research via quantitative methods such as surveys, demographic analysis and experiments. Falsifiability is the demarcation criterion that Popper (1968) uses to distinguish a positivistic from a non-positivistic approach. His contention is that while a theory cannot be proven conclusively by any number of confirming events, it can be disconfirmed by a single instance in which its predictions do not hold (Markus, 1989).

Individuals do not exist in isolation. They need to be understood in the context of their cultural and social life (Hirschheim, 1985). Phenomenology attempts to do this. It describes and elucidates human experience by seeking meaning, definition, analogy, reason, explanation and other qualitative knowledge. A phenomenologist seeks to understand the subjective world of people through qualitative techniques such as participant observation and open-ended interviews.

Research Methods

The two research paradigms discussed above provide the conceptual foundations for two classes of research methods for practice: *qualitative* and *quantitative*. Positivism underpins the quantitative method while phenomenology is at the core of the qualitative method. Quantitative method, however, can be phenomenological and qualitative method can be positivistic. Which of the two classes of methods is the better is a contextual and contingent matter. What is clear is that neither one is superior to the other (Kraemer and Dutton, 1991; Yin, 1989b).

The quantitative method is beginning to feature very significantly in social science research as a result of better understanding on how to quantify descriptive variables (e.g. via Likert-type scales, weights and ranks) and the easy availability of sophisticated analysis tools (e.g. SPSS and SAS statistical software packages, and PC spreadsheets) (Rudestam and Newton, 1992). The method is characterised by empiricism, quantitative data, statistical methods and hypothesis testing. A research model is often employed in quantitative research (Bennett, 1986; Kraemer, 1991); as noted by Lucas (1991, p. 278), "If there is no model, analysis becomes a frustrating exercise in hunting for relationships." The typical quantitative research seeks to identify causal relationships and explain variances and behaviour in a population via statistical methods applied to a random sample of the population (Wynekoop, 1992). Descriptive statistics are used to describe patterns of behaviour while inferential statistics, in the form of probabilistic arguments, are used to generalise findings from sample to population (Kraemer, 1991).

This feature of the quantitative method, often practised in the form of surveys, makes it potentially suited to address the broad research issues on the state and status of IA usage.

According to Polkinghorne (1991, p. 112), qualitative method is especially useful in the "generation of categories for understanding human phenomena and the investigation of the interpretation and meaning that people give to events they experience." The method seeks to reduce research data, mainly in the form of words rather than numbers, to themes or categories, and analyse and evaluate them subjectively (Rudestam and Newton, 1992). Qualitative studies are often interpretative and non-deterministic and are directed at understanding the phenomena being investigated. There is greater emphasis on description and discovery and less emphasis on hypothesis testing and verification. The general understanding is that qualitative research delivers rather than tests theory (Eisenhardt, 1989). This does not mean that there is no theory guiding the research. On the contrary, there is substantial theory underpinning the research but there is generally no explicit hypothesis per se to be tested, as is common in quantitative research. Nevertheless a theoretical framework can be used (Benbasat, et al., 1987; Markus, 1989; Miles and Huberman, 1984; Yin, 1989b), though those who seek to develop strictly grounded theories may choose not to use one (Eisenhardt, 1989; Glasser and Strauss, 1967; Strauss, 1990). Three fundamental assumptions are applicable to a qualitative research regardless of the specific way in which it is conducted (Patton, 1980):

* Naturalistic inquiry - Seeking to understand phenomena in their naturally occurring states and setting.

* An inductive approach - Beginning with specific observations and moving toward the development of general patterns that emerge from the case studies.

* A holistic view - Seeking to understand phenomena in their entirety in order to develop a comprehensive understanding of the research object.

The qualitative method can provide a rich understanding of *why* events occur, making it suited for a holistic in-depth investigation into information architecture.

3. Specific Research Methods

Specific methods are available for conducting qualitative or quantitative research in the social sciences and IS. A research method is typically classified as quantitative or qualitative depending on which of the two approaches dominates the method in practice. No research method in practice is completely qualitative or quantitative (Yin, 1989a, 1989b). The principal methods for conducting research in IS are experiments (quantitative), surveys (quantitative) and case studies (qualitative) (Cash and Lawrence, 1989).

Experiments

Experiment is very much quantitative in nature and subscribes to positivism . Emphasis is placed on measurements and controlling for extraneous sources of error. The purpose is to isolate a variable of interest and manipulate it to observe the impact of the manipulation on a second variable (Rudestam and Newton, 1992). Bennett (1986, p. 36) contends that "a true experiment is unlikely in management research". Experiment was not considered as an option for this research either. The scope and objective of this research does not require an experiment.

Survey Research

Survey research is by far the most popular research method in the social sciences (Bennett, 1986) and IS (Kraemer and Dutton, 1991). Lucas (1991, p. 273) defines survey research in IS to be "studies that collect data systematically from more than a few entities and perform some sort of statistical analysis of the data." Kraemer (1991, p. xiii) suggests that the purpose of survey research is "to generalize from the sample to the population about some substantive issue." IA's state and status is one of the substantive issues in this research and generalisation on this issue from a sample of organisations is the requirement. Survey research was hence selected to investigate IA's state and status.

The specific method chosen was a postal survey. Postal survey involves questionnaires with a list of questions for information or opinion that are mailed to a sample of cases for completion and return (Miller, 1991; Nachmias and Nachmias, 1992). Other forms of surveys such as personally administered questionnaires and telephone surveys were considered but were rejected in favour of the postal survey because it optimally addressed the IA research requirements on deliverables, effort, resource and time.

The postal survey method has a number of advantages. It permits wide coverage of the target population at minimum cost and effort. The survey can reach sites which are difficult to locate or access physically. A mail questionnaire enables respondents to provide considered answers. This is especially important when a respondent has to refer to a source before responding. The mail questionnaire is a relatively objective approach for obtaining data. The researcher presents a uniform position to all respondents. A respondent can maintain a sense of privacy especially on matters of opinion. The mail questionnaire is a useful way to conduct longitudinal surveys. Overall, the postal survey is a mature research method which is being continually examined and updated for increased effectiveness.

The major disadvantage of mail questionnaire is its low response rate. Postal surveys are so popular that response is now an issue. The response rate for many surveys are well below 50%, some around 10% (Necco, et al., 1987). Bias in sample is another potential problem of postal surveys; e.g. views of respondents and non-respondents can differ significantly. Generalisation from a survey sample can thus be inaccurate. Significant effort and care is hence required to eliminate inherent bias in sample.

Combined Research Approach

A survey of IA's position is necessary for this doctoral research but it is not sufficient. In-depth case studies can provide the required information for a fuller understanding of IA development and usage. Case study research, however, is not as effective for generalising about a population; it is not an appropriate alternative to survey for this task.

The requirements of this research could be more effectively satisfied by a combined approach consisting of a postal survey and in-depth case studies, the former to deal with IA's position and the latter to elucidate key IA development and usage issues. Such a combined approach is advocated by Gable (1994), Kling (1991), Kraemer (1991), Wynekoop (1992) and many others.

Case Study Research

A case study is "an empirical inquiry that investigates a contemporary phenomenon within its real-life context when the boundaries between phenomena and context are not clearly evident, and in which multiple sources of evidence are used." (Yin, 1989b). The method focuses on understanding the dynamics present within single or multiple settings and can involve numerous levels of analysis (Eisenhardt, 1989). Bennett (1986) maintains that case studies yield realism and richness of information by enabling exploration and understanding of issues, problems and relationships in a particular situation.

Case study research has a number of advantages. It allows an investigation to be holistic (Remenyi, 1990). Its nature is such that various data collection techniques are at the researcher's disposal. These include: examination of documents, documentation, archival records and reports; interview of people at various levels within the organisation and others outside; usage of questionnaires; observation; action research. This feature of case study research enables triangulation of findings (Miles and Huberman, 1984). Case study research also permits overlap of data analysis with data collection. The overlap provides continuous opportunities to a researcher to improve the quality of his research through progressive learning and adjustment (Eisenhardt, 1989); case study research, in contrast to survey research, does not utilise a fixed model or formula.

The major disadvantages of case study research stem from the method's subjective approach. The outcome of a case study is dependent not only on those with whom the researcher interacts but also on the researcher. The researcher's skills, experience,

personality, knowledge, bias, culture and education impact the case study. While this is also true for other research methods such as survey, it is more significant in case study research because these characteristics have to be directly related to people in a real-time open interaction. There is also the inherent limitation to the process of observation. Not everything that needs to be seen is seen, and whatever is seen is interpreted in the light of the researcher's characteristics and background. Observation may be distorted by the unintentional influence of the observer on the observed. There is the problem of the researcher "going native" whereby he loses his own perspective and is co-opted into the perceptions and explanations of his informants (Miles and Huberman, 1984). He may also have a tendency to give greater consideration to information from influential, high ranking or articulate informants.

Despite these disadvantages, there is a strong case study tradition in IS research (Hamilton and Ives, 1982; Lee, 1989; Markus, 1989; Simon, 1989; Yin, 1989a). Objective research methods such as experiments and surveys tend to examine phenomena in isolation without considering the social, cultural or historical context within which they exist (Orlikowski and Baroudi, 1991). Case studies on the other hand enable the study of phenomena in their natural settings. A case orientation is thus appropriate in IS research to gain detailed insights into what is fundamentally a complex social system (Hirschheim, 1985; Land, 1985). Benbasat, et al. (1987) suggest that case study research is of potential value in IS for exploring a topic about which knowledge is limited. It is contended here that information architecture is such a topic and that case study research is an appropriate method to get a richer understanding of this topic.

4. Methodology for Information Architecture Research

The methodology which was designed for this research sought to progress from general to specific issues (see figure 3.2). The idea to undertake research in information architecture emerged from personal experience and interest in matters of IS planning and implementation. This idea was developed into a research proposal and refined and sharpened through literature search and guidance from the supervisor. The issues to be

investigated were finalised as a set of research questions (see Chapter 2). Two parts were identified: one part was on IA's state and status; the other part was on development and usage of information architecture.

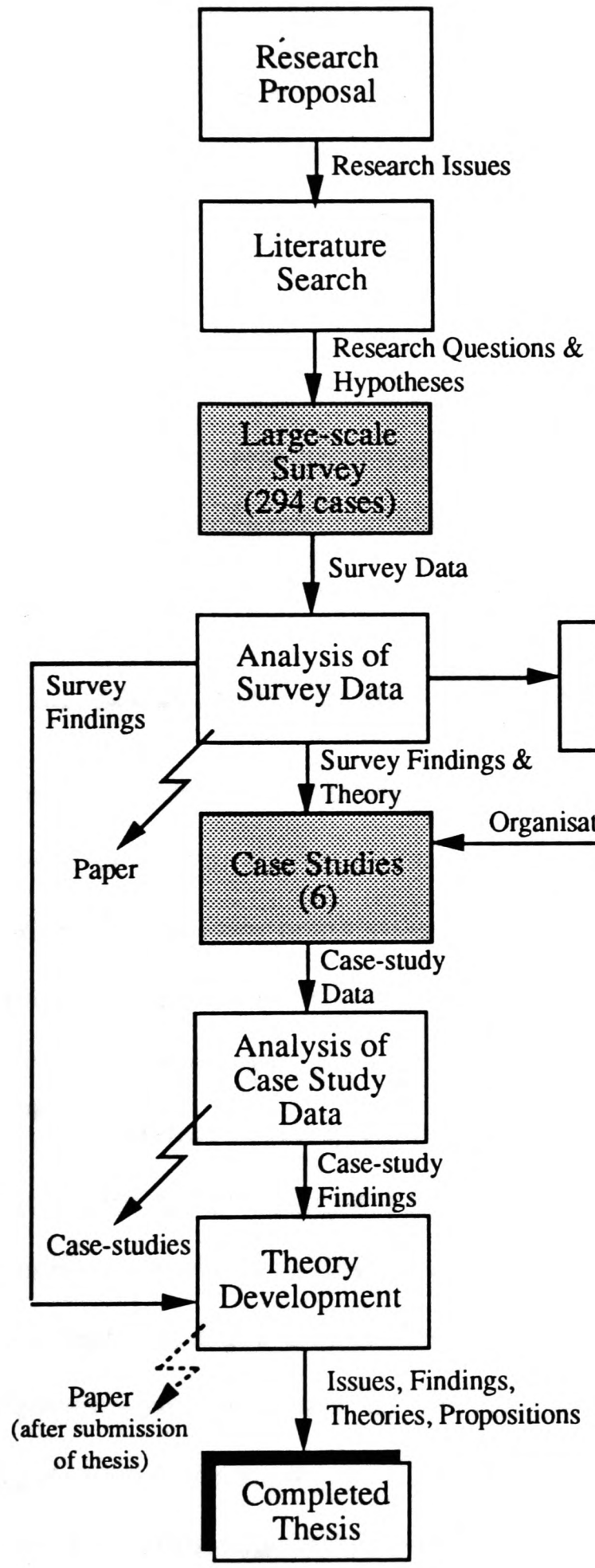


Figure 3.2:
Research Methodology

It was decided that IA's state and status needed to be researched first. This would help to clarify IA's position in the real world and focus the research in the second stage. A large scale postal survey was chosen for this purpose (see below for details). The survey helped to show that information architecture is not a mere theoretical concept but a practical reality that is generally perceived by its users as a useful IS planning tool. A few key issues emerged in the survey as regards the development, usage and form of IA's core components. In-depth investigation into these and other IA issues was conducted via case studies (see below for details).

The combined findings of the case studies and survey in the light of relevant literature helped to elucidate the research issues. Based on these findings and established theories, two frameworks were developed to facilitate IA development and usage. The research findings and frameworks and suggestions for IA practice constitute the contributions of this thesis to the domain of knowledge (see chapters 8 and 9).

5. Large Scale Postal Survey

A random sample of UK organisations, stratified in terms of annual turnover, was chosen to conduct the large scale postal survey (see Chapter 4); turnover is a popular choice for stratifying organisations in IS research (Kraemer and Dutton, 1991). Random sampling is generally recommended in the literature (Attewell and Rule, 1991; Miller, 1991; Nachmias and Nachmias, 1992). Kling (1991), however, has found that theoretical rather than random sampling offers an IS researcher greater design choices. Theoretical sampling requires paying attention to theoretical relevance and purpose in sampling decisions. Kling notes that the broader design choices can yield more meaningful research results. The IA research hence took into consideration Kling's arguments and selected a sample that was biased towards medium- and large-sized organisations, the theoretical assumption being that such organisations were more likely to have an information architecture.

Based on the arguments of Sabherwal and King (1992) on usage of single-informant in survey research, the head of IT was identified as the respondent who would be most appropriate to furnish the required data on information architecture. Limitations of using only the IT head and benefits which could be gained from multiple perspectives were recognised. However it was concluded that a single-informant approach was most practical in view of the financial and time constraints. Furthermore, input from the others would be sought in the next stage of this research, the case studies.

Pre-tested structured questionnaires (see Appendix 1) were mailed to a large stratified random sample. 294 valid responses were received. Relevant data from selected secondary sources were merged with the primary survey data; Gurbaxani and Mendelson (1991) and Lucas (1991) advocate usage of secondary data in survey research. The resulting quantitative data was subjected to statistical analysis and tests. The survey findings have been published in two papers[1]. The results helped to provide a theoretical base from which the case studies could be initiated.

6. Case Studies

The case studies were predominantly qualitative and sought to develop theories by examining the pattern of practices and experiences from multiple cases (Eisenhardt, 1989). A theoretical model was developed to undertake the case studies (see Chapter 5). This was done after considering the opposing views of various writers on the usage of a theoretical model in qualitative research. Eisenhardt (1989) points out that the adoption of a theoretical model for case study research could result in biased observations. Glaser and Strauss (1967) also argue for theory development without any preconceived theoretical model. The grounded theory development advocated by them seeks to deliver a context-based, process-oriented description and explanation of a phenomenon, rather than an objective description expressed strictly in terms of a theoretical model

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1 (a) An OXIIM (Templeton College) Research and Discussion Paper - "Gaining Value from Information Architecture: Research-Based Recommendations for the Practitioner", (b) ICIS'93 (Dec. 1993, Orlando, USA) conference paper - "The State and Status of Information Architecture: An Empirical Investigation".

(Orlikowski and Baroudi, 1991). Lee (1989), Markus (1989), Popper (1968) and Yin (1989a, 1989b), on the other hand, maintain that a theoretical model can be key to an effective qualitative research. They note that there must be clear questions for effective investigation: as Einstein once wrote, "Our theories determine what we measure." Taking into consideration the arguments of these scholars, it was decided that a theoretical model was essential to focus the qualitative research and complete it successfully within the time period. It would, however, not be a model geared towards rigid hypothesis testing; it would be a reference model. The objective was to benefit from a theoretical model without compromising on the richness and exploratory opportunity afforded by qualitative pursuits.

Case Study Organisations

The primary purpose of the case study was to investigate the development and usage of IA. Case study organisations were hence selected on their potential as a source of rich data for developing theories on IA development and usage. Attempts were made to include at least one case of an organisation which was regarded as being successful in the exploitation of IT without the use of an IA. This attempt, however, proved unsuccessful (see Chapter 9). The case studies were hence confined to organisations which were developing and using IA or which had recent IA experience. The arguments of Glasser and Strauss (1967) and Kling (1991) for theoretical sampling support this decision.

The case studies were confined to large business units and non-corporate bodies. The postal survey had indicated that large organisations, regardless of industry, would be most relevant and that corporations/parent organisations were less likely to be engaged in IA efforts. The main criteria used for selecting an organisation was that it should generally be regarded (in publications and by the industry) as an exemplar of good information architecture practice and/or IS planning and a successful exploiter of IT. Other criteria were (Pettigrew, 1989): high experience levels in IA and IS planning, significant recent IA effort, major success or failure with IA, geographical location of organisation, and attitude of the organisation to the research. Time constraint and scope

of investigation limited the number of case studies to 6: "a number between 4 and 10 cases usually works well" (Eisenhardt, 1989, p. 545).

The lack of adequate past research in IA meant that some key assumptions had to be made in conducting the case studies. One such assumption was in relation to IA usage and effective application of IT. The mere existence of an IA was not assumed to be an indication of good IS planning practice or successful IT implementation. It was acknowledged that an organisation which was successfully exploiting IT could be doing so with or without the aid of an information architecture. The scope and constraints of this research, however, did not permit extending the research into how an organisation could successfully implement strategic IT applications without the benefit of an IA; the study was confined to IA development and usage. It was conducted on the assumption that the quality of an IA was reflected in how it contributed to the successful planning and implementation of IT applications in line with business strategies and plans.

Case Study Process

The overall case study schedule was such that at any one time two case studies were active. This phased approach permitted learning and improvement during the whole course of the case studies which lasted twelve months. The average duration of a case study was three months; this was due mainly to the limited availability of key informants for interviews. This situation, however, turned out to be advantageous as it helped to progressively improve each study via overlap of data collection and data analysis (Eisenhardt, 1989).

While it might have been possible to have conducted the case studies via such methods as participant observation and action research, the studies were carried out primarily through in-depth interviews of key informants. This retrospective analysis method permitted exploration and in-depth probing for a richer understanding of experiences, perceptions and views on IA. The management orientation of this research meant that most interviewees were senior executives, a number of whom were from areas other than IT.

Methods such as observation and action research would not have enabled the collection of such rich data from this range of senior executives and IT professionals. Selected observation and action research could have been done in addition to the interviews if the constraint of time had not been a significant one.

In addition to interviews, relevant reports, manuals, documents and systems documentation were studied. Secondary sources - past case studies and information sources in the public domain (reports, databases on companies, etc.) - were consulted. This multi-pronged data collection effort helped to build a rich picture of each organisation, with information architecture at the centre. At the end of a case study, a structured questionnaire specific to the organisation (see Appendix 2 for an example) was distributed for a general reassessment of key issues.

The data collected was largely qualitative: descriptions, lists, tables and graphical models. Triangulation of data across data sources and across data collection methods was done for each case. This effort helped to maximise the validity of the data collected. Where there was uncertainty, the source of the data or some other appropriate person was consulted. The finalised data was analysed within each case and across the cases to detect similarities and compare differences. The major techniques used were data coding, reduction/summarisation, classification, association and clustering. The qualitative analysis sought to identify a pattern on information architecture development and usage across the case studies (Eisenhardt, 1989; Nachmias and Nachmias, 1992) with the theoretical research model (see Chapter 5, figure 5.10) as a source of reference rather than a model to be exhaustively tested.

7. Summary

This research seeks to contribute to both theory and practice of information architecture. A research methodology based on established research paradigms and methods in the social sciences and IS was designed to achieve this objective. The methodology adopted an eclectic approach in the form of a combined postal survey/case study method. Such an

approach enabled the research to progress from general to specific issues without compromising on rigour or comprehensiveness. It enabled the research to benefit from holism through case studies and reductionism via postal survey (Ackoff, 1978).

The next chapter presents the postal survey on IA's position in the real world. The chapter first describes the methodological experiences in the context of the survey. It then presents the data analysis and survey findings. Chapters 6 and 7 do similarly for the case studies.

Chapter 4: Survey - Examining the Adoption of Information Architecture

- Research Model, Hypotheses and Research Issues
- Postal Survey - Process and Experience
- Hypothesis Testing
- Exploratory Analysis
- Analysis of Application Architecture and Corporate Data Model
- Discussion and Propositions

The last chapter described the research methodology for conducting this research in information architecture (IA) development and usage. A postal survey was chosen to examine the general adoption of IA. This chapter describes the survey, its findings and propositions.

1. Hypotheses and Research Issues

Information architecture is both a means and a deliverable of IS planning (ISP). Application architecture (AA) and corporate data model (CDM) have been identified as two key components of IA. They are used as tools for IS planning and blueprints for IS plan implementation. This is the general understanding about IA as revealed in the literature. What is not clear is the extent to which IA is used in the real world and whether it is delivering value to its users. Based on the general arguments in the literature and the overall research hypothesis (see Chapter 2), it was hypothesised that:

* *Information architecture is a widely-used and valuable IS planning tool.*

A research model was developed to depict this general hypothesis and facilitate the development of more concise hypotheses which could be investigated and tested in the survey. The model is shown in the top half of figure 4.1 and is identified as 'Hypothesis Testing'.

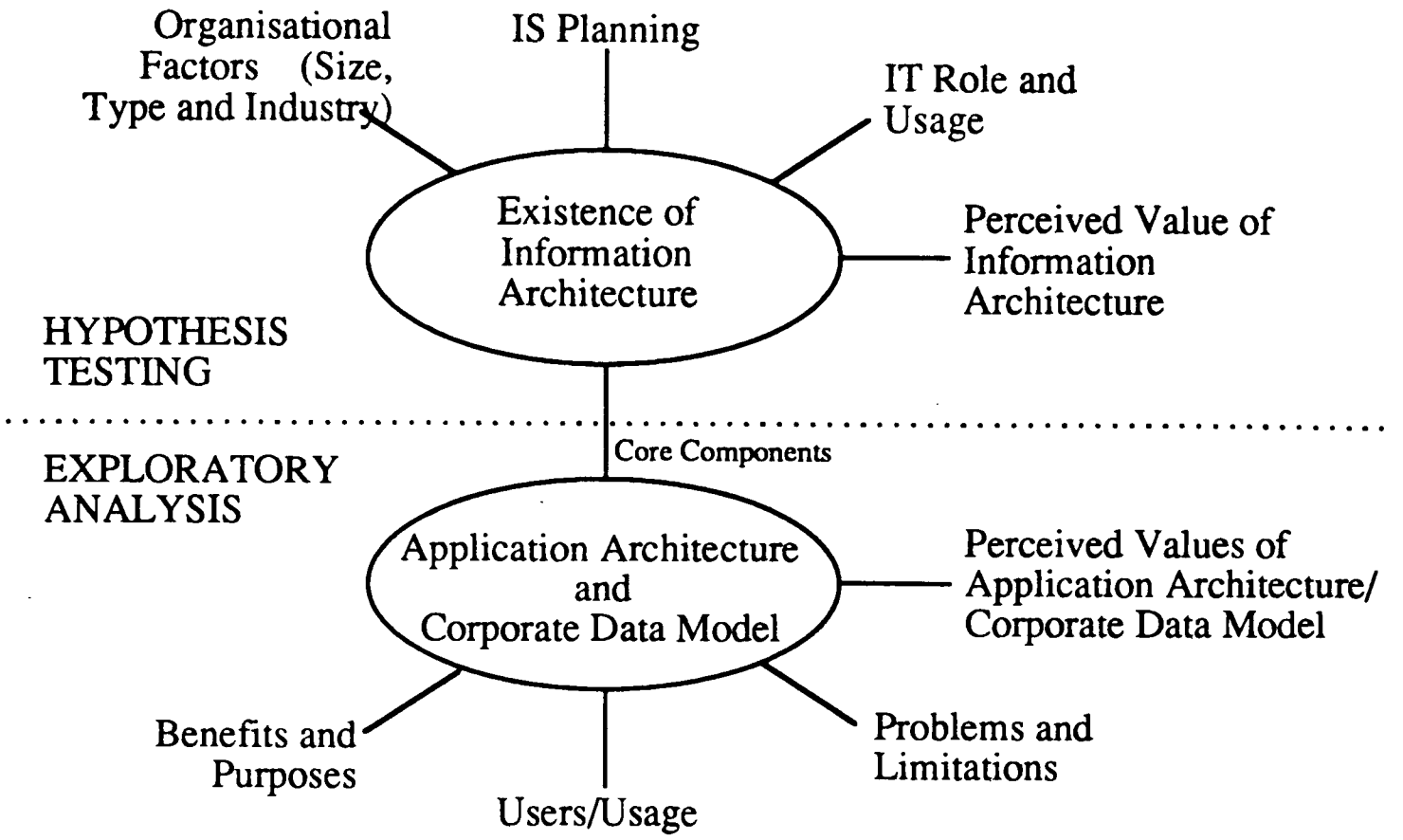


Figure 4.1: Survey Research Model

The following two hypotheses were formulated in relation to IA's state and status. They were derived from the general hypothesis and structured for quantitative investigation:

H1: Information architecture is used by a majority of organisations (state).

H2: Information architecture is perceived to be of significant value (status).

It was felt that the relationship between IA and IS planning also required research. The association of IA with ISP is well-known (Hackathorn and Karimi, 1988; IBM, 1981; Premkumar and King, 1991; Zachman, 1987) but recent research (Earl, 1990, 1993) suggests that IS planning without architecture development is not uncommon. The following hypothesis was hence formulated for investigation:

H3: The existence of information architecture is associated with the existence of IS planning.

Issues to be Explored

It was reasoned that in spite of the possible validity of hypothesis H1, certain classes/types of organisations are more likely to have an IA. There was no clear basis on

which to formulate a hypothesis in this regard. Hence the following issue was defined for exploration:

* The relationship of specific organisational factors to IA's presence in an organisation.

A review of the general ISP literature (Earl, 1990, 1993; Lederer and Sethi, 1988; etc.) suggested organisation size, type (parent/business unit) and industry as possible organisational factors relevant to IA. In the course of identifying these factors, IT role and usage emerged as major factors requiring investigation in relation to IA; Premkumar and King (1992) had found an association between sophistication of ISP and strategic positioning of IT. The following issue was therefore defined for exploratory analysis:

* The relationship of information architecture to the role and usage of IT.

Application architecture and corporate data model have been proposed as the two key components of IA. They are based on different paradigms - 'process-oriented' and 'data-oriented' respectively. Both paradigms have strong advocates and are the subject of ongoing debate (Clark, 1990). Data-oriented trends in methodologies (e.g. SSADM) and CASE tools (e.g. IEF), the growth of Information Engineering (Hackathorn and Karimi, 1988; Karimi, 1988), and the strong advocacy for data-oriented IS planning (Finkelstein, 1981, 1991; Martin, 1982, 1989,1990a; Vesely, 1990) are factors which have made CDM *appear* to be the more favoured technique for IS planning. Research findings of Goodhue et al. (1992a), however, suggest that some of the claims for data-oriented planning are probably not valid (see Chapter 2). The position of corporate data modelling is beginning to become apparent via research such as those of Goodhue, et al. (1988, 1992a, 1992b) and Marche (1993) but little research exists on application architecture per se. The relative position of AA and CDM as specific IS planning tools and blueprints remains unclear. In this circumstance, it was decided that an exploratory investigation into AA and CDM was most appropriate.

A research model was developed to undertake the exploratory work. The model is shown in figure 4.1 in the bottom half ('Exploratory Analysis'). 'Benefits/purposes' and 'problems/limitations' of AA and CDM were identified as major issues which needed to be explored. Key questions on AA and CDM for the exploratory investigation were defined with the aid of the research model:

* What are the relative levels of adoption of application architecture and corporate data model?
* How is each perceived and is there a preference between them?
* Are there major differences in their users/usage?
* What are their benefits/purposes and problems/limitations ?

2. Large Scale Postal Survey

A large scale postal survey was carried out to investigate the hypotheses and issues. A survey instrument was developed to collect the required data (see Appendix 1). Questions were formulated on the basis of the survey research model, hypotheses and exploratory issues. In constructing the questionnaire, due attention was given to its simplicity, size, structure, format/layout, presentation and demands on target respondent (Miller, 1991; Nachmias and Nachmias, 1992). Questions on data which could be obtained from secondary sources were excluded from the questionnaire. While effort was made to keep the number of questions to a minimum, controlled redundancy was introduced in some critical areas (e.g. benefits and problems) for triangulation purposes.

The questionnaire was validated in a few of steps. The draft questionnaire was first reviewed by two IT consultants and some college faculty members. The improved draft was pre-tested in person with a representative set of ten organisations. Feedback from these tests was used to revise and streamline the questionnaire. The revised draft was mailed to thirty organisations as a simulation of final process and to detect any inherent problem not revealed in earlier pre-tests. Eleven organisations responded of whom seven

had an information architecture[1]. Two problems related to wording were detected in the returned questionnaires. These were rectified and the questionnaire was finalised.

The final questionnaire had 34 questions. Most of the questions required responses on a 5-point Likert-type scale. The questions were organised to progress from general to specific in the belief that this would facilitate response. Questions requiring descriptive response or greater thought, or those encroaching on confidential matters (e.g. IT expenditure) were located at the end of the questionnaire. The last sheet of the questionnaire was an appendix[2] providing definition and clarification of terms used.

Survey Sample

A sample of 900 UK organisations across industries was targeted to ensure an adequate representative response. The random sample was stratified[3] by organisation size based on annual turnover - the three strata were small[4], medium and large. The sample was a combination of sub-sets from NCC's NCI database[5] and OXIIM's mailing list[6]. The stratification had a bias towards medium/large organisations, the assumption being that such-sized organisations were more likely to be sources of detailed data on IA.

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1 This information (of the 36% response, 23% were IA cases) was later used in the determination of the target sample size (900 organisations).

2 A note was added on the appendix advising the recipient that he/she was welcome to detach and keep it if they found it to be of value. 38% of those who responded retained the appendix. This suggests that there is some level of interest in IA in the industry.

3 Stratification band: small: <£51M; medium: £51M to £250M; large: >£250M. The stratification was predetermined as the NCI database used to define the target sample was stratified by turnover.

4 Most empirical research in IS planning tend to cover only medium/large organisations. Observations indicate that small organisations are less likely to be engaged in ISP and consequently are less likely to have IA. Small organisations were included in the sample to verify the validity of this observation.

5 The National Computing Centre's NCI (National Computer Index) database, stratified in terms of annual turnover, contains data on more than 10,000 IT sites in the UK.

6 The Oxford Institute of Information Management (OXIIM) has a mailing list of more than 1,000 organisations. These organisations are mainly large ones.

The final questionnaire was mailed, together with a cover letter[7] and a self-addressed stamped envelope, to the heads of IT[8] or identified contact persons. 294 valid responses[9] were received, giving an effective response rate of 32 percent. As the number of responses and response rate were satisfactory (Nachmias and Nachmias, 1992), follow-up measure was not taken to better the response.

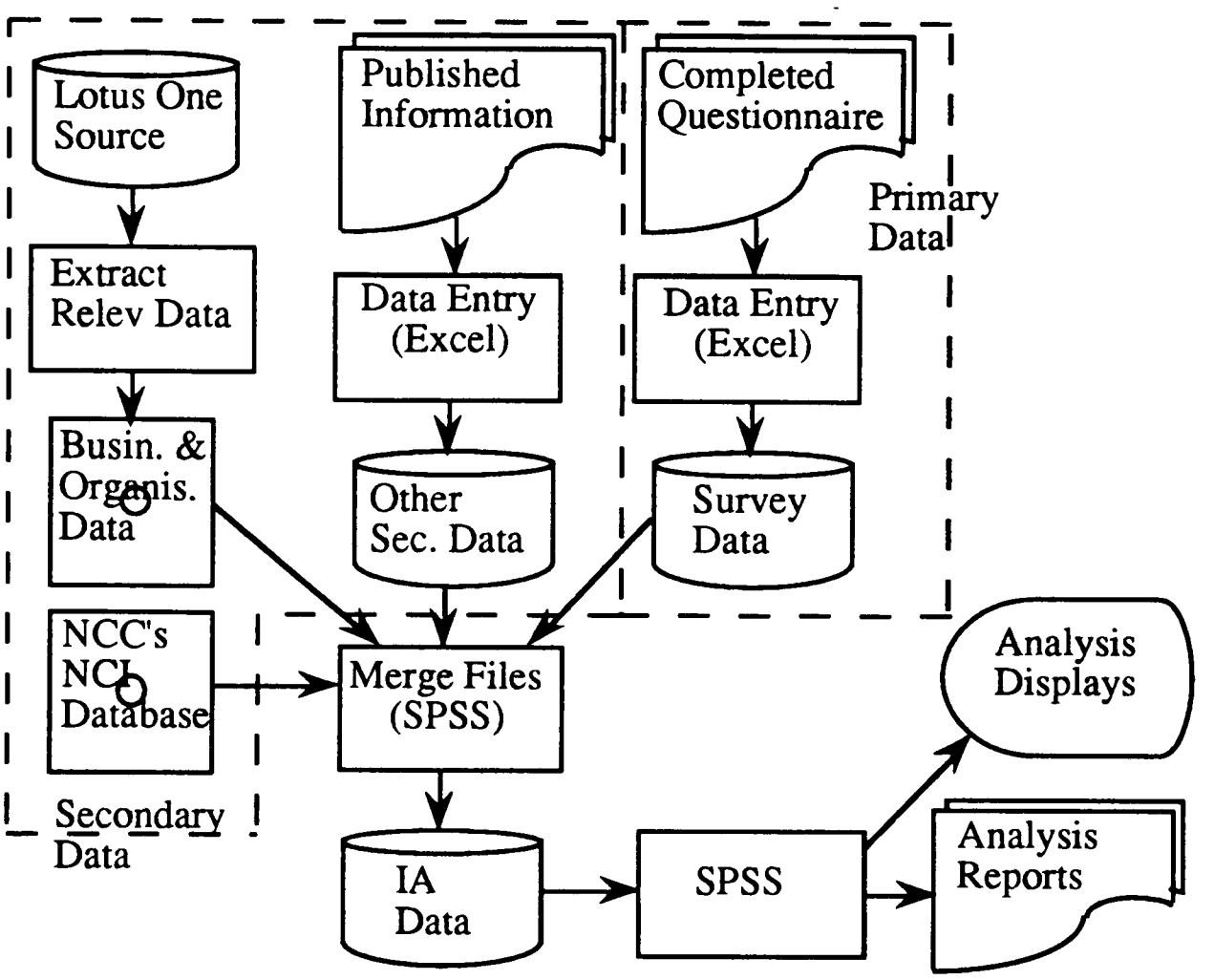


Figure 4.2 : Processing of Survey Data

The completed questionnaires were checked and coded where necessary. The data was entered, verified and validated using Microsoft Excel (see figure 4.2). The spreadsheet was later imported into SPSS and merged with other files created from the following

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7 The letter explained the importance of the information architecture issue, and informed respondents that they would receive of a copy of the paper on the survey.

8 Head of IT refers to all heads of the IT function regardless of what they are actually called - IS manager, IT manager, IT director, chief information officer, etc.

9 305 questionnaires were received but 11 could not be used for various reasons - late arrival, insufficient data and duplicate response.

secondary sources: Lotus One Source Database of more than 130,000 UK companies; NCI database; published information (year books, annual reports and industry reports).

A profile of the final sample is shown in figures 4.3a to 4.3d. Most of the organisations in the sample were medium or large sized. This disproportionate distribution was the result of the emphasis placed on medium/large organisations in sampling. The usage of existing databases (NCI database and OXIIM's mailing list) for selecting the target sample inevitably introduced some bias, the most obvious one being in the distribution of industry/sector (see figure 4.3d). The sampling approach adopted led to a high proportion of business units and subsidiaries (59%). The deliberate targeting of the questionnaire resulted in a high proportion of respondents who were heads of IT.

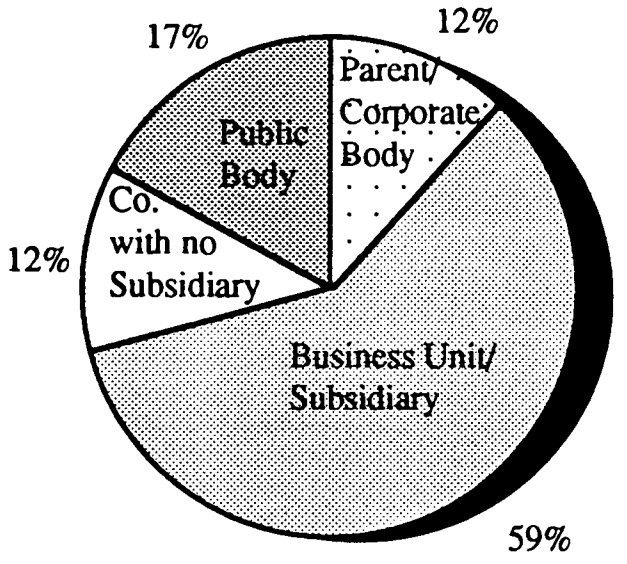


Figure 4.3a: Sample by Organisation Type

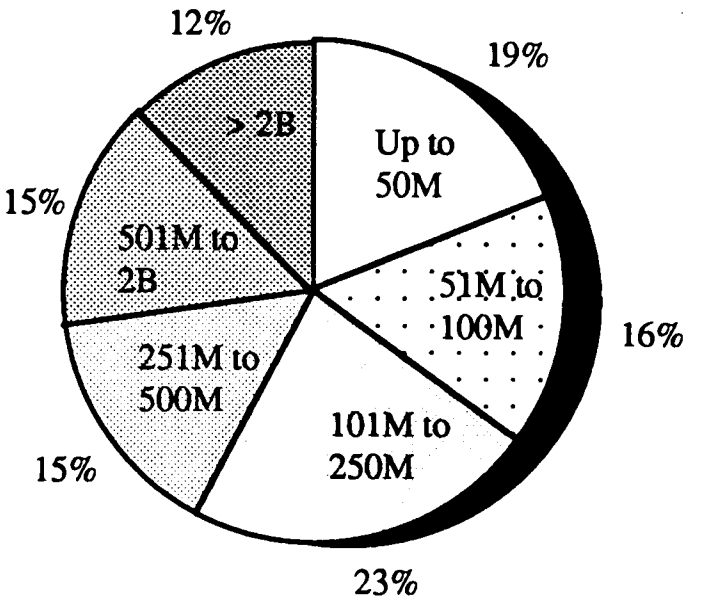


Figure 4.3b: Sample by Annual Turnover (£)

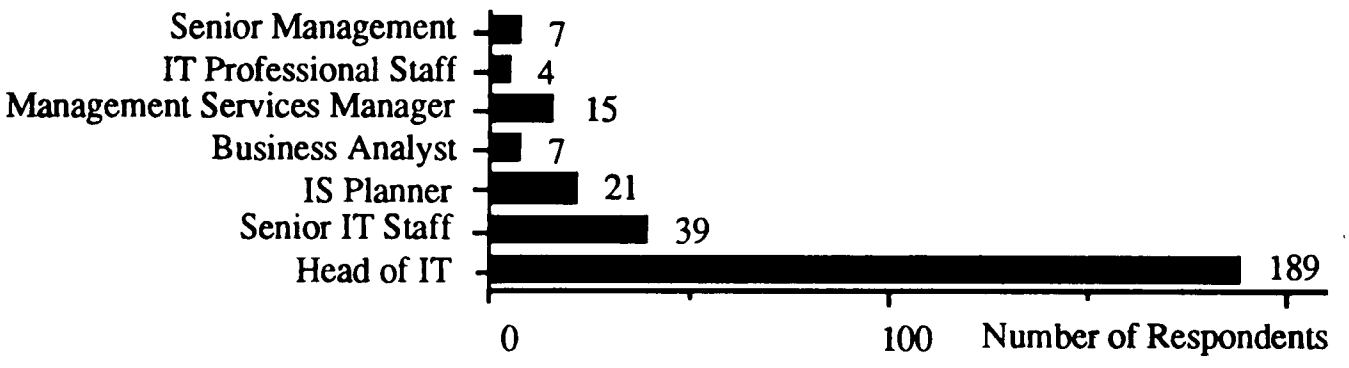


Figure 4.3c: Sample by Respondent's Position

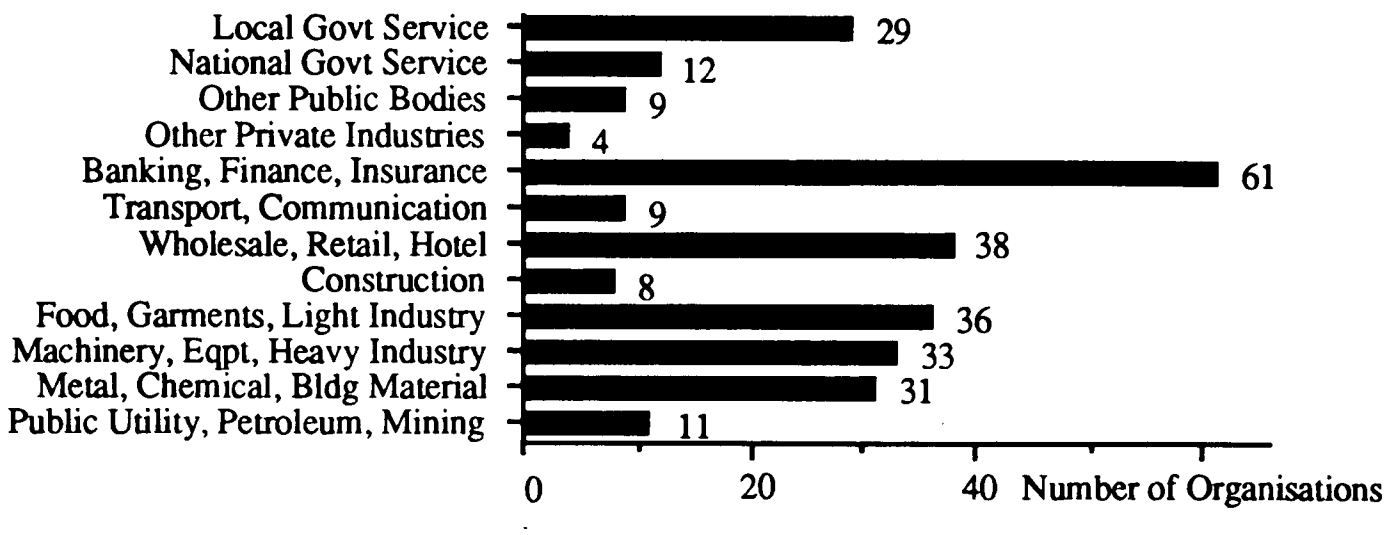


Figure 4.3d: Sample by Industry/Sector

An individual's response was taken as representing his/her organisation's response. IT heads made up 67% of the respondents; this suggests that IA is of some interest to IT heads in general. (Had there not been such an interest, the IT head would have probably passed the survey questionnaire to someone else for response.) It was acknowledged that this predominance by one group of respondents could introduce some bias in the sample data. However, as IA is most relevant to IT heads (see figure 4.14) and IT heads are in the best position to provide a considered response on IA, it was assumed that the bias would not adversely affect the quality of the sample in any significant way.

Derivation of New Data

IA was not a standard item and data on its existence and perceived value were not directly available from the sample. These data were derived from the corresponding data of IA's key components: the existence of AA, CDM or both was indicative of the existence of IA; the IA value was taken to be the higher of the two perceived values of AA and CDM. Such a derivation permitted investigation into IA, based on concept rather than content.

3. Hypothesis Testing

A statistical package, SPSS (Statistical Package for the Social Sciences), was used to test the hypotheses and conduct the required exploratory analyses. SPSS[10] has the required

10 The fact that SPSS runs on a Macintosh, the computer which I use, also helped in the decision.

statistical analysis features, is a popular tool in IS survey research and "is probably the most widely used suite of programs for statistical analysis in the social sciences." (Bryman and Cramer, 1992, p. xiii).

Selection of Statistical Tests

Much of the survey data were nominal or ordinal. The following non-parametric tests were hence used in hypothesis testing and exploratory analysis: Chi-square, Wilcoxon, Mann-Whitney and Spearman Correlation (Siegel, 1956; Norusis, 1990; Keller, et al., 1990; Bryman and Cramer, 1992). The treatment of ordinal data as interval data is not uncommon in IS and social science research (Bryman and Cramer, 1992; Pervan and Klass, 1992; Newsted, et al., 1991). Hence statistics such as mean and standard deviation were generated and parametric tests, in particular t-tests, were performed where relevant and necessary. Regression analysis and multivariate techniques such as factor analysis were considered and tried but were not found to be necessary. In general, statistical tests[11] were chosen on need and relevance rather than popular usage (Pervan and Klass, 1992).

Testing of H1: Information Architecture is Used by a Majority of Organisations

As the sample was stratified and biased towards medium/large organisations, four classes of organisation were defined in terms of size to test the hypothesis (keeping to the original stratification boundaries). The existence/non-existence of IA was cross-tabulated by organisation-size classes via a chi-square test. The results (χ^2=25.32707, df=3), significant at the 0.05 level, suggest that existence of IA is associated with organisation size. The figures shown in figure 4.4 further imply that information architecture is less likely to exist in small organisations. The figures support hypothesis H1, but for only the medium to very large organisations; more than 50% of the organisations in these

11 Statistics from tests are generally not presented in full and are even omitted at times to prevent them from overshadowing discussions.

categories had an IA. However the probable bias in the sample (utilisers[12] of IA being more inclined to respond to the survey) and possible differing interpretation of information architecture (in spite of a glossary with examples having been attached to the questionnaire) does not permit such a deduction as regards the hypothesis. Hence it can only be concluded that *information architecture is not a mere concept but a reality existing to some extent, particularly in medium to very large organisations.*

Organisation size category[a] -->	Small	Medium	Large	Very Large
No. of organisations in category	54	103	78	26
Percentage having an IA	28	59	65	77

a Based on annual turnover - small: <£51M, medium: £51M to £250M, large: £251M to £2B, very large: >£2B.

Figure 4.4: Information Architecture Existence by Organisation Size

Testing of H2: Information Architecture is Perceived to be of Significant Value.

A Likert-type scale was designed to measure the perceived values of IA. The mean perceived value of IA for the whole sample was computed as 3.51 (see figure 4.5). A t-test was performed to determine if this value was significantly greater than that of a normally distributed population with a mean value of 3.0. The test results were found to support hypothesis H2 at the 0.05 level.

Further tests showed a big difference between the perception of IA utilisers and non-utilisers and suggested a relook at the hypothesis. The ordinal nature of the data suggested a non-parametric test. As the test involved unrelated data, a Mann-Whitney test was conducted. The results were found to be significant at the 0.05 level (U=2668.5, Z= -7.8648): utilisers of IA generally perceived it to be of 'significant use' (3.92) while non-

12 A 'utiliser' of IA is an organisation which has an information architecture. A 'non-utiliser' of IA is an organisation without an information architecture.

utilisers did not even consider it to be of 'some use'[13] (2.62). This result called for amendment of hypothesis H2 for it to be meaningful and empirically supported:

* *Information architecture is perceived to be of positive value by its utilisers.*

Segment of Sample	Mean IA Value	Other Statistics on Perceived Value of IA
Utilisers of IA	3.92	sd=0.836, se=0.064, t=14.41, df=169
Non-utilisers of IA	2.62	sd=1.19, se=0.134, t=-2.86, df=77
Whole sample	3.51	sd=1.135, se=0.072, t=7.11, df=247

* IA value scale: 1=Irrelevant, 2=Little Use, 3=Some Use, 4=Significant Use, 5=Absolutely Essential.
* sd=standard deviation, se=standard error, t=t-test value, df=degree of freedom
* All mean IA values were found to be significant in t-tests at the 0.05 level and population mean=3.0 .

Figure 4.5: Information Architecture Value

Many of the IA utilisers commented on the potential of IA and the value they had gained from using it. Some of the individual respondents were clearly 'believers' in IA. A few seemed to have championed IA's inception in their organisations, and hence might have given it a high rating. IA utilisers, from the small to the very large, generally appeared to have a uniformly high perception of the value of IA (see figure 4.6).

Some non-utilisers of IA remarked on their negative IA experience. They had used IA, found it to be of marginal value and demanding on resources, and consequently abandoned it. A number of the small organisations and some very large corporations indicated that IA was irrelevant to them. Some of these very large corporations contended that IA was more relevant to planning at the business unit level rather than at the corporate level. Though non-utilisers of IA generally rated it low (see figure 4.6), some medium/large non-utilisers were more positive about it. This was perhaps due to the fact

13 The low rating of IA and non-usage of this tool was not a reflection of lack of interest in IA by non-utilisers. On the contrary, non-utilisers accounted for 63% of those who had retained the questionnaire appendix (IA definitions and clarification).

that some of them were in the process of examining the potential of IA to them (as revealed in their comments).

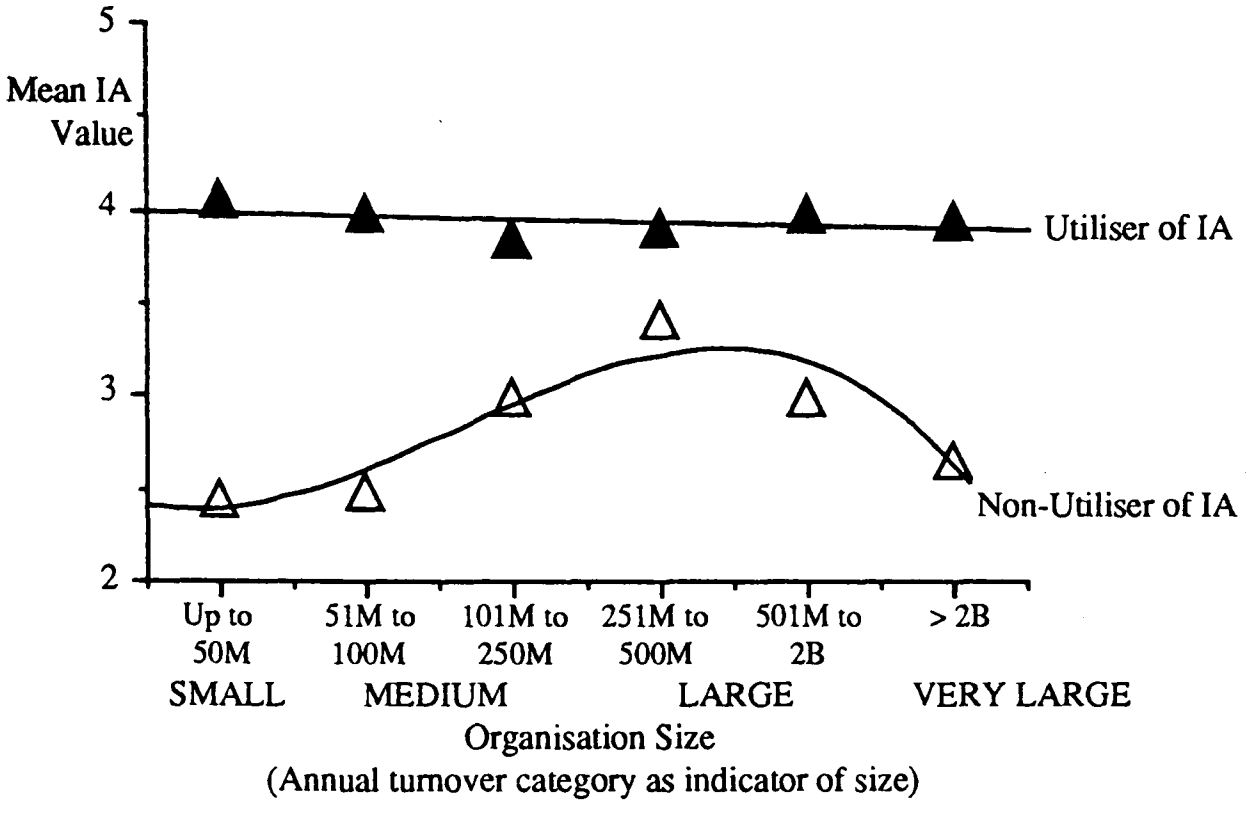


Figure 4.6: Information Architecture Value Vs Annual Turnover

Testing of H3: Information Architecture is Associated with IS Planning

A chi-square test was performed, cross-tabulating IA existence by ISP existence (see figure 4.7); the results were significant at the 0.05 level (χ^2=72.68718, df=1). The test was followed by an investigation into situations leading to IA development. The investigation showed that 67% of IAs resulted from IS planning (see figure 4.8). Both these results support hypothesis H3.

Though the evidence supports hypothesis H3, it is apparent from figure 4.7 that the IA-ISP relationship is not a tight bond: 24% of organisations which had ISP did not have any IA, and 14% of IAs[14] were not associated with any ISP. This implies that IA is not a mandatory tool or deliverable of IS planning. It can be of value on its own in situations

14 It could be argued that some of these IAs might not be "true" information architecture models. As it was not possible to identify the cases of "true" IAs, the subjective responses were accepted.

of major organisational change or major IT investment, or it can even be developed as part of an IS project (see figure 4.8).

	Organisations without ISP	Organisations with ISP	IA total (cases)
Organisations without IA	76	47	123
Organisations with IA	24	147	171
ISP total (cases)	100	194	294

Figure 4.7: Information Architecture-IS Planning Association Matrix

Situation	% of Cases[a]
IS planning process	67
Major changes in organisation	54
Major IT investments	44
Part of IS project	42
Major changes in IT department	17

a A respondent could provide multiple responses.

Figure 4.8: Situations Causing/Leading to IA Development

The probable existence of a bond between IA and IS planning has been shown empirically. The literature suggests that the type of IS planning methodology used plays a part in this bond (IBM, 1981; Lederer and Sethi, 1988, 1992; Martin, 1989, 1990a; Premkumar and King, 1991, 1992). Most of the popular formal methodologies, such as BSP, IEM, Method/1 and Nolan Norton, provide for development of information architecture. So do the CASE tools, such as IEF, which support such methodologies.

IS Planning Methodology	All Cases (A)		IA Cases (B)		Ratio
	Count	% Cases[a]	Count	% Cases[a]	
Formal Methodologies					
Business System Planning (BSP)	6	3	6	4	1.00
Information Engineering (IEM)	22	12	20	14	0.91
Method/1	6	3	5	4	0.83
Nolan Norton Methodology	4	2	3	2	0.75
Other Methodologies/Techniques					
Critical Success Factor (CSF)	33	18	29	20	0.88
Value Chain Analysis	13	7	11	8	0.85
In-house Customised Methodologies	137	73	99	69	0.72
Other Methodologies[b]	31	16	25	18	0.81

a Multiple responses were possible.

b Soft systems methodology, other consultant-methodologies, business process analysis, portfolio management, leverage analysis, annual business planning and "common sense".

Figure 4.9: IS Planning Methodologies and Information Architecture

Formal ISP methodologies are advocated by IT vendors/consultants and many IS writers. In practice, however, in-house customised methodologies are the overwhelming choice of organisations (Premkumar and King, 1991). This is also the finding of the survey from an IA-based consideration of ISP methodologies (see figure 4.9). Perhaps formal methodologies do not fit organisational expectations/requirements or specific IS planning needs, and therefore in-house customised methodologies are used instead. One respondent did remark that the level and magnitude of commitment demanded by formal methodologies (in terms of personnel, training, time, money and other resources) were beyond what his organisation was prepared to commit; hence his organisation formulated its own in-house methodology from established techniques and methodologies.

The survey evidence suggests that an organisation's in-house methodology generally does not hinder IA development: 72% of those who practised in-house methodologies had IA, and 69% of IA utilisers had adopted in-house methodologies. Effort is made by these organisations to adopt or incorporate in the in-house methodology techniques for development of IA. Data flow diagramming and entity relationship modelling/data modelling were found to be the two most popular techniques chosen for this purpose.

Though IA development is often considered to be a crucial part of many formal methodologies, an IA may not necessarily be developed in the practice of such a methodology. The survey found that some organisations which practised such formal methodologies did not have an information architecture (see figure 4.9). This was perhaps because the methodology's support of the planning process was regarded as being more important than its architecture deliverables (Earl, 1990, 1993).

4. Exploratory Analysis of Information Architecture: General Issues

Some exploratory analyses were conducted with the aid of the survey research model (figure 4.1). In one of these analyses, the relationships between specific organisational factors and IA existence were investigated via chi-square tests at the 0.05 level. The results show that of the factors investigated, only organisation size has a probable relationship with IA existence (see earlier H1 results). The other results are as follows:

* Existence of IA does not vary by industry.

* IA existence is not associated with organisation type (corporation/business unit). This is in spite of some very large corporations explicitly stating that IA was irrelevant to them.

Role of IT and Information Architecture

The role of IT was stated in the questionnaire (Q30) using Schein's (1989) classification of major IT roles, and concepts associated with these classifications (Earl, 1989; Feeny, 1988; McFarlan, 1984; Porter and Millar, 1985):

- Vision to transform - IT as the basis for transforming organisation and industry (output oriented).
  - * Role 1 - Gaining/sustaining competitive advantage through IT.
  - * Role 2 - Functioning in an industry which is increasingly becoming IT-based.

- Vision to automate - IT as "a way of replacing expensive, unreliable human labor with sophisticated robots, systems, and other IT devices." (throughput oriented).
  - * Role 3 - Improve productivity and efficiency.
  - * Role 4 - Reduce labour and other costs.

A 5-point Likert-type scale was used to measure the perceived magnitude of each of the above-mentioned roles. T-tests were carried out at the 0.05 significance level to determine if there was an association between the magnitude of each of these roles and the existence/absence of IA. The results were significant for all the roles except Role 2 (see figure 4.10). The results support the proposition that IA is relevant to organisations which proactively determine the nature and extent of IT's role to their business (Roles 1, 3 and 4). The test results do not indicate IA as being relevant to organisations which are dictated to by their industry norms as regards IT application (Role 2).

Role	Mean Value[a] of Role (IA Exists)	Mean Value[a] of Role (No IA)	t value	Degree of Freedom	2-tail p
Role 1	3.65	3.05	4.23	283	0.000
Role 2	3.30	3.05	1.75	280	0.081
Role 3	4.41	4.23	2.13	289	0.034
Role 4	3.94	3.64	2.54	285	0.012

a Scale: 1 = not a role; 2 = minor role; 3 = some role; 4 = major role; 5 = dominant role.

Figure 4.10: IT Role and Existence/Absence of Information Architecture - T-test Results

Usage of IT and Information Architecture

Earl (1988b, 1989) argues for distinguishing business sectors by IT usage. He proposes the following four sectors of which the first three are related to strategic use of IT:

* Delivery - IT is the means of delivering goods and services, i.e. it is indispensable.
* Dependent - Business strategies and operations increasingly depend on IT.
* Drive - IT potentially provides new strategic opportunities.
* Delayed - IT is useful but is optional to the business and activities.

The association of IA with the 'delayed' sector was investigated through a question on whether IT was 'essential or optional' to an organisation (Q31). A chi-square test at the 0.05 level found the association to be significant[15]: χ^2=7.41438, df=1. 94% of IA utilisers and 84% of non-utilisers indicated that IT was essential to them. It can be reasoned from the test results that an organisation which views IT as an option is less likely to have an IA.

A 5-point Likert-type scale was used to measure the perceived extent to which the three strategic-sector taxonomies were applicable to the organisations which considered IT as being essential. T-tests were carried at the 0.05 significance level to determine if there was an association between the magnitude of each of these modes of IT usage and the existence/absence of IA. The results were significant for only the 'dependent' sector.

The overall emphasis placed by organisations on the 'drive' mode of IT usage was relatively lower than the emphasis on the other two modes (see figure 4.11). Most organisations considered 'drive' as being only of some applicability to them. Perhaps if an organisation placed greater emphasis on 'drive' and aggressively sought out new IT opportunities, its usage of IA in this regard might be significant.

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15 Twenty eight organisations responded that IT was 'optional'. Most of them were public bodies and small companies.

Mode of IT Usage	Mean Value[a] of Mode (IA Exists)	Mean Value[a] of Mode (No IA)	t value	Degree of Freedom	2-tail p
Delivery	4.16	3.94	1.64	260	0.102
Dependent	4.07	3.72	3.25	260	0.001
Drive	3.60	3.60	0.36	257	0.723

a Scale: 1 = not a usage; 2 = minor usage; 3 = some usage; 4 = major usage; 5 = dominant usage.

Figure 4.11: IT Usage and Existence/Absence of Information Architecture - T-test Results

In the 'delivery' form of IT usage, a set of applications must be in place for an organisation to deliver its goods and services, and the organisation has little option but to implement those applications. The industry norms often dictate the essential IT applications which need to be in place. A look at industries such as banking, retailing and manufacturing shows the validity of this statement. The need for an IA in this situation of reactive response is unclear. The t-test result delivered this message.

The t-test results for the 'dependent' form of IT usage suggest that organisations whose strategies are increasingly dependent on IT are more likely to have an IA. The IA is perhaps a tool used by such organisations to proactively identify new strategic IT opportunities.

The results of the above sets of tests related to IT role and usage mode suggest that IA is of relevance to organisations which seek strategic opportunities via IT, i.e. *information architecture is related to the strategic positioning of IT*. This conclusion is consistent with those of Premkumar and King (1992) and Sullivan (1985) who note that a sophisticated IS planning approach is more appropriate where IT is positioned strategically. Premkumar and King, in particular, suggest IA development as an indicator of ISP sophistication.

5. Analysis of Application Architecture and Corporate Data Model

An objective of the survey was to explore IA's key components - application architecture (AA) and corporate data model (CDM) . The exploratory analysis, conducted with the aid of the research model (figure 4.1), was confined to only responses from utilisers of AA and CDM; t-tests at the 0.05 level showed that while utilisers of AA and CDM differed in their valuations of the models, non-utilisers generally did not. Statistics on the major variables of AA and CDM are listed in figure 4.12.

Items	Application Architecture	Corporate Data Model
Number of utilisers	149[a]	102[a]
Perceived value[b]		
Mean -	3.86	3.64
Other statistics - (t-test at 0.05 level with midpoint=3.0)	sd=0.83, se =0.068, df=148, t=12.67, 2-tail p=0.00	sd=0.96, se=0.097, df=98, t=6.57, 2-tail p=0.00
Frequency of development (%):		
As and when necessary -	51	69
Every year -	24	14
Every 2 or 3 years -	12	8
> 3 years	13	9
Frequency of usage (%):		
Occasionally each week -	17	26
Occasionally each month -	39	37
Occasionally each year -	34	27
Rarely -	10	10
Usage of CASE tool (%)	57	69
Usage of formal methodology for application development (%)	63	76

a 80 of these utilisers had both AA and CDM.
b Scale: 1 = Irrelevant, 2 = Little Use, 3 = Some Use, 4 = Significant Use, 5 = Absolutely Essential.

Figure 4.12: Major AA/CDM Variables and their Statistics

Adoption and Valuation of Application Architecture and Corporate Data Model

Figure 4.12 shows that there were more utilisers of AA than CDM. A chi-square test (χ^2=48.12, df=1) at the 0.05 level supports the proposition that AA is more widely used than CDM. Both AA and CDM were generally perceived to be more than just of some use in IS planning. Their mean values were 3.86 and 3.64 respectively. These were confirmed as being significantly greater than the midpoint via t-tests at the 0.05 level. The visible difference in the perceived values of AA and CDM was confirmed as being significant via a t-test (t=-4.73, df=215) and a Wilcoxon test (Z=-4.5153) at the 0.05 level; two fundamentally different tests (one a parametric and the other a non-parametric) were conducted as it is a seminal issue in this research. These findings suggest that:

* *Application architecture is used more widely and has a higher perceived value than corporate data model in IS planning.*

Sources of Application Architecture and Corporate Data Model

AA and CDM owe much of their existence to IS planning. However, the survey data showed that either one or both of these models could exist even if no IS planning had been performed. Hence an investigation into situations leading to development of these models was carried out. Figure 4.13 summarises the major findings: IS planning was the major source of AA while IS project was most relevant as a source of CDM. The significance of this relationship was confirmed via a chi-square test[16] at the 0.05 significance level by crosstabulating occurrence of AA and CDM against source in terms of ISP and IS project (χ^2=8.55666, df=1). This relationship harmonises with the frequencies of AA and CDM development (see figure 4.12). Of the two, CDM was developed more on an 'as and when necessary' basis, possibly when required by a project. A higher proportion of AA, as compared to CDM, was developed on a more

16 For the purpose of this test, a subset of the survey sample was selected ensuring mutually exclusive cases in terms of AA/CDM and ISP/IS project (45 cases); some cases in the full sample had both AA and CDM as IA components, and both ISP and IS project as sources of IA.

definite frequency, a characteristic found to be applicable to the majority of IS planning in the sample[17] .

Situation	AA[a] (% of Cases[b])	CDM[a] (% of Cases[b])
IS planning process	70	36
Part of IS project	35	50

a To avoid any intervening or spurious effects, AA cases were confined to those without CDM, and similarly CDM cases were confined to those without AA.

b A respondent could provide multiple responses.

Figure 4.13: Major Situations Leading to Development of AA and CDM

Techniques for Developing Application Architecture and Corporate Data Model

Though AA and CDM share a common foundation in the form of business domain, their bases within the domain are different - it is 'business processes' for AA while it is 'business entities' for CDM (IBM, 1981, 1992; Martin, 1989, 1990a; Texas Instruments, 1989, 1992). This difference was reflected in the survey sample. Data flow diagramming and entity relationship diagramming/logical data modelling were found to be the two dominant techniques associated with development of AA and CDM respectively. Furthermore, of the two IA components, CDM was associated more with CASE tools and formal application development methodologies (see figure 4.12). These findings reflect CDM's greater affinity to application development and consequently its association with IS project. The results of the analysis of individual users of AA and CDM within an organisation strengthen this emerging pattern.

17 IS planning frequency is not presented in the main text as a statistic because of the sample's focus on IA. Nonetheless, the computed frequency is presented here to substantiate this argument: as and when necessary - 32%; every year - 42%; every 2 or 3 years - 20%; > 3 years - 6%.

Users of AA/CDM	Mean AA Score[a]	Mean CDM Score[a]
IT Management[18]	4.26	3.41
Systems Analyst[19]	4.03	4.09
Data Administrator	3.38	4.18
Senior Management	2.20	1.78
Functional Management	2.57	2.26
Business Planner	2.44	2.26

a Likert-type scale: 1= not a user, 2= occasional user, 3= regular user, 4= frequent user, 5= main user

Figure 4.14: Users of Application Architecture and Corporate Data Model

Users of Application Architecture and Corporate Data Model

The usage of AA and CDM by their users[20] (as perceived by the individual respondents) was examined (see figure 4.14). Horizontal comparisons were made via Wilcoxon tests to see whether the users differentiated between the two models. The test results were found to be significant at the 0.05 level for all users except the systems analyst and business planner. These two users were not judged to differentiate between AA and CDM as regards these models' relative usefulness to them. The systems analyst was a 'frequent user' while the business planner was more of an 'occasional user' of both models. The data administrator however was judged to prefer CDM over AA; he was a 'frequent user' of CDM and a 'regular user' of AA. The reverse was noted for IT

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18 'IT Management' includes head of IT, application development manager and others generally regarded as belonging to the IT management team.

19 'Systems Analyst' includes all IS development staff including the IS planner.
Initially, 'IS planner' was identified as a separate category of user. Pre-tests indicated (wrongly) that the concept of 'IS planner' was not prevalent, and as such this category was removed from the questionnaire. It became clear after receipt of completed questionnaires that positions responsible for IS planning existed in at least 22 of the 294 responding organisations. Respondents appeared to have incorporated usage of AA/CDM by "IS planner' together with that of 'systems analyst'; this was indicated a few times in the questionnaire.

20 The term 'user' refers to a grouping or an individual who uses an IA/AA/CDM model, reviews it or attends presentations of it

management, functional management and senior management: IT management was a 'frequent user' of AA and a 'regular user' of CDM; functional management was an 'occasional user' of both models, with a preference for AA; senior management, an 'occasional user' of AA, was only a marginal user of CDM. The emerging evidence suggests that AA is preferred by management and CDM is favoured by those involved in IT-oriented tasks. This pattern of IA usage found considerable support in the analysis of AA and CDM benefits and problems.

6. Benefits and Problems of Application Architecture and Corporate Data Model

The clarification of the benefits and problems of AA and CDM is an important objective of this survey. Two 5-point Likert-type scales were used to measure the perceptions of the respondents. The results are tabulated in figures 4.15 and 4.16. T-tests at the 0.05 level were carried out for each of the item's scores; the significant scores are underlined in the tables. Where it was feasible, comparisons were made between the AA and CDM scores for each of the items. Wilcoxon tests and t-tests at the 0.05 level were used; two fundamentally different tests were carried out in view of the importance of the differentiation between AA and CDM. The two tests conveyed identical results for each comparison; items with significant variation in scores are italicised in the tables.

Benefits/Purposes of Application Architecture and Corporate Data Model

Corporate data modelling is often advocated as a business modelling tool (Chen, 1976, 1993; Finkelstein, 1981, 1991; Martin, 1982, 1989, 1990a). In response to a question on this matter, respondents gave an average score of 3.21 to CDM. The score is not significant but does suggest that the respondents viewed CDM to be somewhat of a business modelling tool. The score however is not significant enough to support the claim that CDM is a business modelling tool in the way that some writers do.

The IS literature rarely refers to AA as a business modelling tool; hence a question to this effect was not included in the questionnaire. The AA was however thought to have

potential for facilitating IT-related responses to changes in business. A question on this issue was included in the questionnaire for both AA and CDM. The respondents gave average scores of 3.35 and 3.15 to AA and CDM respectively. AA's score is not only significant but also significantly higher than that of CDM.

Benefit/Purpose	AA		CDM	
	Mean Score[a]	Rank	Mean Score[a]	Rank
Business planning				
Business modelling tool	-	-	3.21	6
Facilitates responses to changes in business	3.35	9	3.15	7
IS planning				
Tool for communicating IS plan to senior management	3.53	5	2.33	9
Tool for communicating IS plan to functional mgt.	3.56	4	2.81	8
Tool for communicating IS plan within IT dept.	3.95	2	3.76	3
Provides rigour to the IS planning process	3.46	7	3.50	4
Project implementation				
Facilitates preparation of IS project specifications	3.48	6	-	-
Provides inputs for application development	3.45	8	-	-
Blueprint for integrated application development	4.30	1	-	-
Facilitates realisation of the integrated IS goal	3.76	3	3.46	5
Blueprint for implementing corporate database	-	-	3.87	2
Provides inputs for data analysis and database design	-	-	3.89	1

a Scale: "1 = Not a Benefit/Purpose" to "5 = Major Benefit/Purpose"; midpoint = 3.0 .

Figure 4.15: Benefits/Purposes of Application Architecture and Corporate Data Model

The survey raises serious questions on CDM's role as an ISP communication tool. CDM's lowest ranked benefit, with a significant score of 2.33, implies that CDM was not considered to be appropriate for senior management communication though writers such as Martin and Hershey (1986), Sager (1990) and Vesely (1990) suggest so. CDM's

role as a tool for communication with functional management is unclear as the score of 2.81 is not significant. CDM's communication role was judged to be significant only in so far as it concerned the IT department. CDM was nonetheless perceived to provide rigour to the IS planning process.

In comparing the above-mentioned scores of CDM to the corresponding ones for AA, it was found that the AA scores were not only significant but also significantly higher as regards ISP communication roles. The application architecture was judged to be of value for communicating the IS plan to top management, functional management and within the IT department. The AA was also perceived to provide rigour to the IS planning process.

Both AA and CDM were regarded as useful tools for implementing an organisation's IS plan and realising its integrated IS goal. AA's top benefit was perceived to be its role as a blueprint for integrated application development. AA was also considered to facilitate preparation of specifications for project work and inputs for application development. CDM's key strength was assessed to be in database planning, design and development.

The evidence contained in figure 4.15 suggests that CDM's top benefits/purposes lie mainly in project implementation. AA's major benefits/purposes also lie in project implementation but the AA has significant relevance to IS planning particularly in management communication matters. The emerging association of AA with IS planning and CDM with IS project was detected earlier in the analysis of sources and users of AA and CDM. This pattern is further supported in the analysis of AA and CDM problems.

Problems of Application Architecture and Corporate Data Model

Both senior management and functional management were perceived to find AA and CDM complex. This was identified as the number one problem for both models (see figure 4.16). The scores of AA (3.05 and 2.90) were however not significant, suggesting that the problems were not perceived to be very serious for AA. In contrast, the scores of CDM at 3.73 and 3.46 were not only significant but also significantly higher than those of AA, suggesting that the two complexity problems were judged to be

of some seriousness and more applicable to CDM. The CDM was also perceived to be irrelevant to senior management and possibly even to functional management (scores of 3.40 and 3.03 respectively). This was however not the case for AA.

Problem	AA		CDM	
	Mean Score[a]	Rank	Mean Score[a]	Rank
Relevance to Management				
Senior management find it complex	3.05	1	3.73	1
Functional management find it complex	2.90	2	3.46	2
Senior management find it irrelevant	2.57	4	3.40	3
Functional management find it irrelevant	2.52	6	3.03	4
IS Planning				
It shifts ISP focus from business to techniques	2.18	9	2.77	8
Development of it extends duration of IS planning	2.36	8	2.69	9
Additional resources are required to develop it	2.65	3	3.02	5
It is difficult to develop	2.43	7	2.84	7
It is difficult to maintain	2.56	5	2.88	6

a Scale: "1 = Not a Problem/Limitation" to "5 = Major Problem/Limitation"; midpoint = 3.0 .

Figure 4.16: Problems/Limitations of Application Architecture and Corporate Data Model

The respondents indicated that of the two models, CDM was more likely to introduce bias towards techniques (rather than business) during IS planning. CDM, as compared to AA, was also judged to affect ISP more adversely in matters of planning resources, duration and development/maintenance difficulty.

The analysis of AA and CDM's problems provides additional evidence supporting earlier findings. It suggests that, from a management perspective, CDM is perhaps not an appropriate tool for use in IS planning. The AA is more appropriate in this regard but it does have some inherent complexity problems.

7. Discussion and Propositions

The findings of the survey are discussed and interpreted below by relating them to relevant literature.

Information Architecture: The General Message from the Survey

The survey has found that information architecture is being used to some extent in the real world and that organisations utilising IA are generally experiencing positive values from it. The findings also suggest that IA is closely associated with IS planning. This does not mean that an IA has to be developed in every IS planning exercise or that all organisations will find IA useful. Small enterprises are unlikely to benefit from major IA effort in view of the resources/commitment required; nonetheless they could benefit from the IA concept via simple focused IS blueprints. Medium/large organisations are more likely to gain value from IA usage particularly if they position IT as a strategic/essential resource. Anecdotal evidence, however, suggests that some very large corporations/ parent organisations may not require an IA.

The usefulness of IA cannot be interpreted to imply that an IA-driven IS planning is the right approach. On the contrary, an architecture-driven planning often turns out to be less successful (Earl, 1990, 1993). The need to inject business considerations in IS planning has been argued by many writers (Feeny, 1988; Feeny et al., 1992; Galliers, 1987; Keen, 1991, 1993; King, 1978; McLean and Soden, 1977; Pyburn, 1983; Willcocks, 1992a, 1992b). It is therefore appropriate that IA's relevance and usefulness to the planning task are gauged from this perspective. Usage of IA beyond IS planning ought to be anticipated and catered for to minimise the "need for substantial further analysis" after the planning (Lederer and Sethi, 1988). However, such an effort should not cloud IA's primary role as a planning tool; form and content of IA should be a contingent matter.

The above discussion helps to position IA in the real world. Some of the propositions, in particular those which can be studied via case studies, will be investigated further in the next stage of this research.

Comments and Propositions on Corporate Data Model

The survey found CDM to be of value more as a tool for implementing the IS plan rather than facilitating the planning process. CDM's strength was perceived to be in the project/technical domain: application/database development, data management and communication within the IT department. The survey did not find CDM to be useless in IS planning. Usage of CDM was perceived to add some rigour to the IS planning process. The CDM was even considered to be somewhat of a business modelling tool. However these IS planning benefits were overshadowed by CDM's[21] perceived weakness in relation to communication with management. This latter evidence brings into question the validity of data-driven IS planning approaches.

Information Engineering and other forms of data-oriented IS planning methodologies and approaches are being strongly advocated by some writers (Finkelstein, 1981, 1991; Hackathorn and Karimi, 1988; Martin, 1982, 1985, 1989, 1990a, 1990b; Martin and Hershey, 1986; Sager, 1990; Texas Instruments, 1992, 1993). Many of these writers justify their advocacy of data-oriented IS planning by contending that data is stable. Marche (1993), via his empirical work, questions the validity of their contention on data stability, and thereby implicitly challenges the notion of data-oriented IS planning. Other researchers explicitly argue that data orientation is not an appropriate paradigm for IS planning. Goodhue et al. (1988, table 2) note that "It is not always clear to the planners or top management whether a strategic data model is being developed to produce a systems plan, create an architecture, or to design new databases." Goodhue et al. (1992a) report the existence of significant problems in IS planning exercises based on data modelling techniques (see Chapter 2); they found corporate data models to be complex in format and content, and demanding on planning resources.

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21 It could be argued that some CDMs, particularly those developed during IS projects, might not be true "corporate" data models. Exclusion of these types of CDMs from the analysis did not alter the results.

While claims on CDM's usefulness in IS planning are being increasingly challenged, the position of data modelling per se in application/database development and data management remains strong. Martin (1989) argues that conceptual data modelling is an essential tool for the data administrator. Codd (1970), Martin (1990a), Towner (1989) and others assert that a data model is vital for constructing a robust database on which integrated applications can be built. Research evidence - such as Carlis and March (1984), March and Kim (1992) and Ross (1987) - support the usage of data models in information systems development and data management.

The message emerging from the survey and literature evidence is that *a corporate data model is not appropriate for use in IS planning*, and that *corporate data model and other high-level data models are potentially of value in application/database development and data management*. This research will seek further evidence via case studies to ascertain the validity of these propositions. The case studies (see Chapters 5, 6 and 7) will examine the success/failure of CDM as an IS planning tool, and clarify the position and usage of other high-level data models in relation to IS planning and implementation.

The 'Data Vs Process' Debate from an IS Planning Perspective

Finkelstein, Martin and others maintain that process is more susceptible to change as compared to data, and hence advocate data-oriented[22] IS planning and application development. IBM (1992) and Zachman (1987), on the other hand, are calling for equal emphasis on both data and process in such efforts. Some recent methodology literature such as Periasamy (1990), Rock-Evans (1992) and Yourdon Inc. (1993) seek to integrate process and data in application development efforts.

While the debate on 'data' and 'process' (and more recently 'object') is continuing in the IT domain, 'process' is emerging as the clear leader in the business domain. Porter's (1985) Value Chain Analysis framework is a popular tool for modelling and analysing

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22 Object-orientation is emerging as the new IS paradigm. As its position in relation to IS planning is still unclear, the discussion is confined to "data-orientation" and "process-orientation", the currently prevalent paradigms.

the key activities of an organisation. Ives and Learmonth (1984) have developed a generic customer-resource life cycle that describes the process by which a customer acquires, uses and disposes of resources; their business-oriented framework is used in the identification of strategic IT applications. Business process reengineering (Hammer, 1990; Hammer and Champy, 1993) and process innovation (Davenport, 1993) are based on business processes and how these processes can be innovatively redesigned with the aid of IT for gaining strategic advantage. Davenport (p. 1) emphasises that "Business must be viewed not in terms of functions, divisions, or products, but of key processes."

The evidence from this survey suggests that, despite the data-oriented push, process orientation remains (or is being reinstated) as the preferred IS planning approach. This is perhaps because of the increasing orientation of IS planning to business. Data orientation and related changes have been happening to IS planning approaches in the form of Information Engineering and other such methodologies (Premkumar and King, 1991) but these changes do not appear to have altered the generally low level of ISP success in any significant way (Earl, 1990; Lederer and Sethi, 1988).

Comments and Propositions on Application Architecture

Application architecture falls within the 'process-oriented' taxonomy of IS modelling approaches. The survey found AA to be of value for IS planning and implementation. The AA incorporates rigour into the planning process. It facilitates integrated application development and realisation of the organisation's integrated IS goal. The AA serves communication needs within the IT department on ISP matters. It helps in the planning of IT-related responses to changes in business. Though AA is relevant to senior management, the general perception is that it is somewhat complex in so far as senior management communication is concerned. The need is therefore for a less complex AA attuned to senior management. However a less complex (and consequently less-detailed) AA may become a less-effective blueprint for integrated application development. Hence complexity/simplicity decisions on AA need to be tempered with considerations on its subsequent usage in application development.

The message emerging from the survey findings is that *a two-level application architecture is required to address the conflicting demands from IS planning and IS plan implementation.* The theories and experiences in the structured methodology world (Gane and Sarson, 1979; ISS, 1991; Yourdon, 1989; Yourdon Inc., 1993) provide a basis for such an approach. The overall AA is targeted at senior management and is used during IS planning in management communication tasks. The detailed AA, based on the overall model, serves technical requirements, project planning and implementation.

The association of information architecture with the strategic positioning of IT suggests that the overall AA should focus only on strategic IT applications. Such a model can be useful in getting senior management involved in IS planning, an issue which has been highlighted by Earl (1990, 1993, 1994), Feeny, et al. (1992), Lederer and Sethi (1988), and Rockart and Crescenzi (1984). Organisational behaviour theories (Mintzberg, 1973, 1975) suggest that due consideration of senior management's behavioural characteristics is necessary for effective communication with them (see Chapter 5 for more detail). Hence in the design and development of the overall application architecture, format and appearance need to be given due consideration alongside content. This would enable senior management to understand and relate strategic IT applications more easily to business strategies and operations. The overall AA does not have to be purely conceptual or technology-independent as technology could be the key factor for leveraging a business process (Hammer and Champy, 1993). An AA targeted at senior management hence needs to include relevant aspects of the proposed technology at a macro level.

The detailed AA serves as the ISP blueprint and is treated as a form of technical specification. The model should contain sufficient detail to facilitate the consequent project planning and development work. It may be appropriate in complex cases to develop a few models at the detailed level covering different parts of the overall AA. The number of such models is kept to a minimum and the level of detail is contained as otherwise the AA development effort may encroach prematurely into conventional systems analysis territory.

The above propositions on AA, though based on empirical evidence and generally accepted theories, require further validation, elaboration and clarification. This will be done in the case studies.

8. Summary

This chapter has described a large-scale postal survey on the state and status of information architecture. The survey has shown that IA is not just a concept but a reality. IA is perceived by organisations, which utilise it, to be a useful tool for IS planning and implementation. IA's key components (AA and CDM) are valued differently, AA being rated higher[23] in relation to IS planning. CDM is perceived to be complex and irrelevant to senior management and hence is not regarded as appropriate for inclusion in IS planning. Data modelling's value is in IS plan implementation rather than IS planning. AA's potential value for IS planning is limited by the model's complex nature. A two-level application architecture set has been proposed - one level targeted at senior management and the other targeted at the project team.

These propositions require further investigation. A qualitative research in the form of case-studies has hence been proposed to investigate these propositions and associated issues. The next chapter (Chapter 5) discusses the relevant established theories and literature. A theoretical research model based on the propositions, theories and literature is developed and proposed to drive the case-study work described in Chapter 6.

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23 If the focus of the research had been application development, the ratings might have been reversed. Analysis of responses from only IT professional staff indicated the likelihood of this happening.

Chapter 5: A Redefined Information Architecture - The Theoretical Model

- Research Domain
- Managerial Communication
- Management Information Characteristics
- Information Systems Planning
- Components of Information Architecture
- Management Requirements
- Management Behaviour
- Strategy and Business Planning
- Earl's 'Organisational Approach'
- IT Architecture
- Theoretical Research Model - Development and Verification

The IA survey findings helped to clarify the state and status of information architecture. However the results did not adequately illuminate a number of key issues on the development and usage of IA. Specifically, what is a good IA, what is its nature and content, why is it created, and how can it be efficiently developed and effectively used in the planning and implementation of an organisation's information system? Additional research was required to clarify these issues. Hence the research proceeded to an in-depth qualitative investigation via six case studies. This chapter discusses the theories relevant to the research and develops a theoretical model for the investigation. The next chapter delves into the case studies proper.

1. Research Domain

The focused research domain shown in figure 5.1 was defined to enable the development of a rich picture for a holistic qualitative investigation. IA development and usage was the core issue to be investigated. Key issues related to this core point were identified. The IA survey had found evidence supporting the existence of a bond between IS planning (ISP) and IA. This relationship is also indicated in the literature on ISP. Hence IS planning and implementation of the plan (project) were included in the research domain as two of the key issues. IT architecture was also included in view of its integral relationship with IA (Darnton and Giacoletto, 1992; Nolan and Mulryan, 1987; Zachman, 1987). The literature on IS planning (e.g. Feeny, 1988; King, 1978; Mclean and Soden, 1977;

Remenyi, 1990; Ward, et al., 1992) indicate that an investigation into ISP would be incomplete without adequate coverage of business planning and strategy development. The IA survey had found some evidence suggesting the potential value of IA as a business modelling tool. Furthermore Chen (1976, 1993), Palmer (1991) and Martin (1982) strongly advocate usage of corporate data model (CDM) for business modelling. It was therefore necessary to include strategy development and business planning in the research domain.

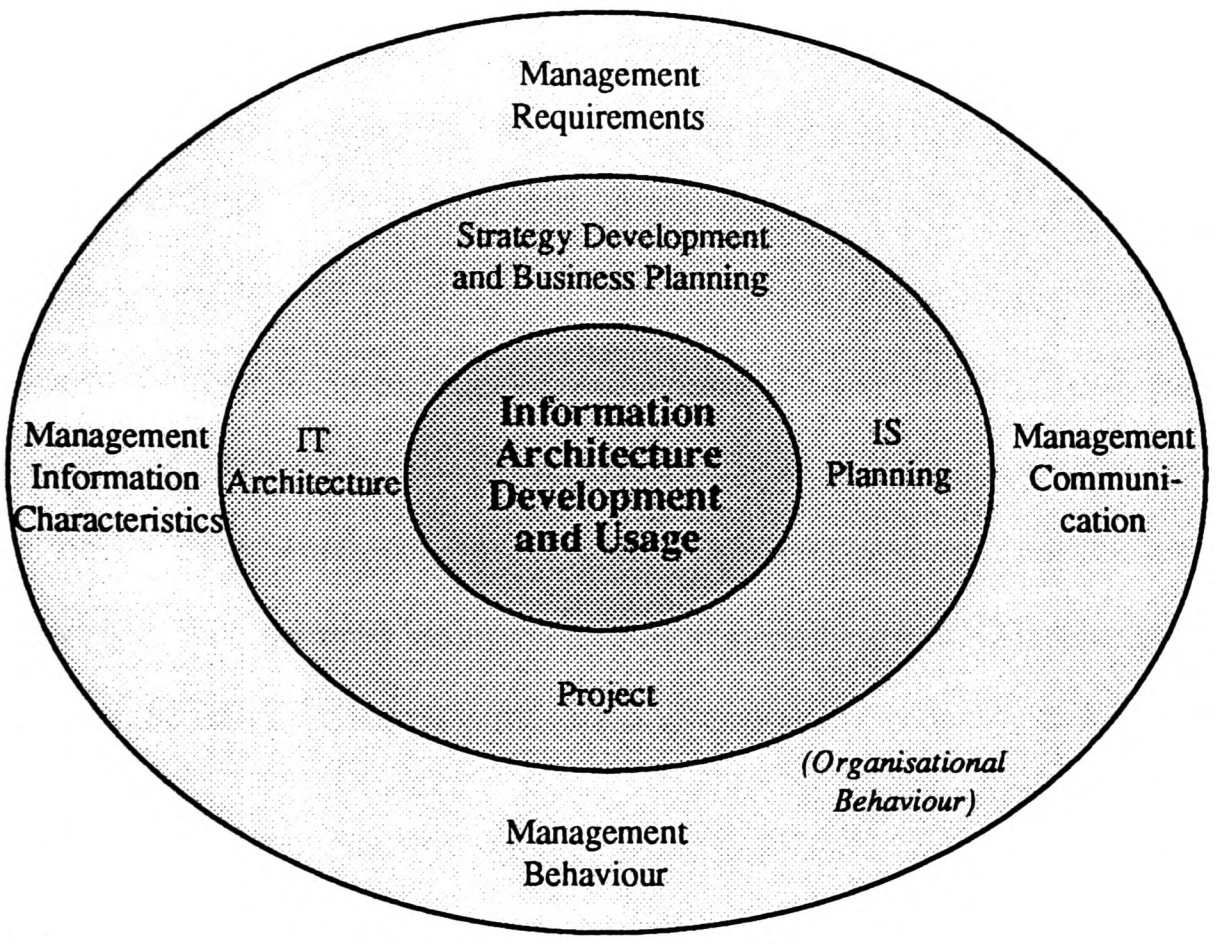


Figure 5.1: Focused Research Domain

While the above-mentioned four issues are closely linked to IA, they do not constitute the only major issues relevant to IA. Land (1992, p. 6) points out that "information systems are essentially social systems of which information technology is but one aspect". He advises IS researchers to take account of this fact "if the outcome of their research is to have relevance in the real world." Following Land's advice, a more holistic view of IA from a sociological perspective was taken. A problem with such an approach, however, is that it tends to introduce numerous issues in the research domain: culture, history,

power, politics, motivation, etc. It is not feasible to investigate all of them in a research project such as this. Hence for the purpose of this research, only issues of direct relevance and significance to IA were included in the focused research domain.

The IA survey suggested the potential value of IA as a management communication tool during IS planning. The survey also identified the likelihood of problems in the usage of IA by management. It was reasoned that inadequate addressing of management behavioural characteristics in the development of the IA models could perhaps be at the root of this problem. The IA research literature is not very helpful in illuminating these two issues. Researchers have tended to focus more on IA's role as a blueprint for information systems development (Brancheau, et al., 1987; Goodhue, et al., 1988; Hackathorn and Karimi, 1988). Some researchers such as Goodhue, et al. (1992a), and Kim and Everest (1994) do touch on the communication issue; they have generally reported unsatisfactory IA experiences (see Chapter 2). Earl (1990, 1993) implies the existence of management communication problems in IS planning practices which adopt an architecture-oriented approach. It is apparent that management communication and, associated with it, management behavioural characteristics are of importance to IA. The two issues were therefore included in the research domain as is depicted in figure 5.1.

These two issues helped to identify another two organisational behaviour issues which are of direct relevance to IA. The purpose of IA is to model a solution for the IT application requirements of the organisation. Comprehensive and accurate knowledge of organisational IT requirements is thus a prerequisite for developing an effective IA model. The organisational requirements are to a large extent represented by the requirements of senior management and functional management. Determination of management requirements is thus an important part of the IA development process. Management requirements was therefore included in the research domain as a key issue.

The process of developing an IA involves communication of information on the IT requirements of the organisation between the person(s) developing the IA and senior management and functional management. The IA, when later used at the project level,

communicates information on these requirements to the project teams for them to develop the required IT applications. There are thus different levels of managers - a manager being taken as "anyone above a certain level, roughly above foreman whether ... in control of staff or not" (Stewart, 1976) - with differing interests in the IA. Their expectations from the IA are different and so are the characteristics of the information (Gorry and Scott Morton, 1971) which they seek from it. Hence characteristics of management information was included in the research domain.

The research domain model (figure 5.1) does not represent IA's complete domain. Nevertheless it seeks to depict key issues associated with IA and provides a basis for conducting the qualitative investigation into IA's development and usage. Each of the items in the model is discussed next in an effort to build a theoretical research model.

2. Management Requirements

Davis (1993, p. 371) defines user-requirement as "a user need or a necessary feature, function, or attribute of a system that can be sensed from a position external to that system." Management requirements can be understood similarly as a need sensed by management in relation to the business. Senior managers generally believe that early and accurate identification of their requirements is a crucial factor in the successful implementation of an organisation's information system (Wasserman, et al., 1983). Davis (1982) contends that many IS failures can be attributed to a lack of clarity in requirements definition. Podger (1979) offers a way to handle the requirements definition issue. He suggests defining requirements by recognising that a system can be divided as follows:

* An *inner* zone of basic values and principles which would require a revolution to change.

* An *intermediate* zone of general procedures which are subject to change but where the lead time between the change being formulated and required is quite long.

* An *outer* zone of specific procedures, subject to more rapid and frequent change.

Professor Frank Land of the London School of Economics, in an interaction with the author, suggested another way to understand and classify requirements:

* Requirement whose satisfaction is *necessary* for performing an essential business process - e.g. billing the customer for goods supplied.

* Requirement which has the capability of *improving* the carrying out of a business process - e.g. the provision of timely or more complete information to a decision maker.

* Requirement which is *idiosyncratic* - i.e. it helps a particular individual or group to carry out a business process in a way which is peculiar to that individual or group.

While noting that are a number of ways of defining requirements, Land (1982, p. 64) notes that "Any model of user requirements has to take into account the need to preserve the informal element in information systems." A recent user-requirement theory from Software Engineering gives due recognition to the informal element and provides a comprehensive and structured basis for understanding management requirements. Kano, et al. (1984) typify requirements as *normal requirements*, *expected requirements* and *exciting requirements* (see figure 5.2; refer to Zultner, 1993):

* Normal requirements - These are the requirements formally and explicitly stated by a person in response to requests, verbal questions, written questionnaires and other interrogatory instruments. Normal requirements satisfy (or dissatisfy) in proportion to their presence (or absence) in the deliverable. They are often wrongly taken to represent all the requirements of the person and tend to ignore the informal element; it does not mean that something unstated is not a requirement.

* Expected requirements - These requirements are 'musts' that have to be met and may include informal requirements. They may be implied or are so basic that a person may not think it is necessary to state the requirements explicitly - until it is found to be missing in the deliverable. The person may even be unaware that the deliverable can be delivered without it. Presence of expected requirements in the deliverable meets expectations but does not necessarily lead to satisfaction. Their absence, however, is very dissatisfying. 'Online Help' is an example.

* Exciting requirements - These are the most difficult requirements to uncover. They are unexpected, beyond expectations or unknown (but have potential), and yet are highly satisfying when delivered. Their absence does not dissatisfy.

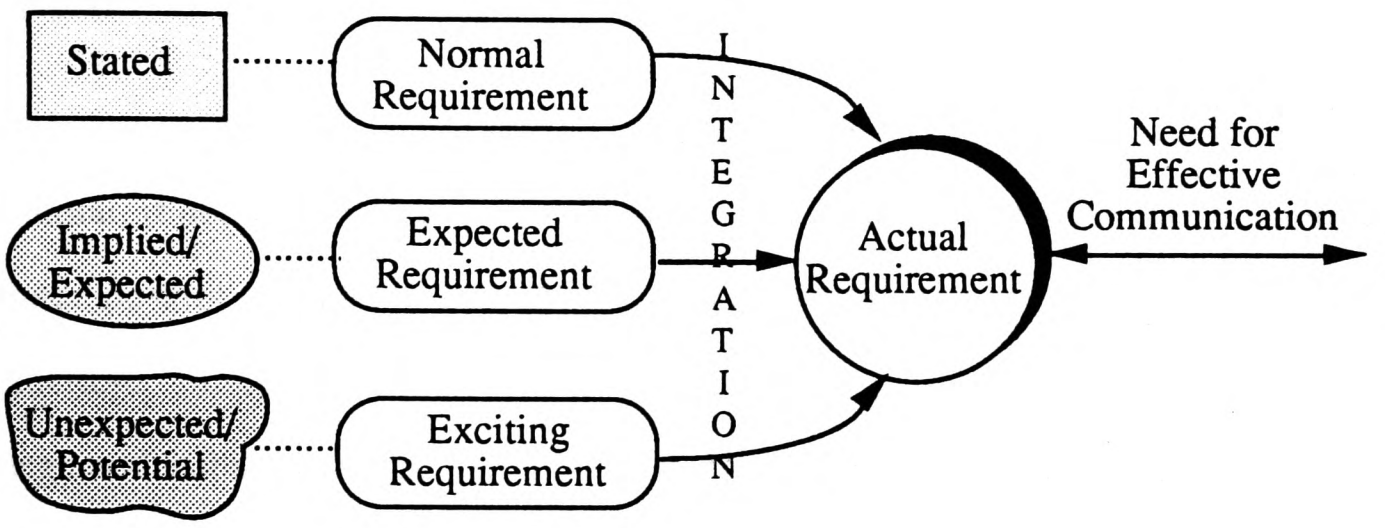


Figure 5.2: Requirements Model (Based on the Classifications of Kano, et al., 1984)

The actual requirement of a person is the integration, rather than the summation, of all three types of requirements (see figure 5.2). The relative significance of each to actual requirements depends on such factors as the individual's level, responsibility and decision making process. Simon's (1960) classification of managerial decisions helps to clarify this dependency. Managers make "programmed" or "nonprogrammed" decisions in solving problems, or as Gorry and Scott Morton (1971) put it "structured" and "unstructured" decisions. Operational level managers need to be explicit in their requirements in order to carry out their repetitive and structured decisions. Expected and exciting requirements are relevant to operational level activities but normal requirements

are likely to dominate these activities . On the other hand, exciting requirements are likely to be more relevant to senior management which is often engaged in relatively unstructured decision making processes.

Senior management generally takes a holistic view of the organisation, embedding it in its environment (Beer, 1979). They operate in a less precise information domain which includes substantial external information (Davis and Olson, 1985; Gorry and Scott Morton, 1971). Senior management's normal requirements are only part of their actual requirements. They expect the analyst/investigator to know their expected requirements and are unlikely to spend time making these requirements explicit; their tendency is to be brief and action oriented (Mintzberg, 1973). Senior management is concerned about business strategies and innovation (Davenport, 1993) and hence exciting requirements are of particular significance to them.

As depicted in figure 5.2, a senior manager's stated requirements can thus only constitute a minimal, if not a meagre, representation of his actual requirements. The requirements change, possibly influenced by factors such as learning, experience, knowledge, interactions, interpersonal influence, group dynamics, business operations, business strategy and technology. Effective communication techniques are necessary to determine the actual requirements of a senior manager. These are however not sufficient - other factors such as task, organisational culture, interpersonal influence, politics, motivation, etc. are also of importance. Conventional techniques such as requests, interviews and questionnaires would only result in normal requirements. More sophisticated communication techniques are required to make explicit key expected requirements . Workshops and brain storming can help to reveal management's hidden, implied and expected requirements (Rockart and Crescenzi, 1984). The leverage offered by informal information systems and interpersonal communication networks in this regard have been well-documented (Kotter, 1982; Mintzberg, 1973; Stewart, 1988). These techniques coupled with a participatory environment and teamwork along the lines of Earl's (1990,

1993) 'organisational approach' are an effective way of clarifying normal requirements, exposing key expected requirements and identifying exciting requirements.

Just as data flow diagrams and other analysis modelling techniques are used to model user requirements during systems development (Yourdon, 1989), information architecture can be used to model management and organisational requirements during IS planning. The IA is a tool to elicit, model and communicate the requirements of an organisation as regards IT application and the business as a whole (an extension of the IA concept which is discussed later in this chapter). Effective communication is at the root of any effort to identify the requirements of an organisation accurately and comprehensively (Byrd, et al., 1992; Bostrom, 1989) and the IA is a tool to engage senior management and others in this effort: modelling 'normal requirements', depicting understanding of 'expected requirements' and proposing 'exciting requirements' in such a manner that senior management and other relevant parties are able to understand, contribute and enrich the IA.

3. Managerial Communication

Studies have shown that both organisational and individual performance improve where managerial communication is effective (Snyder and Morris, 1984; Alexander, et al., 1989). The criticality of management communication becomes apparent when it is recognised that managers spend most of their time communicating (Kreitner, 1992; Mintzberg, 1973).

Communication requires two parties - the communicator and recipient - and is only possible if the two share a common understanding. The communicator has a message which the recipient may or may not wish to receive. If the communicator wishes to be effective in his communication with the recipient, he has to attune his communication style, media and content to the recipient. Drucker (1980, p. 391 - 392), adopting a dramatic style, emphasises this issue thus:

> "It is the recipient who communicates. The so-called communicator, the person who emits the communication, does not communicate. He or she utters. Unless there is someone who hears, there is no communication. There is only noise. The communicator speaks or writes or sings - but he does not communicate. Indeed, he cannot communicate. He can only make it possible (or impossible) for a recipient - or rather, 'percipient' - to perceive.
>
> .... One can communicate only in the recipient's language or terms. ... In communicating, the first question has to be 'Is this communication within the recipient's range of perception? Can he receive it?'. "

The above arguments suggest that an IA should be developed from its targeted recipient's perspective and language - as Socrates pointed out in Plato's *Phaedo*, one has to talk to people in terms of their experience. Thus if the IA is targeted at a few different types/levels of people, a few IA models are necessary. Furthermore a technically conceived IA is unlikely to be well-received by senior management, people who have a greater inclination towards conceptual matters (Katz, 1974). This perhaps explains why information architecture in its current form is generally perceived by senior management as being complex.

The IA survey found that the corporate data model was not only perceived to be complex but also irrelevant to senior management. Senior management expects to be informed on projects and deliverables of IS planning (Lederer and Sethi, 1988; McLean and Soden, 1977). The CDM, however, describes the business in terms of entities and relationships, and is unable to satisfy senior management's expectations on projects and recommendations. There is a conflict between communication content and expectation. The importance of synchronising communication content with recipient's expectations is clarified by Drucker (1980, p. 393) thus:

> "As a rule we perceive what we expect to perceive. ... the unexpected is usually not received at all [except may be in the case of Exciting Requirements - see above]. It is

> not seen or heard, but ignored. Or it is misunderstood. ... Before we can communicate, we must know what the recipient expects to see and hear."

Drucker also notes that communication always makes demands on the recipient. If it fits in with the expectations, aspirations, values and purposes of the recipient, it is powerful. If it goes against them, it is unlikely to be received at all - this may have been the case with the CDM and senior management.

This last point raises the issue of subjectivity. A complex IA model such as a detailed application architecture might not serve senior management communication needs effectively even if it contained all the information which needed to be conveyed to management on an application. A separate model specifically for senior management communication purpose is required. The need for such management-oriented AA models has been argued in the conclusion of the IA survey. It has been asserted that AA models attuned to management's behavioural characteristics would be better received by management. Such an approach would heed the management communication fundamentals discussed above.

4. Management Behaviour

In seeking to understand management behavioural characteristics, it is useful to first examine cognitive style. Cognitive style refers to the way in which people process and organise information and arrive at decisions based on their observation of situations. Cognitive complexity outlines a person's capacity to acquire and sort through various pieces of information from the environment and organise them in such a way that they make sense (Steers, 1988). People with low cognitive complexity tend to use less information, be categorical and stereotypic, depend on simple rules and make less subjective contribution (Elbert and Mitchell, 1975). People with high cognitive style, on the other hand, are less deterministic in behaviour and are more subjective in their decision making process. They tend to use more resources and information, are more consultative in problem solving and are generally able to handle complex situations better

(Mitchell, 1970). The cognitive style described reflects the essence of many of the recent management behavioural theories.

Of the many behavioural theories, one of the best known ones is the classical theory of Fayol and Gullick. When their theory is considered in the light of Mintzberg's (1973, 1975) work, a dichotomy in the characterisation of management behaviour can be noted. (See Hales, 1986 for a discussion of this dichotomy.) This dichotomy however offers a practical way, in line with the cognitive style described earlier, to develop models such as the IA for use by the various types and levels of managers.

Fayol and Gullick present a manager as a highly structured and disciplined individual who plans, organises, coordinates and controls his work. Mintzberg (1973, 1975), however, found managers to be somewhat different. His finding portrays managerial characteristics as one of pressure, interruption, brevity, orientation to action, reactive rather than reflective responses, informal rather than systematic actions, frivolous rather than well-organised ways, preference for verbal rather than written communication, usage of 'soft' information (gossip, opinion, etc.) and working with outsiders and colleagues as much as with subordinates. The difference was so stark that Mintzberg (1975) described the then prevailing perception of managerial jobs as a folklore. His practical management behavioural theory, as Hales (1986) calls it, found support in the work of various other researchers of whom Kotter (1982) and Stewart (1988, 1991) are notable. Ives and Olson (1981) conducted a similar study on IS managers and found this theory to be applicable to them too.

It can be deduced from the practical management behavioural theory that the conventional IA does not fit the behavioural characteristics of senior management. This mismatch possibly explains one of the findings of the IA survey: the complexity of AA and CDM from a senior management perspective. The mismatch could also help to clarify Earl's (1990, 1993) findings that IS planning approaches which advocate development of architecture (Technological Approach - see Chapter 2) are generally less successful. Based on current practice, the architecture resulting from this approach is probably

detailed and complex and consequently not conducive for effective senior management involvement, a factor which Lederer and Sethi (1988) have identified as most critical for IS planning success.

While IA in its current form does not appear to be well-received by senior management, it has a more favourable reception from those operating predominantly in the IT domain (see IA survey findings, Chapter 4). Based on earlier discussions on management communication, the case for a set of IA models attuned to the various recipients' expectations, perceptions and familiarity is clear. However the, possibly ostensible, conflict of behavioural theories causes some confusion as to the direction to be adopted for developing these various IA models.

Anthony's (1965) classification of management and Simon's (1960) structured/ unstructured decisions and their association with operational management/strategic management (Gorry and Scott Morton, 1971) together provide direction for resolving this conflict. By relating the two behavioural theories to the management theories proposed by these scholars, it can deduced that the classical behavioural theory relates more closely to operational management while the practical behavioural theory relates more to strategic (senior) management. This however does not mean that an operational manager or senior manager behaves exclusively according to the classical or practical management behavioural theories (Mintzberg and Quinn, 1991). Both theories are applicable to all managers but to varying extents as is reflected in the continuum shown in figure 5.3.

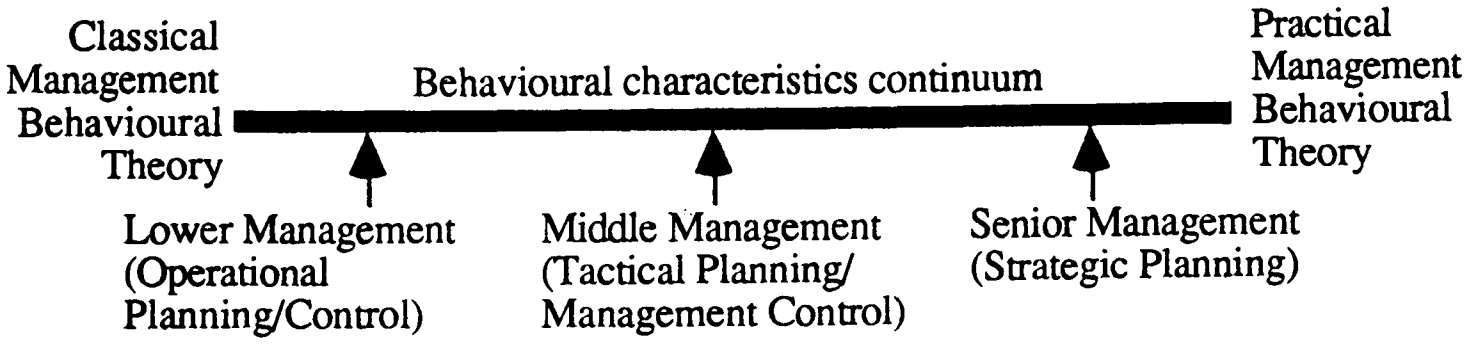


Figure 5.3: Behavioural Characteristics Continuum

Katz's (1974) finding on managerial skills supports the proposed continuum. He observed that as a manager progresses from operational towards strategic management, the need for technical skills becomes less and the need for conceptual skills becomes greater. Technical skills is more in the domain of the classical behavioural theory and conceptual skills is more reflective of the practical behavioural theory.

The behavioural characteristics continuum shown in figure 5.3 offers a direction for development of IA models. Managers on the left half of the continuum are more likely to conform to the classical behavioural school and require technical skills. Hence detailed and technical IA models are likely to be better received by them; this was found to be the case for the data administrator, project manager and systems analyst in the IA survey. Managers on the right half of the continuum (senior management) are more inclined towards the practical management behavioural theory. The typical IA models, such as those shown in Chapter 2 (figures 2.1 and 2.2), do not fit these managers' behavioural characteristics and conceptual requirements. A new set of IA models are required for them. The emerging paradigm is one of relatively 'soft' IA models for senior management and relatively 'hard' models for operational level managers. This proposition will be investigated in the qualitative research.

5. Management Information Characteristics

Gorry and Scott Morton (1971) developed a set of management information characteristics continua to reflect the association between the characteristics of information used by the various managers and their organisational levels. The continua is presented in figure 5.4 with additions derived from the work of Davis and Olson (1985) and Mintzberg (1973, 1975). It has been structured to enable it to be related to the behavioural characteristics continuum shown in figure 5.3. Joint consideration of these two models helps to clarify how IA models can be developed for effective usage.

Information architecture is of relevance to the various managers at the different organisational levels. It conveys IS planning/implementation information to these

managers who span from strategic to project levels. The IA models must fit these managers' behavioural characteristics to facilitate communications on the IT requirements of the organisation from their perspective. The information characteristics continua offers guidance for achieving this fit. It is a potentially useful frame of reference for the design and development of IA models for the different management groups. This is a proposition which is to be investigated. In particular the research will seek to establish:

* Whether IA models targeted at operational managers reflect the characteristics shown on the left of the information characteristics continua, and

* Whether IA models targeted at senior management reflect the characteristics shown on the right of the information characteristics continua.

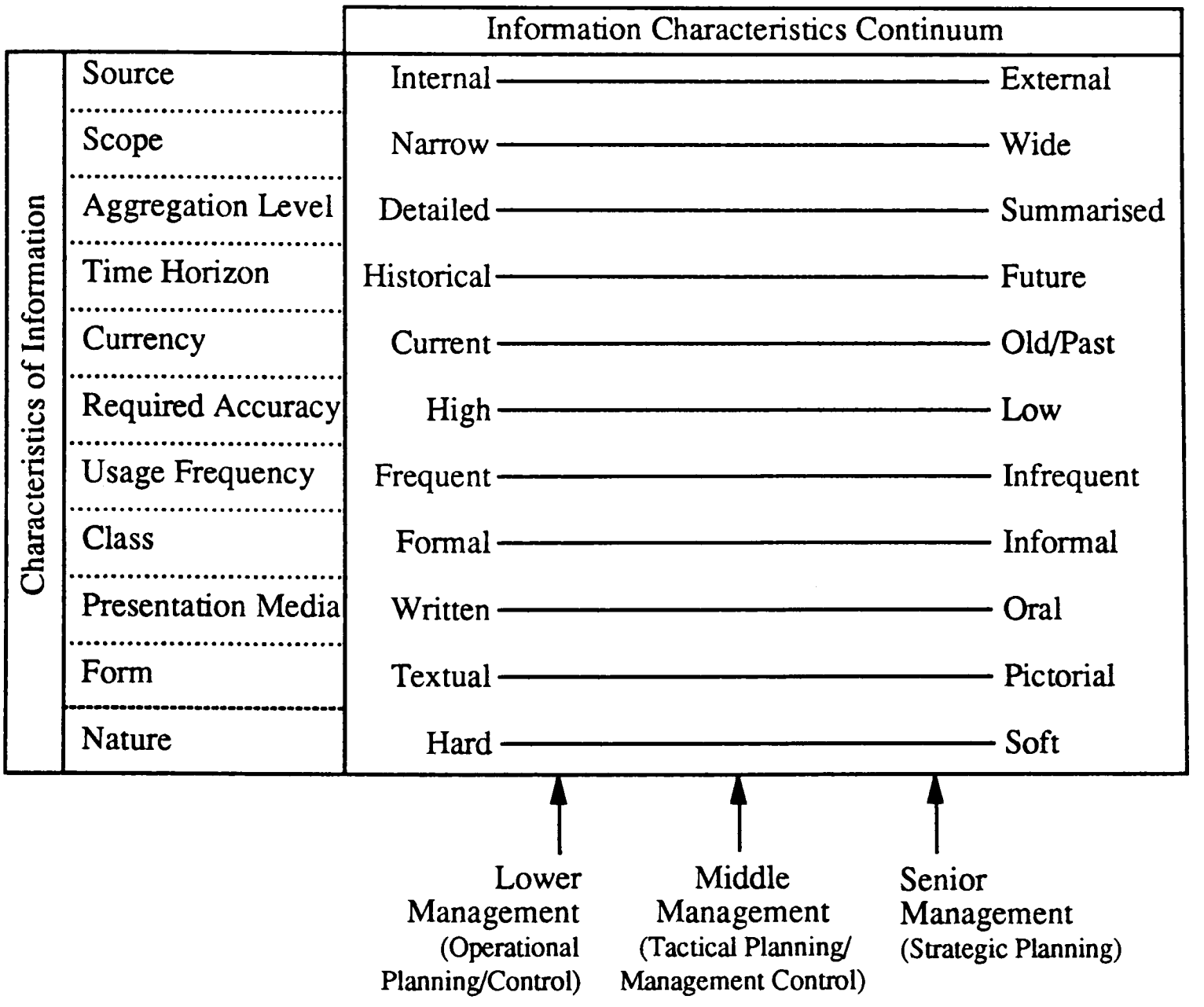


Figure 5.4: Management Information Characteristics Continua

6. Strategy Development and Business Planning

The boundaries between IS planning, strategy development and business planning are not discernible in many of the organisations that are successful in their IS planning practice (see Earl's 'organisational approach' below). The relevance and contributions of IA to this integrated planning arrangement require investigation. In order to do this, it is necessary to clarify strategy development, business planning and IS planning and how these three are integrated.

Strategy and Business Plan

Porter (1980, 1985, 1987) defines strategy to be a company's broad based plan on how it will compete in its business environment. He differentiates strategy as "corporate strategy" (the business a company ought to be in) and "competitive strategy" (how the company can achieve competitive advantage in that business). Such a differentiation is not made in this thesis. Here, strategy is understood as being about where and how to compete effectively.

Strategy can be generic (such as Porter's product differentiation, cost leadership and focused/niche market) or specific. A generic strategy is implemented via specific business strategies. For example, an IT application can be one specific strategy to lower the costs of production; another specific strategy to implement the same generic strategy could be outsourcing. Information architecture is a tool for senior management to deliberate on specific strategy implementation at least in so far as IT is concerned; alternatives can be modelled and discussed. This is a proposition which will be investigated.

Mintzberg (1983) sees strategy development as a mixture of formal and informal, and planned and emergent. Strategy development is not just top-down but is also bottom-up with contributions from the operational level. Lenz and Lyles (1985) argue that "In no sense is strategy-making an exact science. It is, instead, a combination of analytical techniques, administrative processes and human judgement that bears elements of both art and science." Hamel and Prahalad (1989) pursue the artistic dimension further:

"Creative strategies seldom emerge from the annual planning ritual. The starting point for next year's strategy is almost always this year's strategy. Improvements are incremental." Strategy development is thus a continuous process periodically intervened by business planning which helps to consolidate and formalise the organisation's strategic thinking. It involves everyone including the IT function. Hence the notion of the IT department merely planning and acting on the strategies and business plans received by it can be deduced as being incorrect at least in some sectors. Mintzberg (1994, p. 108) in his recent work, *The Fall and Rise of Strategic Planning*, clarifies this paradigm on strategy thus:

> "Strategic thinking[1] is about synthesis. It involves intuition and creativity. The outcome of strategic thinking is an integrated perspective of the enterprise, a not-too-precisely articulated vision of direction ... strategies often cannot be developed on schedule and immaculately conceived. They must be free to appear at any time and at any place in the organization, typically through messy processes of informal learning that must necessarily be carried out by people at various levels who are deeply involved with the specific issues at hand."

Mintzberg further argues that a strategy is different from a plan (p. 108, 112):

> "Planning has always been about analysis - about breaking down a goal or set of intentions into steps, formalizing those steps so that they can be implemented almost automatically, and articulating the anticipated consequences or results of each step. ..... Planning cannot generate strategies. But given viable strategies, it can program them; it can make them operational."

Planning is a markedly different effort from strategy development. "Here a kind of great divide must be crossed from the nonroutine world of strategies and programs to the routine world of budgets and objectives." (Mintzberg, p. 112). The position taken in this

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1 'Strategic thinking' and 'strategy development' are assumed to mean the same thing.

research is that a strategy is not the same as a business plan. The business plan is the means to initiate, execute and control strategic actions and pursuits.

The Strategy Development-Business Planning Framework

Mintzberg's arguments on strategy suggest a vertical integration between strategy development, business planning, functional level planning and projects. The strategy-planning framework shown in figure 5.5 has been developed on this basis. The framework harmonises with Earl's 'organisational approach' to IS planning and is used later to develop the theoretical model which relates IA to strategy development and business planning (see section 11).

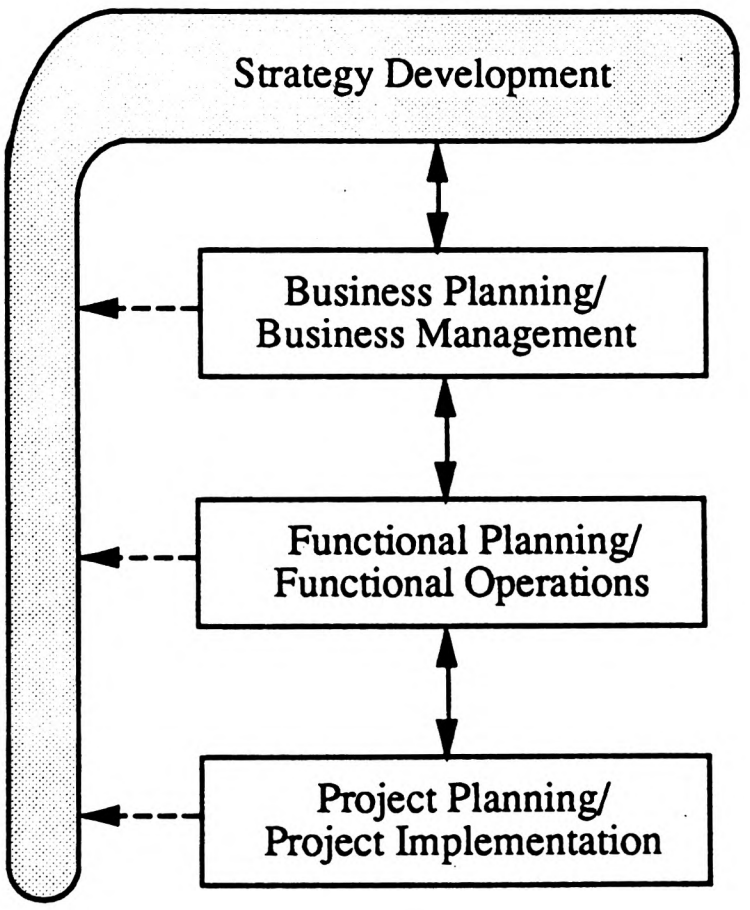


Figure 5.5: Strategy Development-Business Planning Framework

The strategy-planning framework shows that strategy development is a continuous holistic activity benefiting from activities at all levels. Strategy development feeds into business planning but is also influenced by it. Functional planning and operations, though formally consequent to business planning, influence business planning and contribute to organisational strategy. A similar situation exists for project planning and

implementation. The framework depicts a cycle for which strategy development provides the backbone. The organisation's environment affects its strategy, its activities at the various levels and their contributions to organisational strategy (Beer, 1979). (The environment, though relevant, has been excluded to keep the framework simple.)

7. Information Systems Planning

IS planning was introduced in Chapter 2. The need to link IS planning to strategy development and business planning is the subject of much scholarly work (Earl, et al., 1988; Feeny, et al., 1992; King, 1978; McLean and Soden, 1977; Sprague and McNurlin, 1993; Willcocks, 1992a, 1992b; etc.). IS planning is discussed here in this regard and in relation to the strategy-planning framework proposed above.

Many organisations conduct IS planning exercises based on their business plans. The resulting IS plans, however, have generally not been very successful (Earl, 1990, 1993; Lederer and Sethi, 1988, 1992). Changes in business and organisational requirements and technologies upset the carefully laid out IS plan. IS planning methodologies often claim to be business focused and to allow for changes in business plans but they generally do not accomplish this satisfactorily (Lederer and Mendelow, 1989). An IT department may respond to these changes by updating its organisation's IA (the IA survey found that more than 80% of the AAs and CDMs were maintained) but this effort appears to be inadequate (more than 65% of the AAs and CDMs were abandoned/replaced by the end of 2 years). While business planning is at least an annual affair with build-up and control activities throughout the year, IS planning is typically a project conducted every two to three years (Premkumar and King, 1991). Efforts to keep the IS plan in synch with the business plan appear to be more than just updating an information architecture. Recent advancement in IS thinking seeks to redress these issues.

An organisation has to be alert and flexible and respond quickly to changes in its dynamic business environment. Strategic thinking, as advocated by Mintzberg (1994) and supported by organisational theories such as Beer's (1979) *Viable System Model*,

potentially enables an organisation to do this effectively. Strategic thinking does not differentiate between an organisation's resources or functions but considers them holistically in pursuing the organisation's course and response to the environment. The notion of a separate strategic IS planning, or for that matter any other individualistic strategic planning, does not synchronise with strategic thinking. The need for an urgent strategic IT application has to be met regardless of whether it is covered by an IS plan. Current thinking advocates holistic and continuous effort within the IT function and the organisation as a whole.

8. Earl's 'Organisational Approach'

Earl's recent research (1990, 1993, 1994) offers new insight into the state of IS planning and offers direction for greater effectiveness and success in IS planning along the lines just discussed. (See chapter 2 for a summary of the research.) His *Organisational Approach* is conceptually similar to the Strategy-Planning Framework shown in figure 5.5 and is a key theory to this research. The approach's emphasis is on the process of IS planning as an organisational effort rather than an IT undertaking. It involves continuous integrated effort via multi-functional contributions and shared understanding of key business themes, with attention on management participation and commitment. Appropriate involvement by all relevant parties is seen as paramount for successful IS planning. Earl contends that the 'organisational approach' blends most effectively what he considers to be the necessary conditions for successful IS planning: method (procedure, technique, tool and methodology), process (stakeholders, involvement, responsibility, relationship and interaction), and implementation (projects, schedules, resources and contingencies).

The 'organisational approach' is based on the premise that vertical and horizontal integration of planning and implementation processes are essential. Vertical integration is strategic integration: it calls for the intertwining of strategy development, business planning including IS planning, and project implementation. Horizontal integration is functional integration. "Neither strategic integration nor functional integration alone is

adequate to effectively manage IT. Stated differently, each is necessary, but not sufficient." (Henderson and Venkatraman, 1989, p. 8).

The 'organisational approach' looks at strategy development and business planning holistically and positions strategic IS planning integrally within this arrangement. As shown in figure 5.6, the IT department is an equal partner in strategy development and business planning. Earl (1993, p. 14), in summary, sees the approach as a manifestation of strategy development according to the Mintzberg (1983, 1985, 1987, 1994) school:

"Mintzberg's view succinctly summarises the Organisational Approach."

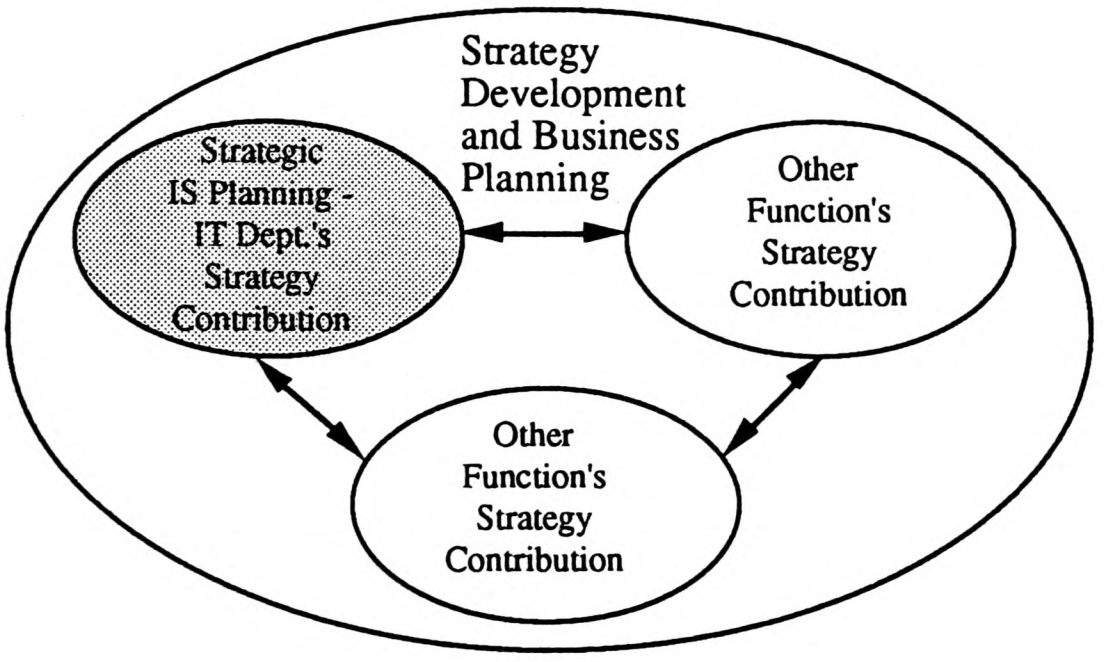


Figure 5.6: IS Planning and Business Planning

Project Implementation

Earl contends that in the 'organisational approach' form of IS planning, there are "no IS projects, just business projects". He argues that the conventional notion of IT project is no longer valid and IS plans which are conceived as such are likely to fail: "In short an 'IT project' is often a failed project." (Earl, 1992b, p. 3). An IT project is confined to the IT domain and has minimal direct business implication. It would typically be related to IT infrastructure. Nevertheless, where an IT infrastructure undertaking is in relation to a business strategy, it would be a business project.

The implication of the 'organisational approach' is that an IT department makes its contribution to the larger business project as part of a multifunctional undertaking (see figure 5.7 - this model is used later in the development of the theoretical model in section 11). A business project is planned collectively via consultation and collaboration during functional level planning. Plans from functional units are considered collectively during the organisational-level business planning. Business projects formally emerging from the planning are jointly implemented by the various functional units. This has been my experience and that of project managers such as Doo (1993) on successful implementation of strategic IT applications.

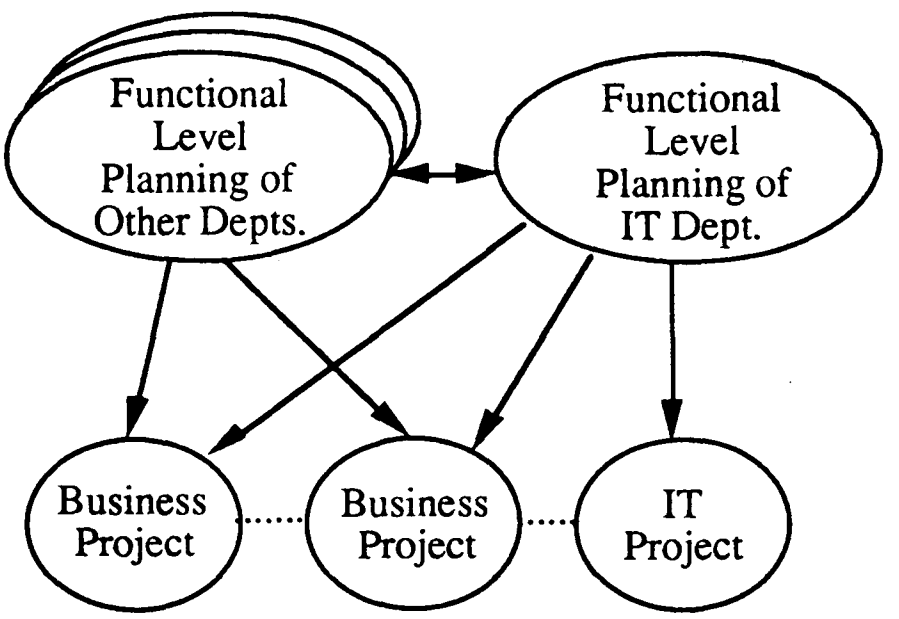


Figure 5.7: Business Project

Potential Contribution of Information Architecture to the 'Organisational Approach'

Earl notes that the current practice of the 'organisational approach' is "somewhat fuzzy and soft" and has some weaknesses. Corporate buy-in for IT can be problematic: "At the top of the corporation, there could still be doubts about the strategic cases for IS and the resource levels." (Earl, 1990, p. 28). This could be due to the general lack of rigour and "codified technique or procedure" in the approach. The tendency for the approach "to background technical considerations" sometimes leads to deficient technical plans. The quality of IA and IT architecture is often compromised in the pursuit of business themes and opportunities. Earl notes the need to address architectural issues in IS planning and

points out current efforts by some companies to combine the Organisational and Technological approaches (see Chapter 2 for clarification) in IS planning. He sees this as an important issue requiring resolution and calls for research in "how to operationalise the 'organisational approach' more definitively." (Earl, 1994, p. 25).

This research positions IA as an integral part of the 'organisational approach'. The IA can facilitate the continual evaluation and revision of IT-driven and -enabled options in relation to business strategy and plan. It is a tool for business and IS planning as well as the link to project implementation. Current evidence suggests that project implementation is one of the key areas where IS planning is failing (Earl, 1990, 1993). Lederer and Sethi (1988) identified "the need for substantial further analysis in order to carry out the plan" as one of the top IS planning problems. This thesis argues that a properly conceived IA can address the problem. The in-depth research will seek evidence to support this proposition and examine the role played by IA in the practice of the 'organisational approach' form of IS planning.

Support for the 'Organisational Approach' from the Literature

Hax and Majluf (1991) argue that planning that is isolated from other managerial processes and senior management concerns is misguided. In noting this argument, Kovacevic and Majluf (1993, p. 78) assert:

> "IT must be framed as part of the corporation's overall management process. IT strategic planning is not a purely technical process, handled by IT specialists, but a managerial procedure that involves the organization as a whole. ... It should harmoniously combine all of the organization's hierarchical levels, integrating the IT strategy into the overall strategy in the corporate, business, and functional arenas. It should be part of a more general strategic management process that addresses organizational, cultural, and behavioural issues. It should call for participation of numerous parties in the firm, encouraging a partnership between IT specialists and top managers."

The above assertion is a strong endorsement of Earl's 'organisational approach' even though no reference is made to it in the paper. In fact few papers, except for those by Earl, make explicit reference to the 'organisational approach'. However, a number of them support the paradigm underlying the approach. Cash, et al. (1992, p. 18) maintain that "Effective IT policy and control involve a partnership between general management, IT management, and user management." Heygate and Brebach (1991) believe that "the work of developing and implementing an IT-based strategy should be no different from that associated with an ordinary business strategy. Both require an iterative, top-down, and bottom-up process, which must be fully understood - and committed to - by business and IT managers alike." Williamson (1993) asserts that corporate goals, business processes, human resource, technology and data cannot be considered separately but need to be viewed collectively with the IT function as a partner in the effort. Galliers (1991a, p. 60) points out that "the IS strategy is very much embedded in business strategy: it both feeds off and feeds into the business strategy process." An A.T. Kearney study reported that companies with integrated IS and business plans financially outperformed, by a factor of six to one, those companies without this integration (Lederer and Mendelow, 1986). Keen (1993) has recently presented the essence of the 'organisational approach' in terms of IT-business fusion. He asserts that it is virtually impossible to gain competitive advantage based on IT alone, and that it is the fusion of the IT within the organisation that gives it the strategic value. He argues:

> "Fusion means that the processes of planning and implementation are so intertwined that the firm's technology is indistinguishable from the business processes and human elements of service and communication that exploit technology." (p. 19)

9. IT Architecture

IT architecture and information architecture are both parts of the information systems architecture. (See figure 2.3 in Chapter 2 where IT architecture is briefly introduced.) IT architecture influences and is influenced by IA. While IA answers the question "What are we building?" (Buckelew, 1985, p. 294), IT architecture answers the other questions

"What are we going to use to build it?" and 'What are we going to use to run it?'. Though senior management is more concerned about how technology is used rather than what the technology is (Taylor, 1993), it is necessary for them to be involved in technology matters because technology is a potential source of competitive advantage (Keen, 1991, 1993). An IT architecture can be a tool for senior management to do this.

McKay and Brockway (1989, p. 4) define IT architecture as "the structure of technology for doing business", and IT infrastructure as "the enabling foundation of shared information technology capabilities upon which business depends." These writers visualise infrastructure as a 'motherboard' into which technologies acquired over time may be slotted. The concepts, standards and technological philosophies underlying the 'motherboard' and its compatible 'cards' is IT architecture. While IT architecture is conceptual, IT infrastructure is physical, the "IT capability budgeted for and provided by the information systems function and shared across multiple business units or functional areas." Weil (1993, p. 553).

A good IT infrastructure based on a properly conceived IT architecture can enable an organisation to effectively and efficiently respond to competitor moves on strategic IT matters such as implementation of innovative IT applications. An improperly conceived or poor IT architecture is a potential source of strategic disadvantage. It could prevent an organisation from responding adequately to IT-related events in the business environment.

Both IT architecture and IT infrastructure change but the IT architecture evolves more slowly. A relative stability is associated with IT architecture while IT infrastructure is seen as being more dynamic via ongoing additions, upgrades, enhancements, expansions and replacements of physical technological resources. An organisation's operating IT infrastructure is one of many alternatives chosen for implementing the organisation's IT architecture. The IT infrastructure, while being based on the IT architecture, contributes to the evolution of the IT architecture in the course of changes happening to it. In fact, it

is unlikely that an organisation would conceive an IT architecture solely from theories and paradigms, be it Open Systems or any other technological paradigms.

Experience suggests that Mintzberg and Water's (1985) "deliberate" and "emergent" strategies appear to be also applicable to IT architecture development. An organisation's IT architecture emerges from its IT infrastructure but is enhanced and expanded by deliberate consideration of relevant technological issues, trends and events. Earl (1989, p. 114) points out that "Architecture in particular is never completed; it takes shape as demands emerge and issues are resolved. It must be constantly updated to reflect the IS strategy and technological change." Nolan and Mulryan (1987) and Mulryan (1987) lend support to this proposition on IT architecture development with evidence from case-studies.

Reach and Range of IT Architecture

Keen (1991) offers the concept of technology *reach* and *range* for appreciating IT architecture. *Reach* refers to the locations an organisation's IT infrastructure, based on its IT architecture, is potentially able to reach. *Range* refers to the degree to which the IT architecture permits the direct and automatic sharing of information across the organisation. The ideal is that a computer-generated transaction, document or message should be accessible to an IT-user regardless of location or workstation/terminal used. *Range*, as understood in this thesis, also embraces the technological facilities and services (such as office automation, e-mail, EDI, DSS, EIS, etc.) which an IT architecture is able to support. Range of facilities and services supported by an IT architecture determine its associated IA's technological scope and type of applications. Occasionally, the IA can cause changes to the IT architecture's range; e.g. an application in the IA may require a technology not within the existing range.

While reach and range define the potential of an IT architecture in technological terms, availability defines the actual technologies and resources readily available in the organisation for exploitation, i.e. the IT infrastructure. An IT architecture's reach and

range can be extensive but if the organisation does not have the need or the resources to exploit it in the foreseeable future, then any major investment in achieving that level of reach and range may prove to be uneconomic. Conversely, an organisation whose IT architecture's reach and range is limited can find itself handicapped when the need arises for it to exploit a new technology or expand its IT infrastructure. The organisation has the resources to do so but its IT architecture does not permit the required implementation/ expansion.

10. Component of Information Architecture: Business Model

Application architecture and corporate data model have conventionally been the key components of IA. (See Chapter 2.). Some writers have recently included business models as another key component of IA (Darnton and Giacoletto, 1992; Inmon and Caplan, 1992; Kim and Everest, 1994; Sowa and Zachman, 1992). There is however some ambiguity as to what represents a business model and which ones can be regarded as IA components. The IA survey has cast some doubts on claims that a CDM is a business model (Chen, 1976, 1993; Finkelstein, 1981, 1991; Martin, 1982, 1990a); the CDM is generally not perceived by senior management as being relevant to them. The AA too is not viewed as a business model. Financial models, spreadsheets or other decision support models are not business models though they are sometimes referred to as such; they are in reality focused decision making tools (Shim and McGlade, 1984).

A proper business model needs to reflect the essence of an organisation's business and underlying strategies. It "should be expressed in business language, not IT terminology." Haeckel and Nolan (1993, p. 132). The business model should enable an organisation to best describe the way in which it operates or would like to operate in its business environment (Tapscott and Caston, 1993). Haeckel and Nolan consider a good business model as one which facilitates modelling of environmental changes. Porter's (1980) *Competitive Forces* framework is a popular technique for developing an organisation's business model in terms of its environment. Porter's (1985) other well-known framework, *Value Chain Analysis*, is equally popular for business modelling in terms of

key business activities. These and other similar forms of business models are included as the third key component of the IA (see figure 5.8).

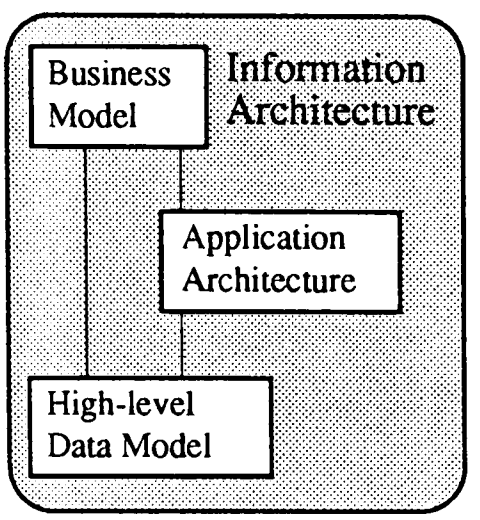


Figure 5.8: Components of Information Architecture

The inclusion of business models as part of an IA is provisional as it has yet to be established whether business models come within the realm of an information architecture and, if so, which ones are part of an IA. The relationships between these business models and the other components of IA are also not clear. This research will examine the nature and types of major business models, their potential position as an IA component, their relationships with other components of IA, and their development and usage. The research will do likewise for the other IA components.

11. The Theoretical Research Model

The contents of the research domain shown in figure 5.1 have been clarified and related to the information architecture research. A review of the relevant issues discussed earlier shows that while the focused research domain enables the development of a rich picture, it is still too broad to permit effective investigation by a single person within the available time. A theoretical research model for the in-depth investigation was therefore developed.

Development of the Research Model

Earl's 'organisational approach' is central to the theory being developed. The approach calls for vertical and horizontal integration within an organisation. Vertical integration,

also referred to as strategic integration, involves alignment of the organisation with its business environment (Beer, 1979; Henderson and Venkatraman, 1989, 1993; Lawrence and Lorsch, 1967). Horizontal integration is the integration of functions including IT at the various levels. This research argues that an information architecture is a facilitator of the horizontal and vertical integration. Figure 5.9 is a first cut research model depicting the essence of this argument.

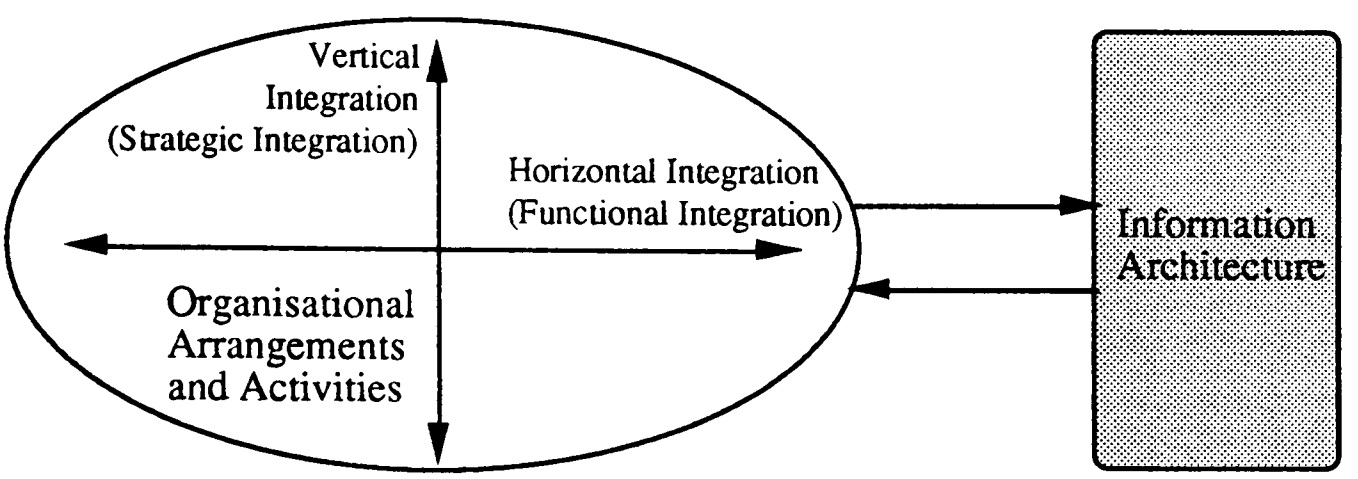


Figure 5.9: First Cut Research Model

The first cut research model is developed into the research model shown in figure 5.10 by referring to the research domain and using the information and models discussed/developed thus far. The integration of the 'Strategy-Planning Framework' (figure 5.5) with the 'IS Planning and Business Planning' (figure 5.6) and 'Business Project' (figure 5.7) models produces a comprehensive picture of the *Organisational Arrangements and Activities* object. The content of the *Information Architecture* object is made explicit with the aid of figure 5.8, 'Components of Information Architecture'. IT architecture is phased into the model based on earlier discussions. The importance and pervasiveness of 'Organisational Behaviour' has been clarified. The research model is therefore given an organisational behaviour setting.

Strategy Development and Business Planning

Although it is not reflected in the research model, strategy development is continuous, with bottom-up contributions from functional departments and operating units. Strategy

development utilises business models and other IA components as tools to discuss and deliberate on IT-related strategies. IA models attuned to senior management behavioural characteristics and requirements are used in management presentations and workshops.

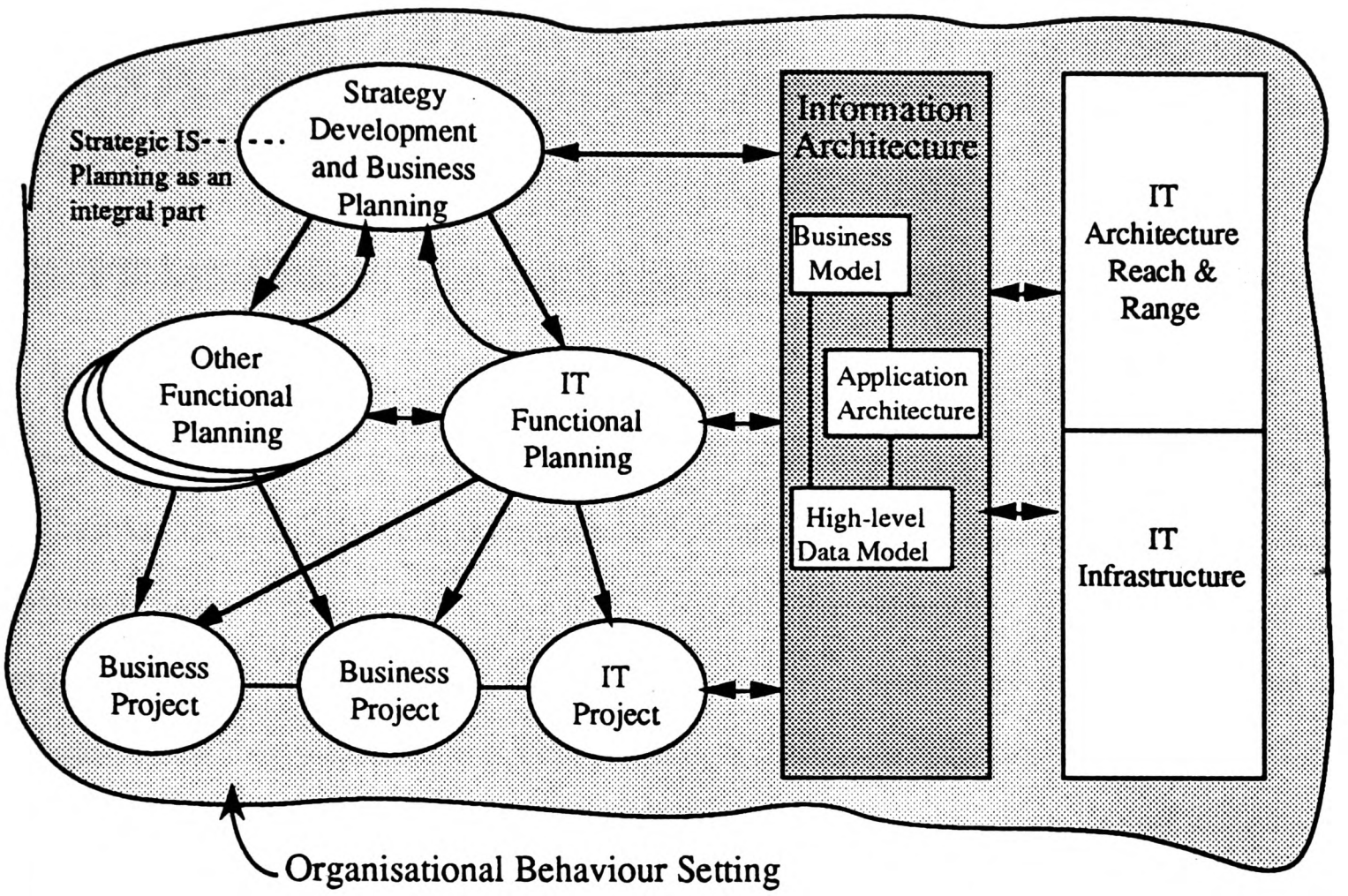


Figure 5.10: Theoretical Research Model

The planning of strategic IT applications is done as an integral part of business planning. A strategic initiative is at least the fusion of the strategies of the various business functions including that of IT. Within the larger extended enterprise, it may even include relevant parts of the strategies of external stakeholders such as suppliers and associates. IT is intertwined with the business and has to be planned in situ just as is commonly done for the other key functions such as marketing and production. Strategic IS planning has to be an ongoing effort inseparable from strategy development and business planning. The strategic IS plan is consolidated and formalised during business planning and appears as an integral part of the business plan.

Appraisal of emergent strategies and development of deliberate strategies is done as part of business planning. Appropriate business models permit modelling of the organisation's business and strategies and the contributions from the various functions including IT to a strategy implementation. A number of alternatives are possible for implementing a basic strategy and the modelling of these options via IA facilitates their evaluation and selection. The IA is complemented in these tasks by the IT architecture in matters of technology reach/range and infrastructure.

Functional Level Planning

A functional unit's planning is not an independent activity but vertically integrated upwards with business planning and downwards with project implementation and operations. There is horizontal integration of functional-level effort at these three levels: business plans are proposed/approved, projects are executed and systems are implemented and operated through cooperation and contribution from the various functions; planning, implementing and operating of the business is done with reference to cross-functional business processes. Doing it in any other way is not feasible in today's highly integrated organisations. The IT function and its planning, implementation and operation are no exception to this arrangement.

The business models emerging from strategy development and business planning become the blueprint for the various functions to act cohesively. The model is used to identify and discuss their contributions and commitments to the business strategy/project. In the case of the IT function, this amounts to the IT applications which need to be developed in tandem with the rest of the business project. An application architecture is used to specifically model the IT function's contributions to the business. It is developed recognising the behavioural characteristics and requirements of the various recipients. Two levels of architecture are developed by the IT department: a simple one for communication with senior management and functional management and a more detailed one for use by the project team. The IT architecture is consulted to ascertain the availability and appropriateness of technologies for implementing the applications.

Project Implementation

As has been clarified earlier, an IT project is confined to the IT department, deals with IT infrastructure matters and has minimal direct impact on business initiatives. Application development is thus not an IT project. The typical IT application is developed as part of a business project. The development work may be carried out in-house or may be outsourced and coordinated by the in-house team. The actual application development arrangement makes little difference to the application's position in relation to business and strategy - the IT application is ultimately fused with contributions from other functions in the delivery of a strategy. The application development, regardless of whether it is done in-house or outsourced, requires a multidisciplinary effort with contributions from relevant functional departments. Though a project has a budget, defined deliverables and start/end dates, it is not conducted in isolation from other projects. A project recognises its impact on other business projects and implemented systems. Such an approach enables the various business projects to contribute to a higher level of integration in the organisation.

One common requirement of systems development is that the application should be integrated with other applications, existing, planned and potential. IA is a tool for realising this integration. The AA , in particular, is useful for identifying an application's interfaces with other applications. Integrated organisational arrangements and integration of applications and work processes are key for realising an integrated information system.

At the technical level, integration of applications is enabled by integration of databases. Data modelling leverages development of integrated databases (Carlis and March, 1984; March and Kim, 1992; Ross, 1987). Business area/project data models are typically employed in these tasks. The business area/project data model, while facilitating data normalisation and detailed data modelling during application development (Martin, 1990a; Towner, 1989), is of value at the outset of the project itself; it complements the application architecture in the planning/scoping of IT application. The business

area/project data models together could be sufficient for inter-linking the separate databases to realise an organisation's integrated database; a corporate data model may thus become unnecessary for this task.

The Organisational Behaviour Setting

Argyris (1992) recommends that IS design should take account of the cognitive and behavioural styles of executives. Keen (1976) points to the potency of this factor in IS matters in general. These scholars' recommendations are being incorporated in the research model by providing it an organisational behaviour setting (see figure 5.10). In particular, management requirements, communication, behaviour and information characteristics have been identified as relevant. These four issues collectively provide guidelines for developing IA models in relation to managerial interactions and characteristics. The behavioural characteristics (figure 5.3) and management information characteristics continua (figure 5.4) are useful references for developing the various IA models. IA models developed in this way are likely to be better received by their targeted recipients and foster the 'organisational approach' to business and IS planning.

The inclusion of organisational behaviour issues in the theory contributes to its soundness and holism. From a research approach perspective, it goes some way towards addressing Land's (1992) call for recognition of IT activities as part of larger social systems and Checkland's (1992, p. 363) concern on the lack of systemic focus in IS research and practice:

> "... the field of information systems has, rather surprisingly, neglected systems thinking as an underpinning to both its theoretical and practical concerns."

Systems Thinking and Information Architecture

Feeny (1993, p. 9) defines systems thinking as:

> "the ability and inclination to view organisational activity holistically, with a recognition of connections, relationships and interdependencies."

Systems thinking is based on the General Systems Theory (Von Bertalanffy, 1950, 1972). It is at the core of the 'organisational approach' and business/IT fusion discussed earlier. Systems thinking emphasises that an organisation's competitiveness is dictated as much by how the factors of production, marketing, human resource, IT, etc. are cohesively mobilised as by what those factors are. An organisation with strong but non-cohesive elements may not be a superior performer. Superior performance is achievable even if the organisation's components are not individual top performers, provided they work cohesively as a system, complementing and supporting each other. In referring to planning, Ackoff (1978, p. 30) takes this issue further:

> " A plan - which is a system of solutions to a system of problems - can be feasible even if none of its parts are feasible when considered separately. Solutions that are infeasible can interact separately to yield a feasible system of solutions."

Ackoff, Beer (1979), Senge (1992), Senge et al. (1994) and others call for increased holistic consideration in organisational planning, management and operations. But the practice of pure holism is neither feasible (Brooker, 1965; Dearden, 1972; Flood and Jackson, 1993) nor necessary (Emery and Sprague, 1972). Reductionism has its advantages (analysis, simplification, standardisation, modularity, specialisation, differentiation, etc.) and can be practised within the confines of holism. Such an approach is consistent with Mintzberg's (1994) strategic thinking (synthesis) and business planning (analysis), and is advocated by Ackoff (1973, p. 664):

> "Neither negates the value of the other, but by synthetic thinking we can gain understanding that we cannot obtain through analysis, particularly of collective phenomena."

This thesis contends that an appropriately conceived IA potentially offers the benefits of both holism and reductionism at least in so far as IS planning is concerned. Information architecture, while maintaining a holistic perspective (Nolan and Mulryan, 1987), has the potential to provide the required reductionism and rigour for effective IS planning. IA is hence positioned as an integral part of the 'organisational approach' to IS planning.

12. Verifying the Theoretical Research Model

The assembly of the theoretical research model's components into a cohesive whole was based on Earl's 'organisational approach', Mintzberg's paradigm on strategy and the literature on information architecture. A holistic perspective was taken in building up the research model. Though various established theories were used in the development of the model's components, the model itself was nonetheless a new construct the soundness of which needed to be checked before its usage (Straub, 1989). A *newly* conceived proposition proven subsequently wrong via extensive research effort might not amount to much in terms of contribution to knowledge. There should at least be a reasonable chance that the proposition would be valid, might have contingent validity, or could be modified and redeveloped as a grounded theory (Glaser and Strauss, 1967). Verification of the proposed theoretical research model prior to field work thus became a necessity. Zachman's (1987) information systems architecture (ISA), the most widely referenced IS architectural framework (Kim and Everest, 1994; Teng, et al., 1992; Von Halle, 1992; etc.), was the key instrument used to verify the theoretical model.

Zachman's (1987) Information Systems Architecture (ISA) Framework

For the planning and implementation of an organisation's information system, Zachman (1987) advocates the abstraction of the system in terms of data, function/process and network/technology, and looking at these abstractions from the perspectives of the

system development life cycle and stakeholders (see figure 5.11). He argues that all these three aspects of an information system are equally important and that each provides a unique appreciation of the information system. The various stakeholders' interests and responsibilities are also distinct and unique and the stakeholders have to play their parts for the information system to materialise.

Relevant models are used to engage the different stakeholders progressively. Various models are thus developed, covering the three aspects and targeted at the different stakeholders. The models are different but complementary. This is exemplified in figure 5.11. The need and value of multiple architectural models for IS planning and implementation is emphasised by Zachman (p. 291) thus:

> "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. .... We are having difficulties communicating with one another about information systems architecture, because a set of architectural representations exists, instead of a single architecture. One is not right and another wrong. The architectures are different. They are additive and complementary."

	Data	Function/Process	Network/Technology
Scope Description (Planner)	List of things important to the business	List of processes the business performs	List of business locations
Business Description (Owner)	Corporate data model	Process flow diagram	Logistics network
Information System Description (Designer)	Logical data model	Data flow diagram	Distributed system architecture
Technology Constrained Description (Builder)	Physical data design	Structure chart	Computer system architecture
Detailed Description (Sub-Contractor)	Data definition description	Programme specification	Hardware/ software specification
Delivered System	Database	Application	Computer system

Figure 5.11: Information Systems Architecture Framework (Zachman, 1987)

Sowa and Zachman (1992)[2] have extended the ISA framework to include people, time and motivation as additional dimensions. They contend that the ISA's holistic characteristic is enhanced with the inclusion of these three aspects of IS.

Verification of the Research Model with Zachman's ISA Framework

It is clear from the brief explanation of Zachman's ISA framework that there is much in common between the framework and the proposed theoretical research model. The three aspects of information system from the original ISA framework are in the research model - data model (data) and application architecture (function) within the IA, and the IT architecture (network). The research model too recognises the importance of modelling as a means of engaging stakeholders in relevant activities. Various models are required for the different stages which an information system effort goes through; this is reflected in the research model. The models are unique and complementary and need to be targeted at the recipients; this is also an important message of the research model. The extended ISA framework includes people to incorporate delegation of authority and assignment of responsibility. Authority and responsibility as well as sequence and time-cycle are implicit in the nature and arrangement of the processes in the research model. The model has embraced human factors via its setting in an organisational behaviour domain.

The above comparison suggests that the theoretical research model is largely consistent with the ISA framework. There are however some differences. The ISA framework attempts to be exhaustive and definitive in its treatment of IS planning and implementation. Hence it may appear to the IT practitioner as a type of IS 'cookbook'. The proposed research model on the other hand embodies a broad framework for the practice of strategy development, business planning, IS planning and project implementation with the aid of IA and IT architecture. The research model emphasises processes while the ISA framework emphasises models.

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2 This discussion focuses on Zachman's (1987) original IS architecture framework rather than the more recent framework from Sowa and Zachman (1992) because the extended framework has not received the level of endorsement which the original framework continues to receive. The extended framework has yet to be endorsed in a significant way in the literature.

No empirical evidence is available as yet to support the ISA's usefulness. The framework has a few weaknesses that have been identified and addressed in the theoretical research model. Being definitive, the ISA framework may constrain its users from examining issues beyond those contained within the framework. The framework appears to assume that all the stakeholders have equal interest in the three (now extended to six) aspects of an information system. No attempt is made to differentiate their actual interests. The IA survey shows that the "owner" (senior management) does not view corporate data model as being relevant to them. The "owner" is likely to be more interested in business matters and view technological and other aspects of an information system in relation to the business (Earl, 1990).

Taking the above issue one step further, it could be argued that the ISA framework does not adequately address business issues. Business is included in the extended ISA within the 'motivation' dimension and targeted at the "owner". It is a little simplistic to treat business goals and strategy as just another dimension in the planning and implementation of an information system. The literature suggests that IS planning should be driven by the business plan or fused with business planning. The meta or supra relationship which business planning has with IS planning is not adequately reflected in the ISA. The fusion of IT with the business also raises questions on the validity of treating business and strategy as just a dimension, if not a cell, in the ISA framework.

The ISA addresses human factors by explicitly incorporating stakeholders and people in the framework. This is a major step in the planning and implementation of information systems. The framework, however, does not address behavioural issues. It is possible that the framework assumes the usage of behavioural theories in its adoption. Nevertheless, the need to address these behavioural issues in business/IS planning and implementation is clear and the theoretical research model does that at least in so far as IA models are concerned.

Other Verification Effort

The theoretical research model was also checked and refined through discussions with the supervisor and Templeton College faculty members. It was later presented to some practitioners and information management consultants for their comments (Andersen Consulting, IBM, Nolan Norton, Shell Expro and SmithKline Beecham). These discussions helped to further refine the model and ready it for the case study work.

13. Summary

This chapter has described the conception, development and verification of the theoretical research model for conducting the qualitative research into the development and usage of information architecture. The underlying theory contends that IS planning and implementation has to be done integrally with business planning and business project and not separately. A properly-conceived IA, complemented with an appropriate IT architecture, is a tool for this holistic IS planning and implementation.

Relevant theories and literature on organisational behaviour, strategy and information management were examined and discussed in the course of developing the theoretical research model. The next chapter discusses the investigation of the model via six case studies. The chapter documents the information gathered and organises it for validation of the research model and development of propositions in Chapter 7.

Chapter 6: Case Studies - Evidence of the Redefined Information Architecture

- The Case Study Process
- Case Study No. 1: Shell UK Exploration and Production
- Case Study No. 2: Thames Water Utilities
- Case Study No. 3: Rover Group
- Case Study No. 4: Allied Dunbar
- Case Study No. 5: Safeway Stores
- Case Study No. 6: British Rail

The last chapter developed the theoretical research model for conducting an in-depth investigation into the practice of information architecture. This chapter describes the case studies that were carried out on the basis of the theoretical model and presents the data collected[1]. The next chapter analyses the data and seeks to validate the research model.

The Case Study Process

Six case studies were conducted. The organisations were from different industries (see figure 6.1). This was not intended (being brought about by the criteria employed in the selection of case study organisations - see chapter 3) but nevertheless helped to enrich the investigation. The British Rail case study is different from the other five in that it was conducted primarily to benefit from the organisation's experience in a major information architecture project which was concluded in mid-1993 at a cost of £0.6 million; British Rail is not regarded as an exemplar of IA usage but their 'failed' IA project provides evidence on IA development and usage from a contrasting perspective. All the organisations are very large (see figure 6.1) and amongst the leaders in their respective industries. With the exception of British Rail (a big public body), all are major business

1 Some of the quotes from the case study interviewees have been reserved for use in later chapters.

units of prominent business groups in the UK. The organisations' IT departments are very large, with staff size ranging from 100 to 1,400 .

Organisation	Organisation Type	Industry	Turnover (£)	IT Budget (£)
Shell Expro	Business Unit	Petroleum	3.1 billion	60 million
Thames Water	Business Unit	Utilities	700 million	30 million
Rover Group	Business Unit	Manufacturing	3.5 billion	70 million
Allied Dunbar	Business Unit	Insurance	1.7 billion	30 million
Safeway Stores	Business Unit	Retailing	5.5 billion	40 million
British Rail	Public Body	Transport	3.7 billion	100 million

Figure 6.1: Profile of Case Study Organisations

Framework for Case Study

A general framework for conducting the case studies (see figure 6.2) was abstracted from the theoretical research model (see chapter 5, figure 5.10). The framework was used to communicate with the contact person in each organisation on the case study data requirements, and to clarify to the interviewees the study and its objectives. Such a framework was found to be essential to establish a common understanding on what was being pursued. The theoretical model was not used for this purpose because of the possibility that it could bias opinions and data.

Scope of Case Study

Figure 6.2 shows the scope of the study: from strategy development and business planning to the project level, with focus on information architecture. Application development was beyond the scope of the case-study but was covered selectively where there was a need to do so. IT architecture was covered in so far as it related to IA.

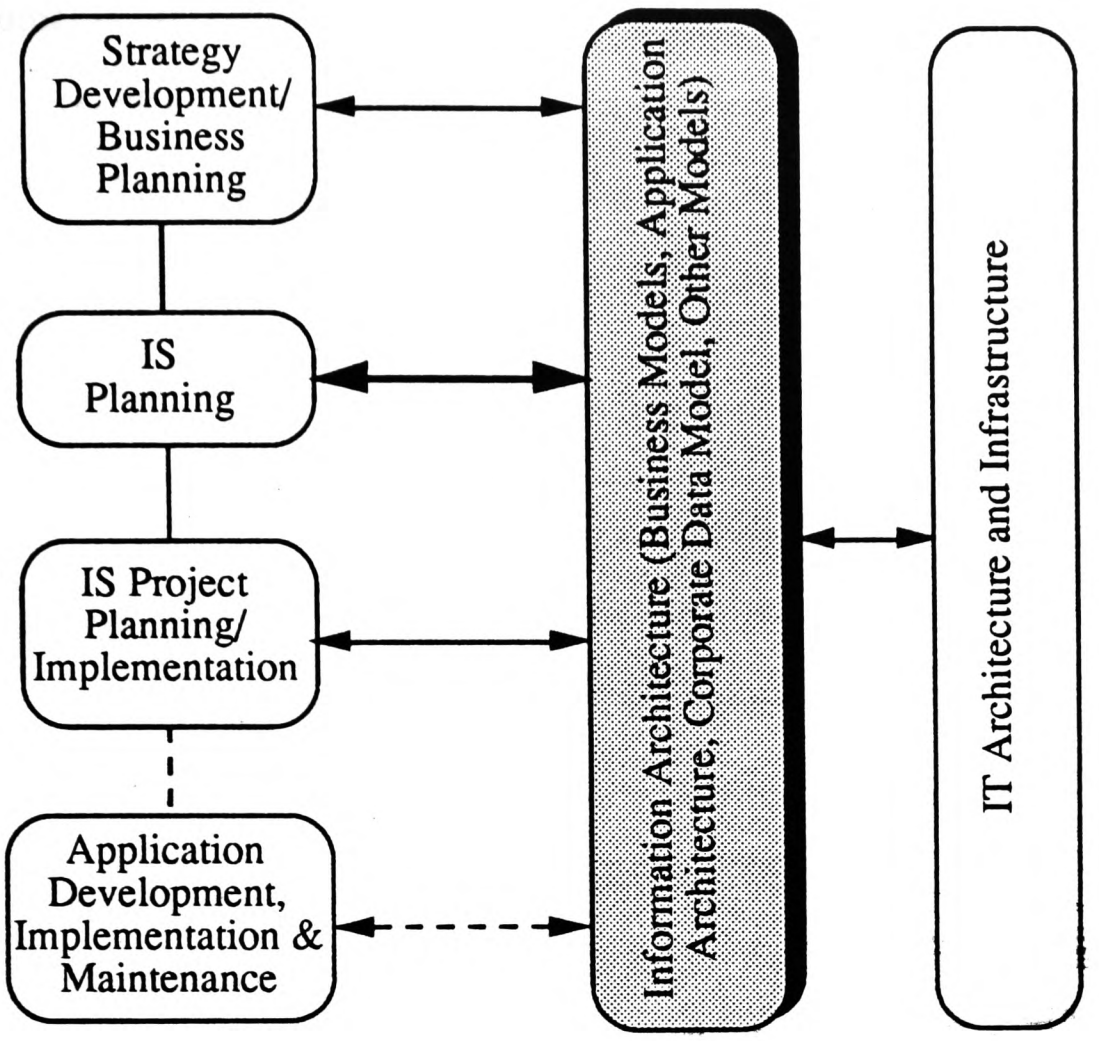


Figure 6.2: Framework for Case Study

Data Collection

The case study framework provided a basis for identifying and interviewing the relevant people; at least one informant for each of the areas within the scope of the case study was interviewed. Interviewees were mostly senior executives ranging from board members to senior IT professionals with managerial responsibilities. The following people were interviewed in all cases[2]: head of IT, head of a functional department (often a board member), a major IT-user, a project manager, a data management executive and an IT executive with responsibility for IS planning. Others were interviewed depending on need and situation. The number of people interviewed per case study ranged from six to thirteen. An interview was typically one and a half hours but some lasted as long as three

2 The job titles vary across the cases; e.g. 'director' in one organisation refers to a board member while in another it refers to a senior executive who is not on the board. In order to facilitate inter-case study comparisons, the job titles have been standardised ; e.g. a member of an organisation's IT management team, other than the head of IT, is referred to as either a manager or senior manager depending on his level in the team even though he may be referred to as a director in the organisation. Where the job title is unambiguous, it is quoted in its original form.

hours. Documents, reports, systems documentation, manuals, archival data, and secondary data (books, magazines, reports and journals available in the public domain) were also studied. This effort facilitated preparation for interviews as well as enabled the verification and triangulation of data gathered during the interviews.

Case Study Report

The gathered data was compiled into draft case study reports. Each draft was sent to its respective organisation for verification and validation of facts. The updates and feedback were evaluated and incorporated into the final case study report. Copies of the finalised reports were provided to the organisations concerned. This chapter now presents a summary of each of the case study reports. The structure of each summary is as follows:

* Company profile
* IT function[3]
* Strategy development and business planning
* Information systems planning
* Project implementation
* Business model
* Application architecture
* High level data model
* IT architecture
* Conclusion

3 The term 'IT function' is used to refer to the organisational unit which has the primary responsibility for IT. Occasionally , the term 'IT department' is also used as an equivalent. Standardisation via these terms was found to be necessary as the case study organisations differed in how they referred to their IT functions. The other units in these organisations are referred to as 'functional units' for a similar reason.

1. Case Study No. 1: Shell UK Exploration and Production (Shell Expro)

Duration: May to August 1993

Interviewees:

K. Karney	IT Manager (Head of IT Department)
K. van der Spek	Head, Corporate Data Management
A. Moore	Head, Corporate IS Planning
K. Lowe	Head, Independent Computing Unit (Personnel Dept.)
J. Davies	Senior IT Executive, Data Modelling
P. Leenheer	Senior IT Executive, Business Modelling
A. Wandsworth	Information Planner
D. de Jong	Senior Manager, Operations
B. Botter	Head, Petroleum Engineering
I. Blair	Petroleum Engineer
K. Macdonald	Finance Executive
L. Sim	Senior Executive, Personnel Dept.
B. Ottmann	Principle Data Management Consultant, Shell Group

Company Profile

Shell U.K. Exploration and Production (Shell Expro) is one of more than 200 principal operating companies in the Royal Dutch/Shell Group. Shell Expro is the largest operating company in the Group outside North America. Shell Expro's annual turnover was £3.1 billion in 1993. The company is engaged in the exploration and production of crude oil and natural gas within the geographic boundaries of UK. The company's main area of operation is the North Sea where it is the largest operator. It satisfies 30% of UK's oil and gas requirements.

The Shell Group is owned by the Royal Dutch Petroleum Company from the Netherlands (60%) and The Shell Transport and Trading Company from the United Kingdom (40%). The Group has hundreds of subsidiaries, joint ventures and associated companies throughout the world. Fortune magazine (26 August 1991, pp. 79-82) ranked Shell as the second largest industrial corporation in the world and rated the company as the most profitable corporation in 1991. The Group has been leveraging its business in very significant ways via technology since the early 1980s. Shell is considered to be the technological leader in the petroleum and energy business (Financial World, 16 April 1991, pp. 58-63).

As per Group policy, Shell Expro is accountable for its own viability. Its operating policies, standards and broad strategies are however guided by the parent company, and it draws on the vast resources, expertise and experience available within the Group. IT is an area where Shell Expro has significant interactions and relationships with service companies and other operating companies. Shell International Petroleum Maastschappij (SIPM) located in Hague and Shell UK's Information & Computing (UIC) subsidiary are two service companies which are of particular relevance to Shell Expro's IT function. SIPM is Shell's central body on IT policies and standards; it also coordinates IT efforts throughout the Group. UIC supplies the necessary IT facilities (hardware, software, etc.) and services to Shell Expro.

IT Function

The IT function in Shell Expro is highly decentralised. The IT department accounts for an annual budget of about 60 million pounds and employs 130 people. The major responsibilities of these people are identification, planning and analysis of IT applications and management of application implementation. Shell Expro's preference for packaged solutions and outsourced software development has minimised the need for in-house software developers.

A central IT unit headed by an IT manager reports to the Operations Division head. The central IT unit is responsible for company-wide IT matters, data management, IS planning and IT architecture/infrastructure. User-department IT affairs are handled by 15 independent computing units operating within those departments and with links to the central IT unit. The respective functional management, however, are responsible for identifying and defining their information requirements and justifying IT investments.

According to company documents (The Shell Review, July 1992; Application Portfolio, Shell Report No. IC 91-039, September 1992), IT is positioned as a strategic resource in the Group. The IT manager, however, describes it as a "utility" in Shell Expro. Its major objective is seen as increasing and sustaining profits. An information planner notes this objective thus:

> "The only competitive advantage from IT in oil exploration and production is to work that margin so that you are making more money. Restructuring industry or company through IT is not a major issue or concern."

The information planner's view on the role of IT harmonises with those of the senior executives who completed the structured case-study questionnaire distributed at the end of data collection; see figure SE1. These executives generally perceived the major role of IT in Shell Expro as business automation rather than business transformation. The Group, however, sees greater scope for exploitation of IT beyond mere automation:

> "IT is a powerful enabler. However, in many organisations it continues to be deployed at its most fundamental level of task automation. Many opportunities to enhance profitability are thus missed." (Application Portfolio, Shell Report No. IC 91-039, September 1992, p. 4)

Strategy Development and Business Planning

In line with Group practice, Shell Expro conducts an annual strategic planning exercise. Central to this exercise is a top management workshop which focuses on the long-term

viability of the company. A key input is focused scenarios on the petroleum industry. Key issues, strategic options, and current business strategies and their success are discussed in the light of the scenarios and company goals. The resulting strategic plan, endorsed by the Group, drives the business planning exercise which is conducted subsequently.

A major planning element within the Shell Group is "group scenarios" (de Geus, 1988; Johnson and Scholes, 1993; Wack, 1985a, 1985b). Scenarios are a type of business model which describe the economic, political, sociological, technological and environmental trends in the business. A multidisciplinary team in Shell Group Planning with extensive expertise in the hydrocarbon business develops 25-year horizon scenarios of the petroleum industry. The scenarios are described and modelled using graphs, charts and graphics. The scenarios are sent/presented to operating companies within the Group for their use and feedback. Shell Expro's business planners use the scenarios and facilitate the development of "focused scenarios" in strategic planning workshops. The company's strategic plans are thus underpinned by industry scenarios.

Compared to strategic planning, the annual business planning exercise is more formal. The last business plan together with an appraisal of its implementation is a major input. A management workshop is held to develop the new business plan. The participants are senior management and all heads of divisions and departments. The IT manager also attends the workshop. The resulting plan looks five years ahead but may include major initiatives beyond that time frame. In its final form, the plan lays out the company's business objectives, strategies, projects, budgets and priorities.

Though IT is pervasive and its potentials and contributions are acknowledged in Shell Expro, the IT department contributes to the company's strategy development and business planning in a limited way. The head of IT participates in these planning exercises more in a supportive role; input from IT is mainly in the form of response. Strategic and business plans are formulated and IT's position within these plans are determined subsequently. The predominantly reactive role of IT is seen as an effective

way to operate in an environment where need to gain competitive advantage through IT is not considered to be a major issue. The IT manager describes his department's responsibility thus:

> "It is not up to IT to say that a new application is needed. IT fails when line management sees it as an IT responsibility."

Information Systems Planning

IS planning (ISP) in Shell Expro is an ongoing activity which is driven by the company's business plan and which conforms to Group IT standards. It is

> "the process which identifies for general management the medium to long term IT plan in support of the organisation's business objectives. Information planning is therefore primarily about understanding business needs, identifying strategic opportunities, and defining the business areas which will most benefit from IT investments." (ICS Standards and Guidelines: Information Planning Process, March 1993, p. 2)

Full-time information planners maintain overall responsibility for the IS planning task. Each business function develops its own IS plan, basing it on the function's approved business plan. The IS plan is jointly developed by the department/division's management and senior IT personnel from the associated independent computing unit. These plans are coordinated and consolidated into the organisational IS plan by the IS planners. The resulting plan targets IS projects for the following year and rolls forward for 5 years. No formal ISP methodology is used in this ongoing IS planning effort. An IS planner summarises the thinking of the company on methodology thus:

> "Information planning is just a rolling forward of the information strategy plan and does not require a formal methodology ..... Doing an awful lot of hard work to come up with basically the same thing that you could have without the formal methodology."

Respondents → / ↓ Selected Key Items	Head of Data Management	Head of IS Planning	Senior Operations Manager	Average
Role of IT ('1= Not a role' to '5= Primary role')				
Automation	4	5	4	4.3
Transformation	2	3	3	2.7
IS Planning Success/Failure (1= Failure, 2= Some benefits but IS planning is not needed to achieve them, 3= Better than not doing it, 4= Successful but can be better, 5= Highly successful)	4	4	3	3.7
IS Planning Taxonomy ('1 = No match' to ' 5 = Perfect match')				
Administrative Approach	3	2	3	2.7
Methodological Approach	2	3	3	2.7
Technological Approach	3	3	3	3.0
Business-led Approach	4	5	4	4.3
Organisational Approach	2	2	2	2.0
Perceived value of EP Business Model (1= Irrelevant, 2= Little use, 3= Some use, 4= Significant use, 5= Absolutely essential)	4	4	2	3.3
Perceived value of EP Data Model (1= Irrelevant, 2= Little use, 3= Some use, 4= Significant use, 5= Absolutely essential)	5	3	2	3.3

Figure SE1: Responses to Structured Questionnaire - Selected Key Items

ISP methodology is however used in the occasional ISP project conducted when there is a major change in the company's business strategy or technology. The study uses an in-house ISP methodology (a combination of BSP, Information Engineering and object-

oriented concepts) and CASE tools (Oracle and IEW). The company's strategic/business plans and IS plan provide the foundation for conducting the study. The project team includes information planners and key executives from the major business lines. The resulting strategic IS plan provides a vision for IT usage and specifies the application portfolio, implementation approaches and options. It becomes a source of reference for IT management tasks and the ongoing IS planning process.

To a request to assess the success of Shell Expro's IS planning, three senior executives (two from IT and one from Operations) responded that it was satisfactory but could benefit from some improvements particularly in relation to senior management involvement (see figure SE1); this message was also conveyed during the various interviews. To another request to classify Shell Expro's IS planning in terms of Earl's (1990, 1993) taxonomy of ISP approaches, the three executives responded that it best fitted the 'business-led' approach . IS planning in Shell Expro is dominated by the drive from business strategies and plans. Methodologies, architectures and administrative procedures are relevant to the planning process but are over-shadowed by the drive from business. The strong business thrust appears to diminish proactive contribution from the IT function.

Project Implementation

The typical project in Shell Expro is an integration of related component projects from functional units across the business; it is a business project. This concept also applies to the development and implementation of IT applications. There are IT projects but these have little direct business implication; they deal mainly with the IT infrastructure. Regardless of whether it is a business project or an IT project, an IT investment is treated as any other business investment. It is screened, ranked, implemented and managed according to the company's established procedures for projects.

A business project is large and is handled by a multi-disciplinary team in a phased manner. The project manager is from the business line which has the most stake in the

project. There can be a few groups, each responsible for a component of the project. The groups work together and cooperate under the leadership of the project manager. The group responsible for the IT component is no different from the other groups in this arrangement. The IT group focuses on systems analysis and design and utilises application development methodologies and CASE tools in these tasks. Software development is outsourced.

Business Model: The Exploration and Production Business Model

Over the last couple of years, Shell's group-level IT function has made available an "Exploration and Production Business Model" and an "Exploration and Production Data Model" (hereinafter referred to as the 'EP business model' and 'EP data model' respectively) to Shell Expro and other exploration and production companies in the Group. These two models have been developed to facilitate business planning, IS planning and integrated information system implementation in the Shell companies. The Group maintains custody of the models, and refines and updates them on an ongoing basis. The two models are classified as strategic resources by the Group.

The Shell Group claims that its EP business model is the first of its kind; other petroleum companies are said to be in the course of developing similar models. Shell contends that the EP business model, being generic in nature, is applicable to any company in the petroleum industry. The EP business model is a set of activity-entity CRUD matrices. It spans the entire spectrum of the petroleum exploration and production business. It defines the activities and key information entities of the business in terms of the petroleum resource life cycle and value chain. The model shown in figure SE2 is an overall business model which helps to illustrate these underlying concepts. Each phase of the life cycle consists of a unique set of activities, collectively called "driver activities", each with a clearly identifiable business objective. The driver activities are managerial in nature. A driver activity can initiate one or more of the recurrent "execution activities". Both driver and execution activities are underlain by "support activities". All these three sets of activities are overlain by "management activities".

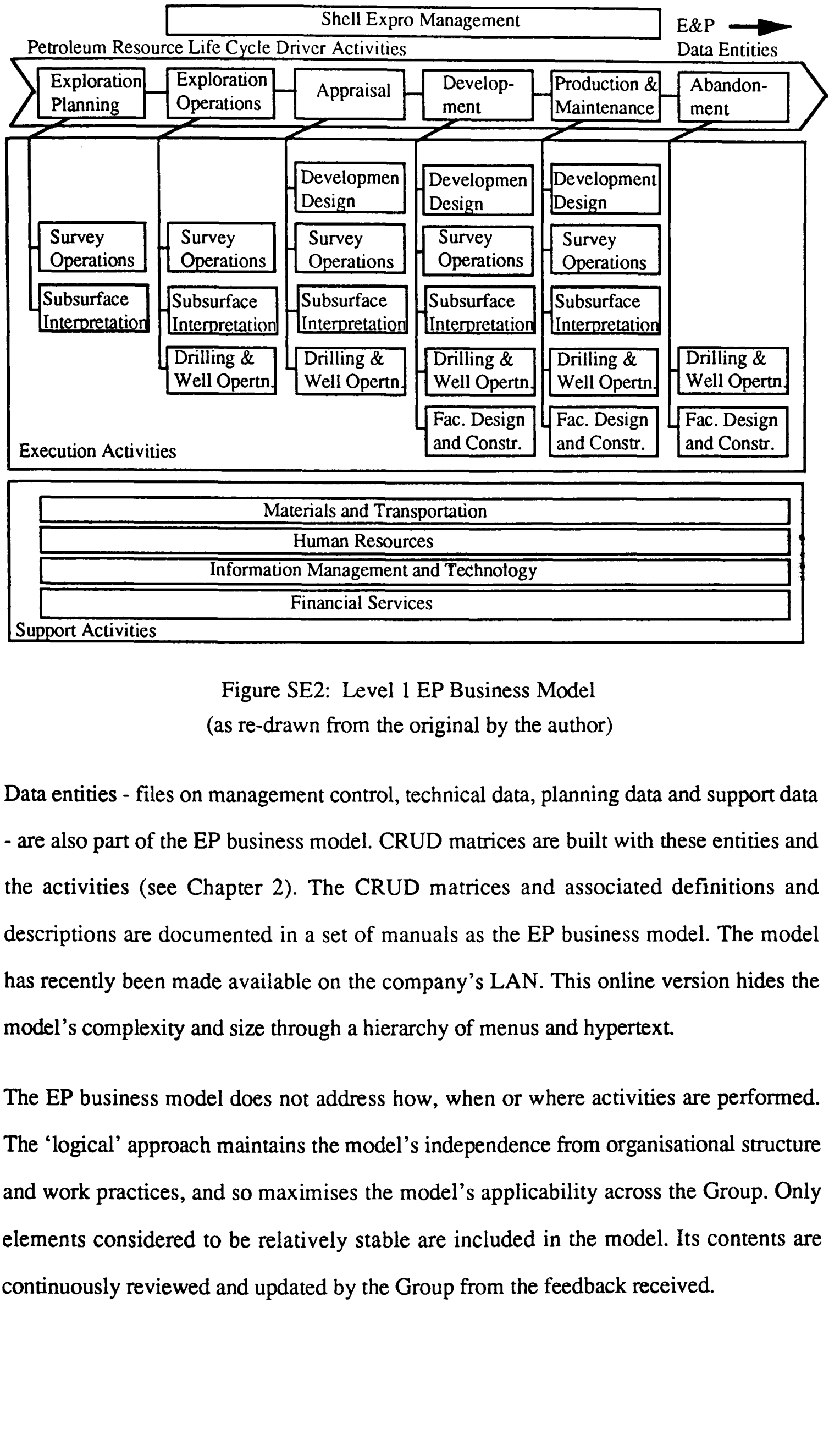


Figure SE2: Level 1 EP Business Model
(as re-drawn from the original by the author)

Data entities - files on management control, technical data, planning data and support data - are also part of the EP business model. CRUD matrices are built with these entities and the activities (see Chapter 2). The CRUD matrices and associated definitions and descriptions are documented in a set of manuals as the EP business model. The model has recently been made available on the company's LAN. This online version hides the model's complexity and size through a hierarchy of menus and hypertext.

The EP business model does not address how, when or where activities are performed. The 'logical' approach maintains the model's independence from organisational structure and work practices, and so maximises the model's applicability across the Group. Only elements considered to be relatively stable are included in the model. Its contents are continuously reviewed and updated by the Group from the feedback received.

The EP business model consists of 3 levels. Level 1 is shown in figure SE2. The level 1 activities and information entities are 'exploded' to the next level in a top-down manner. Each activity and information entity is subdivided to create about five new items. The level 2 model is presented as a CRUD matrix (similar to figure BR1 for British Rail case study). The current version has about 130 activities and 80 information entities. Level 2 appears to be transitory but is used for organisational analysis and in IT management discussions. The level 2 items are not sufficiently detailed for use in business and information planning. The process of 'explosion' is hence continued to level 3. The result is a very large CRUD matrix consisting of more than 300 activities, 200 entities and 4,000 relationships documented in more than 100 pages. In spite of its size and complex appearance, the level 3 matrix is considered to be the most important and useful of the matrices; it is referred to as *the* EP business model.

The EP business model is advocated by the Group as a major frame of reference for business and information planning. It is also recommended for use in business area analysis, data management, feasibility studies and project work. The data management group in Shell Expro, the 'champions' of the EP business model in the company, claim that the model is very useful and can be used even beyond the IT area in in-depth analysis of the business, review of organisational structure, audit of business processes and other similar business tasks. The model has been used to design a Shell subsidiary for operating a new oil field in Norway. Shell Expro IT executives are very positive about the EP business model. A senior IT executive maintains:

> "There's recognition of the EP business model's value all the way to the top."

The general experience in Shell Expro, however, is that the model is only of marginal value for business planning and strategy development. The company's business executives are less positive about the EP business model's usefulness. This assessment by business executives was revealed in the case study interviews and in the responses to the structured questionnaire (see figure SE1). The following comments from business executives reflect the negative perceptions:

> "I have seen bits and pieces of it but have not used it. ... You really wonder what the originator is trying to achieve. I haven't met any business executive who understands it. It is difficult to understand."
>
> "I was told that the EP business and data models were useful but the experience so far in Petroleum Engineering has been otherwise. ... I don't know much about it really even though it is placed at my disposal."
>
> "I was involved in a small study where it was used. The impression I got is that you can use it to prove whatever you want to prove - a self-fulfilling prophecy."

The EP business model is perceived as being too complex and detailed by the business executives. The model's domain of usage is IT. IS planners make some reference to the model in their planning tasks. IT executives in the functional departments use the model in functional level IS planning, business area analysis and feasibility studies. The model is perceived to facilitate integration of applications and serve evaluation and selection of packages but is not thought to be of much value in project implementation.

Senior IT executives generally assessed the EP business model to be of significant potential value to the company. They noted the less-than-intended usage of the model but argued that this might be due to the model's infancy. They however acknowledged that the current EP business model was not 'user-friendly' for presentation to business executives and senior management and that a concise graphic version of the model might be more appropriate for this purpose. They pointed to the online version as an effort in this direction in making the EP business model more palatable to business executives.

Application Architecture: The Output of Business Area Analysis

Business area analysis is an information analysis technique for understanding and defining the IT application requirements of a business area. It is a joint exercise involving the relevant independent computing units and functional departments. A typical exercise takes about 3 months. It uses the EP business model as the primary input and the EP data

model as a supplement. The exercise identifies activities and entities relevant to the business area in the EP business model (level 3 CRUD matrix), and details them into lower level activities and entities (level 4 and, if necessary, beyond). A CRUD matrix for the business area is then built using the detailed activities and entities.

Applications relevant to the business area and appraised as worthy of continued usage are selected and mapped onto the CRUD matrix. This process reveals IT requirements which are being satisfied by existing applications. Gaps, redundancies, and new opportunities for IT application are identified, and new applications are defined and marked on the matrix. The flow of data from one application to another is modelled. The whole matrix is simplified and consolidated into an application architecture in a manner similar to that described in Chapter 2. The resulting integrated application architecture is an IS planning tool for the business area. It is used in feasibility studies, project planning/scoping and package selection/implementation. A few senior IT executives, when requested, rated it as being of significant value for these tasks. An overall application architecture for the whole company is not seen by them as a necessity for these tasks:

> "The concept of a large overall application architecture for the whole company is not practical. A portfolio map is more useful." (a senior data management executive).

High Level Data Model: The Exploration and Production Data Model

Prior to the emergence of the EP business model, data modelling was positioned as an important means for IT-user communications during IS planning. However, the data models were not found to be effective in this task. With the advent of the EP business model, data models were abandoned in favour of the EP business model for IS planning. This has remained so even after the subsequent introduction of the EP data model.

The EP data model is the highest level data model in Shell Expro. There is no corporate data model in the company; a conventional corporate data model is not perceived to be of significant value and is thought to be problematic to develop. The EP data model fulfils the traditional roles of corporate data model and more. The EP data model provides a

high-level view of the company's data, independent of technology, application or implementation considerations. It consists of 30 generic templates covering the entire exploration and production business (see figure SE3 for an example). The templates have been developed using the entity-relationship diagramming technique coupled with basic object-oriented concepts such as subtype/supertype. The complete EP data model contains about 500 entities. These entities are defined to be consistent with the EP business model's 17 high-level information entities. The EP data model does not seek to be fully accurate or contain an exhaustive list of all relevant business entities; it is evolving. It is available both as a document and as an Oracle/CASE LAN application.

The EP data model is positioned in Shell Expro as a major data management tool for data sharing and database integration. The company's data management executives claim that the EP data model contributes to the appreciation of data as a corporate asset and is a useful complement to the EP business model in business planning, IS planning, business area analysis and feasibility study. They perceive the EP data model to be of significant value to the company (see figure SE1).

In spite of these claims and perceptions by data management executives, the general perceptions by business executives were found to be somewhat different, particularly in relation to the EP data model's usefulness beyond the IT domain. It was generally perceived to be complex and irrelevant to senior management and functional management. It was seen by them to be in effect an IT analysis tool. Even IS planners were found to use it sparingly in their tasks. The following comments from business executives reflect the negative perceptions:

> "I haven't a clue on how you use this data model. It doesn't mean anything to me."

> "Talking to users about entities is not a practical thing ..... Data models do not inform them on applications. ..... People want applications, not databases."

> "I don't really care about the data model. Design of database is not my concern. It is for IT to set it up."

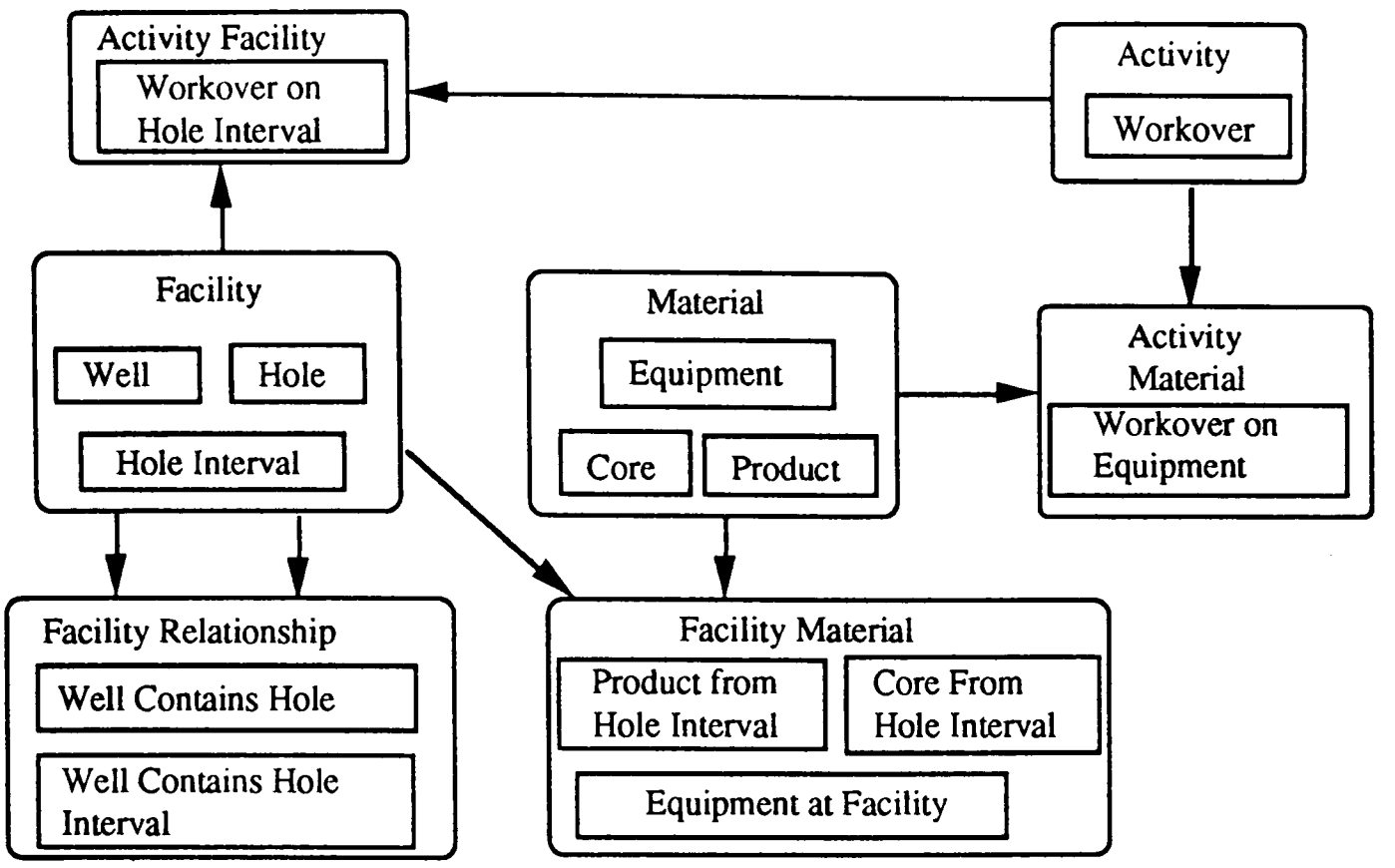


Figure SE3: An Example of an EP Data Model Template (as re-drawn by the author)

Some IT executives, while conceding that there may be some validity in the negative perceptions of business executives, maintained that the EP data model was of value in project implementation tasks:

> "IT-users think development of data models is a waste of time. They are more interested in applications but don't realise that a data model is needed to build it." (a data management executive).

The EP data model is seen by IT executives as being useful for developing project level data models and for specifying, selecting and implementing packages (Shell Expro's preferred software implementation option).

An industry-wide EP data model is currently being developed by a consortium of major IT/software vendors and petroleum companies including the Shell Group. The POSC data model, as it is called, is intended to provide a common foundation for development of integrated software packages for the petroleum industry. It is expected to help software vendors to optimally deliver to the petroleum companies packages and IT solutions which are technically advanced, sufficiently integrated and easily implementable

with little modification. Shell Expro intends to replace its EP data model with this data model when it becomes available. The expectation is that the replacement would enable exploitation of software packages in the company's implementation of IT applications.

IT Architecture

Shell Expro's IT architecture is essentially a set of IT standards and recommendations which address technology reach and range issues (Keen, 1991) and which are used for implementing, maintaining, expanding and enhancing the company's IT infrastructure. The architecture is developed at the Shell Group level by taking into consideration the following factors: the Group's long term business plan, the increasing role played by IT in the operations of individual companies and across the Group, the potential contributions of IT to the business, existing investments in IT, and trends in technology and IT industry. The corporate approach to IT architecture planning is seen as appropriate in view of the global operations of the Group and the need to standardise technology across its hundreds of subsidiaries for a global corporate computing system. In the planning of the IT architecture, conscious effort is made to ensure that technology decisions do not constrain current and future business efforts of the Group. Attention is paid to the Group's need for maximum geographical reach of technology with minimal problems on sharing of IT resources and data within and across the Group.

The IT architecture is proactively planned with the Group's business vision and corporate IT requirements in focus. Sufficient options are however provided within the IT architecture to provide individual operating companies flexibility in the implementation of specific technology. In this regard, the "Harmonised Target Environment" approach is seen as being particularly relevant and useful. "Harmonised Target Environment" is the set of technologies and standards specified as part of the IT architecture to harmonise technology implementations across the Group. This specification includes, in addition to technology standards (such as operating systems, communication protocols, database management systems and programming languages), recommendations on the various types of software and hardware and preferred vendor products. It is an explicit but

sufficiently rich specification which enables Shell Expro or any other subsidiary to select and implement in a harmonised manner the technologies, standards and IT resources that it considers will optimally satisfy its technology requirements. Shell Expro's IT infrastructure is thus a specific implementation of the Group IT architecture but which harmonises with the rest of the Group's technology implementation. In line with recent Group initiatives, Shell Expro is actively converging to an Open Systems environment incorporating client/server architecture, cooperative processing and GUI.

The IT infrastructure defines the information technologies available to the company for implementing an application. Where a new technology or resource is required, it is acquired subject to what is allowed by the "Harmonised Target Environment". Shell Expro's application architecture is thus influenced to a large extent by its IT architecture in technology matters; the impact of the company's application architecture on the IT architecture however is minimal. Shell Expro influences Group-level IT architecture planning and decisions via feedback and input based on IT implementation experience and any unique technology requirement emerging from its application architecture.

Conclusion

A major objective of Shell Expro's IS planning is to migrate its application portfolio towards greater systems integration within and beyond. A highly integrated information system, which is also linked to the systems of other Shell companies and business associates, is expected to create new business opportunities, reduce operating costs, increase business effectiveness and enable Shell Expro to be more responsive to change. The IT architecture planned at the Group level is viewed as an important tool in the effort to achieve the foregoing. The EP business and data models are seen as enablers of IS integration as they facilitate the development of the necessary integrated business area application architecture and project data models for implementing the desired integrated information systems. Some benefits of the EP business and data models in this regard are evident but claims about their usefulness in business and IS planning remain unproven, at least in so far as the findings of this case study suggest.

2. Case Study No. 2: Thames Water Utilities Ltd.

Duration: July to November 1993

Interviewees:

M. Ribbins	Management Systems Director (board member)
M. Green	Senior MSD Manager, IT Services
P. Ratcliffe	Senior MSD Manager, Systems and Projects
R. Westlake	Planning and Security Manager, MSD
T. Harle	Project Manager (Customer Information System)
J. Brown	Project Manager (Capex)
J. Bonner	Data Management Executive, MSD
J. Boudier	Finance Director (board member)
D. Boam	Senior Manager, Operations Division
P. Spillet	Strategic Planning Manager
J. Cooper	Senior Accountant
T. Fox	Business Planning Executive

Company Profile

Thames Water Utilities Ltd. (TWUL) is the largest water utility company in the UK. Its turnover was more than 700 million pounds in 1993. The company employs 7,000 people. It operates in the Thames Valley-London region covering about 130,000 square kilometres of area. The company provides water and sewage services to 11.5 million people. Its current annual investments on capital projects total more than £400 million. It is a strategic business unit of Thames Water Plc., a large group in the water and sewage industry. It accounts for about three-quarters of the group's annual turnover of £1 billion and enjoys much autonomy from its parent company. Its business environment appears to be stable; it does not face any competition in its areas of operation (it has total monopoly), and demand from its market is continuous and sustained. Thames Water,

however, does experience a certain measure of control from the director general of Water Resources and some pressure from other external forces (see figure TW2a). The company was a water authority up till 1989 when it was privatised through an act of Parliament, an act which also covered the privatisation of other water and sewage authorities in England (a total of 10 large and 26 small bodies).

IT Function: The Management Systems Department

The Management Systems Department (MSD) is Thames Water's IT department. It is relatively large, accounting for a budget of £30 million in 1993. The senior management of the department consists of the director and three senior managers. Reporting to the director and senior managers are more than 200 IT executives and staff members (section managers, project managers/leaders, technical managers, analysts, etc.). The strategic value of IT to the company's business is reflected in the way the Management Systems department is positioned in the organisational hierarchy; it is one of the company's key functions and the department's director is a member of the executive board. Board meetings and other interactions enable the MSD director to keep other board members informed on IT matters and developments. The director does not "teach IT to top management; what is relevant emerges naturally during the interactions."

Thames Water practises an organisation-wide integrated management arrangement and has adopted a team approach. The MSD director considers the team approach to be an effective way to manage the complexities and challenges being experienced by the company. He argues that teams provide the benefits of a matrix structure even though the organisation may not be structured thus. Workflow within and between teams becomes the organisation's workflow. The team approach is conducive for MSD to make its contributions to the organisation's goals and efforts. MSD practises the team approach within the department too. A senior MSD manager observes:

> "This collective approach helps us to see through the mass of detail and complexity confronting us."

MSD's motto is that corporate interests supersede departmental interests. Successful delivery of IT applications is seen by the department as a critical factor for the implementation of many of the company's business strategies. The department hence emphasises not only the quality but also the delivery of applications. The MSD is generally regarded as being successful in delivering its commitments to the company (MSD's 1991 User Survey). The MSD director sums up his department's focus thus:

> "If you can't deliver, you are dead. If what you deliver doesn't work, you are also dead."

IT is an organisationally-pervasive strategic resource in Thames Water. Its primary value to the company is reflected in the following official statement:

> "Information technology offers the ability to exploit human potential by generating value-added information from data and hence improving efficiency. For success, employees at all levels will need to be provided with the correct systems and tools specifically designed to meet their individual business requirements ..... The information systems challenge for the 1990s is therefore to provide the best support to our employees to enable them to manage effectively and efficiently, and thus keep Thames Water at the forefront of the UK water industry." (Information Systems Strategy 1991, Feb. 1992, pp. iii)

IT is seen as a valuable tool for harnessing the potential of Thames Water's human resource and for achieving efficiency in capital usage. It is viewed primarily as an automation tool but is also thought to have potential as a business transformation tool. This was reflected in the case study interviews and in the responses to the structured questionnaire distributed at the end of data collection (see figure TW1).

Strategy Development and Business Planning

Strategic planning, as perceived by Thames Water, is the "process for defining where the company is, where it wants to be in the future and how it intends to get there in terms of

resources and timescales." (statement in MSD's planning report). Strategies are developed to address the long-term goals of the company as well as the regulatory pressures and business threats/opportunities it experiences. Thames Water's board reviews the company's business strategies and long-term plan annually in relation to company goals, regulatory pressures, emerging business threats and opportunities, and company performance. Workshops are typically conducted, and key issues, strategic options, and current strategies and their successes are discussed. The strategic planning exercise delivers long-term business strategies and plan.

The annual business planning is held after the strategic planning exercise. The major inputs are the long-term strategies and plan, review of the preceding year's business plan, emergent issues and opportunities, and the inventory of company resources. The final business plan is a medium-term document which specifies the budgets, projects and activities for three years, with focus on the next year. It is developed by combining and integrating the departmental plans and budgets submitted by the various departments including the IT department. Thames Water's strategic planning manager summarises the involvement of MSD in strategy development and business planning thus:

> "MSD is no different from any of the other key functions in its involvement in the company's strategic and business planning."

Information Systems Planning

IT applications in Thames Water are conceived in the course of normal business operations. They are also deliberately planned via formal IS planning projects. The identification and planning of these applications is a joint effort by MSD and relevant functional departments. Depending on the business imperatives, these emergent/planned IT applications are included in MSD's submission to the company's annual business planning exercise. The typical IT application crosses business lines and is itself part of a much larger business effort. Hence, before including an application in the departmental plan, the Management Systems Department discusses it with the business functions

which have a stake in it. This discussion enables each participating department to incorporate in its business plan the resource requirements and contributions related to its commitment to the whole business project.

The IT department's annual planning exercise is part of the company's ongoing IS planning process. A formal IS planning (ISP) project is also conducted every two years as part of this process. The project is handled by a multidisciplinary executive team under the initiative and direction of the MSD. The team assesses the potential of emergent applications, analyses the success of implemented applications and last IS plan, identifies new applications based on business requirements, and reviews the status of IT resources in the light of the company's business strategies/plans and last ISP project recommendations. The team discusses priorities of applications and expected investments and identifies potential benefits, problems and implications. The guiding philosophy is to direct IT investments at corporate systems and minimise departmental systems and technology "islands".

The ISP report, after being approved by the board, is issued to all managers in the company. It becomes one of the key documents defining and guiding the company's business strategies and their implementation. It defines Thames Water's IT related-business strategies, information architecture, IT architecture and overall implementation plan. The document, though comprehensive, does not cover all application requirements. A few unplanned IT applications do emerge in the course of normal business operations; e.g. the Asset Management Process project which emerged from business demands, and the Job Management System which had to be in place prior to the implementation of the Customer Information System. The ISP document is updated to reflect the implementation of such applications. As noted by an MSD manager:

> "After all, it [the ISP report] is a snapshot and therefore if key projects come up, we have to implement them."

Respondents → / ↓ Selected Key Items	Planning &Security Manager (MSD)	Project Manager (MSD)	Senior Systems Develop. Executive	Senior Operati-ons Manager	Average
Role of IT ('1= Not a role' to '5= Primary role')					
Automation	4	4	5	5	4.5
Transformation	4	4	4	3	3.8
IS Planning Success/Failure (1= Failure, 2= Some benefits but IS planning is not needed to achieve them, 3= Better than not doing it, 4= Successful but can be better, 5= Highly successful)	4	4	4	4	4.0
IS Planning Taxonomy ('1 = No match' to '5 = Perfect match')					
Administrative Approach	3	3	4	3	3.3
Methodological Approach	1	2	2	2	1.8
Technological Approach	3	4	3	3	3.3
Business-led Approach	3	4	4	2	3.3
Organisational Approach	5	4	4	3	4.0
Perceived value of Application Architecture (1= Irrelevant, 2= Little use, 3= Some use, 4= Significant use, 5= Absolutely essential)	4	5	4	4	4.3
Perceived value of Corporate Data Model (1= Irrelevant, 2= Little use, 3= Some use, 4= Significant use, 5= Absolutely essential)	2	3	4	2	2.8

Figure TW1: Responses to Structured Questionnaire - Selected Key Items

Neither the ISP project nor the ongoing IS planning employs a formal ISP methodology. Formal methodologies have been used in ISP exercises in the past but the experiences have not been satisfactory. A soft approach has hence been adopted; greater importance is placed on the planning processes. This approach is perceived to be better at addressing the key IS planning concerns of involvement by senior management/users and integration of IS planning with business planning; the MSD director is not convinced of the value of ISP techniques such as CRUD matrix and entity relationship diagramming. Thames Water has adopted a less-rigorous approach in spite of choosing Andersen Consulting's Foundation as the methodology for application development. An MSD manager points out:

> "We found we were already using sections of Andersen's methodology before its formal introduction into the company - sections such as 'top management and user involvement' and 'business alignment'. The bits we weren't using and have not adopted are those on specific techniques. ..... We work on the KISS principle - Keep It Simple Stupid."

Key business issues such as critical success factors, value activities and IT-based competitive strategies are addressed in IS planning via workshops. Workshops are conducted during the ISP project and as part of ongoing IS planning. Models such as business system architecture (see below) are developed and used in these workshops. IT executives claim that workshops foster teamwork and provide an effective mechanism for debate and brainstorming to achieve common understanding. Workshops permit collective development of IT solutions to business problems.

To a request to assess the success of Thames Water's IS planning, four executives (three from MSD and one from Operations) responded that it was satisfactory (see figure TW1) but there was room for improvement particularly in relation to structure and rigour of planning. Satisfactory involvement of senior management and business functions was indicated as the ISP's strength. Though the case study interviewees generally conveyed a

similar message, there were a few business executives who were critical of the IS planning process. The strategic planning manager feels that:

> "Every time there's something new [in IT], they [MSD] present it to senior management and ask for more money for more systems. There is a need to focus on just the key systems."

The director of finance, however, is more positive of Thames Water's IS planning:

> "We have moved substantially away from solutions looking for problems. ..... There is a need for senior managers now to have an understanding and appreciation of other disciplines, particularly key ones such as IT. The IS planning arrangement contributes to management's understanding of IT. ..... I don't regard my understanding of IT as being that different from my understanding of other key areas such as water operations."

The director of finance's view on IS planning synchronises with the classification of Thames Water's IS planning. To a request to classify the company's IS planning in terms of Earl's (1990, 1993) taxonomy of ISP approaches, the four executives responded that it best fitted the 'organisational approach'. There is more of management interaction and less of planning technique in the IS planning. Concern for participation in relation to business strategies supersedes methodological, administrative and other issues. Formal methodology has little relevance to the planning process. Nonetheless architectural issues are considered to be useful and are handled through simple techniques (see below).

Project Implementation

A business project has strategic implications. It does not have to be IT-based but, with the increasing integration of IT with the business, most business projects have an IT component, often a substantial one. Application development is therefore regarded as a business effort. It is an integral part of a larger business project. There are IT projects but these deal primarily with IT infrastructure and do not impact the business directly. The

typical business project is multi-disciplinary with varying degrees of departmental responsibilities and contributions. Such an arrangement is regarded as being effective:

> "The integrated project team on the Material project is working very well." (A functional executive's remark in MSD's 1991 User Survey).

The project team is often large and comprises smaller groups within it. The project manager is often from the department which has the most stake. Where the project manager is from a user-department, a senior IT professional assumes the role of technical advisor to the project manager; he looks after the application development tasks. Regardless of the discipline from which the project manager comes from, he adopts a business approach in handling the project. A project manager from MSD points out the need for such an approach thus:

> "I couldn't do my job if I didn't take such an approach because the Capex project is not an IT project. It is a business project."

Application development is done within the confines of its business project. IT professionals in the project team work with potential IT-users and software contractor personnel to deliver the application. Thames Water does not view programming as a core competency required for the water-sewage business, hence the company's preference for packages and outsourced software. The IT professionals use Foundation and its associated Design/1 CASE tool to perform the necessary analysis/design tasks.

Business Model

Thames Water develops and uses a few types of business models in the planning of its business and IT. Of these models, the following were mentioned by case study interviewees as being significant: business environment model, organisational business activity model, business area activity model and business system architecture.

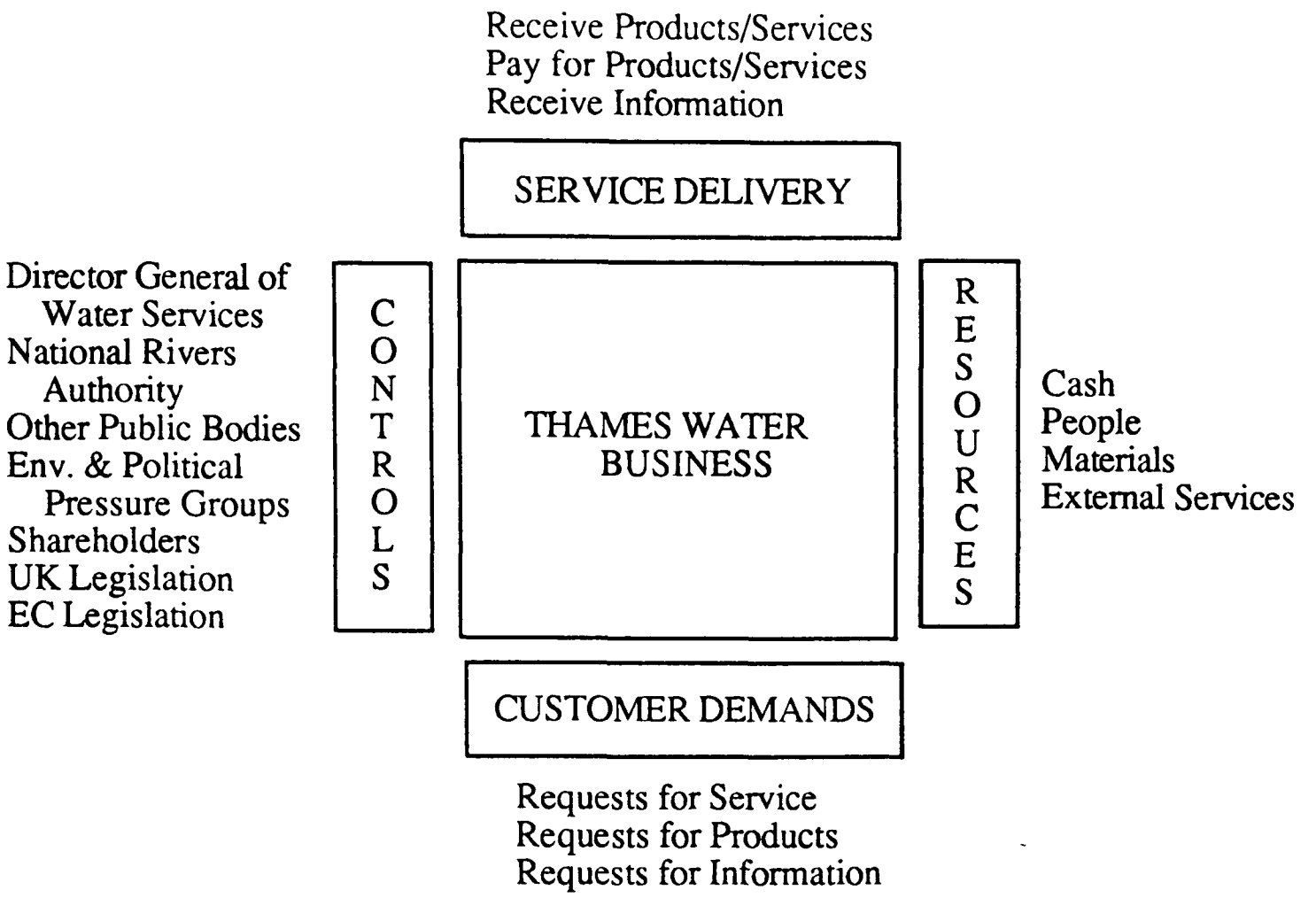


Figure TW2a: Business Environment Model

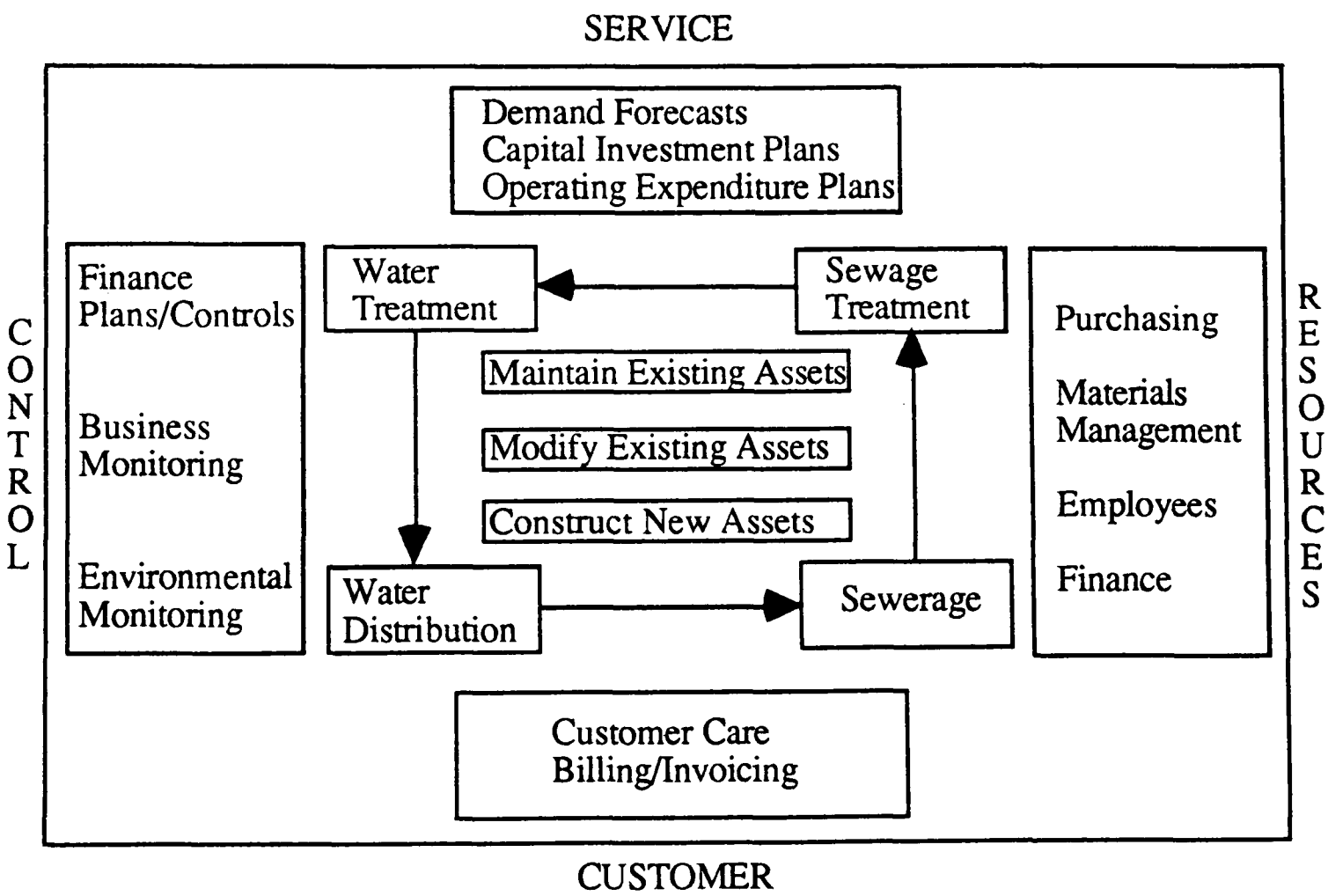


Figure TW2b: Organisational Business Activity Model

The company's highest level model is that of its business environment. The model resembles Porter's (1980) Competitive Forces framework (see figure TW2a). As noted by a senior MSD manager:

> "If you do it right, the models should essentially look the same regardless of techniques employed."

The business environment model depicts the company's business, scope and objectives. The model was developed in 1988 by senior IT executives and some IT consultants through discussions and interactions with board members and senior business managers. No special tool or technique was used in this effort. The effort relied on the experience, knowledge and expertise of those involved. In the early part of its life, the model was referenced by senior management in strategic and business planning. It is now referenced only occasionally by them on the initiative of MSD executives. The model is reviewed and updated during the ISP project. Currently, it serves more as a form of documentation than a planning tool.

Complementing the environment model is a macro level business model showing the company's major business activities (see figure TW2b). The business activity model's current status is similar to that of the business environment model; they both have the same history of development and usage. An MSD manager observes that both models are stable. He further notes that they are generic enough to be applicable to any water-sewage company. He suggests that they could even be applied to a company in one of the other utility industries through appropriate replacement of words related to 'water' and 'sewage'.

A conceptual business area activity model, such as the one shown in figure TW3, is occasionally used by a functional department in its communications with senior management. The model, developed using simple graphics, reflects a chain of value activities related to the business area's deliverables. The model is fairly stable but could change when activities are redefined due to changes in the deliverables or resources.

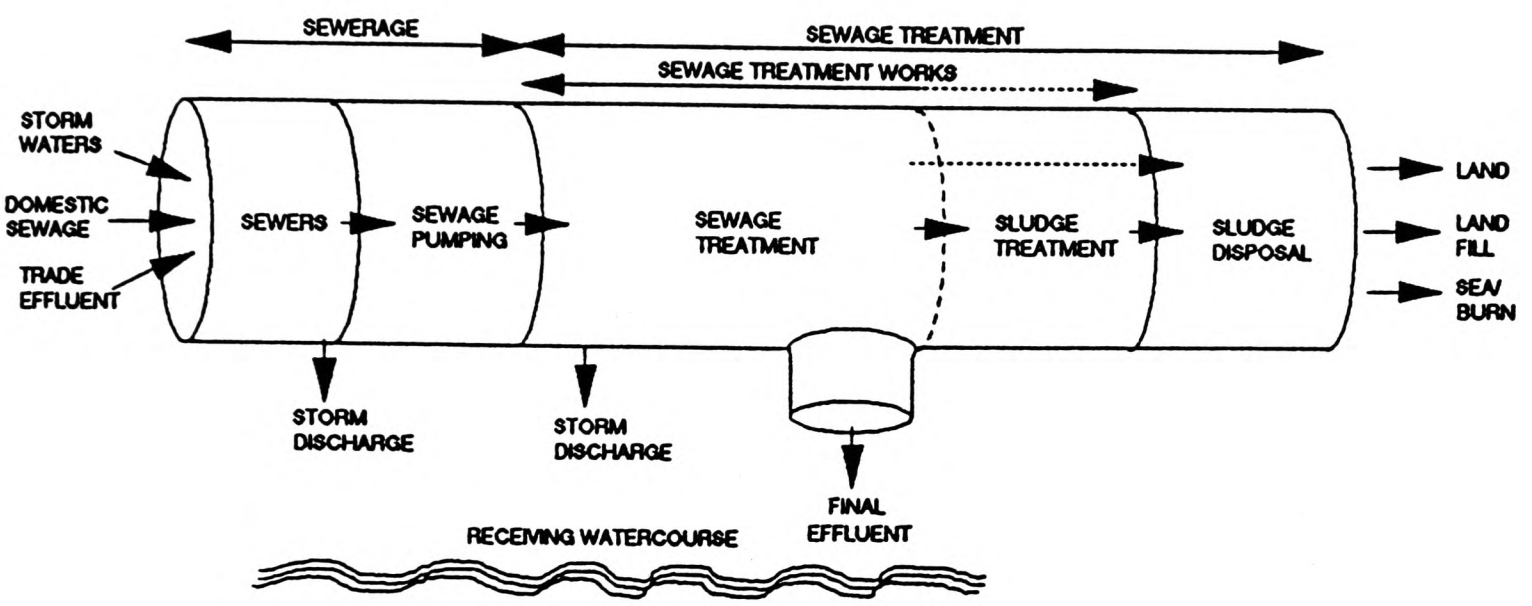


Figure TW3: Business Area Activity Model for "Sewerage and Sewage Treatment"

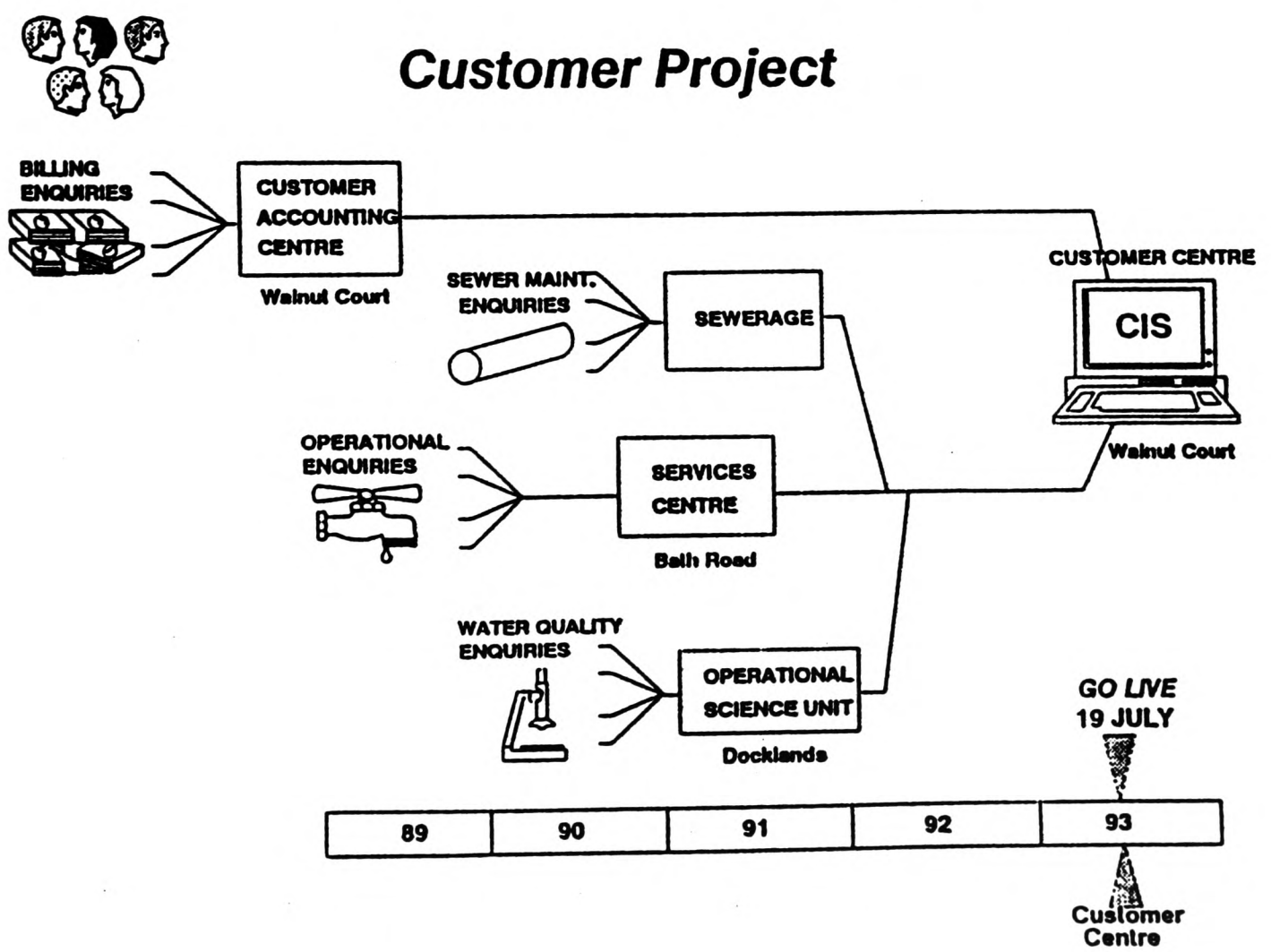


Figure TW4: Business System Architecture - Customer Information System

Of these business models, the business system architecture is regarded as a significant IS planning tool (see figure TW4 for an example). A business system architecture shows at a macro-level how IT and other resources available for implementing a strategy are configured into a system. A strategic IT application is an integral part of a business strategy implementation and is reflected thus in the model. The model is typically used in the management workshops which are conducted as part of the company's integrated business/IS planning process. It is developed or revised jointly by the workshop participants; IT executives act as initiator and facilitator. The model enables senior management to vision the implementation of a strategy. It permits discussions and deliberations of alternatives for implementing the strategy: role and contribution of IT and other resources are assessed; new strategic opportunities/initiatives are identified.

Thames Water's business system architecture is unique to the company. The model's underlying concept may be applicable to other companies but not the content per se. The arrangement of Thames Water's resources to deliver a strategy is unique to it. The business system architecture is graphic and is set at a macro level to keep it simple and suitable for senior management use. No special technique is used to develop the model. It is often simply sketched out before or during a workshop and given a more aesthetic appearance through use of graphic tools. Recently there has been emphasis in presenting the business system architecture in pictorial form. Senior management has been found to be more receptive and participative in planning workshops where pictorial models have been used. The usefulness of the business system architecture is reflected in the following comments:

> "A business system model shows effectively the interactions between the various business elements including IT." (a senior functional executive).

> "It is useful for talking to management about a system and explaining that everything important has been considered and incorporated." (a senior MSD manager).

"This might look like a well laid model but it has been modified a number of times via interactions with business executives." (a senior MSD manager).

While noting the usefulness of the business system architecture, a business executive cautions on its contents:

"There is a fine line between doing something useful and putting in details. It all depends on whom the model is aimed at. ..... If you can't understand it, it is not worth having."

Application Architecture

The value of the business system architecture extends beyond business/IS planning to the project level. However, they are not seen by the IT department as being sufficient to plan the implementation of IT applications. An application architecture (AA) is regarded as the tool for this purpose. The application architecture defines the scope and inter-relationships of the company's existing and planned IT applications. The architecture is developed/revised jointly by the IT department and user-departments during the ISP project. No sophisticated tool or technique is used. Only simple graphics modelling is done. The current AA consists of an overall model and eleven detailed models.

The overall application architecture (see figure TW5) shows the integration of the company's major IT applications. It depicts the alignment of applications with the business and is consistent with the organisation level conceptual business models (see figures TW2a and TW2b). The architecture is a "system road map" which serves both as a tool and a deliverable of the ISP project. MSD management is the major user of the overall AA. They refer to it when a high-level perspective of the company's information system is required. A project manager and/or his technical advisor sometimes refer to the architecture at the outset of their project to check on its overall implications and links to other projects/applications.

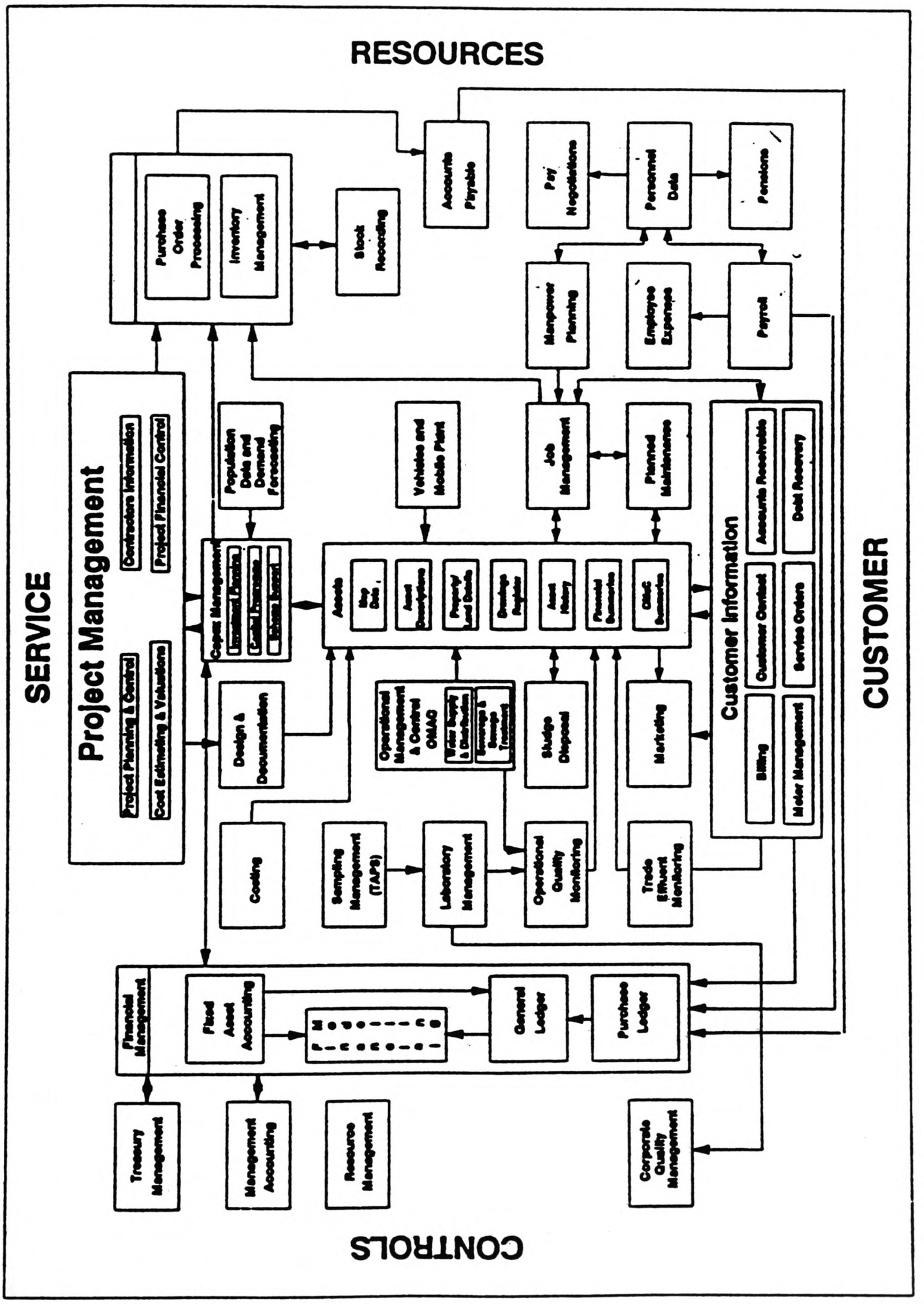


Figure TW5: Overall Application Architecture

Senior management rarely use the overall AA on their own. MSD executives occasionally walk through the model with them during business/IS planning to clarify the department's contributions to the business. The architecture's complex and technical appearance however are perceived to make this task somewhat difficult. A simpler model is thought to be more effective for the purpose of communication with senior management. A senior IT manager notes:

> "The overall architecture is not an easy model to comprehend and top management doesn't speak flowchart. It requires to be walked through carefully for them to appreciate it. An optimised model would be better."

While the overall AA is perceived to be relevant to management, it is not seen as being of much use to the application developers. Detailed application architecture is seen as the model relevant to application developers. A detailed AA is developed for each major application depicted in the overall AA (see figure TW6 for example). The detailed application architecture depicts the major sub-systems within an application. The model serves as a link between IS planning and project implementation and is utilised in the planning and initiation of application development. The architecture is used by IT professionals in the development of high-level logical data flow diagrams and context diagram in the early stages of systems analysis. The architecture is used in the specification and evaluation of packages.

A detailed AA for a specific project is sometimes developed beyond the formal ISP project. This happens when need for an unplanned application emerges and there is no AA for it in the ISP document. The model is ultimately incorporated into the ISP document and the overall AA is appropriately updated.

Four MSD and business executives were requested to assess the value of the application architecture to Thames Water. They assessed the AA to be of major value to the company (see figure TW1). It was seen as being particularly useful in relation to the planning and implementation of the organisation's integrated information system.

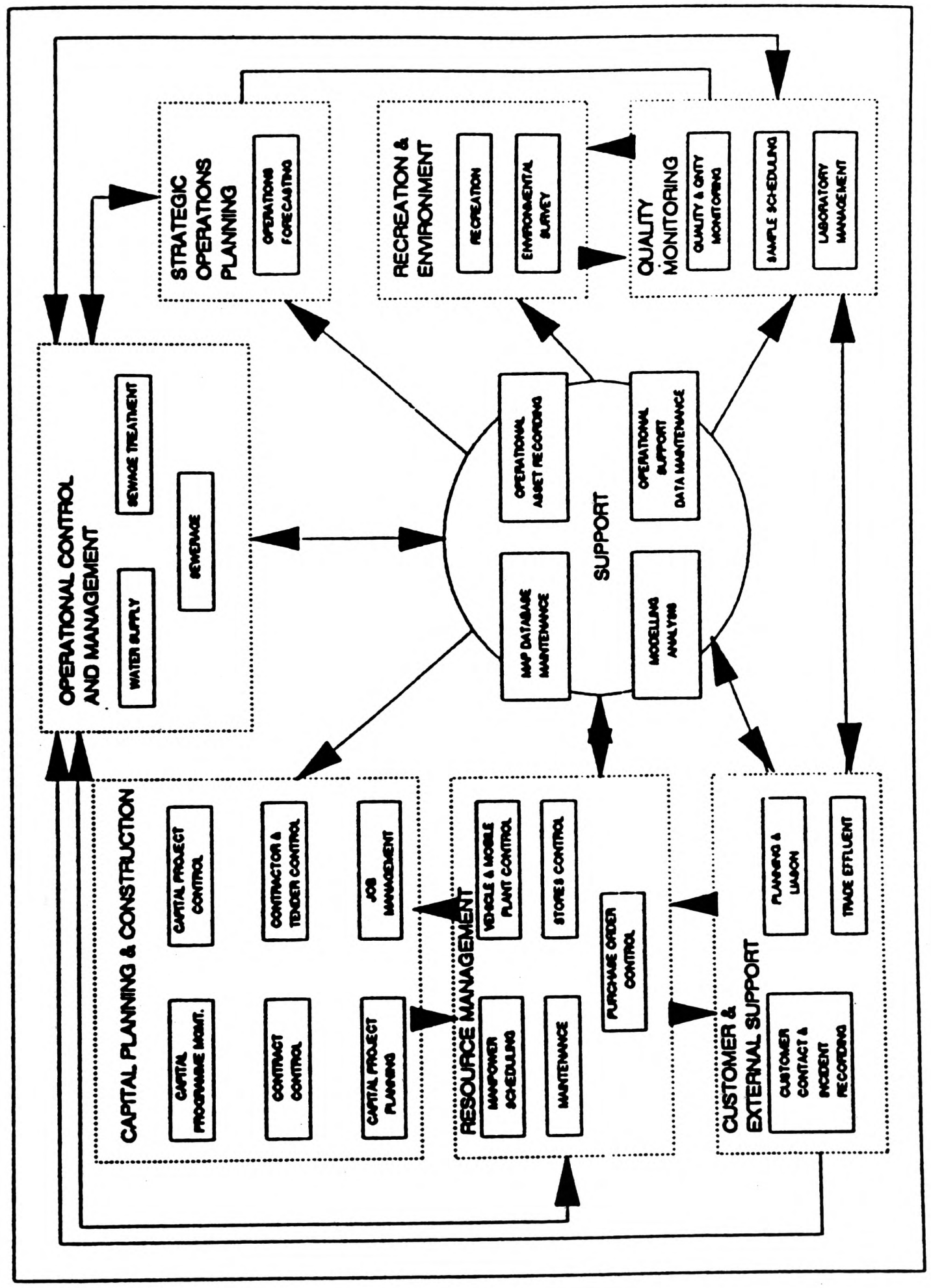


Figure TW6: Detailed Application Architecture - An Example (Operations)

High Level Data Model

Thames Water views data models to be of little use in business and IS planning. The company confines data modelling to project and data management tasks. A corporate data model (CDM) is not even developed for the latter purpose. A CDM was at one time considered to be an imperative. A group was set up in 1989 to build Thames Water's CDM. The effort expended was considerable (IEW I-CASE tool, Information Engineering methodology, and human resource and time); a senior IT manager estimates the total cost to be about £0.25 million. The resulting corporate data model was however found to be dysfunctional. Thames Water's IT department sought information from the IT departments of the other nine large UK water-sewage companies on their corporate data modelling experience. A situation similar to that of Thames Water was revealed across the companies. The companies were in the process of developing or had CDMs but none of them reported deriving any major value from their data models. Hence, after much deliberation, Thames Water decided to abandon its CDM effort and to confine data modelling to the project level and data management. Recalling the project outcome, a senior MSD manager maintains:

> "If we have failed in one area, that's it. Corporate data modelling is very intellectually stimulating but its development is difficult to justify in Thames Water."

He attributes the failure of corporate data modelling to six factors:

* People responsible for CDM development are too technically focused.
* Much effort is required to develop the CDM.
* The concept of CDM does not fit business planning.
* CDM does not fit management characteristics, experiences and expectations.
* Existing applications cannot be altered to comply with the CDM.
* CDM usage does not facilitate package implementations.

The four MSD and functional executives who completed the structured questionnaire assessed the CDM to be of only marginal value to the company (see figure TW1). This

assessment on CDM was also echoed by the director of finance. He asserted that a CDM was of little relevance to board members. He contended that top management's main interests were in the final deliverables, benefits, implications and costs, and not in techniques or technicalities of IT; he saw CDM as fitting the latter category. The strategic planning manager summed up this issue thus:

> "It is ridiculous to present it [CDM] to management. It doesn't answer their questions on IT."

In contrast to the corporate data model, the business area/project data model was perceived by IT executives and project managers to be of major value to the company. They considered it to be essential for data analysis, database design and database integration. Business area/project data models are confined to specific business areas/projects (see figure TW7 for an example). The data models are widely developed and used in project planning and scoping as well as in application/database development. A number of such data models exist. They are the highest-level data models in Thames Water. Collectively, they are perceived to adequately serve the company's data management needs and database integration requirements. A project manager notes:

> "The project data model helps us to understand the business view and build the required database for the application."

The value of the business area/project data model, as perceived by MSD executives, appears not to be affected by the project implementation method (package or bespoke development). Business area/project data models are used in package specification, evaluation, selection, customisation and implementation. The data model is central in application development for data analysis and database design tasks. It is used in database migration. While MSD executives are unanimous in their support of business area/project data modelling, a few functional executives argue that a data model is of little relevance to them:

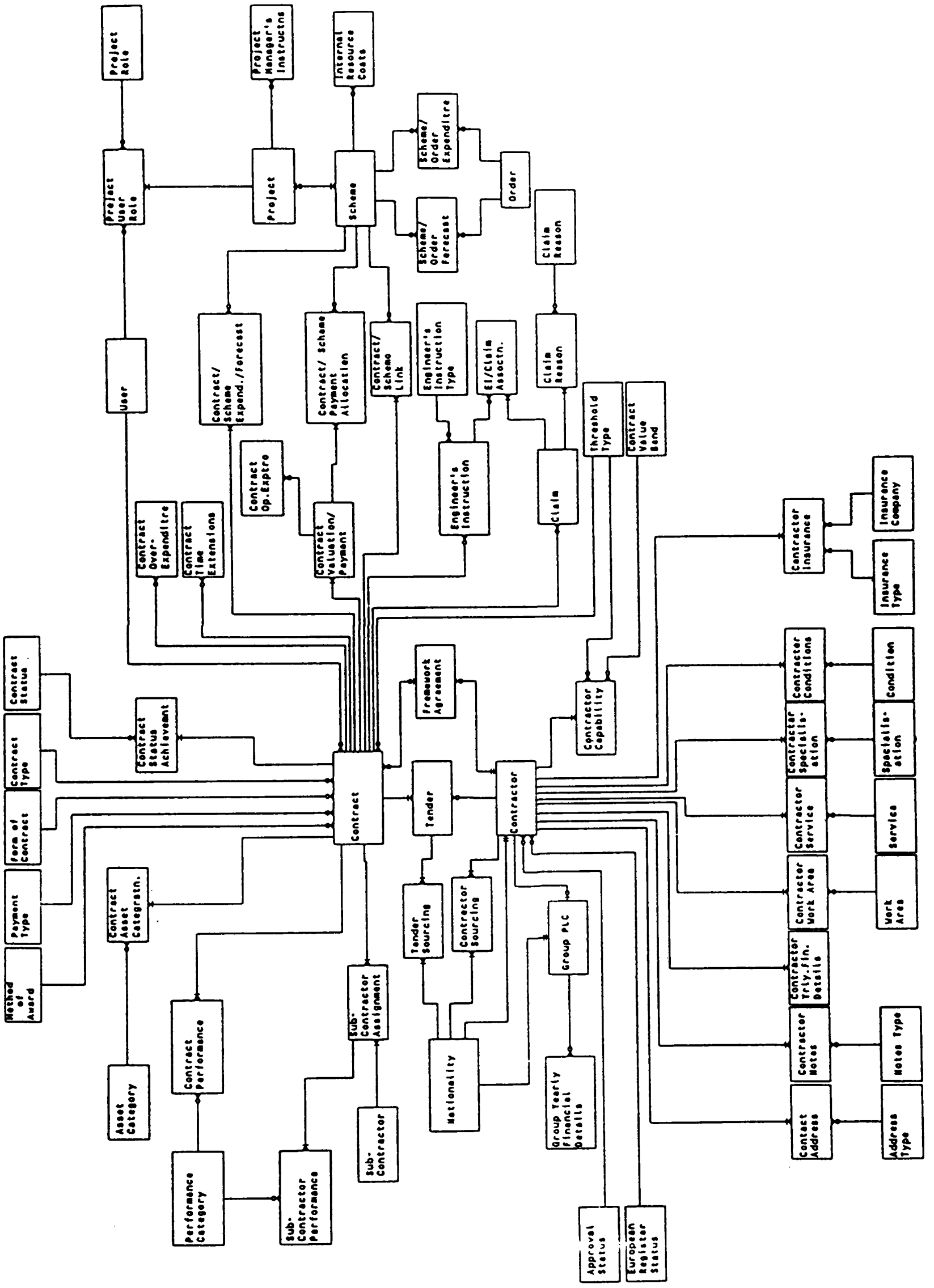


Figure TW7: Business Area/Project Data Model - An Example (Capex)

"It is complex. It doesn't tell me the applications. It just tells me what I already know."

"I don't need to get involved in data modelling but details on data are relevant. As far as I am concerned, data modelling is really a process of confirmation rather than information."

IT Architecture

Thames Water's application architecture and business system architecture influence and are influenced by the company's IT architecture. The IT architecture and its implementation are considered by MSD to be a major determinant of the quality and level of integration of the company's information system. The architecture is reviewed during the ISP project, in major application development efforts or when significant changes occur in technology. The architecture contributes to the planning, implementation and assessment of the company's IT infrastructure.

Technology standards are central to an IT architecture. They help to minimise technical incompatibilities and promote network and systems integration. Thames Water has chosen to define its technology standards with IBM mainframe technology at the core. This technology was chosen as a replacement for Thames Water's ICL system and was implemented in 1989 based on the company's key computing requirements and on technical grounds. "It allowed putting IT into the company in a rapid way", claims a senior MSD manager. He further argues that an "ideal" decision based on a conceptual IT architecture such as Open Systems might not have permitted the quick implementation of applications:

"The architecture would have been too open and may not have led us to focus and deliver on target. Much of our delivery is related to being on firm grounds. I don't think there'll be any major change in the company's core information technology in the foreseeable future."

In choosing IBM mainframe as the core technology, Thames Water also took into consideration its expected future IT requirements, potential problems of legacy systems and advancement in information technology. MSD claims that the company's decision to build its IT architecture around IBM mainframe technology is sound. A senior MSD manager points out that the technology's basic components (MVS, DB2, SNA, CICS) are primary elements in IBM's SAA (Systems Application Architecture) (IBM's strategic technological direction - Libutti, 1990); there is a large user-base and the IT market oriented around these technologies is well-supported and continues to grow. The senior MSD manager asserts that the IBM mainframe choice does not constrain Thames Water in technology matters. The company has effectively interfaced computing systems from other vendors with the IBM mainframe system and is in the process of embracing client-server computing, GUI, Open Systems and downsizing technologies. The MSD manager further maintains that there is a major difference between IBM product and IBM technology. IBM product refers to what the vendor actually offers to the market. IBM technology refers to standards from the vendor which have industry-wide implications and which can be implemented on non-IBM products.

Thames Water's IT architecture is defined at three levels - network , computing system and workstation. The architecture is designed to integrate all computing resources and provide for maximum reach by IT via a network of loosely coupled computing systems and workstations. The company's network architecture (see figure TW8) sets out the topology and standards for this loose coupling and associated data communication. It seeks to address the requirement for every workstation in the user environment to be able to connect to all the computing systems distributed throughout the company and to share data and IT resources. It further provides for Thames Water's electronic linkage with the outside (suppliers, business associates, IT contractors, employees in their homes, etc.).

Thames Water's IT architecture has emerged from the IT infrastructure which was initially selected and implemented on technical considerations in 1989 in the light of an AA which covered the company's critical strategic IT applications . The definition of IT

architecture in this way appears not to have affected the company's ability to embrace new technologies, its expansion of the IT infrastructure, or its delivery and implementation of IT applications.

The IT architecture and infrastructure are consulted during the development of the business system architecture and application architecture. The IT infrastructure defines the technologies and resources available for implementing applications depicted in the company's information architecture. Where new technologies or resources are required for an application in the information architecture, these are identified subject to what is defined or allowed by the IT architecture. Effort is made to ensure that limitations of the existing IT architecture and infrastructure do not deny IT applications of potentially useful technologies. At the same time, applications are not permitted to utilise technologies which could lead to the emergence of technology islands. The two-way relationship between information architecture and IT architecture helps in this regard.

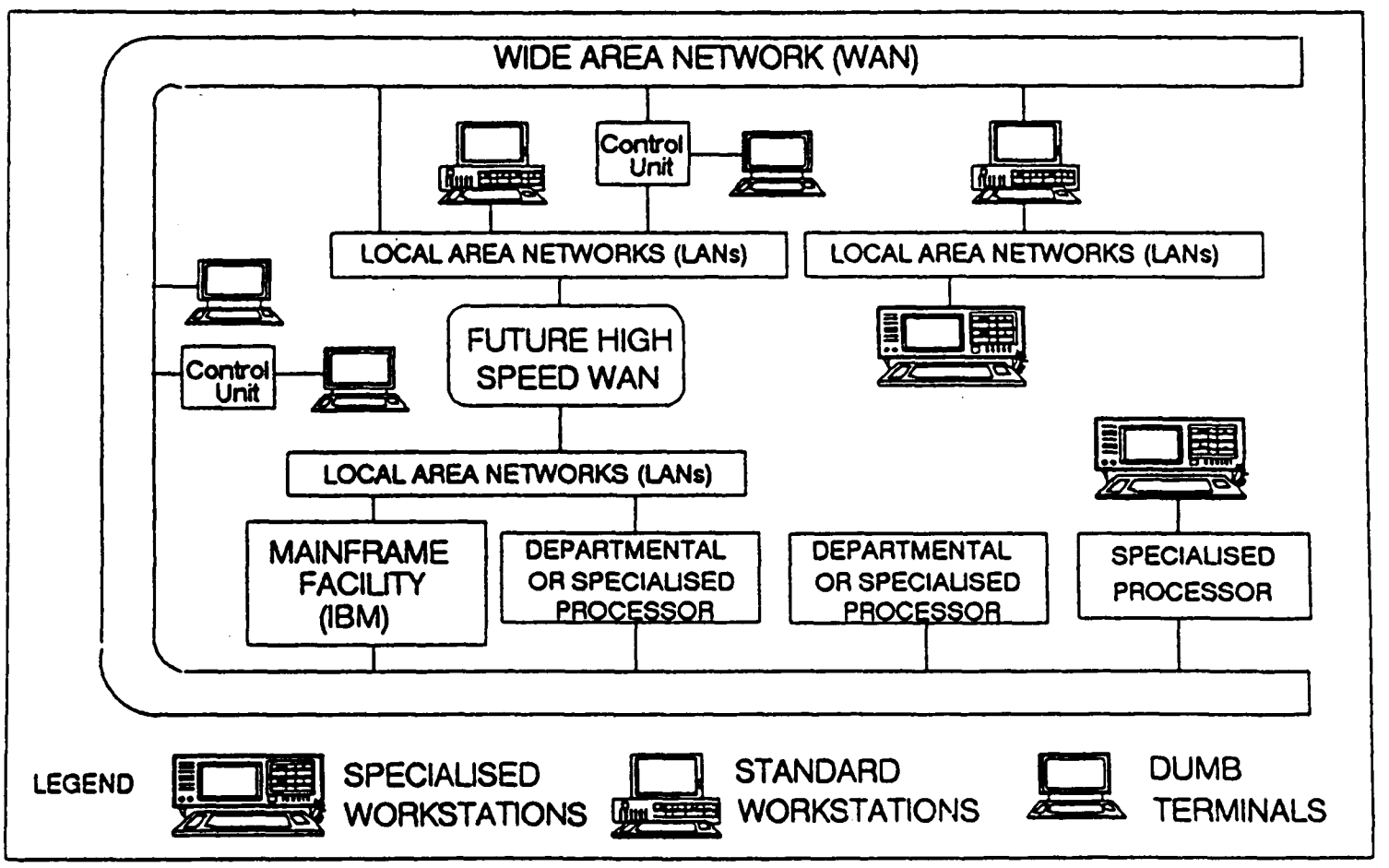


Figure TW8: Network Architecture

Conclusion

The Management Systems Department views IS integration as a key to achieving Thames Water's vision of a highly integrated organisation:

> "The only way that this vision of our Company's business activities can be implemented is through the development and support of integrated corporate systems." (MSD's 1992 ISP document, p. 2-5)

The current Business Process Improvement project is a major initiative in this regard. The aim of this project is to exploit existing and future applications by linking them to a creative and innovative reengineering of Thames Water's business. The project involves business system architecture development and uses Hammer and Champy's (1993) reengineering principles.

Some of the MSD executives interviewed pointed out that they had been learning how to exploit IS modelling techniques through experience. The company's unsatisfactory experience with corporate data modelling had led to the model being abandoned. Business area/project data modelling is confined to project tasks and data management. The application architecture has been found to be useful in IS planning and implementation. MSD's recent venture into business system modelling has paid dividends. Senior management has responded positively to these models in business/IS planning. The benefits of business system architecture are now being realised in business process reengineering as well.

3. Case Study No. 3: Rover Group Ltd.

Duration: October 1993 to January 1994

Interviewees:

G. Hains	IT Director, IT Strategy Group
D. Styles	Manager, Database & Technology
D. Stanton	Manager, JIT/DE System
K. Hathrell	Data Management Executive
K. Johnstone	Senior IT Executive, Systems Services
A. Naylor	Director, JIT/DE
M. Smith	Manager, Manufacturing System
G.E. Beadle	CTU Technical Manager, British Aerospace

Company Profile

The Rover Group is one of the largest motor vehicle manufacturers in the UK Its annual turnover in 1993 was about £3.5 billion. The Group designs, manufactures and markets small, medium and executive cars, car-derived vans and specialist four-wheel drive vehicles. Production and management is confined to the UK. The factories and production facilities are located mainly in the Midlands. Rover operates in a relatively mature and highly competitive industry and seeks "to be internationally renowned for extraordinary customer satisfaction." The Group's vehicles are exported to more than 50 countries across the globe.

Rover's parent company is British Aerospace[4] but Honda (UK) holds a 20% stake. Rover operates relatively independently of its parent and has its own board of directors, divisions and business units. Honda's involvement is seen by industry experts and within the company as one of the major factors which has caused a turnaround of

4 BMW became the new parent company after the conclusion of this case study.

Rover's fortunes. The partnership is often quoted, in business literature (e.g. Business Week , 16 August 1993), as a model of Euro-Japanese venture.

Human resource is considered by Rover to be its most valuable asset. This is reflected in the company's organisation culture and human resource management practices. Life-time employment is a recent direction. Employee productivity and efficiency is increased on a continuous basis via improved working methods, processes and arrangements:

> "The new method of working enrols the commitment of everybody to work flexibly and to the highest quality standards, and to seek continuous improvements in productivity, efficiency and cost reduction." (1992 British Aerospace Annual Report).

Rover's organisational culture embraces the company's dealers, suppliers and partner (Honda UK). The Group's purchasing director at Longbridge believes that Rover makes better cars cheaply and quickly and gets new models out into the market faster by working closely with its suppliers (Management Today, May 1992). He points out that enabling this close working relationship is mutual trust coupled with integrated business processes and EDI technology. Similar relationships and links are also in place with dealers and Honda UK. With suppliers, dealers and its partner within its value system, Rover has effectively enlarged its organisational boundaries and created an extended enterprise. IT via EDI is seen as a strategic resource to increase the effectiveness of the extended enterprise.

IT Function

Rover's IT function adheres to a distributed arrangement. There are three IT directors in the company - an IT director responsible for group-level IT strategy and major programmes (reporting to the board member for finance and strategy), and two IT directors in two major operating business units/divisions. Small IT delivery groups are also located within business units/divisions. The three IT directors together comprise Rover's senior IT management and operate as a team. IT interests and issues are handled

at the board level by the three board members to whom the three IT directors report. The IT director (IT strategy group) maintains that the devolved arrangement is the most appropriate one for Rover:

> "A devolved IT structure is difficult to manage but fosters ownership. The current arrangement is a key factor in the successful implementation of IT applications in the Group. The devolved arrangement also encourages variable IT expenditure based on local needs and priorities."

The IT strategy unit, with 12 IT executives and the IT strategy director, is located at the Group level. One of its primary roles is to contribute to the synergy of the company's distributed IT function. The unit serves as a source of expertise to the board on IT matters. The unit's mission is:

> "to provide leadership in the development of appropriately integrated IT plans expressed in terms of business contribution, technical architectures, data improvement and quality delivery techniques." (IT Strategy Unit mission statement).

Rover views IT as a strategic resource. IT is enabling the company to gain and sustain competitive advantage. The IT director (IT strategy group) sees the strategic value of IT becoming more pronounced in the future as the automobile industry becomes increasingly IT-based. He considers the primary role of IT in Rover as one of business transformation. Others, including business executives, also see such a role for IT in Rover (see figure RG2); 'automation' is important but IT's thrust is in the direction of 'transformation'. The IT director observes that the company's business strategies and operations are dependent on IT and there is potential for further IT-based strategic initiatives. In conjunction with the company's systemic management processes and total quality management, IT is targeted at increasing the productivity, quality and efficiency of operations in the company's entire value system, from supplier to customer (Management Today, May 1992, pp. 91-92).

The IT director (IT strategy group) observes that automobile companies have generally believed that "production strategy is the company strategy". He argues that this belief is completely unfounded. Marketing, sales, supplies and other functional strategies are equally important. This effectively calls for holistic thinking and recognition of the value and contributions of each function as an integral part of the whole company. Rover adheres to such a paradigm and hence focuses application of IT not only on production but also on marketing and other areas. The company's application portfolio and planning approach reflect this holistic focus.

Strategy Development and Business Planning

Rover's basic strategies emphasise quality over quantity and margins over market share. These are translated into more specific business strategies which can be implemented as projects. The business strategies have a holistic organisation-wide focus. They cross internal divisional/functional lines and extend beyond the organisation's boundaries to suppliers, dealers and Honda. Each strategy is considered in relation to other strategies and is planned for collective action by relevant parties irrespective of lines and boundaries.

Rover's first formal business strategy was developed by the board in 1990 using a concept called "breakthrough". Basically it was a process of visioning Rover as a successful motor vehicle manufacturer in 1995, clarifying the prevailing position of the company and plotting a course of action, with clear milestones, to realise this vision. The resulting business strategies were documented as Rover's Quality Strategy matrix (see figure RG1). The matrix has been reviewed and updated on a continuous basis. It is a key document and is widely circulated within the company and externally to relevant stakeholders. The matrix is used to progressively check and reconcile plans, tasks and achievements. In each of the cells are the annual milestones for the key business processes. The milestones are ultimately translated into project definitions.

THE ROVER GROUP VISION

Rover is internationally renowned for extraordinary customer satisfaction

QUALITY STRATEGY

ISSUE 2:-
10.12.92

ROVER GROUP

LAND ROVER | ROVER

PROCESS	1991	1992	1993	1994	1995	PROCESS VISION	GROW IN EUROPE	REDUCE BREAKEVEN	MOVE UPMARKET	CUSTOMER SATISFACTION	RELATED INITIATIVE AND CHAMPION
NEW PRODUCT INTRODUCTION	BENCHMARK WORLD CLASS QUALITY & RELIABILITY ALL NEW PRODUCTS DELIVER CORPORATE PLAN RETURN ON SALES DEMONSTRATE UNDERSTANDING OF AND BUY INTO NEW PRODUCT DEVELOPMENT PROCESS	PROJECT MILESTONE EVENTS DEMONSTRATE ALL PROGRAMMES ARE IN CONTROL MEASURED BY KEY TASK ACHIEVEMENT PUBLISH 200 ROVER BLUEPRINT DESIGNS 200 STRATEGIC SUPPLIERS SUPPORTING THE DESIGN AND DEVELOPMENT PROCESS	ACHIEVE WORLD CLASS LEVELS OF TRAINING AND APPLICATION OF QUALITY AND RELIABILITY TECHNIQUES IMPLEMENT A STRUCTURED PROCESS FOR LEARNING FROM PROJECT TEAMS ALL PRODUCTS SPECIFIED WITH CUSTOMER TARGETING PROCESS	70% OF ENGINEERING CHANGE IS IDENTIFIED BEFORE THE D1 EVENT ON ALL PROGRAMMES PRODUCT COMPLEXITY EQUIVALENT TO BENCHMARK COMPANY IN ITS DOMESTIC MARKET "EFFECTIVE COST MANAGEMENT" APPLIED TO ALL NEW PROJECTS.	ACHIEVE WORLD BEST IN CLASS QUALITY AND RELIABILITY IN EACH PRODUCT SECTOR	WORLD BEST IN CLASS QUALITY AND RELIABILITY IN EACH PRODUCT SECTOR	○ ○	● 	● ●	● ●	QUALITY & RELIABILITY INITIATIVE A Curtis CUSTOMER TARGETED PRODUCTS N J Stephenson
MANUFACTURE	BENCHMARK COMPETITOR PRACTICES ON KEY PROCESSES	IDENTIFY AND MEASURE PROCESS CAPABILITY OF MACHINING AND BODY IN WHITE OPERATIONS ALL MANUFACTURING OPERATIONS TO HAVE TEAMS OF 10 TO 15 TRAINED IN PROBLEM SOLVING AND TEAMWORK ESTABLISH A CONTROLLED PROCESS FOR PROCESS CHANGE THAT RESULTS IN NO ADVERSE EFFECT ON QUALITY MEASURES WITH ASSIGNMENT OR SHIFT PATTERN CHANGE	ACHIEVE QUALITY AND RELIABILITY EQUAL TO BEST EUROPEAN MASS PRODUCER EACH BUSINESS UNIT IDENTIFIES 4 KEY AREAS OF WASTE AND REDUCES THEM BY 50% IN THE YEAR WARRANTY COST ACHIEVED AT 0.6% OF NET SALES REVENUE ON CARS AND 1.2% OF NET SALES REVENUE ON 4x4 PUBLISH A WORKING ENVIRONMENT STANDARD	ACHIEVE PROCESS CAPABILITY OF Cp = Cpk = 2.0 ON CRITICAL MACHINING OPERATIONS AND Cp = Cpk = 1.3 ON PRESSING, BODY-IN-WHITE AND OTHER MACHINING OPERATIONS. ACHIEVE WORLD BEST IN CLASS EIGHT FIRST TIME LEVELS ON PAINT, VEHICLE ASSEMBLY AND POWERTRAIN ASSEMBLY OPERATIONS	ACHIEVE THE OBJECTIVE OF WORLD BEST IN CLASS BUILD QUALITY BY MODEL	WORLD BEST IN CLASS BUILD QUALITY BY MODEL	●	○	●	●	No. 1 NEW CAR BUYER SURVEY Rover Group Quality Council
LOGISTICS NOTE: THE LOGISTICS PROCESS COVERS ALL ACTIVITIES CONCERNED WITH PROCUREMENT, SCHEDULING, TRANSPORT AND DISTRIBUTION FROM FORECASTING AND SALES ORDER ENTRY TO DELIVERY TO THE DEALER.	ESTABLISH LEAD TIME AND STOCK MONITORS TO ALLOW EFFECTIVE MONITORING OF RETAIL SOLD ORDER LEAD TIME PERFORMANCE IDENTIFY AND MEASURE CRITICAL/HIGH VALUE COMPONENT P TIMES 100% ACHIEVEMENT TO WEEKLY SEQUENCED PLAN CRITICAL/HIGH VALUE SUPPLIERS TO COMMENCE INTEGRATION INTO ROVER PROCESSES	100% ACHIEVEMENT TO WEEKLY PLAN COMMUNICATE LOGISTICS STRATEGY DETERMINE A STRATEGY FOR SUPPLIERS, DELIVERY METHODS AND LOGISTICS MEASURE ALL CRITICAL HIGH VALUE COMPONENT P TIMES ESTABLISH TARGETS FOR CONSISTENT THROUGHPUT TIMES PASS TO SALES BY DUE WEEK 75%, 25% +/- 1 WEEK 185 KEY SUPPLIERS ASSESSED TO RG2000 SUPPLIER COMPONENT STATUS REPORT (SCSR) LAUNCHED 50% OF SUPPLIERS ACHIEVE BS5750	SUPPLIER COMPONENT STATUS REPORT FULLY IMPLEMETED CO-ORDINATED INTERNATIONAL LOGISTICS STRATEGY IN PLACE. SUPPLIER DEVELOPMENT TEAMS OPERATING IN 100 STRATEGIC SUPPLIERS RELIABLE DELIVERY PROMISE DATE TO THE CUSTOMER 100% ACHIEVEMENT TO DAILY PLAN PASS TO SALES BY DUE WEEK 80%, 20% +/- 2 DAYS ALL KEY SUPPLIERS ASSESSED TO RG2000 15% IMPROVEMENT IN RG2000 SCORES 1 YEAR AFTER INITIAL ASSESSMENT. ROVER TOMORROW "SUPPLIER BEST PRACTICE PHASE"	DELIVER FINISHED VEHICLES TO RETAIL CUSTOMERS- • 3 DAYS IN THE U.K • 5 DAYS IN WESTERN EUROPE CUSTOMER ORDER PLACEMENT TO DESPATCH REDUCED TO 1 WEEK ELIMINATE PERMANENT VEHICLE STOCKS 10% IMPROVEMENT IN RG2000 SCORES 2 YEARS AFTER INITIAL ASSESSMENT EUROPEAN STOCK COVER 1.5 MONTHS	TOTAL COMPANY STOCK TURN BEST IN CLASS SINGLE BILL OF MATERIAL 100% ACCURATE PASS TO SALES BY DUE DATE 96%, 4% +/- 2 DAYS 5% IMPROVEMENT IN RG2000 SCORES 3 YEARS AFTER INITIAL ASSESSMENT	DISTRIBUTION EFFICIENCY COMPANY	○	●	○	●	DISTRIBUTION EFFICIENCY AND COMPANY WIDE JUST-IN-TIME C J S Woodwark
MAINTENANCE	BENCHMARK WORLD CLASS MAINTENANCE PRACTICE (ONGOING PROCESS AFTER 1991) DETERMINE ROVER GROUP MAINTENANCE PLAN DETERMINE OBJECTIVES, SCOPE AND ORGANISATION OF MAINTENANCE INCLUDING SPARES AND ASSET IMPROVEMENT STRATEGY FOR EACH BUSINESS UNIT DETERMINE MAINTENANCE SYSTEMS STRATEGY	INTRODUCE TPM TO 30% OF MANUFACTURING ASSOCIATES AND IMPLEMENT STEPS 1 TO 3 OF AUTONOMOUS MAINTENANCE IMPLEMENT MAINTENANCE PERFORMANCE MEASUREMENT PROCESS WHICH IS LINKED TO MAINTENANCE OBJECTIVES ESTABLISH THE COST OF THE 6 BIG LOSSES ESTABLISH A PROCESS WHICH INVOLVES MAINTENANCE AND MANUFACTURING IN MANUFACTURING ENGINEERING FROM CONCEPT TO COMMISSIONING	ACHIEVE STEPS 1 TO 4 OF AUTONOMOUS MAINTENANCE WITHIN THE TPM APPROACH EACH BUSINESS UNIT HAS DEVELOPED AND IMPLEMENTED A COMPUTERISED MAINTENANCE PACKAGE	WORK LIMITED ONLY BY SKILL AND SAFETY	ACHIEVE STEPS 5 TO 7 OF AUTONOMOUS MAINTENANCE WITHIN THE TPM APPROACH	WORLD BEST OVERALL EQUIPMENT EFFECTIVENESS		●		●	TOTAL PRODUCTIVE MAINTENANCE J F Briffitt
SALES & SERVICE	DEVELOP AND PILOT DEALER NETWORK TQI AND QUALITY ASSURANCE TRAINING PACKAGE PRODUCE BEST PRACTICE DEALER PROCESSES REVISE DEALER STANDARDS/CUSTOMER RESEARCH	EUROPEAN STANDARDS AND CUSTOMER RESEARCH DEALER OWNED CUSTOMER RESEARCH/TRACKING ALL DEALERS SUCCESSFULLY IMPLEMENT REVISED FRANCHISE STANDARDS FIELD FORCE TRAINED IN TQI/PROCESS FACILITATION 50% OF ALL DEALER STAFF TRAINED IN TOTAL QUALITY IMPROVEMENT AND QUALITY ASSURANCE	ALL U.K. DEALERS COMPLETED THE CSI II OR TCS PROGRAMME IN QUALITY MANAGEMENT AND CUSTOMER SERVICE COMPARATIVE MEASURES FOR CUSTOMER SATISFACTION IMPLEMENTED IN ALL NSC's AND 20 KEY DISTRIBUTOR MARKETS	100% OF UK NETWORK CERTIFIED TO BS5750 QUALITY MANAGEMENT STANDARD EACH SALES REGION IDENTIFIES 3 KEY AREAS OF WASTE AND REDUCES THEM BY 50% IN THE YEAR	DEALER NETWORK IN TOP THREE FOR OVERALL CUSTOMER SATISFACTION ON ECSS IN EUROPE AND ON LOCAL MEASURES IN NSC's AND 20 KEY DISTRIBUTOR MARKETS WORLD BEST IN CLASS CUSTOMER RETENTION ALL EUROPEAN, NSC AND 20 KEY DISTRIBUTOR MARKET DEALERS MEET ISO 9002 REQUIREMENT ALL EUROPEAN DEALERS COMPLETE CSI II OR TCS PROCESS	DEALER NETWORK WITHIN TOP THREE IN ALL KEY MARKETS	●		●	●	EXTRAORDINARY CUSTOMER SERVICE J K Russell
CORPORATE LEARNING		79% OF ALL ASSOCIATES HAVE ASKED FOR A PERSONAL DEVELOPMENT FILE AND HAVE HAD AT LEAST ONE DISCUSSION WITH THEIR LINE MANAGER AFTER COMPLETING IT ESTABLISH AN ACCESSIBLE NETWORK OF SUBJECT SPECIALISTS AND A KNOWLEDGE DATA BASE INCORPORATE LEARNING REQUIREMENT INTO EVERY FINCAP OR MAJOR CHANGE PROGRAMME PROPOSAL DEMONSTRATING BENEFITS ESTABLISH ACTION PLAN FOR ACHIEVING EFFECTIVE NETWORKING ACROSS ROVER GROUP	50% OF ALL ASSOCIATES HAVE AN ACTIVE PDP ACHIEVE TARGET OF 50% INDIVIDUAL DEVELOPMENT PLANS AGREED BY LINE MANAGERS 10% INCREMENT PER ANNUM IN AWARD OF CERTIFICATES OF ACHIEVEMENT FROM 1991 BENCHMARK OF 1000 EMPLOYEES RECEIVING CERTIFICATES ANNUALLY IMPLEMENT PERSONAL DEVELOPMENT REVIEW (PDR) PROCESS	75% OF LINE MANAGERS CAN DEMONSTRATE A SIGNIFICANT APPLICATION OF THE CORPORATE LEARNING PROCESS	ACHIEVE WORLD BEST IN CLASS LEARNING COMPANY BASED ON BENCHMARKED CRITERIA	WORLD BEST IN CLASS LEARNING COMPANY	●	●	●	●	SUCCESS THROUGH PEOPLE D G Bower
MANAGEMENT OF PEOPLE	BENCHMARK BEST PRACTICE MANAGEMENT PROCESSES AND MEASURES	TOTAL QUALITY LEADER CHANGE PLANS FOR ALL FUNCTIONS AND BUSINESS UNITS EACH AREA WITHIN THE BUSINESS ESTABLISHES AND MEASURES A ROBUST COMMUNICATIONS PROCESS	EACH FUNCTION OR BUSINESS UNIT HAS AN ACTION PLAN FOR IMPROVING COMMUNICATION AGAINST VIEWPOINT 92 MEASURE IMPLEMENT ROVER TOMORROW:- • ESTABLISH SINGLE STATUS AND GRADING STRUCTURE • COMPANY WIDE IMPLEMENTATION OF MEASUREMENT OF ROVER TOMORROW PROGRESS • ACHIEVE CORPORATE PLAN PRODUCTIVITY TARGETS ABSENCE LEVELS EQUIVALENT TO UK BEST IN CLASS (LESS THAN 3%)	ACHIEVE COMMUNICATIONS IMPROVEMENT TARGETS MEASURED BY VIEWPOINT 94 ONE IMPROVEMENT CONTRIBUTION PER ASSOCIATE PER MONTH	ACHIEVE WORLD CLASS LEVELS OF EMPLOYEE INVOLVEMENT IN IMPROVEMENT ACTIVITY:- • ONE IMPROVEMENT CONTRIBUTION PER ASSOCIATE PER WEEK • 70% OF ASSOCIATES ACTIVELY INVOLVED IN TEAM IMPROVEMENT ACTIVITIES ACHIEVE WORLD CLASS LEVELS OF VALUE ADDED PER EMPLOYEE	AN ENVIRONMENT WHERE ALL ASSOCIATES WILLINGLY GIVE THEIR BEST CONTRIBUTION	●	●	●	●	SUCCESS THROUGH PEOPLE D G Bower
PRODUCT IMPROVEMENT		IMPLEMENT CUSTOMER SERVICE MANAGEMENT SYSTEM (IT BASED SYSTEM) DEVELOP A SINGLE ROVER GROUP PROBLEM MANAGEMENT SYSTEM BASED ON 1991 PROCESS REVIEW DEVELOP A SINGLE ROVER GROUP PROBLEM MANAGEMENT PROCESS (COMMON BUSINESS ENVIRONMENT) MEASURE TIME FROM RECOGNITION OF PROBLEM TO:- • TIME TO RESPOND TO CUSTOMER • TIME TO DEVELOP SERVICE FIX • TIME TO ENGINEER SOLUTION BENCHMARK WORLD CLASS LEVELS FOR RESPONDING TO PROBLEM WITH SOLUTIONS MEASURE INCREMENTAL LOADING OF RESOURCE ON NEW PRODUCTS ESTABLISH SKILLS PROFILE AND DEVELOP TEAM SKILLS WITH APPROPRIATE MEASURES	REDUCE TIME FROM RECOGNITION OF PROBLEM TO SOLUTION BY 20% PER ANNUM	DOUBLE SPEED OF CHANGE PROCESS FROM RELEASE TO IMPLEMENTATION ACHIEVE WORLD CLASS LEVELS OF PROBLEM OWNERSHIP AND SOLVING BY TEAM LEADERS		WORLD BEST IN CLASS QUALITY AND RELIABILITY IN EACH PRODUCT SECTOR		●		●	EXTRAORDINARY CUSTOMER SERVICE J K Russell COMMON BUSINESS ENVIRONMENT M J Bryant N J Stephenson
BUSINESS PLANNING		ROVER GROUP BOARD:- • DEFINES MISSION AND LONG TERM GOALS • APPROVES PRODUCT PLAN AND ALLOCATES RESOURCES • APPROVES 3 YEAR BUSINESS PLANS	BUSINESS UNITS AND OTHER FUNCTIONS ESTABLISH PROCESS FOR MAXIMUM INVOLVEMENT IN THE PLANNING CYCLE			6% RETURN ON SALES	●	●	●	●	J TOWERS GROUP MANAGING DIRECTOR

Primary driver ●
Strong connection ○

Figure RG1: Quality Strategy Matrix

There is no standard strategic planning exercise but an annual business planning exercise conducted as part of Rover's ongoing integrated strategy development and business planning process. The Quality Strategy matrix is key to the whole process. A project proposal may originate from the milestones in the Quality Strategy matrix or it may be an emergent strategic initiative. The various divisions and business units submit their project proposals for consideration in the business planning exercise. The exercise is conducted by the board together with senior managers/directors of the company including the IT directors. A management workshop is conducted with the aid of the Quality Strategy matrix and, where relevant, selected business models (see below). The team reviews the Quality Strategy matrix and its progress, develops new strategies if necessary, evaluates proposals and approves projects for the following year. The final business plan is a list of business projects. The whole planning is a joint management effort. The director of JIT/DE emphasises the importance of such an approach thus:

> "If there is no willingness to share, efforts will be duplicated and benefits of synergy cannot be exploited."

Information Systems Planning

Strategic IS planning comes within the scope of strategy development and business planning. An initiative for an IT application may emerge in the course of normal business operations and management, or it may be planned on the basis of the strategy milestones in the Quality Strategy matrix. The initiative can come from the IT strategy unit, the distributed IT units or a business function. The potential IT application is collectively discussed by relevant divisions/units and justified for inclusion within a business proposal. These applications are evaluated jointly by the three IT directors and sponsoring board members with others in the board during the annual business planning. The formal IS planning is thus done as an integral part of the annual business planning. No ISP methodology or special technique is used. It is essentially a business planning process differing little from planning related to other areas. The final IS plan is contained within the organisational business plan; there is no separate IS plan document.

Respondents → / ↓ Selected Key Items	IT Strategy Director	Manager (Database &Techn.)	Data Mgt. Executive	JIT/DE Director	Average
Role of IT ('1= Not a role' to '5= Primary role')					
Automation	3	4	3	3	3.3
Transformation	4	5	5	4	4.5
IS Planning Success/Failure (1= Failure, 2= Some benefits but IS planning is not needed to achieve them, 3= Better than not doing it, 4= Successful but can be better, 5= Highly successful)	4	4	4	4	4.0
IS Planning Taxonomy ('1 = No match' to '5 = Perfect match')					
Administrative Approach	2	1	1	2	1.5
Methodological Approach	3	2	2	2	2.3
Technological Approach	4	4	4	4	4.0
Business-led Approach	5	5	4	4	4.5
Organisational Approach	5	5	5	4	4.8
Perceived value of Application Architecture (1= Irrelevant, 2= Little use, 3= Some use, 4= Significant use, 5= Absolutely essential)	4	4	5	4	4.3
Perceived value of Corporate Data Model (1= Irrelevant, 2= Little use, 3= Some use, 4= Significant use, 5= Absolutely essential)	2	2	2	1	1.8

Figure RG2: Responses to Structured Questionnaire - Selected Key Items

Rover has recently embarked on a focused IS planning study confined to a business area. In the future, such studies are expected to be conducted occasionally. The study employs Information Engineering methodology and Bachman CASE tool and is conducted as a small project. (Information Engineering and Bachman CASE have recently been adopted as Group standards primarily for application development and data management.) The expected deliverables of the project include a business area application architecture, detailed application architecture and a business area data model. (See below for details.)

To a request to assess the success of Rover's IS planning, four executives (three from IT and one from Operations) responded that it was satisfactory (see figure RG2). They identified the major strength of Rover's IS planning approach as its ability to effectively integrate IT with the business. As regards major weakness, the executives were concerned about the lack of appropriate inputs from IS planning for project implementation. They also contended that the IS component of business planning could benefit from a little more rigour.

To another request to classify the company's IS planning in terms of Earl's (1990, 1993) taxonomy of ISP approaches, the four executives responded that it best fitted the 'organisational approach' (see figure RG2). The emphasis was on the process of planning rather than technique or procedure. The IT director (IT strategy) clarified the irrelevance of ISP methodology to Rover's IS planning thus:

> "We don't use an IS planning methodology because IS planning is integrated with business planning. .... An IS planning methodology does not fit the requirements of business planning."

Project Implementation

Most of Rover's projects are large, complex and multi-functional in nature. The typical business project is implemented via an integrated set of functional plans. The contributions from the various departments and units are balanced according to their relative importance and value to the project. The IT strategy director contends that IT

tends to be one of the important players, sometimes to a substantial extent as in the case of the JIT/DE (Just in Time/Distribution Efficiency) project. An IT application implementation effort, regardless of its size, is treated as part of a business project. True IT projects are those which do not have direct business implications; e.g. hardware/software installation.

The typical business project is managed by a senior executive from the business function with the major stake in the project. IT professionals involved in the project are integral members of the multi-disciplinary project team. The IT group within the team makes its contributions to the project deliverables in co-operation with other groups. The IT group is responsible for analysing the information requirements and preparing specifications for development of software by AT&T Istel, Rover's long-standing software contractor. Rover's IT professionals employ Information Engineering methodology and Bachman CASE tool in analysis/design tasks.

Business Model

A few business models are used as tools/references in strategy development and business planning and other management activities. These models are jointly developed by the relevant functional departments/divisions and the IT strategy unit. Some of these modelling concepts have been adopted from Honda.

A CSF-key process relationship matrix is one of the business models which is occasionally referred to by senior management. It is seen as a simple but useful management tool. It is supplemented by 'fish-bone' diagrams (referred to as 'ishikawa' diagrams) each of which separately depicts the details of the CSFs and key business processes. ('Fish-bone' diagrams are also used for other modelling purposes such as developing a detailed model of a strategy.)

Figure RG3 shows Rover's overall process framework. This is a conceptual model which defines the company's major business activities. The process framework has been developed using value chain concepts. It is occasionally referred to during business

planning and in senior management discussions. It is also a source of reference at the divisional/departmental level. The framework is assessed by the IT strategy director to be easily understood by senior management. He points out that it is stable and independent of technology and is completely within the domain of the automobile business. The IT strategy director considers the framework to be generic enough to be applicable to any motorcar manufacturer. A business executive notes the value of the process framework to the company thus:

> "We at Rover are comfortable with process models. Models such as the process framework are easy to understand."

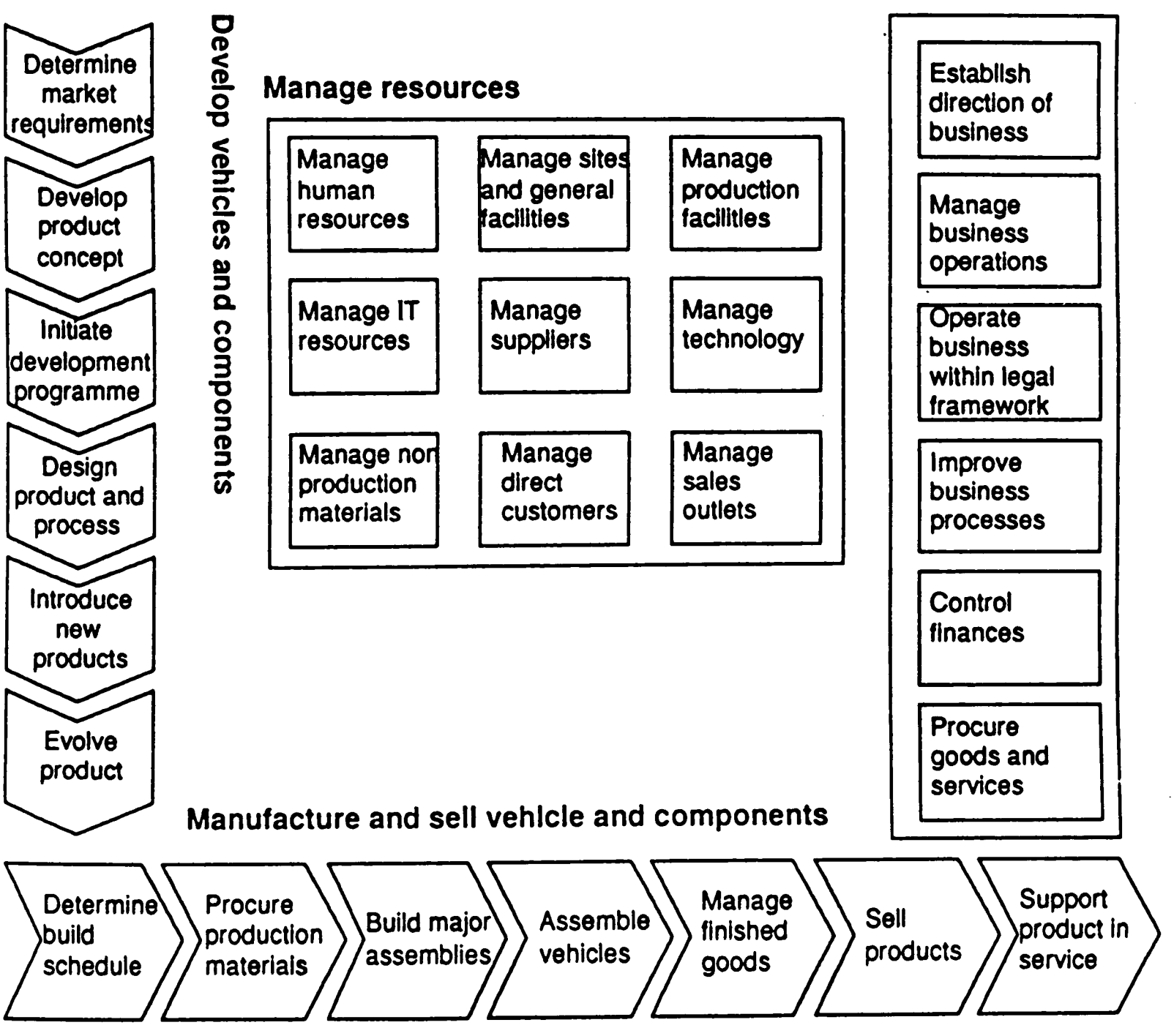


Figure RG3: Overall Process Framework

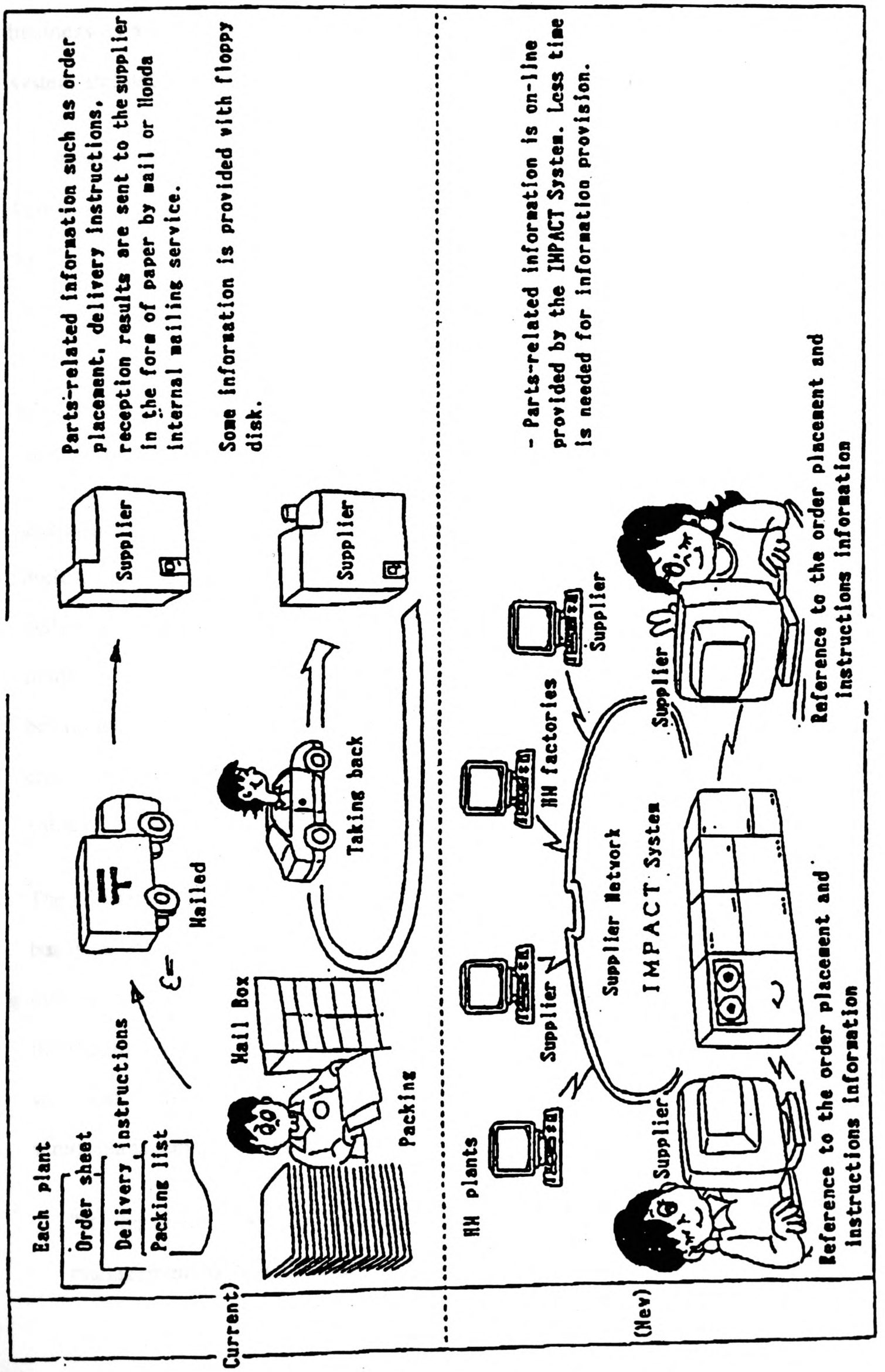


Figure RG4: Business System Architecture - An Example (Parts Order)

The above three types of business models are conceptual and deal with the company's business as a whole. Focused models are also developed. In particular, the business system architecture is proving to be a useful one (see figure RG4 for an example).

A business system architecture is essentially a picture of a strategic initiative. It shows the fusion of strategic resources and systems in the light of broad business strategies related to a major business process. The model is collectively developed by the business functions which have a stake in the initiative. With IT becoming a pervasive strategic resource, the IT function tends to initiate and facilitate the development of the architecture. No methodology or special technique is used. The model emerges from the interactions of executives from the various business functions, often via workshops.

The business system architecture is submitted to Rover's senior management as part of a multi-disciplinary joint proposal for a business project. The architecture is typically walked through with management by a senior executive from the major stakeholder involved in the proposal. If IT is central to the strategic initiative, the walk through may be conducted by a senior IT executive. The business system architecture is presented to enable senior management to vision the strategic initiative, assess its potential business value and contribute to the initiative.

The IT strategy director observes that strategy development and business planning tend to be more effective when business proposals are presented in this manner to senior management. He considers the business system architecture to be a useful tool for interacting with senior management on strategic initiatives. He sees it as a useful tool with which proposals on strategic IT applications can be effectively communicated to senior management. A senior functional executive encapsulates this message thus:

> "It [the business system architecture] takes the technicality out of IT and permits management to view IT issues within the context of the business".

Application Architecture

As business planning progresses from organisational level to functional level, each business function/division maps out its responsibilities and commitments to the company's plan. Rover's IT function uses application architecture (AA) to perform this task. The IT strategy director feels that the application architecture is of significant value to Rover. He is supported in his assessment of AA's value by others including business executives (see figure RG2). The architecture is developed/revised by the IT strategy unit as part of ongoing IS planning. No special methodology, technique or convention is used. Only simple graphic techniques are used to develop the architecture.

The overall AA (see figure RG5) serves as the highest-level IS blueprint. The model helps to depict the integration of information systems with the business. It is used in communications with senior management on strategic IT applications and business strategies. The overall AA is perceived to be useful in this regard but is seen as being of marginal value in project implementation tasks. The architecture is revised/developed as part of ongoing IS planning effort by the IT strategy unit in consultation with relevant business functions. Rover's business plan, incorporating the IS plan, is the major input. Strategic IT applications for the various business areas are depicted on the architecture as a loose coupling of systems.

The IT strategy director points out that "the business is too large for a single detailed model". Hence separate high-level AAs are developed for the various strategic applications (see figure RG6 for an example). The purpose of the high-level architecture is to model an application's relationship to other applications. The model is selectively used by IT management in discussions with senior management. The model is also used by project managers in project scoping. It is perceived to be of little value to application developers.

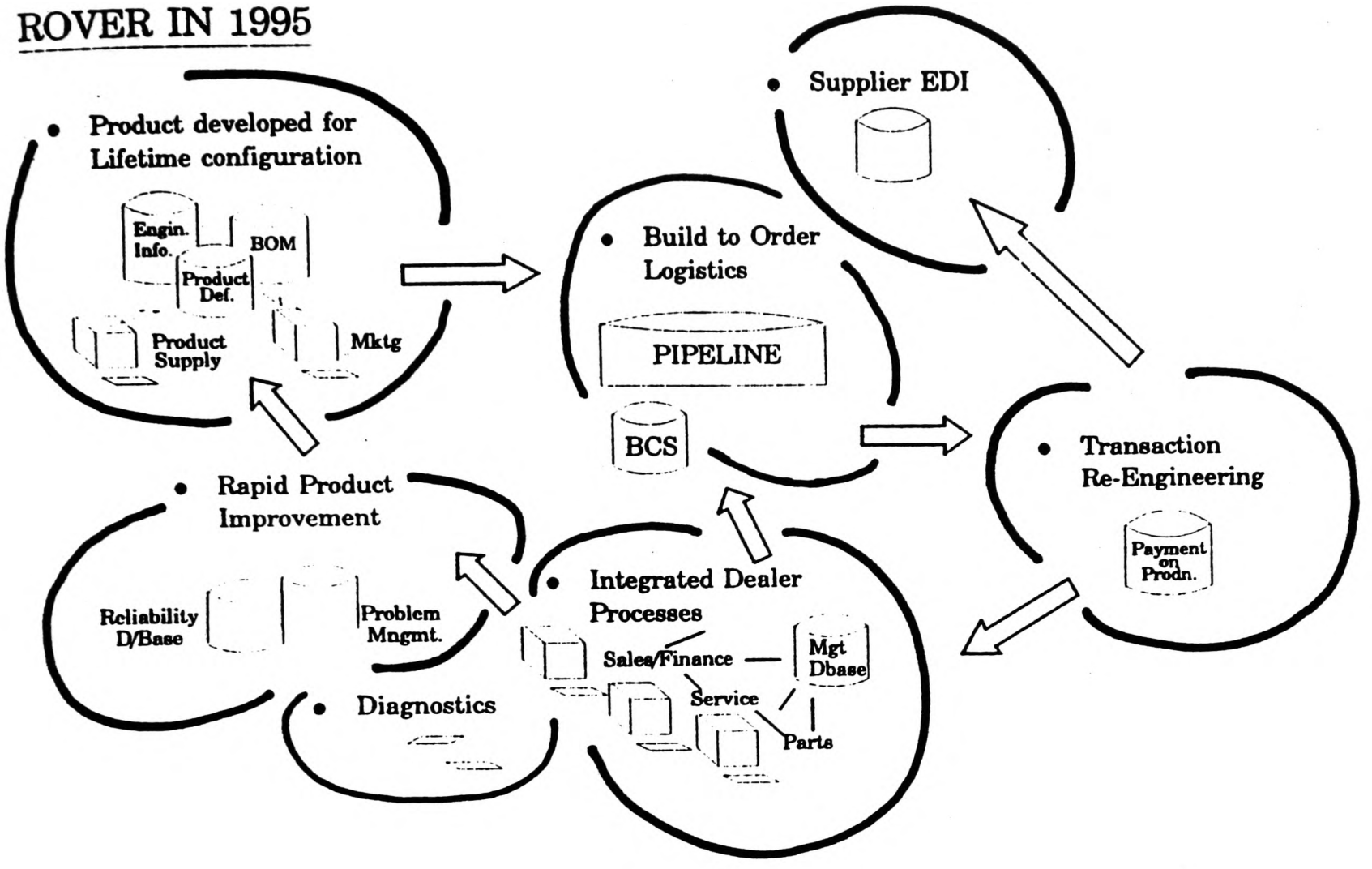


Figure RG5: Overall Application Architecture

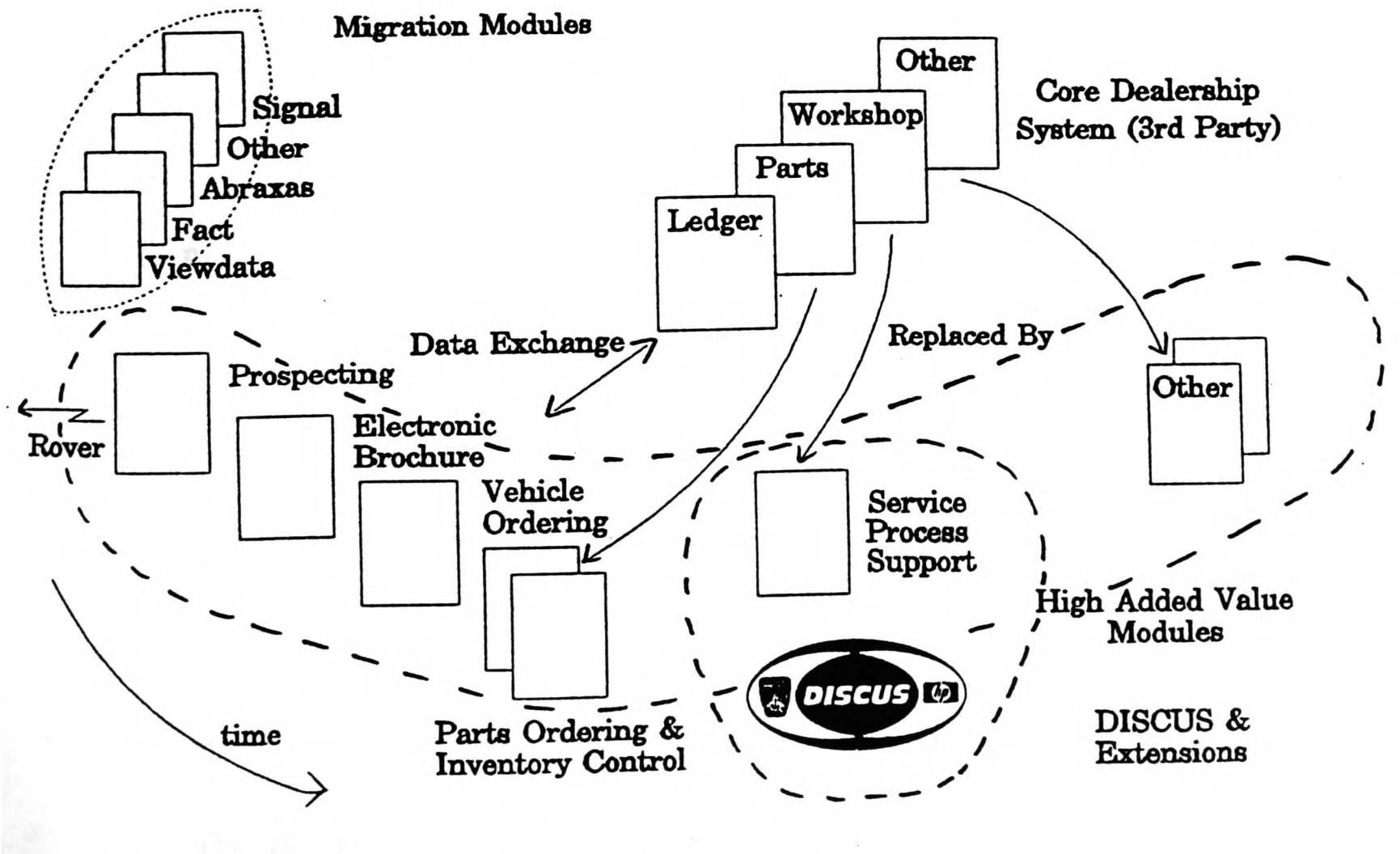


Figure RG6: High Level Application Architecture for an Application - An Example

A detailed AA, with project implementation as the focus and geared towards application development, is perceived by the IT executives interviewed to be the architecture relevant to application developers. Such a model, however, is not currently being developed. The current IS planning arrangement with its focus on strategy and business planning does not require such models to be developed; these models are not meant for presentation to management. The absence of detailed application architecture is thought to affect the progress from IS planning to application development. The occasional focused IS planning exercise confined to a business area is expected to deliver detailed AA(s) for the business area. One set of detailed AA has been delivered in the past in such an exercise and the benefits in relation to application development have been significant (the JIT/DE application). The case for a detailed AA is argued thus in the Business Process Management System (BPMS) concept paper:

> "Modules for BPMS need to be developed within the context of a clearly defined framework, in order to avoid the expense of redeveloping them due to advances or changes in technology."

The IT strategy unit is currently examining its Information Engineering methodology to identify parts which could help in addressing the unit's requirement on detailed application architecture development. Care is however being taken to confine the domain of this effort to functional level IS planning. The current integrated business/IS planning arrangement is perceived to be satisfactory and Rover wishes to maintain its status quo.

High Level Data Model

Rover does not have a conventional corporate data model (CDM). A CDM is thought to be of little value to the company (see figure RG2). The company has attempted in the past to develop a single consolidated CDM but the benefits have not been found to match the effort required. Hence the pursuit of a conventional CDM has been abandoned. Rover's manager of database and technology argues:

> "The concept of corporate data modelling is more important than the model itself."

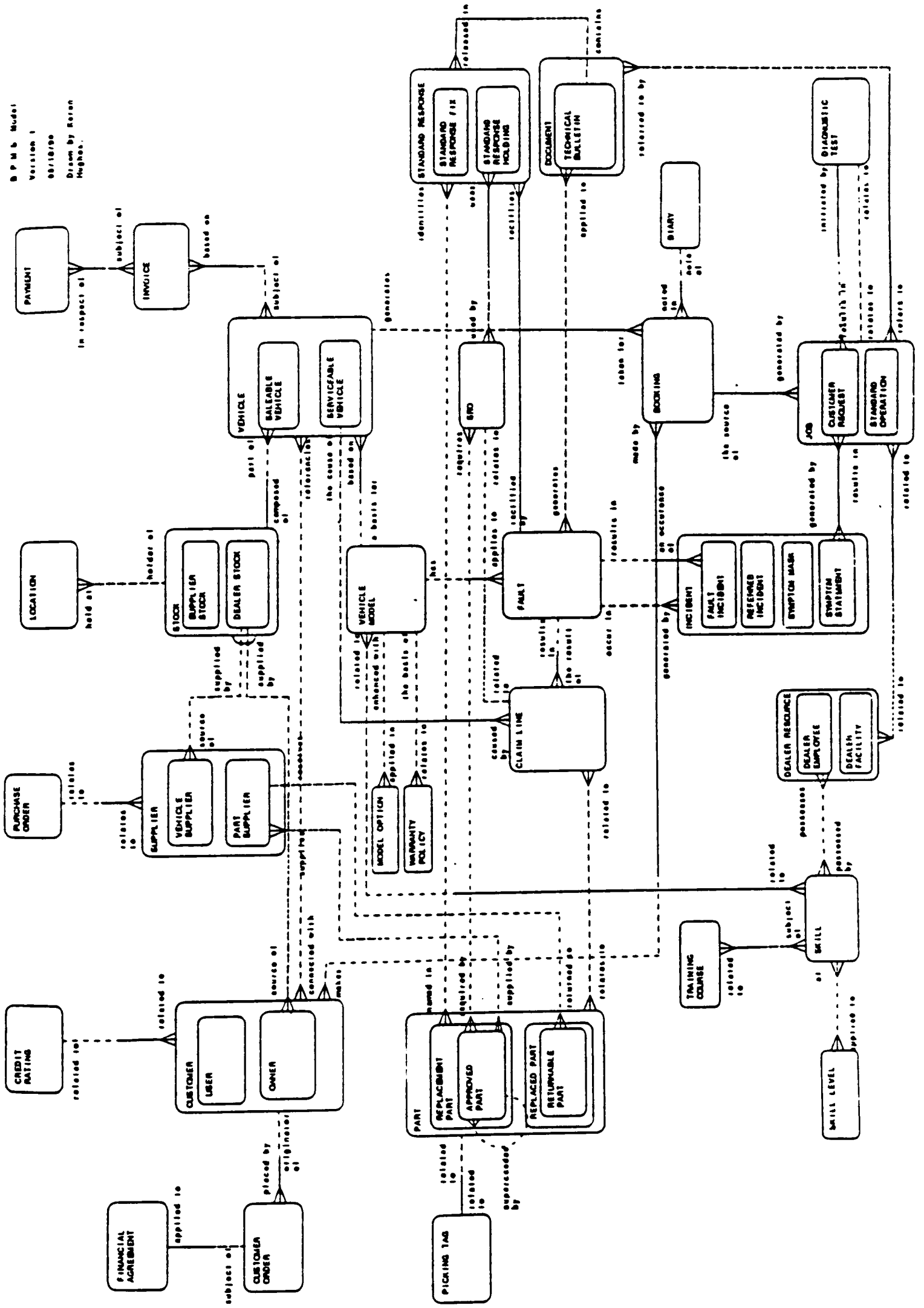


Figure RG7: Business Area/Project Data Model - An Example (BPMS)

In this regard, the company's set of business area/project data models, together with a data dictionary and data naming standard, have been found by IT executives to be adequate. The models satisfy the requirements of data management, database integration and data warehouse development - the traditional domain of CDM.

The IT executives interviewed felt that the set of business area/project data models to be adequate and of significant value in addressing Rover's corporate data modelling requirements. The typical business area/project data model (see figure RG7 for an example) is developed from information on the related business area/project and the relevant business system architecture and high-level application architecture. The data model is created either when the related project is being studied for feasibility or as part of the scoping and planning related to project implementation. Standard logical data modelling technique with Bachman CASE tool is used to develop the data model. There is unanimous agreement amongst the IT executives interviewed that a business area/project data model is "absolutely essential" for project implementation. The project team invests significant time and resource in data modelling, the rationale being that effective data modelling is a prerequisite to realising a quality database. A business area/project data model provides the base for logical and physical data model design and application development. It is seen as especially important in large projects where the efforts of a few teams have to be coordinated and reconciled. The business area/project data model, and data models in general, are however perceived to offer little value for strategy development and business planning or for communication with senior management. A senior functional executive declares:

> "Data models are not for the directors."

IT Architecture

Rover defines IT architecture as the principles, standards and technological resources required to develop, deliver, operate and maintain IT applications. The company contends that "in order for an architecture to work it must be built around standards". It

has hence instituted ISO-based IT standards and has chosen Open Systems as the foundation for its IT architecture. The architecture aims at providing client-server based solutions using multi-level file servers (local file server, local database and information warehouse) in a limited heterogeneous environment. The objective is that ultimately an IT application should serve the business in an integrated and open manner, providing easy and common access irrespective of its host or database source.

The purpose of an IT architecture, as defined by Rover, is to facilitate the integration of the various computing systems spread across the company. The integration is regarded as a necessity to optimise the potential reach of IT infrastructure and the range of services and data sharing capability it can offer. Figure RG8, a high-level schematic of Rover's IT architecture, is used in communications with senior management on these technology matters. Complementing it is the Group network architecture shown in figure RG9 which serves the needs of IT professionals, particularly in relation to IT reach issues.

Rover has adopted a distributed computing arrangement whereby business units and divisions are able to design, configure, select and implement the computing systems which optimally fit their requirements. The architecture of a distributed computing system is guided by the Group IT architecture and standards. Such an approach, while providing flexibility and optimal fit at the local level, helps to ensure the bridging of what may appear as islands of technology. A senior IT executive believes that Rover's corporate-wide integrated computing system is being pragmatically implemented via this loose coupling of distributed computing systems.

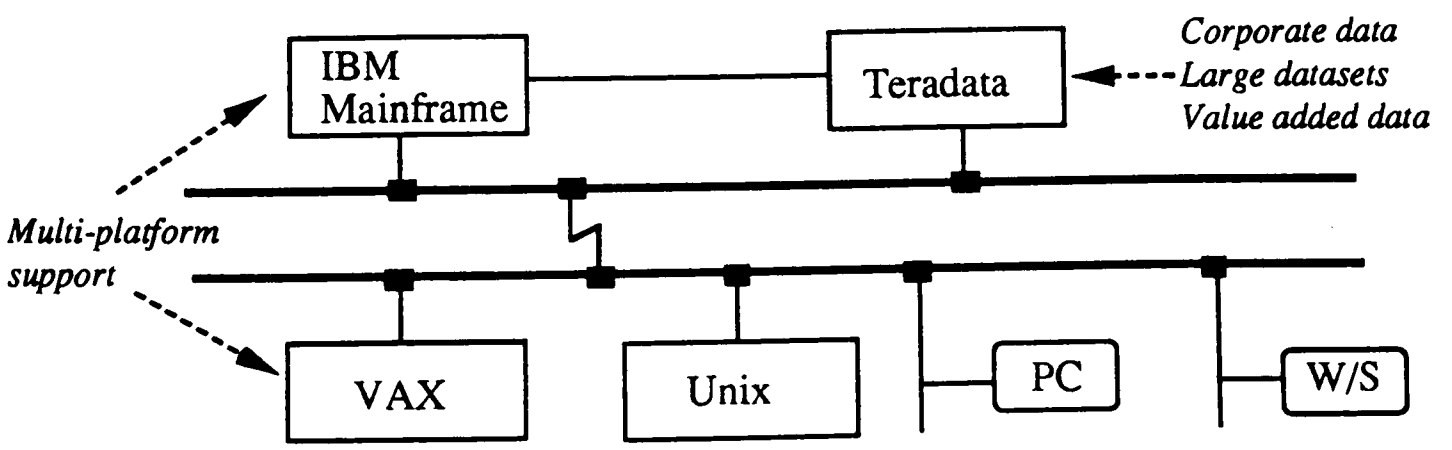


Figure RG8: IT Architecture Schematic

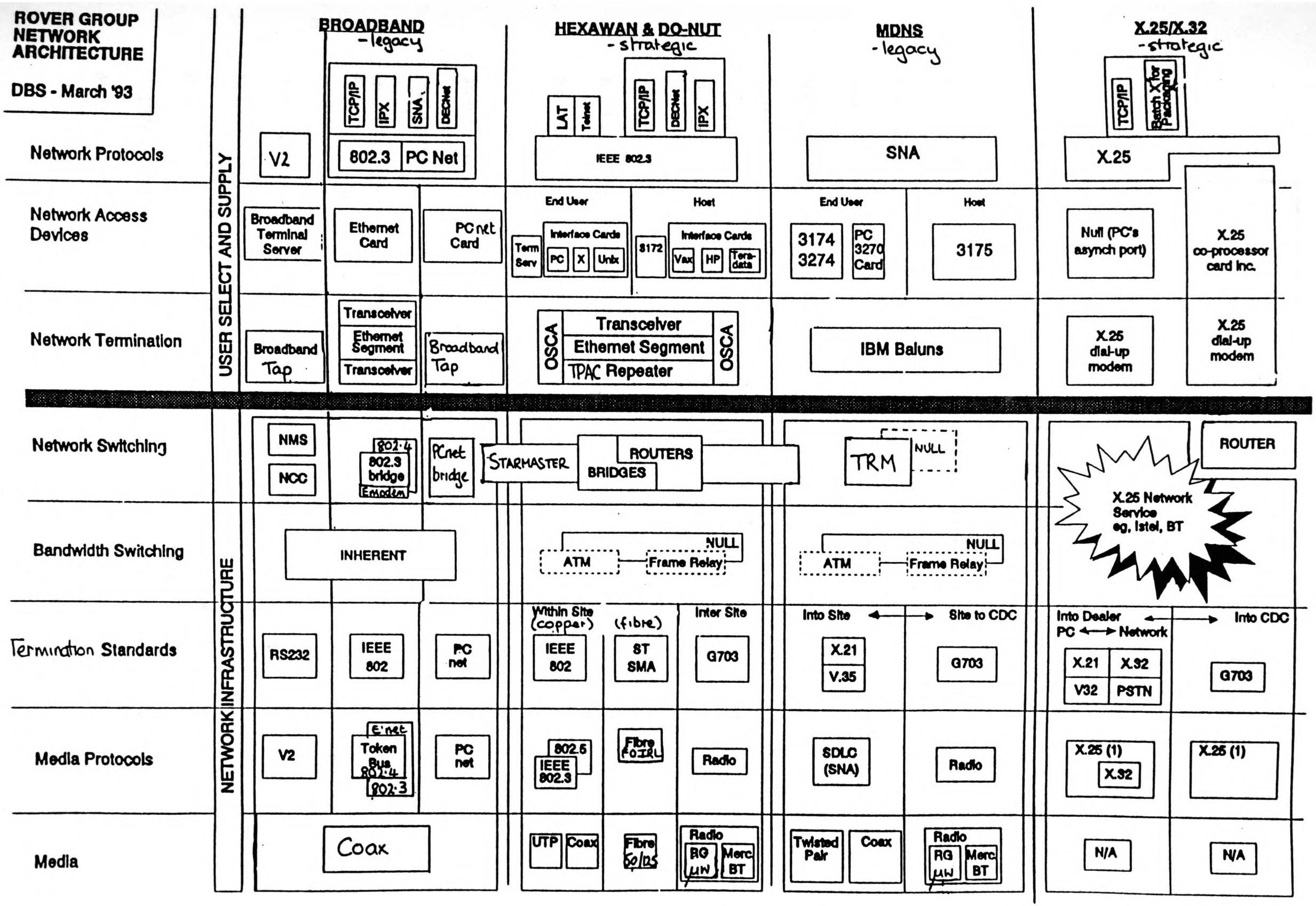


Figure RG9: Network Architecture

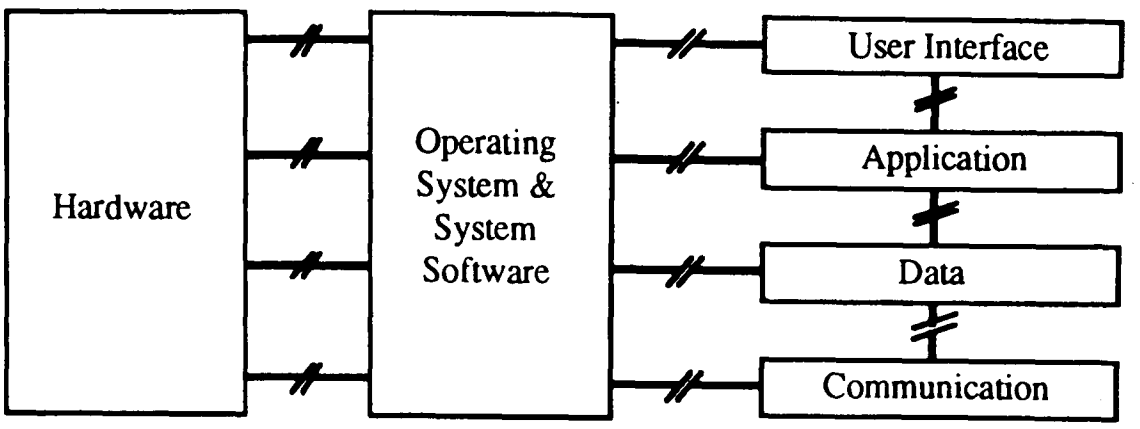


Figure RG10: Conceptual Technology Architecture

Rover has also adopted the loose coupling philosophy for implementing the individual computing systems. The conceptual technology framework shown in figure RG10 is based on the premise that loose coupling of key components provides optimal technological benefits for computing systems. The framework is used by IT management in their communication with senior management on computing system matters.

Rover has identified a small set of preferred IT vendors (with Digital being given significance) in relation to the implementation of its IT architecture. Technology and hardware/software products from one or more of them, or in special cases from others, are selected to implement a computing system. The selection is based on how optimally the vendor's technology/product fit the computing system needed by a division/unit. The shape, size and configuration of a computing system is largely determined by the requirements of the key IT applications relevant to the department/unit. Selection and implementation of hardware and software is thus a local affair but one which is moderated by the IT strategy unit and done using the IT architecture. This approach makes it possible for the distributed computing systems to differ from one another in terms of their platforms and yet be inter-linked. The physical inter-networking of these relatively heterogeneous computing systems constitutes Rover's IT infrastructure. The implementation of the IT infrastructure in this manner helps to gradually shape the IT architecture's actual and potential reach and range.

The information architecture models relevant to Rover's IT architecture are the business system architecture and application architecture. Technology which is allowed by the IT architecture help in the identification and selection of new technologies and hardware/ software resources for implementing the applications depicted in these models. Where the issue of new technology or resource does not arise, the IT infrastructure defines the technologies and resources available for implementing the applications. There is thus a cycle on how information architecture influences and is influenced by the IT architecture and IT infrastructure in Rover.

Conclusion

IS planning in Rover is integrated with the company's strategy development and business planning. The whole integrated arrangement is relatively soft in that it is driven by processes and management interactions rather than methodologies or techniques. A level of rigour is introduced via the usage of selected business models. The business system architecture has emerged as a useful tool in this regard. Hardness, in the form of tools/techniques and models geared towards IT usage, is more evident in IS planning activities at the functional level and in focused IS planning exercises. There is greater emphasis on technical models such as business area/project data models at the project planning level.

The targeting of models is claimed by the IT strategy director to increase the effectiveness of Rover's integrated business/IS planning arrangement. In particular, the integration of IS planning with business planning at the organisational level is believed to be facilitated. The gap in this whole process is between IS planning and project implementation. This gap is being investigated by the IT strategy unit. The Information Engineering methodology adopted by the company for application development is being examined in this regard. The methodology is being examined to see what it can offer for a smooth transition from (functional level) IS planning to application development; the integration of (organisational level) IS planning with business planning is already in place and is generally perceived to be satisfactory.

4. Case Study No. 4: Allied Dunbar Assurance Plc.

Duration: November 1993 to January 1994

Interviewees:

I. Seward	Management Services Director
G. Fletcher	Director, Corporate Systems
A. Wallace	Director, Technology & IT Services
S. Godsave	Asst. Director, IT Strategy
R. Snook	Manager, CASE & Methodology
C. Kerslake	Data Management Executive
C. Thompson	Project Manager
D. Harrold	Director and Board Secretary
I. Bowden	Sales Director
M. Bailey	Divisional Director, Life Business

Company Profile

Allied Dunbar is the largest unit-linked life assurance and pensions company in the UK. It is a strategic business unit of BAT Industries Plc., a large multinational corporation with primary interests in the tobacco industry, but enjoys substantial autonomy in how it operates. Allied Dunbar's turnover in 1993 was £1.7 billion. The company has more than one million customers and manages funds amounting to £11 billion. Its products are principally sold through a direct sales force of 4,500 associates. Competition in Allied Dunbar's core markets (life, pensions, unit trusts and mortgages) is increasing, fuelled by legislative/regulatory changes and by market initiatives. Competitors are changing in structure through mergers, acquisitions and alliances. Building societies and banks are emerging as new entrants in the UK insurance market.

Allied Dunbar considers the following as its strengths: an innovative management, a large direct sales force, good relationship with intermediaries, a highly effective administrative team, many relatively affluent customers and business and systems development capability. The company seeks to exploit these strengths over the long-term. The long-term approach is embedded in the company's business strategies and is reflected in the way it conducts its business. Allied Dunbar is regarded as an innovator in the field of personal finance. The company is viewed as an effective user of IT for strategic advantage (see Microsoft Case Study on Allied Dunbar, 1993).

IT Function

The Management Services Division (MSD) is the IT division of Allied Dunbar. The MSD employs more than 300 people and spent £30 million in 1993. The division is one the key functional units of the company. Its director is a member of the executive board. With the MSD director as a member of the board, the board itself is Allied Dunbar's IT steering committee.

The MSD's primary function is "to deliver significant business benefit through the application of Information Technology" (1993 Allied Dunbar Technology Review). The division sees its responsibilities covering the implementation of new technologies, managing projects, identifying IT opportunities and developing better ways of working throughout the company. The key challenges of the division are to ensure that IT contributes to rather than constrains corporate goals and strategies. The division focuses on exploiting and managing IT within the context of the business. The division's plans and operations are highly integrated with those of other divisions via continuous management processes and co-operative efforts. A close reactive-proactive style of working relationship exists between the IT division and the other divisions. This relationship has led to the physical location of IT professionals in business divisions. A senior functional executive endorses this partnership arrangement claiming that it makes win-win feasible:

> "We are partners. We can't deliver without IT. ... Senior people have good relationship with IT. The close proximity of IT to the business area is a key factor in the good relationship between Management Services and the other divisions."

Allied Dunbar operates in a very information-intensive industry and has positioned IT as one of its strategic resources:

> "We depend to a large extent on information and IT for the cost-effective operation of our business and we deploy substantial resources to provide this." (IT Strategy: Opportunities and Directions, March 1990).

IT is seen as a key automation tool for improving the company's efficiency and effectiveness ("doing the same for less" and "doing more for the same" respectively). It is equally viewed as a potential tool for transforming the company in the way it operates and manages its business (i.e. "doing things differently and doing different things") (see figure AD1). Allied Dunbar's valuation of IT as a strategic resource conforms to industry norms (see Feeny and Knott, 1988). The company has been gaining competitive advantage through strategic IT applications but has found it necessary to sustain the advantage through continual effort. Hence strategic IS planning is done as an integral part of the organisation's ongoing business planning effort.

Strategy Development and Business Planning

Allied Dunbar's business strategies are related to its vision and response to competitive pressures. The company serves a niche market consisting of mainly middle class self-employed and affluent individuals. A diverse range of up-to-date insurance products is offered to the market. Products are differentiated in terms of nature and content as well as service. These generic strategies are relatively stable even though their specific implementation changes over time. Thus the company's business plan, consisting of a list of prioritised projects, reflects rather than constitutes its strategies.

Respondents → / ↓ Selected Key Items	Director (Corp. Systems)	Project Manager (MSD)	Divisional Director (Life)	Sales Develop. Executive	Average
Role of IT ('1= Not a role' to '5= Primary role')					
Automation	3	4	5	4	4.0
Transformation	4	5	3	4	4.0
IS Planning Success/Failure (1= Failure, 2= Some benefits but IS planning is not needed to achieve them, 3= Better than not doing it, 4= Successful but can be better, 5= Highly successful)	4	4	4	3	3.8
IS Planning Taxonomy ('1 = No match' to '5 = Perfect match')					
Administrative Approach	2	(missing)	3	3	2.7
Methodological Approach	1	2	2	2	1.8
Technological Approach	2	2	3	3	2.5
Business-led Approach	5	4	3	3	3.8
Organisational Approach	5	5	5	2	4.3
Perceived value of Application Architecture (1= Irrelevant, 2= Little use, 3= Some use, 4= Significant use, 5= Absolutely essential)	3	4	3	3	3.3
Perceived value of Corporate Data Model (1= Irrelevant, 2= Little use, 3= Some use, 4= Significant use, 5= Absolutely essential)	3	3	2	3	2.8

Figure AD1: Responses to Structured Questionnaire - Selected Key Items

Allied Dunbar believes in organic growth rather than sporadic efforts. The company claims that its ongoing strategic efforts are targeted at total business-driven results rather than small wins. Senior management is responsible for developing the business strategies and plans but involves all executives and professionals in this task in an ongoing manner. The Management Services director contributes to the strategy development and business planning. He ensures, where appropriate, IT's proper place as an integral part of the company's business strategies and plans.

Strategic ideas and initiatives typically emerge across the company in the normal course of business. An initiative may emerge during normal business operations whereupon the divisions, including the IT division, interact with one another before collectively submitting it as a project proposal to the board for consideration during the annual business planning exercise. Board members are thus familiar with strategies and associated project proposals prior to their formal consideration by the board. The project proposals are considered in the light of the last business plan and the company's basic strategies.

Every project proposal requires a champion. The champion generally has the backing of some others in his bid. With strategic IT investments destined to be embedded in the business, the sponsor for an IT application is typically a functional director. The MSD director may initiate a project but the final sponsorship comes from one of his peers. About 50 bids are commonly received for consideration during the annual business planning process. The executive planning team (comprising heads of key functions, including the MSD director and three other board members, and a few key staff members) culls and prioritises about 30 projects from this list for formal consideration and approval by the board.

In the initial stage of the business planning exercise, the focus is to establish a common understanding and appreciation of the current business situation, past performance and the company's vision, beliefs, strengths and weaknesses. Management planning workshops are run to assess the company's strategies and emergent initiatives, to achieve

common understanding and consensus, and to collectively develop/refine ideas, models and solutions. The final business plan sets out the projects to be implemented over the following two years within a five-year context.

Verbal interactions are central to strategy development and business planning in Allied Dunbar. Some business analysis techniques and concepts[5] do feature in these processes but the focus is on management understanding and consensus. Rockart's (1979) Critical Success Factors is widely used. The company's basic business strategies (niche marketing and differentiated products and service) are mapped onto Porter's (1985) Generic Competitive Strategies. The business environment is described (rather than graphically modelled) in terms of Porter's (1980) Competitive Forces. Allied Dunbar sees itself as an extended enterprise covering its distribution channels and, more recently, strategic partners (banks and building societies). The extended enterprise is described using concepts similar to those of Porter's (1985) Value System.

Ideas and strategies originating throughout the organisation are brought together and considered holistically at the board level. A senior functional executive sees this as one of the strengths of Allied Dunbar's planning approach. Absence of an overall formal approach is not seen as a deficiency in view of the expertise and experience resident in the company. The senior functional executive observes:

> "There is a great depth of understanding and expertise in the company. Many have been in the company for a very long time."

Allied Dunbar does not consider its business plan to be a documentation of its business strategies. The MSD director asserts that "strategy is a direction and not a plan." His argument is that a number of options are typically available for implementing a basic business strategy. Changes to the chosen option rather than basic strategy are more likely to be required in the normal course of business. Business planning seeks to select the

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5 There are similarities amongst the case studies in this matter. This is particularly evident in the case of Allied Dunbar and Safeway.

optimal option to a strategy requirement. The business plan, having a relatively short-term focus, provides the necessary flexibility for implementing the long-term basic strategies. The basic strategies are relatively stable but could be modified in the long term to be in line with broader business environment changes, company objectives and vision. An MSD executive summarises these aspects of strategy and plan thus:

> "We have a long-term approach. The lack of a long-term business plan doesn't matter. It is not that a long-term plan is unimportant. It is more important to make the right decisions. In the past, long-term plans were developed but were not found to be practical."

Information Systems Planning

IS planning (ISP) fits in naturally with strategy development and business planning as a senior management responsibility in Allied Dunbar. It is done as an integral part of business planning. Potentially useful IT applications are identified during ongoing business operation and management. An IT application could be identified and initiated by a functional division or the MSD. Regardless of who initiated it, the application is discussed jointly by MSD and other relevant divisions before being included as part of a business project proposal to senior management.

Essentially, Allied Dunbar's ISP is a process of evaluating an IT application proposal in the context of a business proposition using standard organisational processes and procedures. No formal ISP methodology is used in this process. Past experience with formal methodology in organisational level IS planning has not been satisfactory. Only simple analysis and graphic modelling are currently done. Nonetheless, an ISP methodology is occasionally selectively employed in focused ISP exercises confined to specific business areas.

The philosophy on which Allied Dunbar's ISP is based is that strategic IT applications should emerge from the business rather than be planned separately (in a formal exercise or otherwise). In this regard, exposure of management and IT-users to relevant

information technology and potential business opportunities is seen as crucial. The exposure is done through close working arrangements between MSD and other divisions. The MSD director's membership in the executive team is considered to be a major factor in this regard. The working arrangement is supplemented with ongoing seminars and presentations on new technologies, advances and opportunities. The outcome of all these efforts is that strategic IT applications are conceptualised by users and management and guided by MSD staff. The Integrated Sales and Information System (ISIS) serves as a good example to illustrate this aspect of IS planning. ISIS was conceived by the Sales Division based on happenings in the market and trends in the industry. It was planned and implemented jointly with MSD.

The formal IS plan is embedded within the company's business plan. It is enhanced, elaborated and documented by the IT division at the functional level in consultation with other relevant divisions. The whole process is referred to as IT strategy development:

> "IT strategy is the direction we should set for our IT resources in order for us to succeed in a competitive and changing business environment. In particular, it should enable us to continue to have enough flexibility to respond effectively to changing business requirements. A strategic IT vision lies at the heart of an overall IT strategy." (Updating Our IT Strategy, MSD, April 1993).

All aspects of IT implementation come within the scope of the IT strategy - data, applications, communications, technology and people. It covers the entire organisation at a macro level. It is an ongoing process coupled with an annual exercise. The ongoing part deals with (see figure AD2): 'Top-Down Analysis' of business and technology direction; 'Bottom-Up Evaluation' of current IT position; 'Creative Assessment of Opportunities' for IT application. These activities are facilitated by the senior IT executives with responsibilities for IT strategy. The deliverables in the form of IT initiatives are the IT division's proactive contributions to Allied Dunbar's strategies and business plan. When the final business plan is approved, the plan for implementing the IS component is formalised with specific attention to IT 'Infrastructure, the 'Way

Forward' for implementing the IT applications, and 'Finalisation' of the IT plan (see figure AD2). An MSD executive sums up the nature and value of Allied Dunbar's IT strategy development process thus:

> "Though this formal IT planning is effectively the annual IT budget planning, the IT strategy report is not a plan; it is essentially a direction statement. ..... It is all a matter of asking the right questions for improving the thinking process, sharing ideas, involving others and benefiting from others' thoughts and suggestions."

The MSD has defined a set of principles for guiding the implementation of IT strategies:

* Implement solutions in the context of the business.
* Use IT to absorb business complexity wherever possible.
* Develop flexible systems.
* Create a "system image" in the eye of the user.
* Embrace relevant object-oriented principles such as modularity and re-use.
* Seek to raise the awareness as regards potential of IT.
* Continuously review the effectiveness of systems.
* Adhere to organisational communications framework.
* Develop systems which are consistent with the company's information architecture consisting of the application architecture and high-level data models.

The MSD contends that the IT strategy and its development process promotes flexibility, responsiveness and pro-activeness in the implementation of IT applications. An appropriate degree of flexibility in IT applications is addressed by the IT strategy. The strategy recognises that over-provision of flexibility is likely to incur additional costs while insufficient flexibility could lead to constraints in the future. The value of flexibility in the IT strategy becomes apparent when a strategic IT application pursued by a competitor requires Allied Dunbar to respond. The IT industry too may offer a new opportunity for gaining strategic advantage. The company's IT strategy must be able to detect the opportunity and capitalise upon it. A senior MSD executive points out:

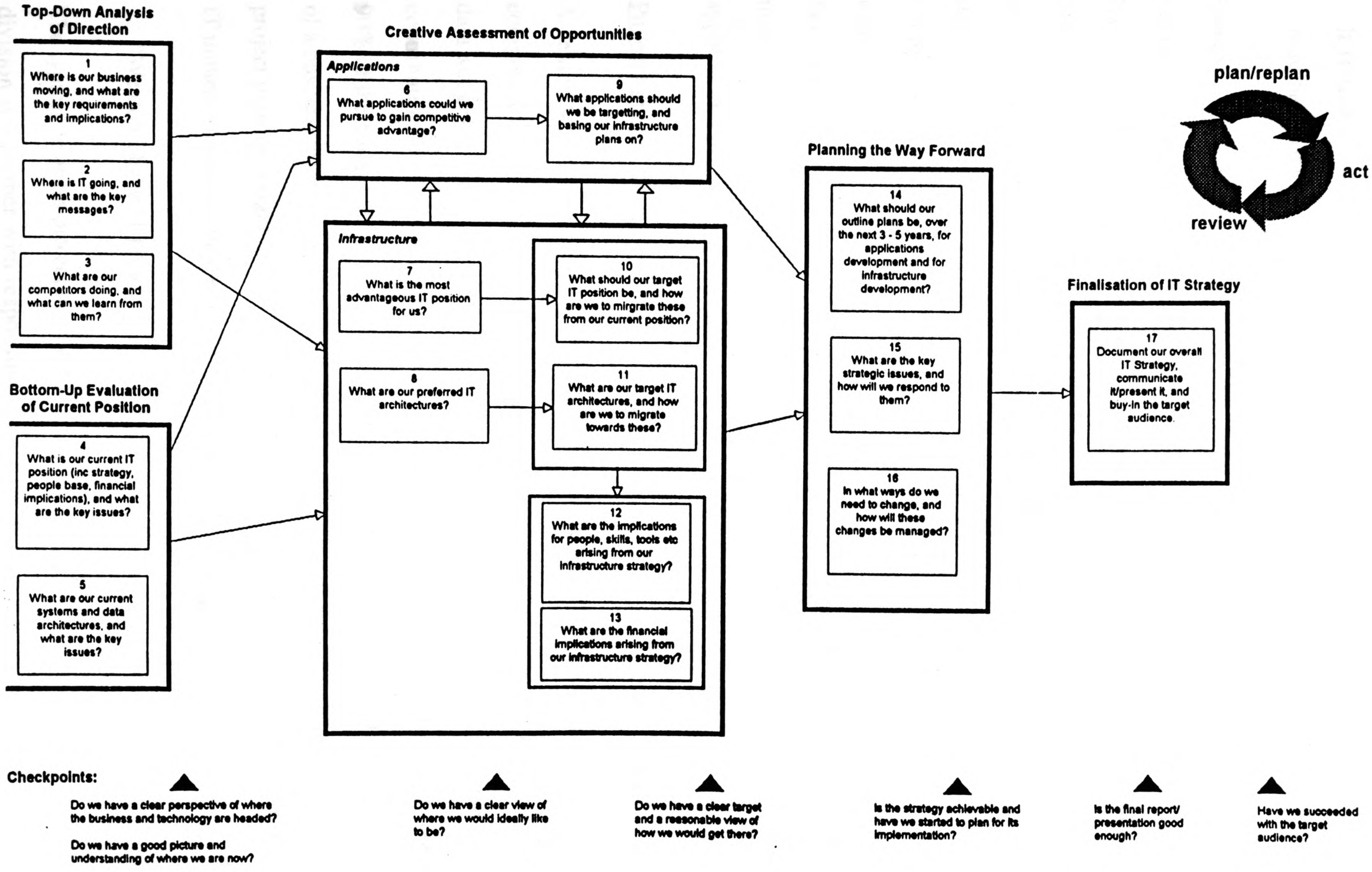


Figure AD2: IS Planning and IT Strategy Development

> "IT strategy is not affected solely by business plan, strategies and competitor moves. It is also affected by what is happening in the IT industry. Hence, it (IT strategy) must be flexible."

Four executives (IT and non-IT) were requested to classify Allied Dunbar's IS planning practice in terms of Earl's (1990, 1993) taxonomy of ISP approaches (see figure AD1). The executives generally felt that their IS planning fitted the 'organisational approach' best; the "methodological approach" was viewed as being least relevant. To another request to assess the success of the company's IS planning, they all responded that it was successful but could be improved, particularly in relation to structure and rigour. They felt that the major strengths of their IS planning approach were its ability to integrate IT with the business and to foster close working relationship between the Management Services Division and other divisions. The executives noted the major weaknesses of their approach as its insufficient rigour and formality and general inability to integrate IT applications optimally.

Project Implementation

A senior MSD executive pointed out that most Allied Dunbar projects had an IT component, often a significant one in terms of investment and impact. The case study data suggests that at least 80% of the projects are estimated to require significant contribution from MSD. In the case of some projects, IT could account for as much as 90% of the budget. Regardless of the size of the IT component, it is also treated as part of a business effort. Even a project focused on IT infrastructure is handled as a business project in its own right, largely within the domain of the MSD. The business approach to IT implementation is emphasised by the MSD director thus:

> "We don't have IT projects. All are business projects."

The typical business project in Allied Dunbar is a multi-disciplinary effort wherein the IT division is a partner with responsibilities for the IT component. The IT component is

handled by an IT specialist group in co-operation with other project team members. This arrangement facilitates the phased and integrated implementation of a project. The project itself is generally managed by a senior functional executive even if it has major IT implications. A senior functional executive highlighted this fact thus:

"I am driving the ISIS project although IT is a substantial component - about 75%."

The nature and extent of effort expended in the development of an IT application is dependent on its projected life. Substantial work is normally not done to an application due to be replaced within a short period. Equally, 'quick fixes' are not performed to an application which is expected to last at least another three years. "Somewhere between these two times (there is no precise measure) the project goes from being 'short lived' to 'long lived' and our attitude to it should change." (Systems Architecture, Sept. 1991).

Strategic applications (such as ISIS, Genesis and Pulsar) are generally custom-built with in-house resources. The MSD's understanding and experience is that such an approach helps to sustain the strategic value of these applications. Though a similar application could subsequently emerge in the industry (and thereby might neutralise the competitive value of Allied Dunbar's strategic application), the company feels that the early-entrant advantage is significant. Furthermore, having developed a strategic application in-house, it is possible for Allied Dunbar to continually improve it, enhance its value and sustain the competitive advantage gained. This has been the experience in the case of the company's ISIS and Pulsar strategic applications. Packages are considered as an option for support applications (typically in the personnel and accounting areas).

The MSD has adopted the LBMS methodology and Systems Engineer CASE tool for application development tasks. Methodologies and CASE tools were perceived by the MSD executives interviewed to be necessary only in this stage of the whole IS planning and implementation process.

The MSD has identified four factors which it considers as being critical for successful development and implementation of IT applications:

* Phased project deliveries - evolutionary application development rather than a 'big-bang' approach, medium-term deliverables and 'quick-wins'.

* Effective human resource - adequately skilled, experienced and motivated workforce can overcome any inadequacy in other areas such as methodologies and tools.

* Multi-disciplinary approach to business project implementation - fosters joint effort (including joint application development), co-operation and application ownership - "Multi-disciplinary teams gives us a distinct competitive advantage." (1993 Allied Dunbar Technology Review).

* Proper project planning - development and delivery of an application without proper planning could lead to non-optimal if not ineffective results.

Allied Dunbar has successfully implemented a number of strategic applications some of which are claimed to be setting standards for the unit-linked life assurance and pensions industry in the UK. Nonetheless the company has also experienced project problems and failures. The company attempts to extract value from these problems and failures by turning them into opportunities for organisational learning. For example, the Portfolio Management System project (which was terminated before delivery) provided opportunities to learn "about managing within a changing environment".

Business Model

Allied Dunbar does not use graphical techniques to model its corporate or competitive strategies though concepts such as business environment and generic strategies are employed. The MSD director claims that this has not been a problem in strategy formulation and planning:

> "Models are in the mind and are made explicit through words."

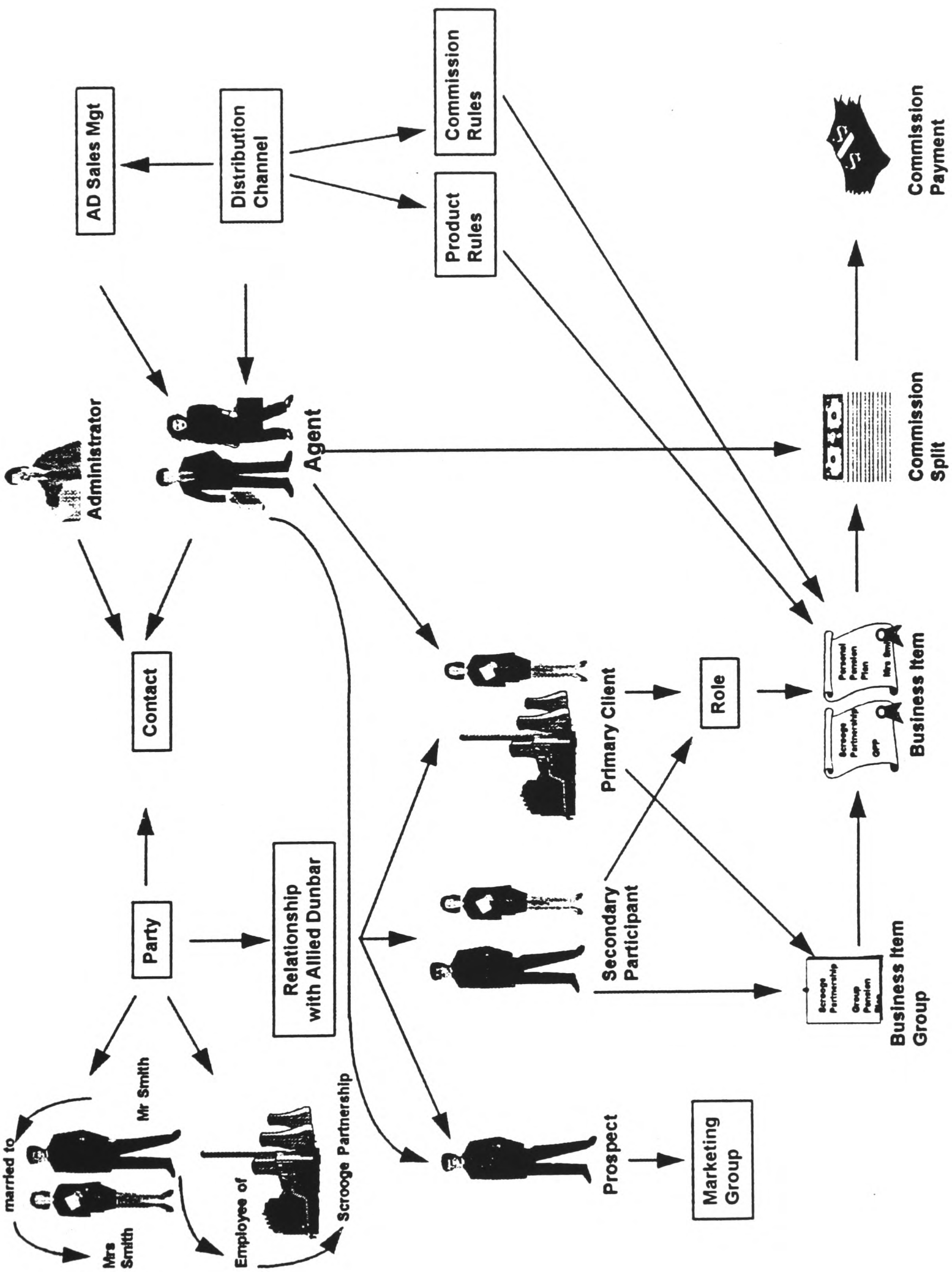


Figure AD3: Business System Architecture - An Example

Most board members and other senior staff have been with Allied Dunbar for a long time, and hence have similar mental models of the business and strategies. Senior management's mental models of the business are thought to be adequate for their needs. The basic business strategies of the company (niche market, etc.) are relatively stable, have long-term focus and are reckoned to be well-understood by management. While senior management does not see a need for explicit conceptual models of the business in its normal activities, it has found business system models of specific strategic initiatives to be relevant and useful.

Graphic models are beginning to feature in senior management planning tasks particularly in relation to the implementation of business strategies using IT. The model conveys a picture of an IT-based strategy implementation within a business context. The business system architecture, as the graphic model is referred to, was perceived by the case study interviewees as a useful tool for communicating with senior management on strategic initiatives. The example shown in figure AD3 was presented by the MSD to the chairman, managing director, board members and some senior executives. The MSD director recalled his observation:

> "All have been happy with it. We stayed clear of words such as 'entity'. We wanted to show what the business looks like. In presenting and discussing it, we got very good input from them."

A business system architecture is pictorial and contains limited detail. It depicts a strategic initiative, showing only the key elements and their relationships. Missing elements are clarified when the model is presented. There are numerous ways of implementing a basic strategy. The business system architecture concept enables the modelling of alternative implementations of a strategy and assessing their benefits and implications. The model shows, at a macro-level, how the business systems and processes are configured to implement a business strategy. An IT application is an integral component of a business strategy implementation. This fact is effectively reflected in the business system

architecture. Different versions of the model may emerge over time, depending on any change to the strategy implementation or the basic strategy itself. Regardless of version, the model is specific to Allied Dunbar. It was generally regarded by those interviewed as not being directly applicable to other insurance companies as it depicts the integration of Allied Dunbar's unique and non-unique resources and core competencies.

The typical business system architecture is developed jointly by MSD and other divisions which have a stake in the delivery of the strategy. The MSD executives facilitate this task. The model serves to make explicit a strategic initiative which has emerged in the course of business. The model is walked through with senior management. It enables senior management to vision the proposed strategic initiative, and facilitates their interactions and deliberations pertaining to the initiative and related strategy.

No special technique is used to develop the business system architecture. It is sketched during a workshop or discussion on a strategic initiative, and later re-drawn with the aid of graphic tools to make it more presentable. The business system architecture has also been developed from IT-oriented models such as a business area data model or application architecture; the model shown in figure AD3 has been developed thus. In the development of a business system architecture, attention is paid to the content, level of detail, layout and form, with senior management as the target audience. A senior MSD executive sees pictures, colour and layout as ways of transforming a complex IT-oriented model into something lively which can engage IT-users and senior management.

Application Architecture

The business system architecture depicts an IT application as an integral component of a business process. However, the model is not sufficient to plan and implement the IT application. An application architecture (AA) is better suited for this purpose. It is created/revised during IT strategy development (and, if necessary, prior to a project) by MSD. The AA serves as a blueprint for developing and implementing integrated IT applications. It also seeks to reduce the complexity of the organisation's information

system, a problem which can arise from unplanned integration of applications. The AA focuses on essentials and facilitates short-term deliveries without compromising on the quality of the long-term deliverable, the organisation's integrated information system. The model serves the project team's communication needs on the scope and interfaces of the application being developed. It helps MSD to seek common IT solutions for common business requirement, thereby minimising application overlaps and duplications. Overall, the application architecture is regarded as a coherent organisational information system structure within which application development should take place.

Two types of AA are developed and used as IS planning/implementation tools in Allied Dunbar: an overall AA and an expanded AA. The overall AA shows at a macro level the company's major IT applications and their inter-relationships (see figure AD4). The architecture is developed using simple graphics and is based on the application portfolio. It is developed and used during IT strategy development as a planning tool. It also serves MSD management in its presentations to senior management on the division's contributions to the business. An MSD executive reported during the case study interviews that he had positive experience when he used these high-level AA models in recent presentations; the architectures were well received by visiting VAT inspectors who needed to be briefed on Allied Dunbar's strategic information system.

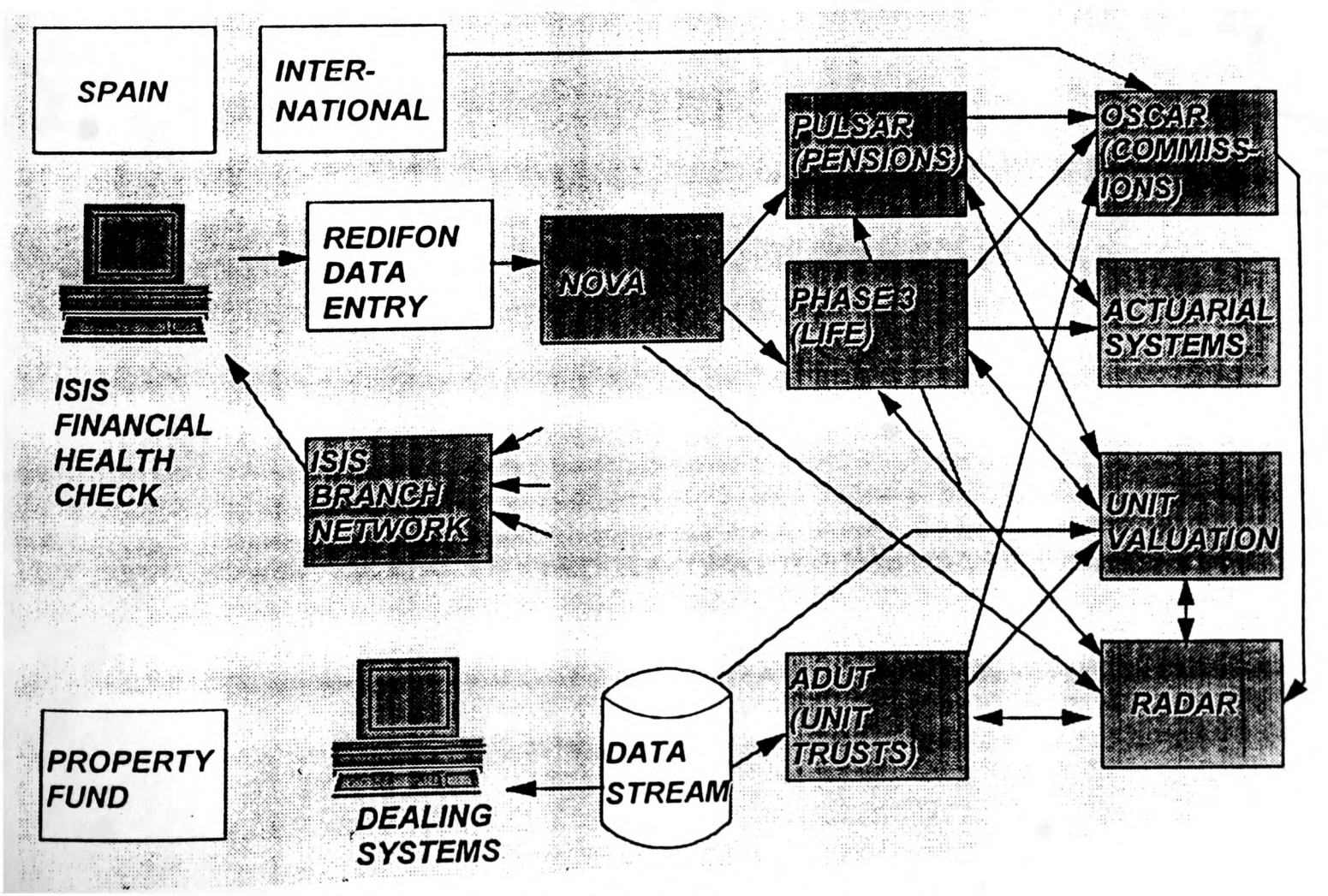


Figure AD4: Overall Application Architecture

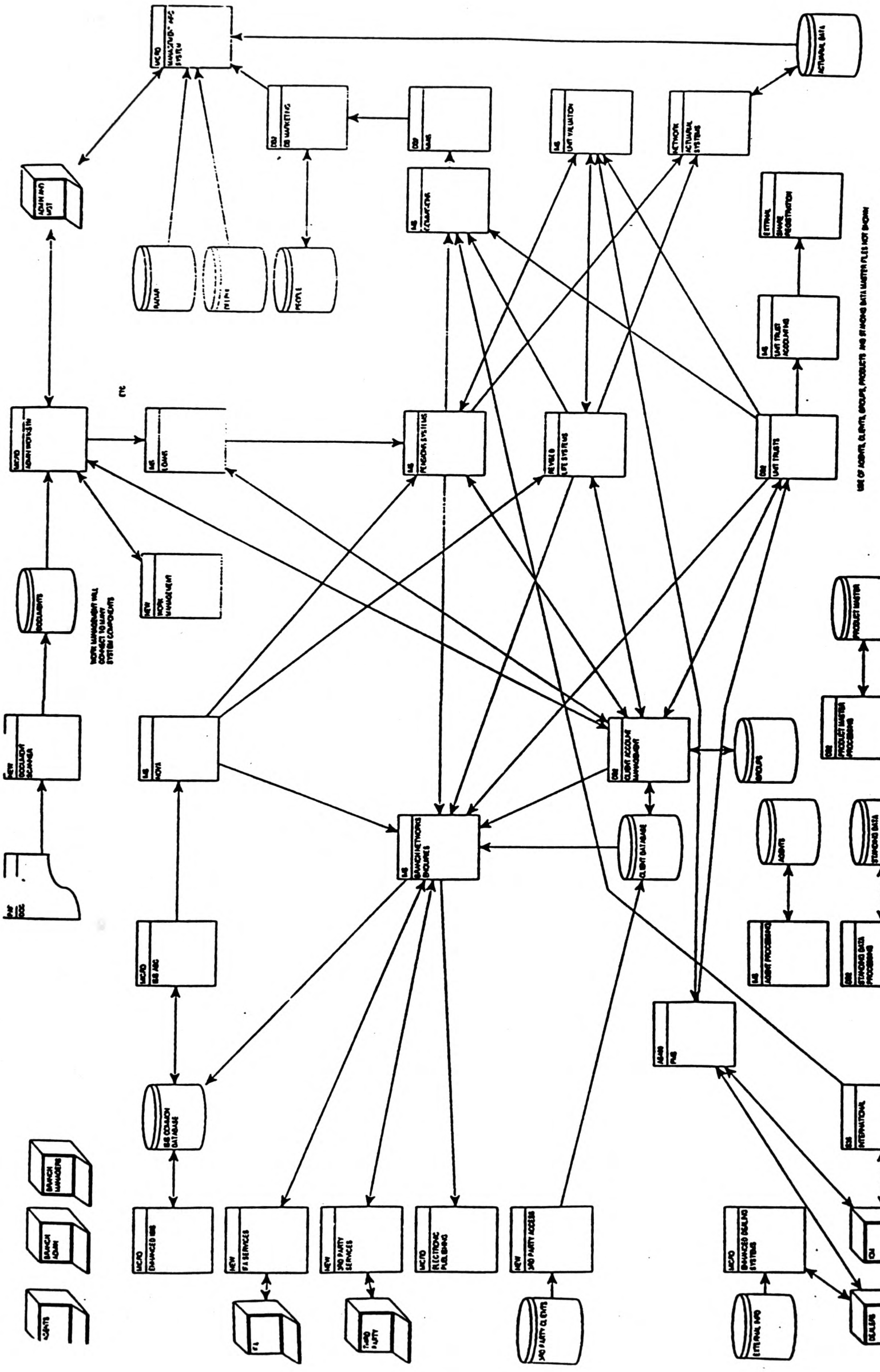


Figure AD5: Expanded Application Architecture

The overall AA is complemented by an expanded AA (see figure AD5). This relatively more detailed model depicts the core applications, their relationships with one another, the major databases involved and the implementation platforms. The model is viewed by IT executives as useful for scoping and planning application development and for building the project level data model. The architecture is created during IT strategy development, using system flowcharting technique and CASE tool. It is based on the prevailing application portfolio and new applications defined in the business system architecture or elsewhere. The expanded AA provides a view of Allied Dunbar's future integrated information system. Comparison of the model with its earlier version, duly updated to reflect the current situation, permits understanding and appreciation of the organisation's integrated IT applications and the changes required.

While the existing AA models are perceived to be of some use to the organisation in IS planning tasks (see figure AD1), they are assessed by MSD executives to be only of marginal value for application development. A detailed AA, depicting an application's subsystems and their inter-relationships, is viewed as a potentially useful IS planning model for purposes of application development. Such a model, however, is not developed as part of Allied Dunbar's ongoing IS planning. The requirements of IS planning per se do not require such a model to be developed. This absence is seen as somewhat affecting the transition from IS planning to application development. Context diagram and high level data flow diagrams are normally developed at the outset of application development to serve the detailed AA requirements. There is in progress a focused IS planning exercise confined to a business area. This exercise is expected to deliver detailed AA(s) for the business area's IT application(s).

High Level Data Model

The MSD defines a corporate data model (CDM) as "the framework within which we (MSD) will provide management information and other non-operational data" (statement from MSD). There are a few organisation-wide data models in Allied Dunbar but none is

clearly identified as the organisation's corporate data model. Depending on the situation, different high-level data models are used to satisfy corporate data modelling needs. The organisation-wide data model developed in the Genesis project (a recent business process reengineering exercise) is representative of the company's CDM (see figure AD6). The model, developed using standard logical data modelling technique with the Systems Engineer CASE tool, is positioned primarily as a database integration tool.

The CDM was perceived to be of some use in IT-related tasks such as database development and data management (see figure AD1). The MSD director, however, asserted that the CDM was complex and was of little relevance to senior management. Similar messages were also conveyed during case study interviews by MSD and functional executives:

* "I haven't seen one (CDM) since 1988. I think it is useful for IT but not for senior management. On the other hand, I could probably draw you one. I know what is in Allied Dunbar."

* "I haven't been successful in presenting the typical corporate data model to senior management."

Noting that the CDM was complex and its development was demanding on resources, some of the MSD and functional executives went further to suggest that a CDM was not really essential to Allied Dunbar. One of them proposed a strategic data model as an alternative to the CDM. (A strategic data model shows only the major entities which are relevant to the business strategies.) Most of the MSD executives interviewed contended that the company's business-area/project data models collectively could satisfy data management and database integration requirements, the traditional domain of corporate data modelling. These executives' contention is worth noting in view of the fact that some of them were very experienced data management professionals. One of them even suggested that it might not be feasible to develop a stable CDM:

"It (CDM) would require very significant effort both to develop and to maintain."

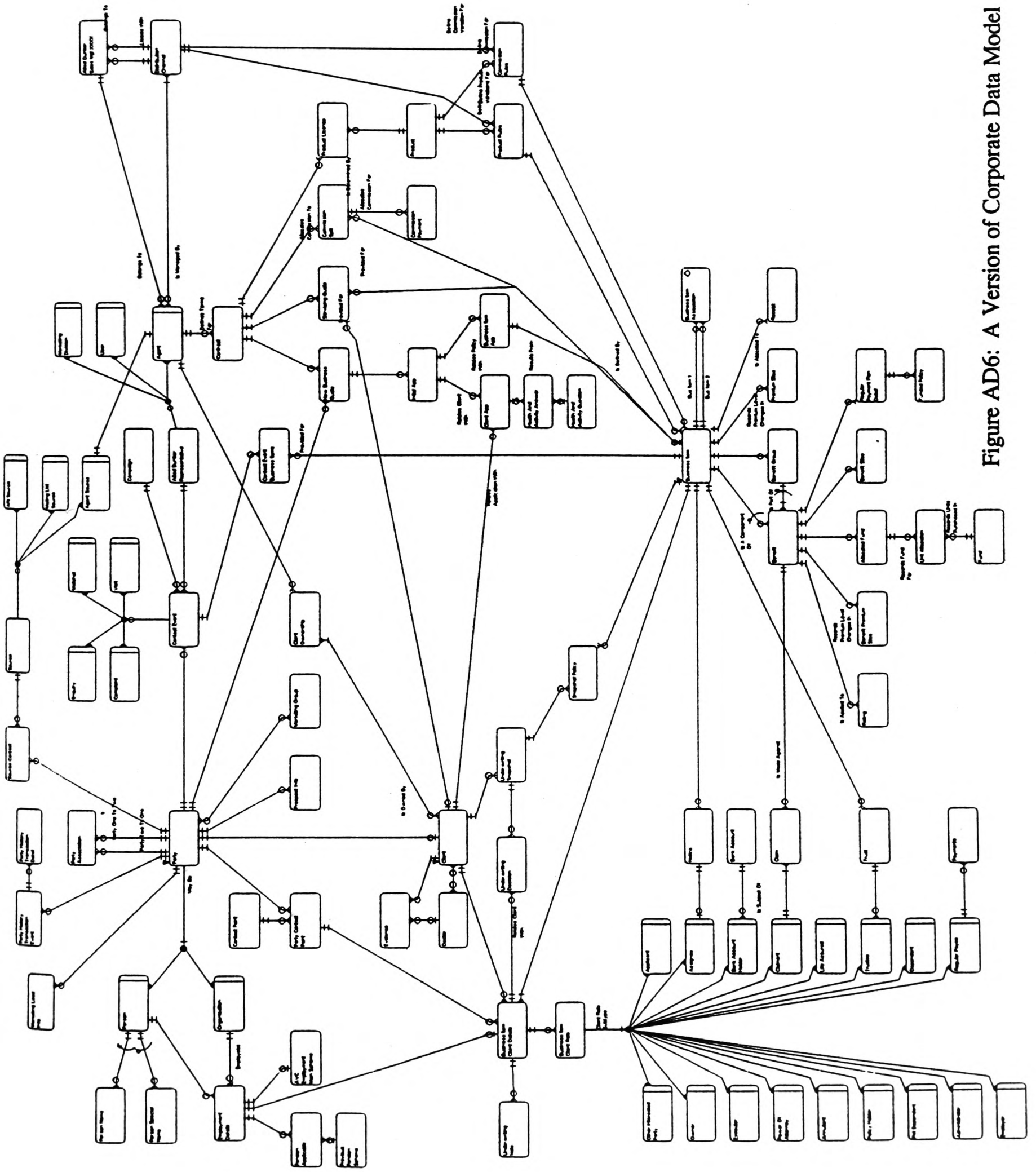


Figure AD6: A Version of Corporate Data Model

Separate business area/project data models are developed in Allied Dunbar for each of the business areas before or at the outset of the relevant project. One of the CDM models might be used in the development of the business area/project data model. The expanded AA is referred to in this task. The business area/project data model is developed for use in project scoping and application/database development. The MSD executives interviewed perceived the business area/project data model to be essential for project implementation work. They contended that a project data model fosters a holistic approach at the project level, facilitating the application's cohesiveness within and integration without.

The MSD executives generally felt that application development without a business area/project data model could result in an unsatisfactory level of database/application integration. The implication of application development without a business area/project data model is that some adjustments would have to be made subsequently to the information system to achieve a satisfactory level of database and systems integration. One of the MSD executives cited his experience in the ISIS project thus:

> "..... The lesson learnt was that we shouldn't have started unless a proper data model was in place. A project data model was not developed because the people involved were IT wizards. Also, they thought that as the system was PC-based, it was very simple and didn't require any data model. If we had approached the total issue early, there would have been less running around later. Issues of application integration, database implementation and performance would have been addressed."

While MSD executives were overwhelmingly positive about the value of the business area/project data model to IT related tasks, most of the functional executives interviewed contended that data models in general were of little relevance to them or to senior management. As noted by one senior functional executive:

> "The data model does not define what applications will be built. Our approach is more process oriented. Data takes a back seat."

The MSD is aware of these user-perceptions on data modelling. Hence the division confines data modelling, including corporate data modelling, to the domains of data management, application development/maintenance and database design.

IT Architecture

Allied Dunbar notes that "successful organisations are the ones that find the effective combinations of technology and exploit the synergy between them "(1993 Allied Dunbar Technology Review). The company points out that "effective IT architectures are a prerequisite for success" in this regard and for "supporting today's systems and in positioning ourselves correctly to exploit tomorrow's opportunities in an affordable manner." (IT Strategy: Opportunities and Directions, March 1990). Focal to the architecture is the ability of IT to extend the company's geographical/operational reach and to enhance/increase the range of IT services. The architecture is seen as a necessity to avoid technological islands and incompatibilities. The MSD argues that

> "Compatibility is one of the keys to the proper application and operation of IT throughout the Company and our IT architectures are enablers of this. Architectures define IT components, functions and structures." (1993 IT Strategy).

Allied Dunbar's IT architecture consists of technology standards and frameworks. Its main purpose is to ensure that the implementation/enhancement of IT applications required by the business are adequately supported by the company's IT infrastructure. The IT architecture and infrastructure influence the application architecture and business system models on the technologies and resources actually and potentially available for implementing IT applications. The selection of a new technology, consistent with the IT architecture, in respect of an IT application modelled in the business system architecture or application architecture leads to these IA components influencing the IT architecture.

The IT architecture is developed/reviewed during IT strategy development (see figure AD2). It underpins the company's strategic decisions in matters of geographical reach of its IT network and range of IT services and data sharing capability. Allied Dunbar has

chosen to build its IT architecture with IBM mainframe technology[6] at the core. A senior MSD executive acknowledges that this approach would result in some dependency on IBM but argues that it has its benefits:

> "We recognise that some dependency on a major vendor such as IBM is required but it is not total dependency. IT architecture is about keeping your options open. Keeping within industry standards and not totally committing to a vendor helps you to do this effectively. ..... Following an industry standard (IBM-technology) enables keeping up with technology development in the course of system development. Don't assume that all applications use IBM products and are on the mainframe. There are non-IBM mainframe products and PC and other computing technologies. We are aware that the world exists beyond IBM even though we have endorsed IBM mainframe technology as the core IT architecture standard."

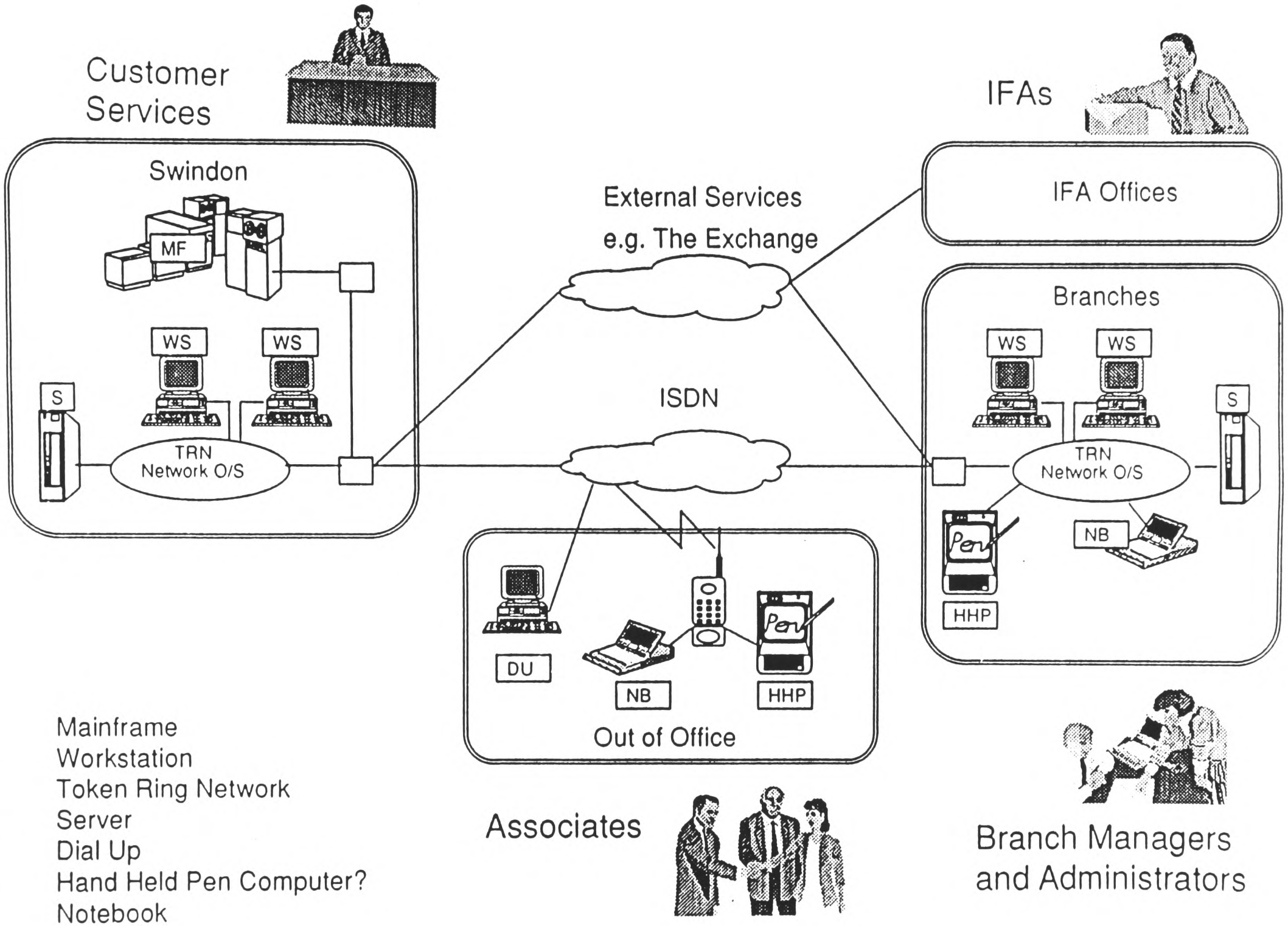
As part of its drive towards improving service and reducing costs, Allied Dunbar is currently redeveloping its existing mainframe-based life insurance application to operate in a client-server mode. In this regard, the company has established a strategic relationship with Microsoft. Microsoft notes:

> "Allied Dunbar is aware that in an increasingly competitive environment, superior service will provide an enduring advantage and help to ensure its success in the future. Its IT emphasis, for the foreseeable future, therefore, lies in developing an infrastructure capable of supporting its staff and agents in providing a quality service to its clients." (Microsoft Case Study Series: Allied Dunbar)

The overall technology framework shown in figure AD7 provides a macro view of Allied Dunbar's computing system. It shows the main types of computer systems and how they are networked to constitute the organisation's technology resource. The architecture supports client-server technology based on a central mainframe and workstations/PCs in

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6 The rationale for the IBM-mainframe biased decision and the approach adopted for developing, enhancing and implementing the IT architecture are similar to those of Thames Water. Hence they are not repeated here. Please refer to the Thames Water case study report.



MF	Mainframe
WS	Workstation
TRN	Token Ring Network
S	Server
DU	Dial Up
HHP	Hand Held Pen Computer?
NB	Notebook

Figure AD7: Overall Technology Framework

a distributed heterogeneous environment. The framework is used in presentations to senior management on technology issues. This conceptual framework is developed into detailed IT architecture showing the computing resources and range of IT facilities potentially available at the various operating locations of the company.

Conclusion

The issue of IS integration is seen as particularly important to Allied Dunbar. The company's products and processes are highly integrated and very information intensive, making it necessary for the IT applications related to the various products and processes to be also integrated. The company visions a highly sophisticated insurance enterprise wherein IT is fused in all aspects and dimensions of the business. The ongoing integrated approach to strategy development, business/IS planning and implementation is considered to be adequately serving this purpose. Information architecture (business system models, application architecture and business area/project data models) is perceived to be leveraging the approach.

The IT division continually examines and seeks to improve its business/IS planning processes and tools/techniques. As part of this effort, information architecture concepts and modelling techniques are examined and refined. A recent effort to present the business system architecture[7] in the form of a pictorial model is reported to have produced satisfactory results. It was found to engage senior management more effectively in discussions on IT-based strategic initiatives.

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7 At the conclusion of the IA survey, an OXIIM research paper, *Gaining Value from Information Architecture: Research-Based Recommendations for the Practitioner*, was distributed to all respondents. Pictorial models are recommended in the paper for communicating with senior management on IS planning matters. An IT executive in Allied Dunbar who had read the paper experimented with this recommendation. He reported, during the case study, that he had found such a model to be effective for communicating with senior management.

5. Case Study No. 5: Safeway Stores Plc.

Duration: February to April 1994

Interviewees:

M. Winch	IT Director
W. Deam	Director, Business Systems & Technology
G. Arthur	Systems Manager
C. Hocking	Head of Data & Technical Architecture
I. Pye	Director, Retail Merchandising
S. Snell	Manager, Trading Systems, Marketing Division

Company Profile

Safeway Stores plc. is the principal strategic business unit of the Argyll Group plc., the third largest food retailer in the UK. Though Argyll is a relatively new entrant in the retailing business (about 15 years old), it is "one of the most successful and respected UK food retailers of the 1990s" (Argyll Group plc. Report and Accounts 1993). The company employs more than 68,000 people. Argyll's sales in 1993 was over £5.5 billion. Safeway accounts for more than 80% of Argyll's sales and operating profits. The role played by Safeway in Argyll and its contributions to Group business are very substantial and continue to increase. Its dominance in the Group is such that, for practical purposes, Safeway Stores and the Argyll Group are treated as one and the same in the Group and by the industry.

There is intense competition and change occurring in the UK retail industry with increased polarisation and concentration of retailers (Clarke-Hill and Robinson, 1994). The retailers' power over the supplier is intensifying in an environment of sophisticated interaction. The retailers are moving away from being merchants and assuming fully responsibility for product development, supply chain management and distribution.

Safeway's current goals in this competitive industry are to maintain/improve its market share, be perceived by customers as the best retailer, and financially outperform the major competitors.

Safeway's organisational culture is dominated by human factors. Open communication as part of normal business is seen as essential to sustain and improve the quality of Safeway's services, products and business. "Trust and relationship are more important than documentation and formal arrangements", observes the IT director. A spirit of partnership and co-operation is built up across the organisation. This emphasis on the human factor is extended beyond the company's boundaries to the community:

> "We are proud of Safeway's record on employment, social and environmental issues. Whether it is training staff for promotion, supporting worthwhile causes, or considering environmental implications of our actions, our aim is to set and maintain exemplary standards." (Argyll Group plc. Report and Accounts 1993).

IT Function

Safeway's IT division employs more than 400 people and spent about £40 million in 1993. The "objective of the IT division is to deliver maximum business benefit in the shortest possible time." (Guide to System Development Methodology, 1993). The IT division is one of the key units of the company and the IT director sits on the company's executive board. IT thus is the concern and responsibility of not only the IT director but also of the board; the board functions as Safeway's IT steering committee. The IT director's membership of the board is in line with IT being positioned as one of the company's strategic resources.

A recent Kompass study ranks Safeway as the most cost-effective investor in IT in the UK retail industry. This ranking is a reflection of the relatively conservative approach which the company has adopted towards IT. Safeway does not generally attempt to install the latest hardware or software merely because it has been recommended by the

vendor or popularised in the media. Neither does the company jump on the bandwagon in such issues as IT outsourcing. The IT director explains:

> "IT is here for taking the business forward, increase our market share and add value to our products and services but we don't contemplate on technology. We are often criticised for this, but we have found our approach to be effective. Safeway's IT applications are leading-edge but not necessarily technologically advanced."

A close working relationship exists between the IT division and the other divisions in Safeway. The IT division responds to requests and initiatives from IT-users but is proactive in keeping them informed on IT opportunities and emerging technologies. This reactive-proactive style of working is claimed to be in line with the partnership arrangement pervasive in the company. A senior IT executive points out:

> "We have no internal customers - only colleagues. We are not providing a service function. We do not just serve the business but also lead it at times."

The IT division is aware of the problems commonly encountered in conventional styles of IT management: parochialism, fragmentation and lack of vision. The division notes that in the conventional style, "rigid vertical divisions compete internally with one another for resource advantage, and IT aligns itself accordingly. Each set of users identify their own problems, and parochial systems result. When there is not enough IT resource available then the powerful and/or loudest grab the major share."(IT Division Objectives and Operating Style information leaflet). Recognising this problem, the IT division takes a longer and broader view as regards IT usage and management. The division views IT activities and deliverables as not just its concern but as also coming within the realm of corporate ownership and responsibility. The IT division believes that its approach to IT management has been successful in the delivery of effective business solutions:

> "By exploiting technology to the full, we aim to significantly improve Safeway's profit and market share through the key assets of Products and People. The IT Directorate believe that this aim can only be met by the adoption of an aggressive

> approach to the true needs of the business in conjunction with a deep seated awareness in each and everyone of us the mind set required. Safeway IT is relatively new and we are therefore neither constrained by an historical 'way of doing things' nor hindered by a fear of change. We do not advocate a 'gung-ho' approach, rather a single minded focus on delivering the maximum business benefit in the shortest possible time." (IT Division Objectives and Operating Style information leaflet).

The IT director argues that time and money can be lost in trying to devise the perfect system. He points out that in the world of fast-moving consumer goods, it is much better to implement something that works for the vast majority of cases and soon pays for itself. "However it is essential that the delivered function should be developed to the highest standards of quality and operability." (Guide to System Development Methodology, 1993). While the business is moving forward, the information system can be fine-tuned. This rationale has resulted in the IT division adopting Pareto's 80:20 rule as one of its major management paradigms. The IT director is a firm believer in this rule:

> "Experience tells us that it is usually the case that only one or two key functions in an application provide the vast majority of the business benefit, yet the 'nice to haves' take up most of the development estimates."

The 20% of a potential IT application which will give 80% of the benefits is isolated and delivered first. The division claims that this approach enables IT-users to receive benefits early and gain a better understanding of their actual requirements before requesting for the remaining 80% which is delivered on a need and necessity basis. A senior IT executive justifies the approach thus:

> "Our business focus does not require us to develop the perfect system. No one really knows what we are finally going to deliver. The 80:20 rule is valid because we are probably going to get it wrong anyway."

Respondents → / ↓ Selected Key Items	Director, Business Systems	Head, Data & Tech Arch	Manager, Mktg. & Trading	Average
Role of IT ('1= Not a role' to '5= Primary role')				
Automation	5	4	3	4.0
Transformation	5	5	5	5.0
IS Planning Success/Failure (1= Failure, 2= Some benefits but IS planning is not needed to achieve them, 3= Better than not doing it, 4= Successful but can be better, 5= Highly successful)	4	5	4	4.0
IS Planning Taxonomy ('1 = No match' to '5 = Perfect match')				
Administrative Approach	3	3	3	3.0
Methodological Approach	2	1	1	1.3
Technological Approach	4	2	3	3.0
Business-led Approach	4	3	4	3.7
Organisational Approach	5	5	4	4.7
Perceived value of Application Architecture (1= Irrelevant, 2= Little use, 3= Some use, 4= Significant use, 5= Absolutely essential)	4	5	4	4.3
Perceived value of Corporate Data Model (1= Irrelevant, 2= Little use, 3= Some use, 4= Significant use, 5= Absolutely essential)	1	3	2	2.0

Figure SS1: Responses to Structured Questionnaire - Selected Key Items

The conservative approach to IT management has not diminished the strategic importance or role of IT to Safeway's business:

> "Safeway is continually improving the efficiency of its supply chain and its service to customers through cost -effective investment and the application of information technology. ..... The cost-effective delivery of systems to analyse and manage routine business functions is generating major opportunities within the supply chain as well as in product, space and supplier performance, marketing and store operations." (1993 Argyll Report and Accounts)

The IT division sees the Safeway-of-the-future as "a very transformed retailing business empowered by information". This vision is based on an understanding that retailing is very information-intensive. While 'automation' is seen as important by the senior executives interviewed in the case study, business 'transformation' is perceived as the primary role of IT in the company (see figure SS1). Store operations and the business as a whole is being transformed while labour intensive tasks, warehousing, transportation and supplier transactions are being automated; Safeway has invested heavily in scanning technology; it is the first UK retailer to achieve 100% scanned sales. Argyll's chairman sums up the strategic value of IT to the company thus:

> "Argyll (including Safeway) survives and prospers on the efficiency and effectiveness of information technology. It has enabled us to cut working capital, to manage our mix more intensively, and to test the evolving structure of the business. We depend on it for our everyday operations and our future development." (IBM brochure on The Argyll Group).

Strategy Development and Business Planning

Safeway's business strategies are related to its vision, objectives and goals. Its business plan, consisting of a list of prioritised projects, reflects rather constitutes its general strategies. A strategy, such as extended enterprise or differentiated product and service, is relatively stable even though the nature and arrangement of its implementation changes

over time. An implementation in the form of a project is in line with a strategy and is a response to the normative demands of the prevailing general business environment. The retailing environment is dynamic and consequently the normative demands change over time, requiring ongoing strategy implementation efforts and occasional development of new strategies.

Market share and net margins are viewed as the primary measures of performance in retailing. Safeway employs a few strategies to achieve these goals. The business is vertically integrated to cover production. This is done via strategic partnerships with a number of food and grocery producers/manufacturers. New stores are planned and opened on an ongoing basis. Effort is made to distinguish Safeway stores from those of the competitors. IT and other technologies are seen as key for implementing these strategies and achieving competitive advantage.

Safeway's overall business strategies have long life. Initiatives in respect of these basic strategies emerge during normal business management and operations. Much interaction goes on between functional heads, senior executives and board members in evaluating and understanding a strategy and its related initiative. When clear understanding has been reached on the value, implications and potential of a strategic initiative, it appears as a business proposal before the board for formal consideration and approval during the annual business planning exercise. During this formal exercise, the last 3-year plan is reviewed and rolled forward in the light of past performance and emerging strategies and proposals. The performance of each business function, including that of IT, is assessed in relation to the total performance of the company. The IT director argues that it is not meaningful to assess the performance of IT, or for that matter any other strategic component, in isolation. IT is treated as just another strategic resource and planned and assessed thus in this entire process.

"IT is not always the biggest cost in many of the projects", observes the IT director. He clarifies that IT investments are balanced against investments in other resources not in monetary terms but in terms of their potential contribution to the business in the short-

term and long-term. When a business strategy proposal is finally approved, the related IT strategy is seen as only an integral component of the business strategy. The IT director feels that it is incorrect to view the IT strategy otherwise; the strategic IS plan is effectively embedded in Safeway's business plan. The closest to a separate IS plan is the IT application portfolio which is developed later during functional level IT planning.

Strategy development and business planning in Safeway rely on both verbal interactions and textual submissions. Though no major business analysis/modelling technique is formally used and identified as such, a few strategic concepts are employed in the analysis and development of business strategies and plans. Business ratios and competitor/industry analysis feature in business planning. Rockart's (1979) Critical Success Factors is used in all facets of business planning and implementation. The company's overall business strategies (low cost operation, and differentiated products and services) relate to Porter's (1985) Generic Competitive Strategies. The business environment is described in terms of Competitive Forces (Porter, 1980). Safeway, the extended enterprise, is depicted in the Supply Chain Architecture (see below) and is discussed in terms of the Value Chain concept (Porter, 1985). Ideas and strategies originating throughout the organisation are brought together and considered holistically at the board level. Management workshops and the models and techniques mentioned above facilitate this process.

Information Systems Planning

Safeway's strategy development and business planning processes accord IT its due status as a strategic resource. IT's potential contribution to the business is evaluated within a total context and the required investment is determined in relation to investments in other areas. IS planning is done as an integral part of business planning.

Safeway believes that strategic IT applications should emerge from the business rather than be planned separately in a formal exercise. The experience and outcome of the last formal ISP exercise in 1985 had not been satisfactory. In the current practice, strategic IT

applications appear as integral components of larger business projects. The planning is an ongoing process of evaluating IT propositions in the context of business proposals using standard business processes and procedures. No formal ISP methodology is used. IT's role and usage from a business perspective guide the process.

IT applications are reviewed/identified/discovered as part of ongoing business operation and management, and discussed with all relevant parties before they are formally included as part of business project proposals. A close proactive-reactive working arrangement is in place between the IT division and the other divisions. The working arrangement is supplemented with ongoing seminars and presentations on technology and business opportunities. The outcome of all these efforts is that strategic IT applications can be conceptualised by IT-users, senior management or the IT division; identification of IT applications is not the sole prerogative or responsibility of the IT division.

The whole working arrangement enables the board to get involved in IS planning only where it is necessary for them to do so - on matters of costs, benefits, deliverables and implications. As a group, top management does not get involved in the mechanics of IS planning. As individuals, however, board members and other senior executives do get involved in IT-related interactions and initiatives during the normal course of work.

The IT division takes about two days annually to formally review and discuss with each functional division their IT requirements. The review presents an opportunity to structure and develop emerging IT initiatives and review old ones. The resulting IT functional plan includes anticipated costs and benefits and proposed project dates. It is submitted to the board for inclusion in the annual business planning exercise.

The 80:20 rule is a major guiding philosophy applied in the aforementioned review. The essential part of an application which must be in place is differentiated from the useful bit which is "good to have". The significance of this philosophy is emphasised thus in the IT division's Objectives and Operating Style information leaflet:

"Life is often about compromises but better to end with a compromise rather than to start with one."

Three executives (IT and non-IT) were requested to classify Safeway's IS planning practice in terms of Earl's (1990, 1993) taxonomy of ISP approaches. The executives felt that their IS planning fitted the 'organisational approach' best (see figure SS1). Involvement and participation by senior management and functional management were viewed as being more important than usage of an ISP methodology. Though formal methodology was considered to be of only marginal relevance to the planning process, IT architecture and IS models were perceived to be of some value.

To another request to assess the success of the company's IS planning, the executives responded that it could be considered as being successful (see figure SS1). The integration of IS planning with business planning was seen as its major strength: the planning process facilitates the understanding of key business drivers, and fosters total commitment to the development and achievement of business goals rather than serving the wishes or IT requirements of specific departments or individuals. The executives interviewed conceded that there was scope for improving Safeway's IS planning. They felt that the ISP process was still not sufficiently open and there was little provision for the support of non-critical areas within the scope of the business.

Project Implementation

A senior functional executive points out that "competitive advantage is gained by how a strategy is implemented and not just on what the strategy is." He asserts that quick and effective implementation is critical for gaining competitive advantage from a strategy. His argument suggests that project implementation is as important as strategy development and project planning. In this regard, the development and implementation of IT applications becomes a significant issue as "most Safeway projects have an IT component" (IT director). Regardless of its size, the implementation of the IT component (application) is treated as part of a business project effort; IT projects are those confined

to the boundaries of the IT division, typically hardware/software replacement or installation.

A project steering committee oversees the work of the project team. The committee consists of senior executives from all the divisions involved in the project. A senior functional executive, typically a board member, is commonly the chairman of the committee.

The project team is a multi-disciplinary working party wherein the IT division is a partner with responsibilities for delivery of the IT component, the IT application. A functional executive is normally the project manager even if the project has major IT implications. Application development is handled by IT professionals in co-operation with the rest of the team and the relevant IT-users. The leader of the IT group serves as the technical advisor to the project manager and has reporting arrangements with the IT divisional management. The project manager is reliant on the IT group leader's technical competence and judgement. Trust and confidence is seen as vital between the project manager and IT group leader.

The IT division considers the company's multi-disciplinary approach to business project implementation as equally applicable to application development within the project. The multi-disciplinary structure of the application development team enables users to contribute to IT analysis/design work. A senior functional executive notes:

> "The user is a major contributor to information system design. The team spirit helps to prevent disasters and promotes coherence. It breaks down barriers between the component functional groups."

In so far as IT is concerned, the IT division seeks to make a series of quick and quality deliveries rather than one big delivery at the end - "nothing more than 6 months." This approach and the 80:20 rule are the guiding principles for Safeway's systems development life cycle. A senior IT executive concedes that Safeway's adherence to the

80:20 rule may result in non-optimal solutions. He does not, however, see this as a major issue:

> "We develop systems quickly - less than 6 months typically. There are trade-offs. Integration of applications is not high and duplication of effort is common. Some systems don't last that long and have to be revised or replaced. But then the business is changing fast and hence the short life of many of the systems is not a major problem."

No application development methodology has been formally adopted for practising the systems development life cycle. Structured analysis/design coupled with data analysis/modelling and Jackson Structured Programming are currently the dominant methodologies practised by the IT professionals. A senior IT executive believes that Safeway's IT personnel are adequately skilled, experienced and motivated to overcome any inadequacy or disadvantage that may arise from the absence of a standard methodology. He, however, concedes that the lack of a standard methodology has resulted in poor systems documentation and could lead to application development problems or curtail IT implementation opportunities in the future. The IT division is hence looking into the methodology issue.

Workshops are a prominent feature of Safeway projects. A workshop is perceived to provide an effective mechanism for achieving common understanding and consensus in the team: "There is no substitute for face-to-face communication", maintains a senior IT executive. It permits the participants to collectively develop designs and solutions. The typical workshop consists of an initial presentation/walkthrough followed by discussions and brainstorming, often with the aid of graphical models such as business models.

Business Model

Common business models, such as the business environment model, are not evident in Safeway. The argument advanced by a senior IT executive is that most members of senior management have been with the company for a long time and hence have clear

mental models of the company's business. The executives have a history of working together and as such have similar mental models. The company's vision/objectives and overall strategies are relatively stable, have a long-term focus and are well-understood by senior management. Furthermore, Safeway's Supply Chain Architecture serves to complement senior management's mental models when there is a need for an explicit business model.

The Supply Chain Architecture is an organisational level business system architecture (see figure SS2). It represents Safeway's vision of the food retailing business and models the business in a holistic manner, from purchase of a product by a consumer to its eventual replacement on the shelf. It depicts Safeway's design of integrated strategies based on the company's resources and strengths. IT and other resources are shown as integral components. The architecture has been kept fairly simple and pictorial to enable easy understanding. This feature of the architecture makes it a potentially effective tool for use in communications with senior management on retailing issues, business strategies and IT applications. The IT director considers the architecture to be an essential planning tool in this regard.

The architecture was first developed in 1985/86 when Safeway decided to base its long term IT strategy on an architecture made up of fully integrated processes which crossed functional barriers. It was developed jointly by senior business executives across the company under the sponsorship and leadership of the IT director. No special methodology or technique was employed. Much of the effort was in the form of in-depth discussions and modelling. The architecture development took into consideration the prevailing systems and technological resources. It sought to address the weaknesses and build on the strengths of those systems and resources. The architecture emerged as an integrated blueprint for planning and implementing strategic IT applications in the context of business initiatives. The Supply Chain Architecture has been continually enhanced and improved. Its custodian is the IT division but ownership rests with top management.

Safeway claims that the Supply Chain Architecture has been a significant strategic effort which has led to benefits in both sales and store operations. As the supply chain is well-integrated, the information system based on the architecture makes available valuable information at virtually every stage of the business chain. The company is positioned to know the throughput, performance and status of its stores and depots and the service level of its suppliers. Safeway is thus able to use the supply chain and modelling process to proactively define the distribution strategy that best fits the situation and needs of a store. A senior IT executive notes:

> "We believe in it. The architecture is based and geared towards flexibility. It has helped to change the business into a demand-driven business. It helps senior management to focus on the key elements in determining business investments."

As an overall blueprint, the Supply Chain Architecture helps to guide and synchronise functional level planning. This is also true for the IT division. The architecture is used in the scoping and planning of IT applications within their business setting. The IT director claims that the model helps Safeway to avoid "the kick and run and gut feel approach" to business planning and project implementation. The architecture's macro-level focus could possibly account for its stability and validity over time. The IT director warns:

> "Its benefit may reduce if you make it formal or include unnecessary detail. Because it is simple, it is stable. Systems have changed but the picture is the same."

The case study interviewees generally perceived the Supply Chain Architecture to offer significant benefits for business and IS planning. The interviewees' general perceptions were as follows:

* The Supply Chain Architecture contributes to a better understanding of fundamental retailing processes.
* It serves inter-divisional communications on the business and strategy.
* It facilitates the identification and evaluation of alternatives for implementing a conceptual strategy.

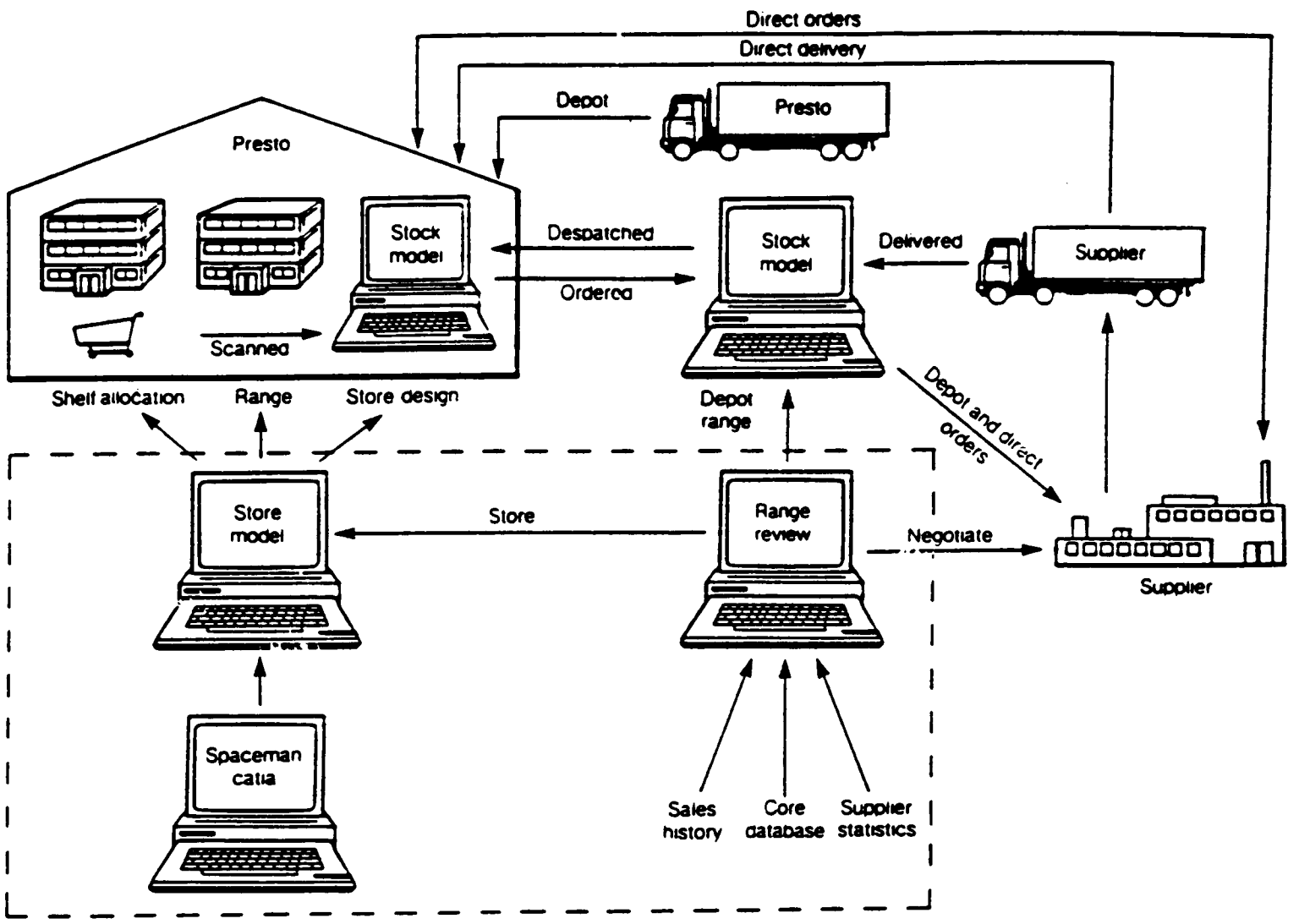


Figure SS2: The Supply Chain Architecture

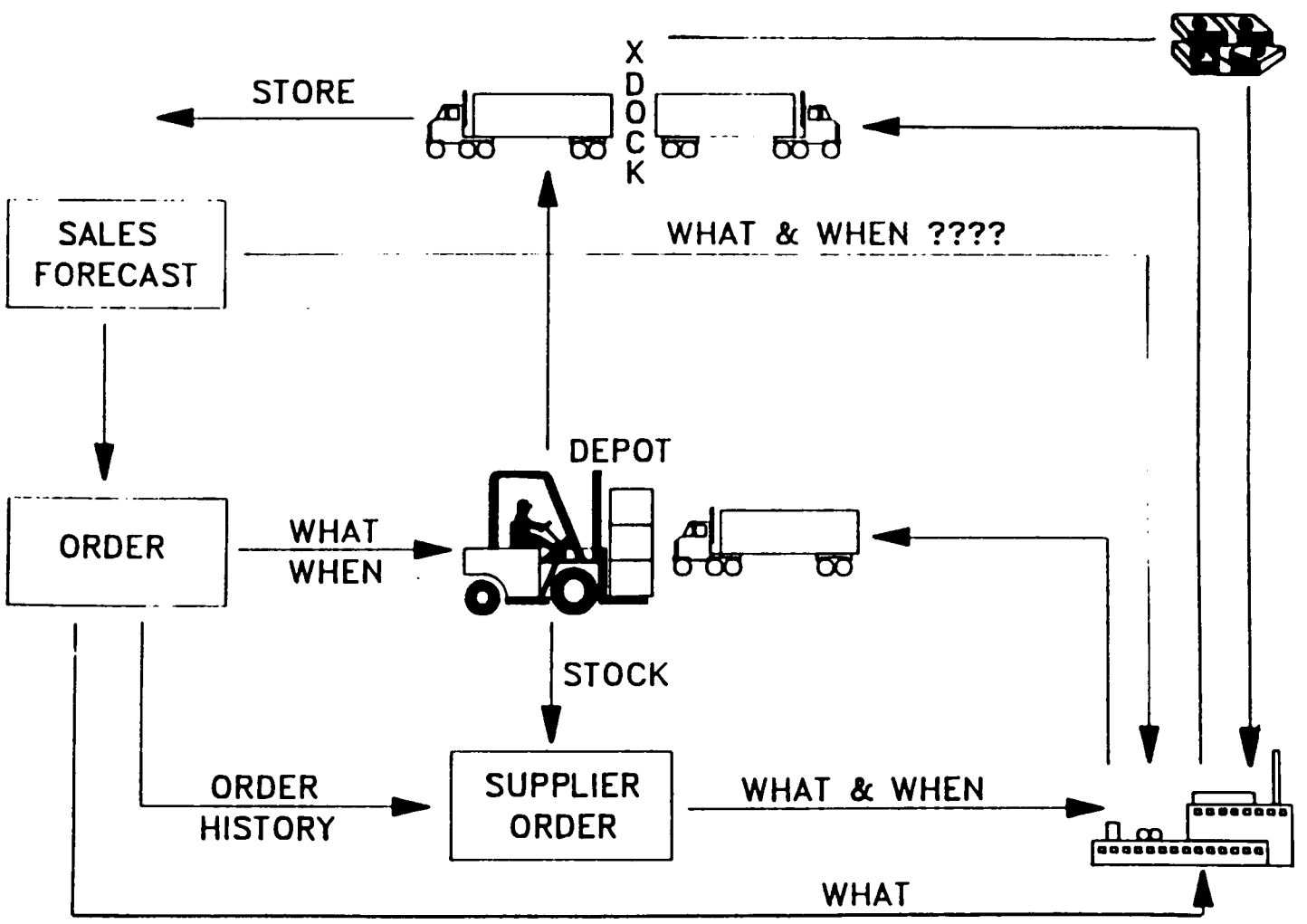


Figure SS3: Detailed Business System Architecture - Orders

* It is used in strategy development and business planning, particularly in relation to business expansion and improvement.
* It is structured such that it is not confined to the food sector. This enables it to be used in planning related to diversification of the retailing business.
* It facilitates development of the IS plan as an integral part of the business plan.

"I wish life were that simple" was how an IT professional summarised his thoughts on the architecture. He felt that it lacked detail and was only of marginal value for project implementation and application development. He however acknowledged that it was useful for integrating current and future applications and was easy for people to understand:

> "An excellent vehicle for getting acceptance by non-IT people. Pictures are always better than words."

The Supply Chain Architecture provides an overall picture but is not sufficient to enable management to understand specific processes in detail. Hence selected detailed business system architecture, such as the one shown in figure SS3, are developed. They are developed by the IT division in consultation with relevant business functions. The focus is on business processes. The target is senior management. The architecture is used in management discussions as a complement to the Supply Chain Architecture.

Application Architecture

While the Supply Chain Architecture is of value in planning the development of IT applications, the general perception of the IT executives interviewed is that an overall application architecture (AA) is more appropriate for this task. The overall AA (see figure SS4) shows, at a macro level, the strategic applications and their integration. The AA is created/revised at the IT divisional level. It is derived from the Supply Chain Architecture and the various detailed business system architecture. No special technique or methodology is used to perform this task.

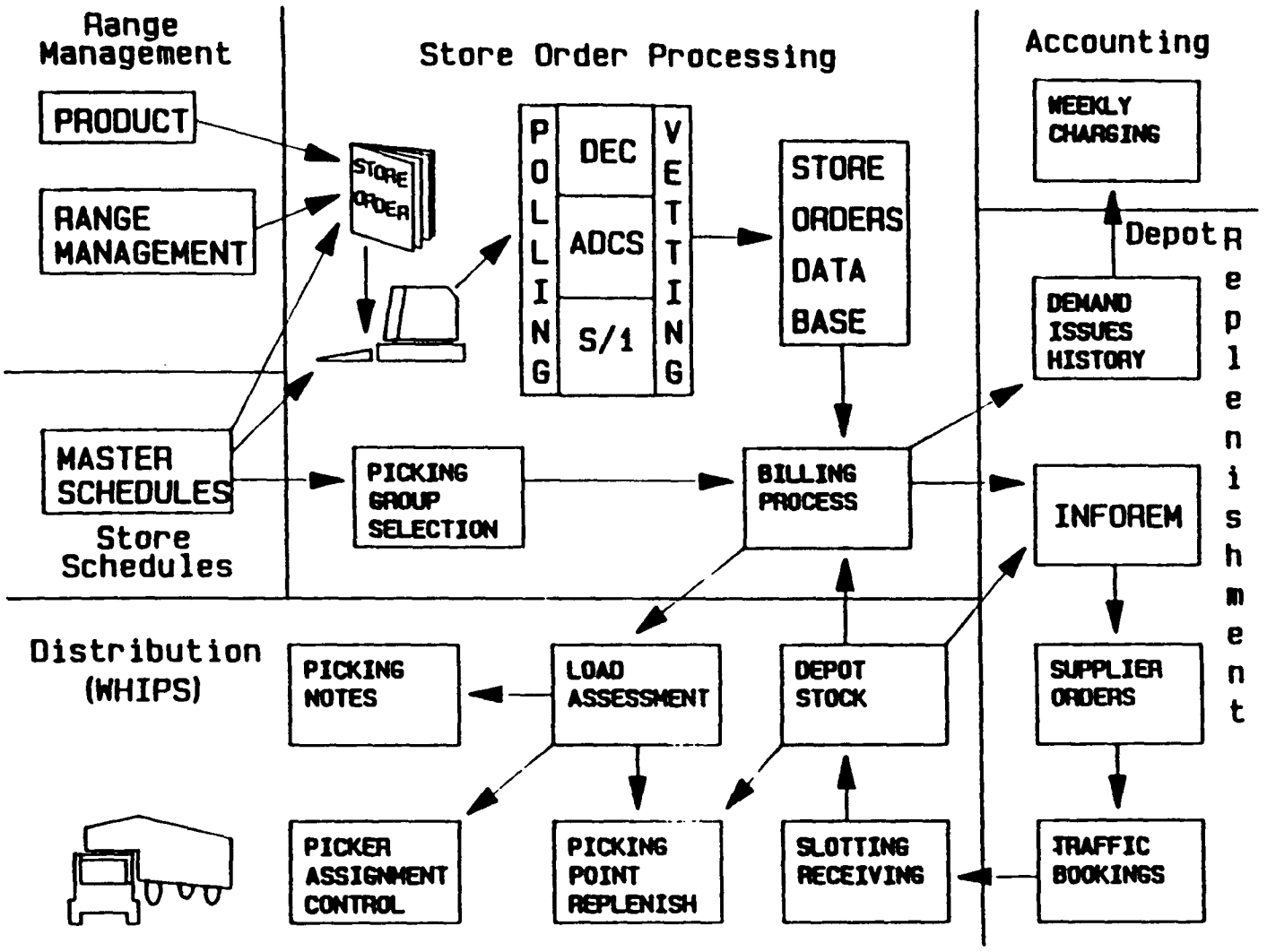


Figure SS4: Overall Application Architecture

The overall AA is used by IT management in their divisional level planning. It is used occasionally in their interactions with functional management and in presentations to senior management on IT applications. The AA contributes to project planning, particularly in relation to scope and interface of applications. The architecture is however not regarded as being of value in application development tasks. The IT executives interviewed felt that a detailed application architecture could be useful for this purpose but such a model is not currently delivered by the IS planning arrangements. The application developers satisfy this need via high-level data flow diagrams which they develop in the initiation phase of the systems development life cycle.

High Level Data Model

Safeway does not have a corporate data model (CDM). The IT director maintains that a corporate data model is of little value to Safeway: "I am not convinced that we need it." He sees the typical CDM as being complex and irrelevant to senior management in spite of its organisation-wide focus. A similar message was also conveyed by the other executives who were interviewed. A few IT and functional executives were requested to assess the value of corporate data model to Safeway. The executives generally felt that the CDM offers little value (see figure SS1) and is not a necessity to the company. This assessment of the CDM is worth noting in view of the fact that a couple of the respondents are very experienced in data management. One of them even suggested that it might not be feasible to develop a stable corporate data model:

> "Trying to develop a corporate data model is futile. It requires significant effort and is unstable. ..... I certainly don't believe that we will ever have one [a CDM]."

The absence of a CDM has not prevented Safeway from successfully building its integrated corporate database[8]. The company has a number of loosely integrated core data bases such as Store, Product, Depot, Supplier, Orders and Sales History. The individual business area databases have been progressively built and integrated in application development projects with the aid of business area/project data models. Data base integration is approached in a pragmatic way, with the 80:20 rule and quick delivery and system quality as the guiding principles. The resulting data bases are not fully integrated and duplications across the data bases do exist. Nevertheless, the data bases have been found to serve Safeway's system needs effectively. The implementation of the data bases as relational data bases (IBM DB2) is perceived to offer flexibility in usage and opportunities for growth and enhancement.

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8 Safeway is a world-wide reference site for IBM on successful DB2 database implementation.

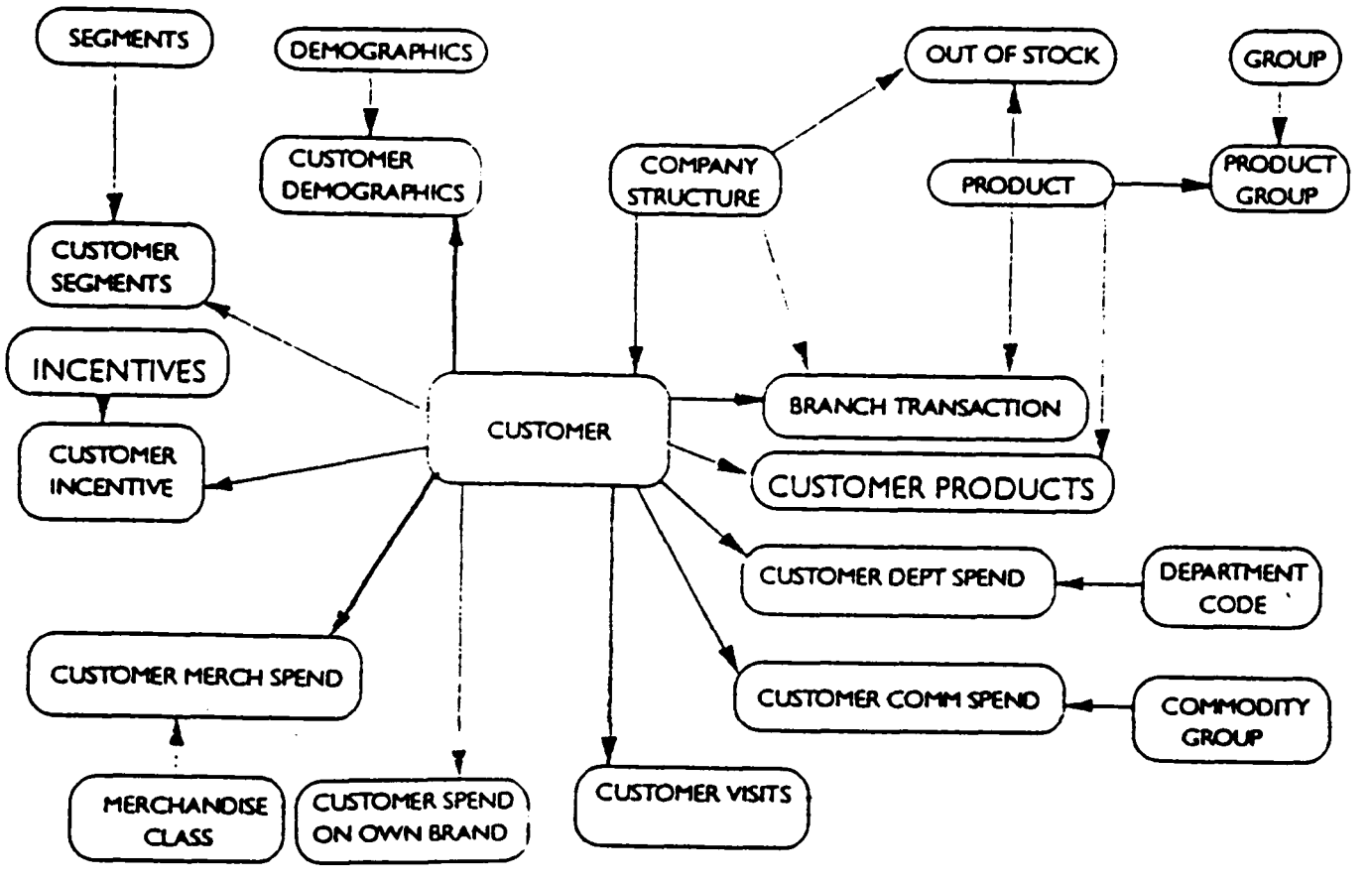


Figure SS5: Business Area/Project Data Model - An Example

The head of data management contends that Safeway's set of business-area/project data models and data dictionary together are sufficient to satisfy the company's data management and database integration requirements, the traditional domain of CDM. Business area/project data models (see figure SS5 for an example) are currently the highest level data models in Safeway. Separate logical data models are developed for each of the major business-areas/subjects - Item/Product; Customer; Supplier; Business Unit/Store. The models are developed/revised at the outset of the relevant project. The company's data dictionary is used in these tasks. The business area/project data model is used in project scoping and implementation. It was perceived by the IT executives interviewed to be essential for project implementation work. The business area/subject data model does not drive application development work. However, it enables the performance of necessary data analysis and data base design tasks (normalisation, logical

data modelling, physical data modelling, etc.) for implementing the business area/subject data base.

In spite of the business area/project data model's value, data modelling in general is not perceived to be an aid for business or IS planning in Safeway. Data modelling's value and applicability is confined to the domains of application development/maintenance and data management. The following comments from the case study interviewees reflect the underlying reasons for this contention:

* "A data model is not relevant to the project manager. I do not have data modelling knowledge. This is an advantage - I can focus on the major project issues. I refuse to get into technicalities."- a senior functional executive serving as a project manager.

* "I have been converted. Initially, I tried to talk about data models but realised that this company is far more effective than my last company even though it does far less data modelling. ..... To this day, I haven't shown a data model to the IT director." - a very experienced data management executive.

* "Application development is largely process driven because users are interested in functionality. The first model developed during a project is a data flow diagram. A data model is developed only after that. Data modelling is done entirely within IT." - an IT executive.

IT Architecture

Safeway's IT architecture consists of technology principles, standards and technology frameworks. The main purpose of the IT architecture is to ensure that the company's growth and expansion are facilitated and not impeded by information technology. With the company expanding its operations geographically (new stores across the country, more extensive links to suppliers, etc.), the IT architecture's provision for technology reach is seen as crucial. The range of the IT architecture as regards sharing of data and IT

resources across the company's computing system is emphasised. An IT architecture is seen as a necessity to avoid technological islands and incompatibilities. A senior IT executive notes:

> "What we need is flexibility when it comes to technology. For this we do not need a list of recommendations but a set of technology principles. These principles define our IT architecture."

Safeway has based its IT architecture and infrastructure on IBM mainframe technology via a long-term strategic arrangement with IBM. The company considers the IBM technology to be the most effective holistic option for implementing the Supply Chain Architecture. The decision is based on the maturity and position of IBM mainframe technology in the industry and the type of IT applications relevant to Safeway. The company feels that its choice of IBM mainframe technology is in keeping with open systems concepts. A senior IT executive asserts:

> "We have got an open system. Everything here talks to everything else and we don't worry about integration. ..... If you mess it up in the first place, then you are not faced with open system issues but technical problems."

The arguments advanced by the IT executives interviewed to justify Safeway's choice of IBM mainframe as core technology are similar to those of Thames Water (see the Thames Water case study) and hence are not repeated here.

Though IT is positioned as a strategic resource, Safeway is not convinced of the benefits of pioneering the implementation of emerging technologies. The company attempts to keep up with the industry in so far as it is practical and beneficial to do so. It only ventures into a new technology when the case is strong and issues are clear; Safeway is currently embracing client-server technology "because of intuitive appeal and not because of hype or technology." Once a technology is implemented, Safeway is "very forward thinking" and attempts to exploit it to the maximum. This conservative approach, while

providing a few advantages, is beginning to show some problems particularly in systems development. An IT executive clarifies:

> "We don't get bogged down with technology. We continue to use COBOL and CICS. This practice has not significantly affected our delivery ability or the quality of the deliverables bút is beginning to affect staff retention. The IT staff want to upgrade their technological skills. We are relooking at our technologies in the light of this new development."

Conclusion

Safeway is seeking to fuse IT with its business and thereby leverage its strategic capabilities. The current pervasiveness of IT and efforts to fuse it with the business at all levels is evident in the various IT-based business projects. Safeway envisages further increase in the role of IT in the company's business in the future. It sees the emergence of a highly sophisticated retailing business in the form of an IT-enabled extended enterprise.

The IT division has established a close relationship with the other divisions as a way to manage and exploit the fusion. The division is a partner in the initiation, planning, delivery and operation of company strategies. The integration of strategy development, business planning, IS planning and project implementation is seen as a necessity to achieve this fusion. This is a demanding and complex arrangement in which methodologies and techniques are de-emphasised in favour of management processes. The Supply Chain Architecture and other information architecture models are facilitating these processes.

6. Case Study No. 6: British Rail

(This report is on the experience of a significant Information Architecture project carried out by British Rail in relation to preparations for privatisation.)

Duration: February to April 1994

Interviewees:

Sir Bob Reid	Chairman
B. Gudgin*@	Director, Information Architecture
D. Garnham*	IT Director, Infrastructure Services
P. Metcalfe	IT Director, Franchising
R. Peal@	Senior Civil Servant, Department of Transport
D. Redfern@	Director of Finance
B. Johnson*	Senior Consultant, LBMS Consulting
P. Haine*	Managing Director, Savant Associates

* Member of IA Project Team
@ Member of IA Project Board

Organisation Profile

British Rail (BR) is a very large public body which is responsible for providing rail transport in Britain. Its turnover in 1993 was £3.7 billion and it employed nearly 130,000 people. BR has undergone major reorganisation in recent years from regional units into business units: Intercity, Regional Railway, Network South East, Rail Freight Distribution and TL Freight.

BR is on the verge of being privatised[9] into a collection of separate but inter-dependent component bodies: BR (in a continuing role), railway track operator, train operators, regulators, franchising directorate and other bodies such as rolling stock leasing

9 At the time of this study, British Rail was being restructured in preparation for privatisation. The case study report presents the situation as at then.

companies, station operators and depot operators. Freight services will be sold outright and passenger services will be split into franchises. Private operators, including companies set up by BR employees, will be able to bid for the 25 franchises. A franchise gives the purchaser the rights and duties of operating a passenger service over infrastructure owned by Railtrack, a new public sector company staffed largely by current BR employees. In the early stages, the government will continue to support the privatised rail service. However, future profitability and opportunities will depend on the commercial initiatives of the individual private companies. One aspect of the privatisation which industry experts are calling attention to is the need for the rail industry to remain and operate as a coherent whole.

BR operates in a "financial straitjacket" (Management Today, Nov. 1992). The organisation's approach to planning is characterised largely by projects rather than business strategies. The focus is on tactical and operational issues, being dictated by financial constraints imposed by the government. Competition (though existing in the form of road and air transport) is not the top issue. BR management's main concern is to provide an efficient rail service at the minimum possible cost to its customers and with minimal funding from the Government. This philosophy appears set to continue even after privatisation (when commercial practices are expected to inject the required efficiency at lower costs and with satisfactory returns to the shareholders).

IT Function

The Business Systems Department, BR's IT function, employs about 1,400 people and spends more than £100 million annually. The department is under the Group Services Directorate. The IT personnel are located centrally and in divisions and business units across the organisation. The department supports BR headquarters, and the various divisions and business units in their need for IT services and computerised information. It is common for systems to be developed and implemented at a local level without looking into organisation-wide implications.

There is also a separate Information Architecture Unit (set up on the initiation of the IA project) under the board member for Finance and Planning. Though this unit is independent of the Business Systems Department, the unit interacts with it on matters of IS planning. The unit has about ten people and is headed by a director. Its role is to infuse business considerations into IT application via IS planning and information architecture. This role is seen as being particularly important in view of the impending privatisation and the need to ready BR's IT applications and services for the new business environment.

The future component bodies in the privatised rail industry are expected to have their own independent IT departments. These departments will need to co-operate to sustain and improve the IT service within the individual companies and in the industry. A central IT function may play the "group" IT role by co-ordinating and linking the distributed IT functions.

BR sees IT in a supportive role - enabling and facilitating the automation of operations and administration. There is little in the way of IT application for competitive advantage. This may change in the new privatised rail business. The ethos has been emphasis on technical solutions and mapping of technology onto rail operations. IT is one of the critical items which underpins safety in the railway. Yet, "IT was not high on the agenda until the consequences of it going wrong were highlighted" (IA director). With the impending privatisation, IT has started to gain greater recognition as a critical and strategic resource. IT is on the critical path of privatisation. Consequently, BR's senior management has approved various IT efforts including an information architecture study:

> "There is widespread recognition that information systems are on the critical path if the Government's timetable for privatisation is to be achieved." (A Preliminary View of the Rail Industry Information Architecture, Feb. 1993)

Initiation of Information Architecture Project

In the early 1990s, British Rail's senior management was becoming concerned about the state of IT in the organisation: there were islands of technology and databases throughout the organisation. The board member for Group Services raised this issue with the then head of IT. The head of IT felt that many of the prevailing IT issues, in particular those relating to duplication and inconsistency of data and low-level of IS integration, could be attributed to data problems. Hence he proposed an IS planning project with focus on data-oriented information architecture. The Government's subsequent privatisation announcement contributed to the approval of the proposal. A budget of £0.75 million was approved for the study. The project objectives were defined as follows:

* To develop an Information Architecture within which the information needs of the new railway industry and information flows between successor bodies can be defined.

* To identify vesting critical systems and initiate quickly those urgent developments needed to ensure such systems are in place before privatisation.

* To identify any compromise made in the interest of privatisation timescales where development of vesting critical systems will not comply with the defined Information Architecture.

The then head of IT was made the director of information architecture and assigned responsibility for managing the IA project and the new information architecture unit. The project team included three executives from functional departments, a few personnel from the IA unit and eight consultants. The consultants were from two IT consultancy firms (Savant and LBMS), one providing expertise and guidance on Information Engineering and the other assisting in data collection, analysis and documentation work; Information Engineering was identified by the IA director as the most appropriate methodology to address the requirements of the IA project. Personnel from the IT department were not

full-time members of the project team but were involved in the project on a need and necessity basis.

The following definition of information architecture was adopted for the project:

> "The Information Architecture is a view of the information needed to support the complete life-cycle of business activities, updated as the business changes. It helps the business to operate in accordance with agreed plans and to measure its performance. Through the project, ownership of data will be identified and a strategic approach to information management will be promoted as an integral part of the business planning cycle." (Information Architecture Project Initiation Document).

The Information Architecture Project

The IA project took nine months to complete and was carried out in stages from October 1992 to June 1993. The project excluded consideration of the Implementation Stage as the available information on the implementation of privatisation was incomplete. The project comprised of four stages:

* Stage 0 - Project initiation. Preparation of project initiation document, overall project plan and project management approach.

* Stage 1 - Development of an overall IA for the new rail industry. Definition of the IA framework and standards for data modelling, quality assurance and project management. Selection of CASE tool.

* Stage 2 - Building of IA for component bodies in the new industry, and identification of critical applications related to privatisation preparations.

* Stage 3 - Migration planning. Gap analysis and development of migration plans. Definition of a high level IT architecture

Two methodologies were required for the project - one for project management and another for investigation, analysis and documentation. CCTA's PRINCE, with some customisation, was adopted as the project management methodology.

The IA project would produce a railway-industry information architecture that would promote data sharing across the industry and facilitate information flows within and between the component bodies. Industry-wide data management would be the theme of the project. An Information Engineering approach was deemed as most appropriate to achieve the objectives of the project. The methodology was customised to fit BR's IA project tasks and requirements and the PRINCE project management approach. One of the consultants notes that the modification was necessary because of the setting of the project:

> "We weren't really looking at one organisation. We were dealing with a multi-organisation arrangement. Data created by one organisation is to be accessed and updated by another. There was a need to develop an information architecture for each organisation as well as a model showing the inter-relationships between them."

Oracle/CASE was chosen to automate the methodology. The tool was chosen because of its repository, customisation facility, data modelling strength and support of the Information Engineering approach. Oracle/CASE was used to document the hard data collected (entities, attributes, functions, critical success factors, etc.) and develop models such as the ERD. The tool's support for matrix development/manipulation (particularly the CRUD matrix) was not found to be adequate. The relevant data was hence downloaded to Microsoft Excel for development of the required matrices.

With these tools and methodologies, the IA project team embarked on what was essentially a strategic IS planning study with IA as the focus. A top-down view of the new rail industry was initially developed. The Government's White Paper, "New Opportunities for the Railways" (14 July 1992), was particularly useful in this regard. The project team sought to identify the critical success factors (CSF), key performance

indicators and major classes of business entities and business functions of the new rail industry. These were identified through study of relevant documents and interviews with various people from top to middle management and specialists, including British Rail's chairman and board members. About 35 people in all were interviewed.

The interviews were complemented with fifteen half-day IA planning workshops. Each workshop was for a specific division/department and was attended by about eight executives. Participants were requested to vision the privatised rail industry and comment on the required information architecture. The workshops were conducted with the aid of CRUD matrices relevant to the division/department.

CRUD matrices were at the core of the IA project and constituted a major part of its deliverables. The CRUD matrices were developed (in a manner similar to that described in chapter 2) using the business processes and entities identified in the interviews and in the study of documents. The matrices were used in the workshops as tools for engaging business executives in IA development. This effort however did not deliver the expected benefits. As noted by some case study interviewees, the CRUD matrices were generally poorly received by the workshop participants. A consultant notes that when the CRUD matrices were presented to functional executives in the workshops,

> "Many couldn't identify with the CRUD matrix. For some it was just too complex."

Nonetheless, the CRUD matrices were used to develop the information architecture[10]. The IA for the new rail industry (see figure BR1) was developed in stage 1 of the project. It was later used to define and scope the information architecture for the component bodies in the new rail industry. The overall IA was updated in the course of developing the component architecture. The final IA for the whole rail industry thus reflects the integration of the various component information architecture. The critical systems related to privatisation preparations were marked on the IA models. This was done jointly by

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10 An information architecture, as defined in the IA project, was essentially an application architecture set in a CRUD matrix.

BR's Business Systems Department and the IA project team, using the information architecture set and documentation of existing systems.

Key Deliverables of the Information Architecture Project

The IA project delivered a set of reports. Included in these reports were three key deliverables: information architecture models for the new rail industry and its component bodies, an industry entity relationship diagram, and an IT architecture.

The IA models were in the form of an application architecture set in a CRUD matrix (see figure BR1). Though the IA project reports claimed that the models had been developed with a business focus, the case study interviews suggested otherwise. The functional executives interviewed felt that the IA models were IT-oriented. They noted that the models looked complex and required some understanding of the underlying conventions and syntax in order for one to comprehend its content. The executives were uncertain as to the value or relevance of these models to business functions.

Some senior IT executives were interviewed as part of this case study. Their views on the IA models suggested that the models were generally being ignored by the IT department. They pointed out that the IA had become obsolete soon after its delivery because of the many assumptions which had been made about the new industry during the IA project. The executives contended that the IA models required to be updated before they could be of any use to the IT department.

Another key deliverable of the IA project was an industry entity relationship diagram[11]. This corporate data model was perceived by the case study interviewees as being complex; it contains more than 50 entities and many relationships (see figure BR2). A senior functional executive noted that one had to be familiar with the data modelling conventions and syntax used before one could attempt to understand the data model.

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11 For all intents and purposes, the industry entity relationship diagram is equivalent to a corporate data model. Hence, it will be referred to as such for consistency across case studies.

OVERALL RAIL IA

RF	FUNCTIONS	SOURCE	ACTIVE PARTICPNTS	BA	DATA SUBJECTS: Railways Bill	Service objectives	Franchise rules	Quality & standards	Franchise agreements	Tenders/bids	Franchisees	Grants & subsidies	Safety standards	Marketplace	Publicity	Access/charging	Freight operators	Open access contracts	Information resources	Suppliers	Infrastructure	Timetable	Emergency procs	Published timetable	Train services	Traction & rolling stock	Personnel	Fares	Sales	Train performance	Accidents/incidents	Revenues	Financial accounts	Property
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	Set railway policy	OB	DoT	A	R	C																												
2	Define service objectives	AB	Reg FA	A		C															R								R	R			
3	Set franchising rules	AB	Reg FA	A		R	C	C					R																					
4	Package passenger franchises	AB	FA RT	A		R	R	C	C		R	R		R		R					R			R								R	
5	Invite tenders	RM AB	FA	A			R		C		R																			R	R		R	
6	Evaluate bids	RM AB	FA	A					R	C	R																							
7	Award franchises	RM AB	FA	A					R	R	C																			R				
8	Negotiate contracts/licences	RM AB	FA Reg Fr	A					C	R			R								R	R						R		R		R	
9	Award grants & subsidies	OH	FA PTE	A					R			C		R												R				R	R			
10	Set safety standards	MH VC	HSE RT	B	R								C																R		R			
11	Market research		FA Fr, BR OA JIB	C										C																				
12	Promote railway industry		RT JIB FA	C										R	C															R				
13	Inform the public	AB RS	All	C										C	C						R					R					R			
14	Define track access charging	OB RS	RT Reg	D												C					R				R									
15	Market open access	RS	RT	D									R			R	C				R					R	R			R	R			
16	Licence & monitor track users	RS BG	RT	D				R	R		R		R				R	R					R			R	R							
17	Manage open access	RS	RT	D				R					R			R	R	C			R				R									
18	Manage key data	BG	All	E				R			R		R	R		R	R		C	R	R	R			R	R	R	R	R	R	R	R	R	R
19	Procure resources	RS	All	F				R					R							C	R				R									
	Plan & develop infrastructure	RS	RT Cons	F				R				R	R	R						R	C					R					R			R
21	Maintain infrastructure	RS	RT Cons	F				R				R	R							R	C					R					R			R
22	Manage network operations	RS	RT	F		R		R					R						R		R	R			R									
23	Create & manage GB timetable	RS	RT	F					R				R						R		R	C			R	R								
24	Create emergency procedures	RS MH	RT Fr	F				R					R						R		R		C				R				A			
25	Market passenger services	RM AB	Fr, BR OA	G										R								R		C				R	R					
26	Resource planning		Fr, BR OA	H				R					R						R						C	R	R							
27	Procure rolling stock	RM MS	Fr, BR Leaseco	H									R			C					R	R			R	C								R
28	Maintain rolling stock	MS	Fr BR Cons	H									R								R	R			R	C								
29	Recruit train and certificate staff		RT Fr, BR	H				R					R						R		R		R											
30	Set fares		Fr, BR OA Reg FA	I										R					R		R	R						C	R					
31	Sell tickets/reservations		Fr, BR OA StOp	I															R		R							R	C					
32	Operate & monitor train services		Fr, BR OA RT	J				R					R				R				R	R	R		R		R			C				
33	Report accidents & incidents	MH	RT Fr, BR OA HSE	J				R					R								R	R	R		R	R				R				
34	Manage incidents	MH	RT Fr, BR	J									R									R								R	R			
35	Manage safety	MH	RT Fr BR	J				R					R																	R	R			
36	Infrastructure charging	RS	RT	K					R		R					R	R	R			R	R				R				R	R			
37	Manage compensation claims	RS	Reg RT Fr, BR OA	K																														
38	Allocate revenues	AJ	JIB Fr, BR OA	K										R		R					R						R	R						
39	Revenue protection	AJ	Fr BR StOp	K																	R							R		C				
40	Pay grants & subsidies		DoT FA PTE	K							R	R																			R	C			
41	Financial management	OA SE	All	K							R																								C
42	Property management	GJ	RT	L																	R										R	R			
43	Engineering R&D	SH RS	RT Fr BR	M							R	R									R														
44	Administer legal affairs		All	N																											R	R			
45	Arbitrate disputes	OE	Reg JIB	N				R	R									R			R					R					R	R			
46	Railway policing	RP	All	N																		R													
47	Ensure quality/industry standards		FA RT Fr BR HSE	O	R		R	R										R								R				R	R			
	Monitor franchisees' performance	OB	FA	O				R		R									R															
49	Provide computer services	RS BG	All	O															R															
50	Industry management reporting		All	O				R											R						R				R		R	R		

Logical Business Areas		Source		Active Participants	
A	Regulation and Franchising	DoT Reg FA	AB	Tony Baker	BR	British Rail Residual
B	Safety Standards	HSE RT	AJ	Alexander Johnson	Cons	Contractors
C	Marketplace	All	BG	Bernard Gudgin	DoT	Department of Transport
D	Track Access	RT	CB	Charles Brown	FA	Franchising Authority
E	Key Data	All	CH	Chris Hall	Fr	Franchisee
F	Infrastructure	RT Cons	DA	David Allen	HSE	Health and Safety Executive
G	Passenger Service Marketing	Fr BR OA	GJ	Gavin Johns	JIB	Joint Industry Body
H	Resourcing	RT Fr, BR OA	MH	Mike Harwood	Leaseco	Leasing Company
I	Tickets	Fr, BR OA StOp	MS	Maren Shrubsole	OA	Open Access Operator
J	Operations	All	RM	Rob Mason	PTE	Passenger Transport Executive
K	Charging and Finance	All	RP	Roger Peel	Reg	Regulator
L	Property	RT	RS	Richard Spoors	RT	RailTrack
M	Engineering R&D	RT Fr BR	SB	Stephen Bennet	StOp	Station Operator
N	Legal	All	SH	Stuart Hill		
O	Monitoring and Reporting	All	VC	Vic Coleman		

B Helling

Figure BR1: Overall Information Architecture for New Rail Industry

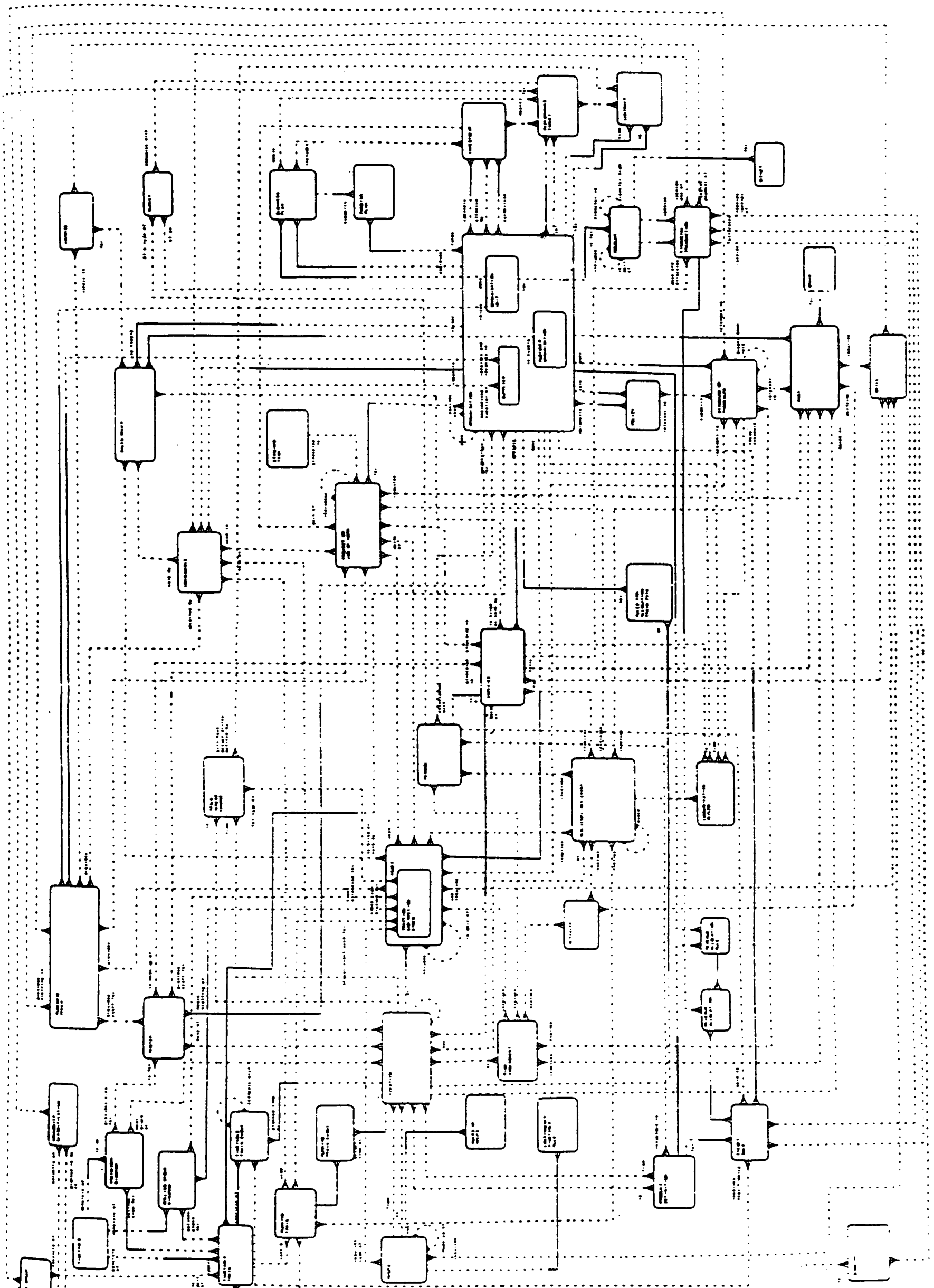


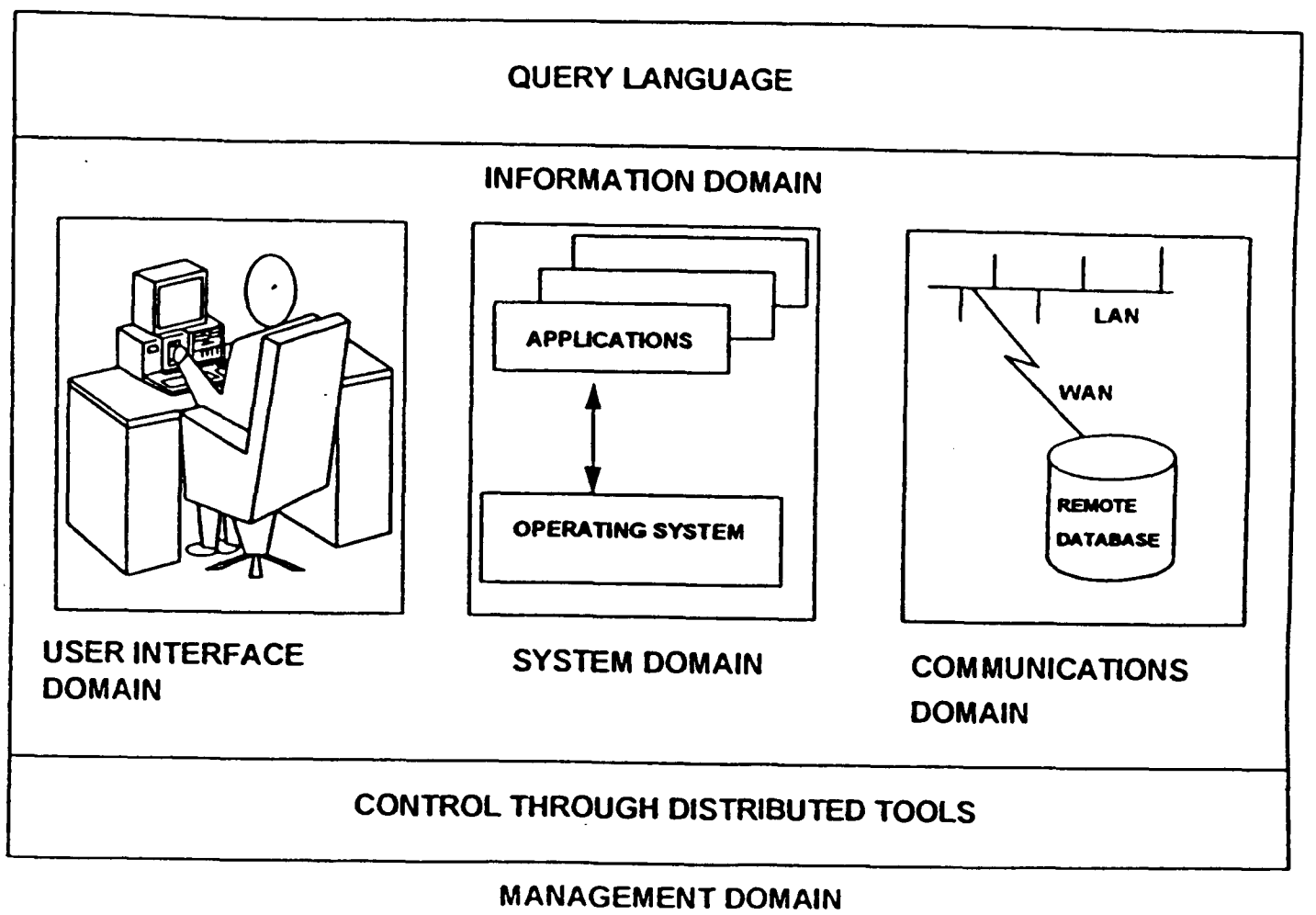
Figure BR2: Entity Relationship Diagram for New Rail Industry

The CDM was delivered by the IA project as a generic data model applicable to all the component bodies. However, not all the entities in the model were applicable to a component body. Some of the case study interviewees felt that this state of the data model reduced its value to the component bodies. They generally felt that the CDM was a failure. The senior executives contended that the CDM was irrelevant to them. One of the IT executives interviewed expressed his view on the CDM thus:

> "I was sceptical from the start. It is all right to do it for a small area. Drawing a data architecture for a large area such as the railways is a gigantic task - very difficult. Having done it, the implementation is going to be even more difficult."

The third key deliverable of the IA project was an IT architecture. An IT architecture was included within the scope of the project as the IA director perceived that the architecture would facilitate integration, flexibility and easy connectivity of the technical resources of the component bodies in the new rail industry. An important requirement of the IT architecture was the ability for the component bodies to cope with the changing business requirements and technologies. The IA project concluded that an IT architecture based on CCTA's (Central Computer and Telecommunications Agency) Open Systems framework (MUSIC) could satisfy the rail industry's IT architectural requirements (see figure BR3). The architecture was conceived on technical grounds independent of the IA. The outcome of the IT architecture proposal was not known at the time of this case study.

No significant business model, such as a value chain or business environment model, was delivered by the IA project. The only noticeable business model was a life cycle model for each component body. Even this model had neither been positioned to be significant nor drawn to reflect the underlying business issues and relevance of IT to the business. A senior IT executive in one of the new component bodies noted the importance of developing and using business models thus:



Management of operational control and maintenance of the technical infrastructure, network and information systems.

User interface between users and IT applications.

Systems software including the operating system and databases.

Information handled by applications and the tools for systems development.

Communications and network interfaces.

Figure BR3: Proposed IT Architecture Framework - MUSIC

"I don't remember seeing any business models in the project. I am going to come back to business process modelling after the privatisation exercise. I am a firm believer that people learn from models and pictures. They take to pictures far better."

Other IS Models Relevant to the Project

High-level application architectures for specific business areas, such as the one shown in figure BR4, were one of the inputs to the IA project. The architectures had been developed prior to the IA study as part of normal systems development. A senior IT

executive contended that these application architectures were of value to application development/maintenance tasks at the business area level. He claimed that such an architecture helped in achieving information systems integration for its related business area. The model served local IS planning needs and was a useful input for project scoping and planning. In comparing the business area application architecture to the IA project deliverables, the IT executive summed up thus:

> "I feel more comfortable (in comparison to the information architecture and CDM delivered by the IA project) with this model."

In addition to the business area application architecture, a business area data model (see figure BR5 for an example) was also developed in BR as part of normal systems development. The IA project inputs included these data models. They were perceived by the IT executives interviewed as being of value for application and database development. This data model was recommended by one of the consultants over a corporate data model for communication with functional management and IT-users on data issues:

> "Taking a business area data model for finance and talking it through with finance executives or even the finance director is feasible and beneficial. A corporate data model would complicate matters."

Major Project Issues

A couple of major issues emerged in the course of the IA project and affected its outcome. One of them was the relevance and appropriateness of the Information Engineering approach. The project team found the approach to be very much technically focused with emphasis on IT-oriented models and techniques. The methodology was lacking in its handling of business issues. The team made attempts to infuse business analysis into the Information Engineering approach. They were not able to make any significant progress beyond CSFs.

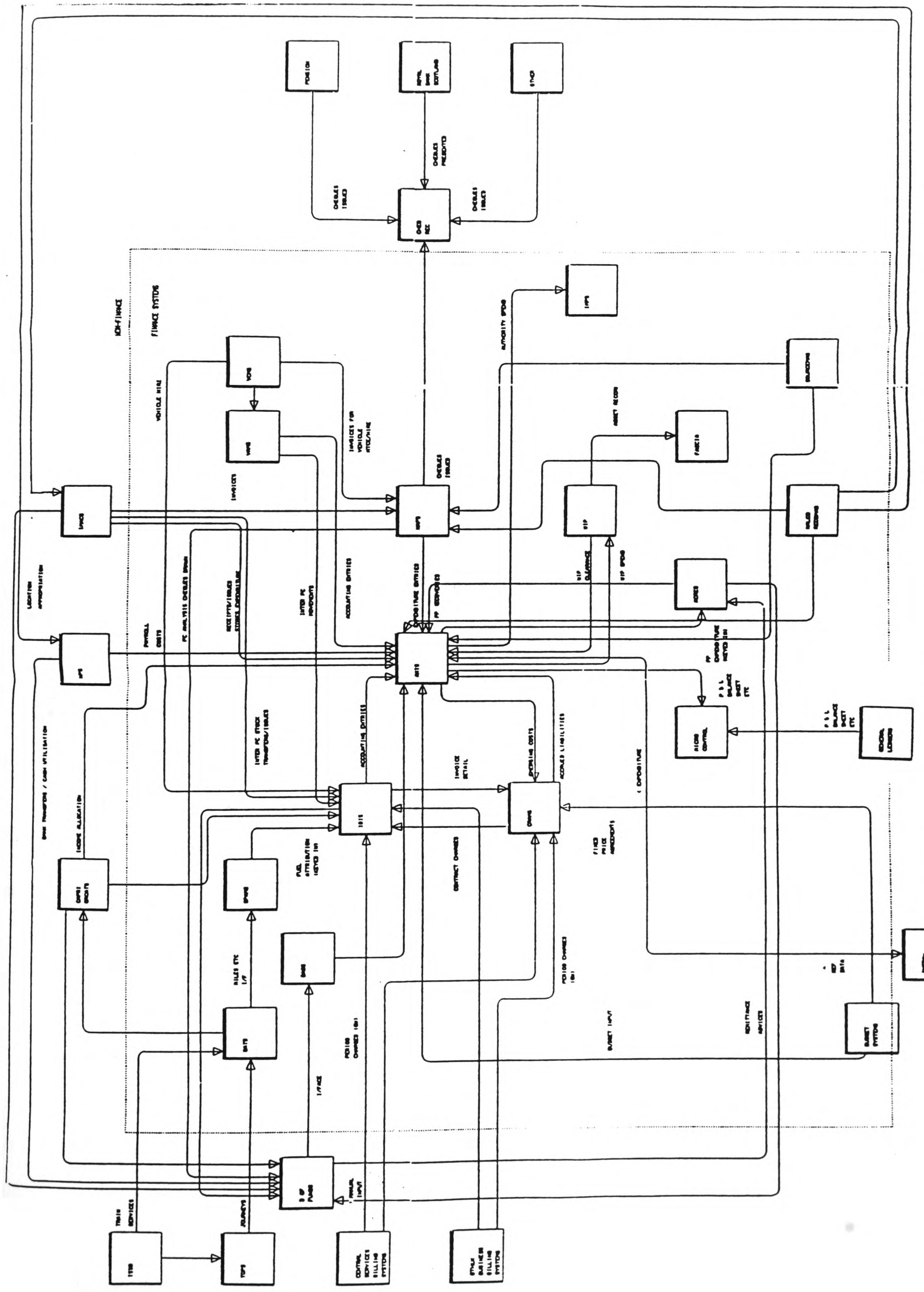


Figure BR4: Business Area Application Architecture - An Example (Finance)

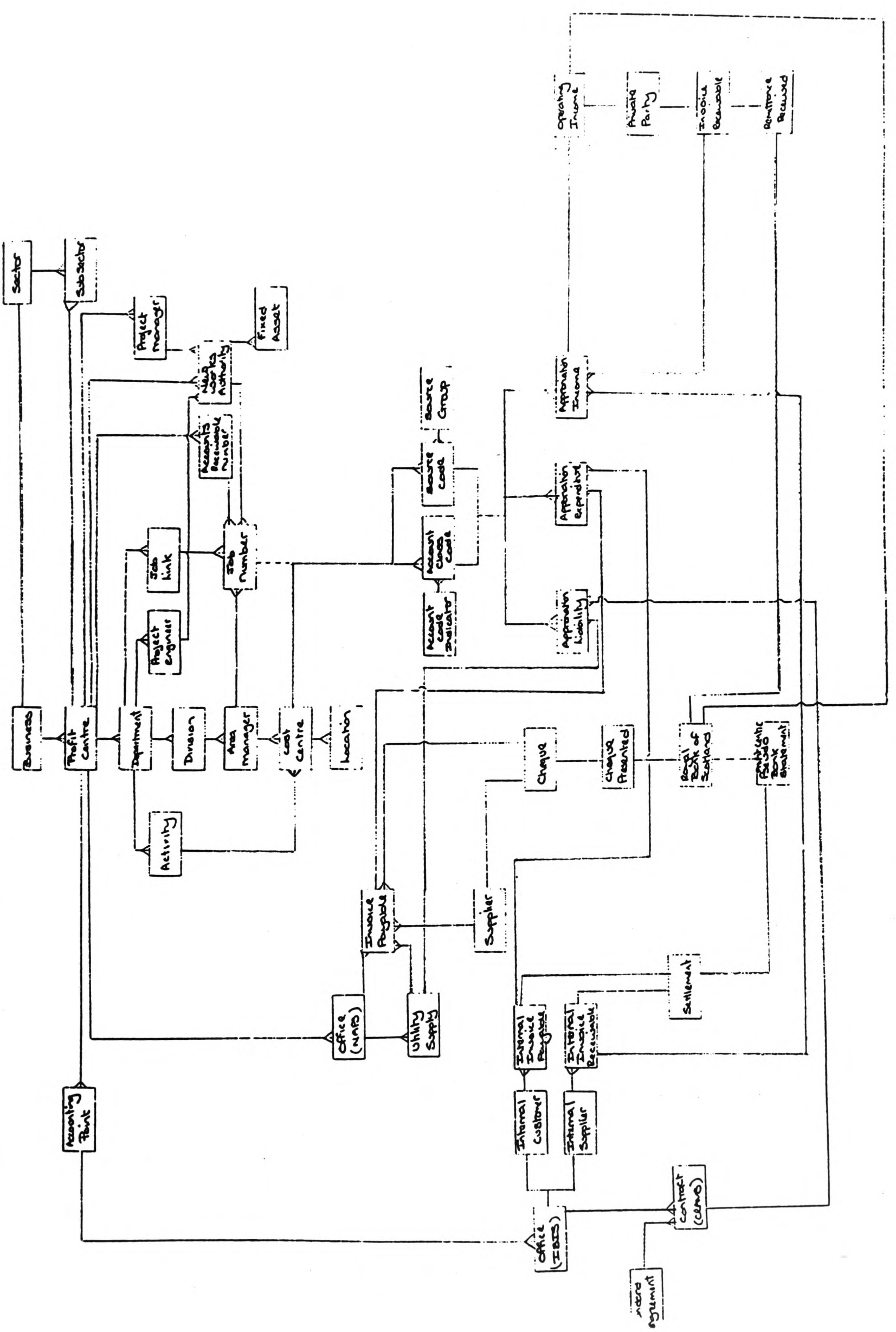


Figure BR5: Business Area Logical Data Model - An Example (Finance)

The consultants involved in the IA project too conceded that "the methodology is inadequate from a business point of view but is sound from an IT point of view. Information Engineering does not recognise the dynamics of industry change." Usage of the methodology, thus, could not help to handle or cushion the constant changes in business requirements which were being experienced throughout the IA project. One of the IA project team members contended that a business-led IS planning with focus on business requirements rather than information architecture would have been more appropriate. He contended that Information Engineering did not permit such an approach:

> "Overall, the IA project team was conscious on the need to do business analysis. But we didn't do it. The methodology didn't require us to do it."

The IA study in relation to the impending privatisation was an uncommon one. Though the consultants had extensive Information Engineering experience, the requirements and situation of the IA project posed a unique problem even to them. There was time pressure, permitting little opportunity for the consultants or the other team members to progressively learn and deliver the project objectives. The lack of relevant problem-domain experience and the time constraint appeared to have been instrumental in emphasising a methodological approach to addressing the project requirements. Information Engineering thus dictated the steps and defined the deliverables.

Though the project experience with Information Engineering was not very satisfactory, many of the interviewees agreed with the consultants that the methodology was sound. Some of them retrospectively felt that it had not been rightly applied: "Methodology was sound conceptually but it was not effective from the aspect of the project." - a senior IT executive involved in the IA project. The methodology provided rigour and technique for undertaking technical planning and implementation tasks. Many of the models it generated (such as CRUD matrices, Information Architecture and ERD) addressed the needs of IT professionals and users involved in project work. Models targeted at management did not feature in the methodology. The CASE tool (Oracle/CASE) which

was used in conjunction with the methodology also did not facilitate development of business models.

In addition to the inappropriateness of the Information Engineering approach, another major issue of the IA project was the marginal involvement of BR's IT department in key project tasks. This inadequate involvement appears to have affected the project deliverables and their acceptance by the IT department. One of the consultant noted:

> "We were subsequently criticised for not involving the Business Systems (BR's IT department) people sufficiently in the project."

The IA project director felt that the biggest resistance to the project came from BR's IT department. The relationship between the IA group and the IT department was tenuous. There was only marginal commitment from the department to the project and its implementation. A senior functional executive clarified the problem thus:

> "The study was done outside the IT department. This created a problem. The IT department felt that someone else was doing their work. They had already identified some gaps in the information systems on their own."

The Outcome of the Information Architecture Project

The IA project was generally assessed by the case study interviewees as being a failure. The mismatch between the expectations of senior management and what the IA project finally delivered was identified by some case study interviewees as one of the major factors underlying this failure. Their contention was that while senior management had been seeking solutions to potential IT problems arising from privatisation, the IA project team had been focusing on data problems and IS integration issues within the confines of privatisation. The deliverables of the IA project were hence poorly received. On whether the IA deliverables were of value to BR, a senior IT executive responded thus:

> "I doubt it. I myself have only referred to it (IA project reports) three or four times since last June. The information architecture will just die."

Some of the senior executives interviewed in the case study noted that senior management was not pushing the IA project deliverables as they were unsure as to what the deliverables meant, particularly as regards IT arrangements and preparations for the privatisation. Functional executives were also noted to be uncertain of the deliverables' relevance or benefit to them. A senior IT executive pointed out that the IT department had generally ignored the IA project deliverables because they had become obsolete. He also suggested that the department could be finding it convenient to ignore the deliverables as it did not have a vested interest in the project; the IT department had been involved in the IA project only in secondary roles. The few people who were attempting to use the IA deliverables were those who had been members of the IA project team.

Though the IA project's hard deliverables were thought to be of marginal value, the soft benefits were perceived to be significant. The project was thought by some case study interviewees to have helped in establishing a better understanding on some aspects of IT amongst IT and functional executives. It was perceived to have directed the attention of senior management to some critical issues such as the need for an integrated IT environment in the new rail industry. The IA director felt that the IA project had moved IT up in senior management's agenda. BR's chairman agreed that the IA project process had helped to highlight IT-related uncertainties and risks to the board.

Conclusion

One of the senior consultants involved in the IA project concluded thus:

> "Basically the senior managers were getting frightened of the kind of stuff we were producing. What we lacked was an effective way to model and communicate with the managers. ... A vital lesson learnt is on the importance of communicating effectively to top management. ... We did a lot of work but probably didn't succeed because of this weakness."

The communication issue was raised with BR's chairman[12] during a case study interview. He suggested a set of models: from high-level simple organisational models targeted at top management and reflecting business and strategic issues to low-level models sufficiently detailed for project implementation purposes. He regarded pictorial models as being particularly useful for senior management communication.

The chairman further contended that an information architecture effort must be approached from the organisation's business needs, environmental issues and risks. Retrospectively, he felt that a certain amount of stability in the business was necessary to develop meaningful and valid IA models. The stability must be reflected at least in the clarity of information and business requirements. The chairman's advice was:

> "Wait till things have stabilised before deciding on an industry-wide information architecture (of the type delivered by the IA project)."

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12 IS architecture is not new to BR's chairman. His last position was with Shell Refining (UK) which is very much like Shell Expro in so far as IS architecture is concerned. The chairman's views on IS architecture are thus more grounded than those of the typical chief executive of a very large organisation.

7. Summary of Chapter

This chapter has summarised the six case studies that were conducted to qualitatively investigate the development and usage of information architecture. A pattern for effective IA practice can be discerned from the first five case studies:

* Integration of business planning with IS planning and project implementation.
* De-emphasis of IS planning methodology/technique.
* Focus on management processes and arrangements.
* Usage of simple graphic models in business/IS planning.

The case studies suggest that relevant IA models can help in strategy development and business/IS planning but such models have to be conceived with senior management in focus. Detailed and technical models are generally not relevant to strategy development and business/IS planning tasks but such models are required at the project level. These models are used by IT professionals and others responsible for project implementation. Overall there is a pattern of 'simple to detailed models' correlating with 'business/IS planning to project implementation'.

The British Rail case study provides, from the perspective of unsatisfactory IA experience, evidence supporting the foregoing. The case study further reinforces the need for information architecture to be viewed from a total business setting rather than parochially from perspectives such as data management or application development. In particular, it highlights the need for effective communication with the relevant stakeholders in matters of IS and business planning.

The next chapter will elaborate on these patterns and relate them to the theoretical research model introduced in chapter 5.

Chapter 7: Case Study Synthesis - Theory vs Practice

- Context for Analysis of Information Architecture
- Components of Information Architecture
- IT Architecture and its Relationship to Information Architecture
- Information Architecture's Support for the 'Organisational Approach'

This chapter analyses qualitatively the case study data presented in the last chapter. The data is classified and organised to reflect patterns existing among the first five case studies. British Rail, the sixth case study, is excluded from the pattern recognition task as the organisation was not selected for its exemplary practice of information architecture. However, the organisation's experience in a major information architecture project lends support to the conclusions drawn from the patterns emerging from the first five case studies. These conclusions are examined with reference to the theoretical research model which was proposed in Chapter 5 and reproduced here as figure 7.1 .

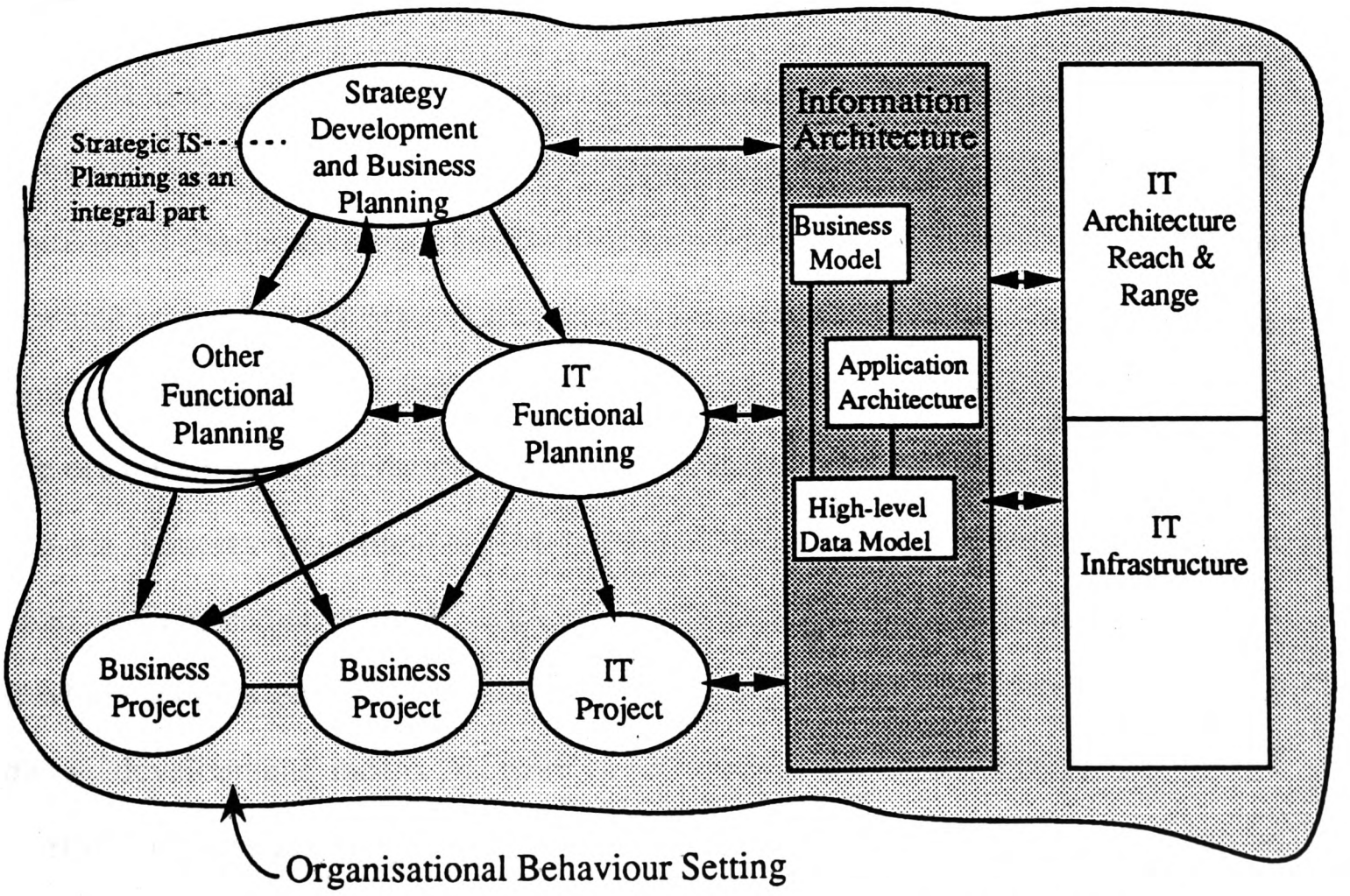


Figure 7.1: The Theoretical Research Model (reproduced from Chapter 5)

Before examining the research evidence, it is useful to take note of some basic facts about the five case study organisations which were selected on the assumption that they were exemplars of IA practice. All five develop and use IAs and are satisfied with their particular IS planning practice and form of IA. Their information architectures include components consistent with those proposed by the theoretical research model. These five organisations thus constitute an adequate sample for meaningful qualitative analysis. The British Rail experience adds an additional dimension to the sample.

1. Context for Analysis of Information Architecture

Information architecture has been proposed as a complement to the 'organisational approach' form of IS planning and the case studies have been conducted on that basis (see the theoretical model, figure 7.1). The research hence needs to analyse IA in the context of the 'organisational approach'. Using evidence from the case studies, the approach is first examined in terms of strategy development and business planning, IS planning and project implementation.

Strategy Development and Business Planning

An organisation's business environment can be described as being 'stable' or 'dynamic' (Burns and Stalker, 1961). A stable environment is predictable and its market and technological conditions remain largely unchanged over time. A dynamic environment is one which is in a constant state of flux and is characterised by competition. The strategy adopted by an organisation relates to the nature and characteristics of its environment. Some organisations define their strategies via 'strategic planning' exercises while others do so via 'strategy development' (Mintzberg, 1994). 'Strategic planning' refers to a formally defined annual exercise which has clearly identified participants and deliverables and which focuses on the company's goals, performance and business environment. 'Strategy development' means that strategy definition is done in an ongoing manner and as part of business planning. The strategy delivered by these two approaches can be categorised as 'deliberate' and 'emergent' (Mintzberg and Water, 1985). Deliberate

strategy is where precise intentions are formulated and articulated by senior management and backed by formal controls to ensure their surprise-free implementation in an environment that is controllable or predictable. Emergent strategy, arising from ongoing business management and operations, is the concerted response of executives from across the organisation to emerging threats and opportunities from the business environment. No organisation relies completely on deliberate or emergent strategy, just as no organisation would confine itself exclusively to 'strategic planning' or 'strategy development'.

In relating the above-mentioned concepts to the case studies, some holistic organisational processes can be noted. Rover, Allied Dunbar and Safeway operate in dynamic business environments. Their strategy development is ongoing and is integrated with business planning. The whole process involves executives from across the organisation. The companies' strategic initiatives tend to emerge in the normal course of business. Rover does have deliberate long-term basic strategies defined in its Quality Strategy matrix (see figure RG1 in Chapter 6) but this serves as a source of reference and does not diminish the significance of emergent strategic initiatives. Allied Dunbar and Safeway do not have such an explicit reference model of their basic strategies. Their basic business strategies[1] are embodied in their company goals and corporate statements. Selected business analysis techniques such as CSF are used by these companies in their strategy development and business planning. Information architecture, in particular business system architecture, features in the holistic strategy development/business planning process in matters of strategic application of IT. This holistic arrangement and its relationship with IA is similar to that depicted in the theoretical research model.

Shell Expro and Thames Water operate in relatively stable industries. Both companies conduct formal strategic planning exercises which vary in some ways in content and approach. Shell Expro's strategic planning is a senior management activity conforming to

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1 Basic business strategy is defined by this thesis as *what* a company should focus on in the pursuit of its business goals.

Shell Group standards. It is facilitated by industry scenario models and delivers deliberate strategies which drive the company's business planning. In the case of Thames Water, due to some competitive pressure there is a certain degree of integration between strategic and business planning. Here there is participation of not only senior management but also functional management in strategic planning. The relatively closer integration of organisational arrangements in Thames Water is particularly evident in its IS planning approach. IS planning is part of business planning in Thames Water whereas it is somewhat consequent to business planning in Shell Expro.

Information Systems Planning

With the 'organisational approach' as a central element of the theoretical model, Earl's (1990, 1993) taxonomy of IS planning approaches (see Chapters 2 and 5) was used to analyse and classify the case study data on IS planning. Some executives from the IT department and functional departments of each of the case study organisations were requested to classify and assess their company's IS planning approach (see Chapter 6). The responses suggest that all five exemplars of IA practice are positive about their IS planning approaches but feel that they could be improved. The companies however maintain that their particular IS planning approach is the right type for them.

IS planning in Shell Expro is an annual exercise with an occasional project and some ongoing effort. It is top-down, formal and 'business led'. The IS planning involves senior management marginally, mainly in matters of finance. Selected IA models and associated techniques are seen as being of value to the business-driven approach but no formal IS planning methodology is used.

IS planning in the other four cases conforms to that embodied in the theoretical research model. It is of the 'organisational approach' type where IS planning is integrated with business planning. (Thames Water has a two-yearly IS planning project complementing this arrangement.) Senior management is as much involved in IS planning as in strategy definition and business planning. From a management perspective, the IS planning

process is similar to planning related to other strategic resources. IT applications are conceived and planned in an ongoing manner within the context of the business. It is done as part of the company's response to the demands of the environment and in relation to other strategic initiatives. The applications are discussed and deliberated upon collectively at the functional level before being included in the formal business planning process. The usage of selected business analysis techniques (e.g. CSF), IA models and management workshops helps to give the overall IS planning process some rigour and structure. This is, however, not via any formal methodology. The following statement from Rover's IT director (IT strategy) on the relevance of IS planning methodology reflects the general thinking amongst the case study organisations on methodology:

> "We don't use a formal methodology in top management planning. Methodology is more suitable for the layers below strategic IS planning. ... A company-wide IS planning via Information Engineering is not a valid thing to do. It would probably take six months and tell us what we already know."

Project Implementation

The theoretical research model prescribes the implementation of an IT application as part of a 'business project'. This is also what the case studies suggest. All five organisations implement their IT applications as business projects regardless of the specific way in which the applications have been conceived or the manner in which the applications are developed and implemented. Shell Expro, Thames Water and Rover prefer to use packages or outsource application development while Allied Dunbar and Safeway seek to develop their software in-house. In spite of this difference, all five companies are unanimous in viewing application implementation as a business effort. This position appears not to be affected by the increasing usage of application development methodologies or CASE tools in these companies. In arguing the case for treating application implementation as part of business effort, Safeway's IT director emphasises:

> "We don't have anything called an IS plan. We have only a business plan and IT is part of it."

The business project approach, though proposed as part of the 'organisational approach' in the theoretical model, appears to be also applicable to other types of IS planning. Shell Expro's IS planning is of the 'business led' type and the company believes in treating application implementation as part of a business project. This is explicitly justified in their "Economic Justification of IT Projects" reference literature:

> "Experience indicates that most successful IT applications occur when IT is treated as just one component of a much larger business project."

Summary of the Context Related to Information Architecture Practice

Figure 7.2 summarises the context in which IA is being practised in the case study organisations. The summary suggests that where the business environment is relatively stable, strategic planning and business planning are separate exercises and strategies tend to be deliberate, with participation in strategic planning being somewhat limited to senior management. Where the business environment is dynamic, strategy development is integrated with business planning as part of an ongoing process, involves executives from across the organisation, and delivers emergent strategic initiatives. These two patterns reflect Burns and Stalker's (1961) 'mechanistic' and 'organic' organisational arrangements and their relevance to stable and dynamic environments respectively.

The theoretical research model relates to the 'organic' arrangement; this relationship is supported by the case study evidence. The 'mechanistic' arrangement is not covered by the theoretical research model. This however does not diminish the importance of the model for IA practice as dynamism is the dominant characteristic of industries today (Peters, 1990, and other business literature). Furthermore, some concepts on targeting of IA which are covered by the research model are also applicable to organisations operating in 'mechanistic' ways.

Case →	Shell Expro	Thames Water	Rover	Allied Dunbar	Safeway
Business Environment	Stable	Stable	Dynamic	Dynamic	Dynamic
Strategy Definition Process	Strategic planning	Strategic planning	Strategy Development	Strategy Development	Strategy Development
Type of Strategy	Deliberate	Deliberate	Emergent	Emergent	Emergent
Participation in Strategy Identification	Limited	Limited to some extent	Extensive	Extensive	Extensive
Nature of Business Planning	Separate activity	Separate activity	Integrated with strategy development	Integrated with strategy development	Integrated with strategy development
IS Planning Type	Business Led	Organisation-al Approach	Organisation-al Approach	Organisation-al Approach	Organisation-al Approach
IS Planning Methodology	None	None	None	None	None
Implement-ation of Application	Business Project	Business Project	Business Project	Business Project	Business Project

Figure 7.2: Summary of Context Related to Information Architecture Practice

The case studies provide support for the 'organisational approach' as the form of IS planning appropriate for integrated strategy development and business planning (see figure 7.2). No formal IS planning methodology is used and there is emphasis on management processes and cooperation. In this IS planning arrangement, IT and other functional level planning activities are ongoing and the annual business planning exercise helps to consolidate this continual effort· Functional level planning, though done largely within departmental boundaries, is a collaborative effort in that the various functions interact and synchronise their business initiatives, proposals and actions. Cohesion

within each function is not at the expense of cooperation between them. The horizontal integration between functions via team effort facilitates the planning and delivery, with minimal complexity, of multifunctional contingent strategies. The cooperation and team approach descends to the project level where application implementations are carried out within business projects.

The above analysis confirms that the majority of the case studies satisfy the target context for study of IA practice. The evidence on information architecture can now be examined with reference to the theoretical research model.

2. Business System Architecture

The results of the case study effort to identify models regarded as being part of information architecture are tabulated in figure 7.3. Of these models, the business system architecture emerged as a pivotal component of IA, giving it a new shape which harmonises with the 'organisational approach' form of IS planning.

Case →	Shell Expro	Thames Water	Rover	Allied Dunbar	Safeway
Business System Architecture	No	Yes	Yes	Yes	Yes
Overall Application Architecture	No	Yes	Yes	Yes	Yes
Detailed Application Architecture	No[a]	Yes	No	No	No
Corporate Data Model	No	No	No	Yes[b]	No
Business Area/ Project Data Model	Yes	Yes	Yes	Yes	Yes

a - Only business area application architecture

b - A few versions of 'corporate data model'

Figure 7.3: Usage of IA Models by Case Study Organisations

Characteristics of Business System Architecture[2]

A business system architecture is a simple pictorial model of how a business system is (to be) implemented. It is used in Thames Water, Rover, Allied Dunbar and Safeway (see figures TW4, RG4, AD3 and SS2 in Chapter 6). The architecture is a macro level depiction of a business system and the integral arrangement of strategic resources, including IT, comprising it. A company's basic business strategy, such as differentiated product or low cost operation, can be implemented in a number of ways. The business system architecture depicts a specific implementation of the basic competitive strategy. The architecture is oriented towards the future. It is unique to the company and is liable to undergo change over time. It can be developed at two levels as has been done in Safeway - an organisation-level business system architecture with a number of focused system architectures. Safeway's explanation of their Supply Chain Architecture (see figure SS2 in Chapter 6) helps to clarify the concept and value of business system architecture:

> "Whilst the concept of process driven businesses is now well understood, it was with some courage back in 1985/86 that Argyll [Safeway's parent company] decided to base its long term IT strategy on an architecture made up of fully integrated processes which crossed all functional barriers. It represented not a set of requirements at that time, but a vision of what food retailing would ultimately become." (Safeway IT Division Objectives and Operating Style information leaflet).

A business system architecture is jointly developed by executives from the functional units involved in a strategy implementation, often under the initiative and coordination of senior IT executives. No special tool or technique is used. The company's goals, critical success factors, key business processes, currently and potentially available resources and basic business strategies are the major inputs. The objective is to produce an integrated model of the proposed strategy implementation for consideration by senior management.

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2 Business System Architecture is discussed in some depth as it is being introduced here for the first time and is a major item in the contribution of this thesis.

Attention is paid to simplicity, business-oriented content and aesthetics, taking into consideration the architecture's target recipient. The business system architecture is walked through during strategy development workshops/presentations. Senior management as a group is able to discuss and deliberate on strategy implementation options by referring to the architecture and holistically considering all strategic resources including IT. In this way, senior management contributes to the architecture and helps to update and finalise it as a blueprint for implementation.

The business system architecture as described here is not a model normally used in Shell Expro's IS planning. Context diagrams and data flow diagrams are instead used to model IT applications and their scope and contributions to the business; these models have been found to be sufficient. The absence of business system architecture is reported not to have handicapped the company in its planning and implementation of IT applications. Shell Expro's experience seems to suggest that perhaps a business system architecture is not a necessity for business-driven IS planning.

Organisational-level Business Processes and Models[3] of Industry

Though Shell Expro does not employ business system architecture in IS planning, the company uses sophisticated models and concepts in strategic business planning as well as IS planning. Shell's usage of scenario models in long-term strategic planning is well-documented (Johnson and Scholes, 1993; Wack, 1985a, 1985b). Thames Water's industry model, based on Porter's (1980) Competitive Forces concept (see Chapter 6, figure TW2a), is less sophisticated than Shell Expro's scenario models and is regarded as being only of marginal use to senior management. The other three 'exemplar' case study organisations do not use industry models. They maintain that it is of little use to them in their 'organic' form of strategy development/business planning.

3 Though industry models and organisational-level business process models are not regarded as being part of information architecture, they are discussed briefly to position them in relation to IA.

Shell Expro, Thames Water and Rover have organisation-level models of their core business processes (see figures SE2, TW2b and RG3 in Chapter 6). The business process model is conceptually based on the life cycle of the company's primary product(s); Porter's (1985) Value Chain is a reference frame for the model. The model is often the result of IT's efforts and is intended for senior management use. It may be occasionally referred to during strategy development/business planning, often on the initiative of the IT head. The model is not seen as an IA or a part of it as it is neither a blueprint for IT application implementation nor an IS planning tool per se.

CRUD Matrix and Business System Architecture

British Rail's IA project did not deliver a pictorial business system architecture of the type described herein. It did however deliver various CRUD matrices. The CRUD matrices were used in management discussions and workshops but were poorly received by their recipients. A senior IT executive clarified his experience thus:

> "It [CRUD matrix] is great as an analysis technique but is difficult as a means for getting people involved. They were not with it. People couldn't understand 'entity'. They encounter difficulty when relating 'entity' to real life things. They wonder what creating an entity means."

This evidence suggests that a CRUD matrix is perhaps not a suitable means for getting management and functional executives involved in IS planning. The comments from British Rail's chairman and senior executives who were interviewed indicate that a business system architecture could have helped and would have been more favourably received. An example of a business system architecture from one of the other organisations was shown to the chairman to obtain his view. His response was:

> "It's good. It's very operationally oriented. What is important is that it stands on its own right without becoming bigger and bigger until it becomes complex."

Shell Expro's experience with CRUD matrices was similar to that of British Rail. The Level 2 and 3 EP Business Models - complex CRUD matrices - were poorly received by functional management and executives. The models were not seen as being relevant to senior management. The main users of these models were information planners and the data management group in the IT department. The models were in their early stages of introduction and perhaps with time more executives might use them. The comments from the case study interviewees however suggested that these executives were likely to be from the IT area rather than business functions.

Value and Usage of Business System Architecture

Thames Water, Rover, Allied Dunbar and Safeway view the business system architecture as a useful tool to conduct the 'organisational approach' form of IS planning where IT influences and is influenced by other strategic resources. These companies see the business system architecture as a tool for planning holistic responses to the competitive demands of the business. The model's characteristics (simple, pictorial, etc.) are seen as being conducive for this task, particularly in relation to senior and functional management involvement. The following comments reflect the commitment of these organisations to the business system architecture concept:

> "We need to have a very good understanding of the business and where it is going. The architecture is a way for us to model and articulate this requirement. Everybody understands it, including the chairman." - IT director (Safeway)

> "I genuinely feel for the first time that I can take something [a pictorial business system architecture] to a user and talk." - a senior IT manager (Allied Dunbar).

> "Pictures - that's why it's good. Pictures bring it more to life. They are effective. The model looks more human." - a senior functional executive (Allied Dunbar).

"Discussing IT strategies with the board essentially involves painting pictures to them. I have been surprised at the impact of simple pictures and models." - IT director (Rover).

"Senior management doesn't have time to read specifications and large documents. ..... I want to see a one-page specification." - a board member (Thames Water)

The business system architecture, as elucidated in the case studies, is a tool for the various functions including IT to collectively vision, conceptualise and propose one or more alternatives for implementing a basic strategy. IT applications are conceived in the context of the business by recognising currently and potentially available technologies as indicated by the IT architecture (see below). No formal methodology is used in this task. The business system architecture provides a means and rigour for management deliberation, contribution and approval on strategy. It later becomes an approved blueprint for the various relevant functions to collectively discuss, plan and deliver the strategy. It can in this way be an important vehicle for horizontal integration of functional effort. The architecture is shared by the functions involved and provides a basis for them to develop their own function-specific blueprints and/or plans in harmony with those of others. In the case of the IT function, its function-specific (but organisation-focused) blueprint is information architecture, part of which is the shared business system architecture.

The theoretical research model (figure 7.1) includes business models as part of an IA. The case study evidence points to the business system architecture as that business model. Though IBM (1992), Texas Instruments (1992) and some others define a business system architecture in the form of matrices, the case studies favour a pictorial model. The case studies suggest that a CRUD matrix is generally not perceived by senior and functional management as a business model. Of the six organisations, only two had CRUD matrices and the experiences of their management and functional executives with CRUD matrices were negative. On the other hand, senior management's response to the pictorial business system architecture was generally reported to be positive across all the

case studies. This general observation was also found to hold true in the researcher's interactions with senior executives on business system architecture issues in the case studies.

3. Application Architecture

As shown in figure 7.3, two types of application architecture (AA) models were found in the case studies: overall application architecture and detailed application architecture. Though they are structurally the same, they differ in their development, content, purpose and usage. The overall AA focuses on the whole organisation and shows at a macro level the major IT applications and their inter-relationships. The detailed application architecture focuses on a particular application and depicts its major sub-applications and their inter-relationships.

Overall Application Architecture

Shell Expro does not have an overall AA for the whole company. A senior IT executive pointed out that the company had a large number of applications (in excess of 600), making it difficult to develop an organisation-wide AA. Perhaps the need for an overall AA does not arise in Shell Expro because its top management is not fully involved in IS planning and IT matters.

Thames Water, Rover, Allied Dunbar and Safeway, on the other hand, each have an overall AA in spite of their large number of IT applications (see figures TW5, RG5, AD4 and SS4 in Chapter 6). The architecture relates to the IT applications depicted in the set of business system architectures. The overall AA shows active and planned applications. It is unique to the company and evolves with implementation/modification/replacement/ retirement of major applications. Being targeted for presentation by the IT department to senior management, the overall AA employs little syntax, is graphic and seeks to be simple. It is positioned as an IS planning tool. It is of some value at the project level for planning and scoping of applications but is of little use in actual application development tasks. The architecture is developed and maintained by the IT department, as part of

functional level IT planning, using information on existing and new applications and the inter-relationships between all the applications. No special tool/technique is used to do this. The following comments from two interviewees reflect how the overall AA is being perceived by the case study organisations :

> "It [overall application architecture] helps to establish our understanding of systems so that we can influence and inform users and managers on application issues."
> - a senior IT executive (Allied Dunbar).

> "The highly complex nature of the business and the integration needs between separate business units means application architecture is important."
> - IT director (IT strategy, Rover).

British Rail's IA project delivered an industry-wide application architecture and a number of overall AAs for each of the component bodies in the to-be-privatised rail industry. Each of these models were presented in a CRUD matrix setting (see figure BR1, Chapter 6); they were poorly received by senior and functional management. British Rail's IA experience supports the message emerging from the other case studies: it is not just sufficient to develop an overall AA but it is equally important that the model is attuned for use by its target recipients. (See Chapter 5, where Drucker's arguments on this communication matter are discussed.)

It is pertinent to recall at this point that the IA survey found AA to be of value in IS planning. The survey proposed an overall AA as a tool for the IT department to use in its communications with senior management on IT applications (see Chapter 4). The case studies have found that organisations engaged in effective 'organisational approach' form of IS planning use an overall AA in addition to the business system architecture for management communications. The IA survey results and case study evidence together support the theoretical research model. A properly conceived overall AA, with senior management as the target recipient, can serve as a tool for the IT function to inform

senior management on IT's role and overall contribution to the business. Senior management's involvement in IS planning is thus further facilitated.

Detailed Application Architecture

Some differences were found in the development and usage of detailed AAs amongst the case study organisations. Thames Water has a detailed AA for each of the applications depicted in the overall AA (see figure TW6, Chapter 6); the company's detailed AAs result mainly from the ISP projects conducted every two years. Safeway does not develop detailed AA as part of its IS planning. Neither does Shell Expro. Shell Expro, however, develops business area application architectures as part of its standard ISP practice. Allied Dunbar has expanded its overall AA for technical planning purposes (see figure AD5, Chapter 6) but no detailed AA for individual applications is developed during normal IS planning. Rover does not develop detailed application architectures as a standard ISP practice but has developed a detailed AA and a business area AA in a focused IS planning exercise. More recently, Rover and Allied Dunbar have found it necessary to occasionally conduct focused ISP exercises confined to selected business areas. Such an exercise seeks to deliver detailed AA(s) in addition to the business area AA and data model.

A glance at figure 7.3 may convey the (perhaps wrong) message that detailed AA is not a useful model. Comments were, however, consistently made in all the case studies that the detailed AA could make a positive contribution to IS planning practice, particularly in linking the planning to project implementation. An IT executive from Rover expresses the need for a detailed AA thus:

> "We need a planning layer with more detail. We need a model for proceeding from planning to project implementation."

If it was that useful, why was it not being developed as part of standard ISP practice? The answers from Rover, Allied Dunbar and Safeway were that their 'organisational approach' form of IS planning did not provide for development of detailed AAs. Their

ISP practices focused on management involvement, for which the detailed AA was regarded as being irrelevant. In the case of Shell Expro, the company's ISP practice did not stipulate the development of detailed AAs but personnel at the project level felt that it would be useful. These four companies generally satisfied their detailed AA requirements by developing high level data flow diagrams at the outset of application development.

The experience in Thames Water and, to a limited extent, in Rover was that readily-available detailed AAs were of value in integrating IS planning with application development. Their experience and the general view of interviewees from all the case studies suggest the following on detailed AA development and usage:

- The detailed AA is a specification prepared by IS planners, or others with IS planning responsibility, as part of IS planning for the application development team; it is hence not presented to senior management.

- It may be developed at the outset of a project if one is not delivered by IS planning for the application related to the project.

- It is developed with the overall AA and business system architecture as two key inputs; the relevant business area AA is also used if it is available.

- The detailed AA is graphic, internally focused and unique and can involve some changes prior to or during its usage.

- It is based on the syntax (typically data flow diagramming) which is associated with the organisation's application development methodology. This feature offers the potential for a detailed AA to be developed with a CASE tool.

The IA survey proposed that a detailed AA developed in IS planning would be useful for integrating the planning with project implementation. The case studies convey a similar message. Both these items of evidence support the theoretical research model in its advocacy of (detailed) AA to integrate IS planning with project implementation.

4. High-Level Data Model

The overwhelming message on data modelling emerging from the case studies is the emphasis on business area/project level data model and the lack of support for corporate data model (see figure 7.3). While all five companies have business area/project data models (see figures SE3, TW7, RG7 and SS5 in Chapter 6), only Allied Dunbar has a corporate data model[4] (CDM) in addition to business area/project data models. Depending on the situation, Allied Dunbar uses one of a number of organisation-wide data models to satisfy its corporate data modelling requirements. (See figure AD6 in Chapter 6 for an example of one of these organisation-wide data models.)

Corporate Data Model

The general experience of the case study organisations is that the effort required to develop a CDM outweighs the benefits it offers. The CDM is seen as complex, detailed, subject to changes, IT-oriented in terms of syntax and form, conveys information on internal hard data, does not inform on applications and is irrelevant to senior management. The absence of a conventional CDM is reported not to have affected the planning or delivery of satisfactory applications and integrated databases in these organisations. Reproduced below are some comments from case study interviewees which convey their general perceptions of CDM:

> "It [CDM] is of no real use to me. It is more of a distraction." - a functional head (Allied Dunbar)

> "I struggle to see its [CDM's] value as a business modelling tool. I doubt that it'll influence the business direction." - a senior functional manager (Allied Dunbar)

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4 In the selection of case study organisations, conscious effort was made to ensure that some of them had a CDM. The completed survey questionnaire proved useful in this regard; Allied Dunbar, Rover and Shell Group reported usage of CDM. It emerged during the case studies that only Allied Dunbar viewed corporate data model in the conventional way.

> "A corporate data model has to cross system boundaries, and frequent renewal makes it of little value. ... It should not be part of ISP. It tends to shift focus from business to technique if done as part of ISP." - principle data management consultant (Shell Group, Shell International Petroleum Co. Ltd., London).

> "I don't feel that you can use a data model to drive business decisions. It becomes very much of an intellectual exercise." - a senior IT manager (Safeway)

> "Senior management is more comfortable with business process models. Even if a data model is presented, they'll put a process on it." - a senior IT manager (Rover)

"Data modelling is too much of a purist view" is how a Thames Water senior IT manager with more than 20 years of IT experience sees corporate data modelling. He maintains that "corporate data modelling has caused some damage" by delaying implementation of applications, posing constraints and advocating impractical database integration. In pointing out that his company had spent £0.25 million on a futile corporate data modelling effort in 1989, he concludes:

> "Consultants tell us to build a corporate data model. So do our IT professionals. But I have grave doubts about its usefulness. There is no real evidence over the last five years that a corporate data model would have increased the success of information system implementation in Thames Water. There has been intensive systems development over the last five years but there's no evidence at all that we have done anything drastically wrong that could have been corrected or avoided if we had a corporate data model."

British Rail's corporate data modelling effort in the IA project is also reported to be a failure. The industry-wide corporate data model (see figure BR2, Chapter 6) delivered by the project was poorly received, seen as being overly complex and inaccurate, and ignored by functional executives and even IT professionals. One of the consultants engaged in the project recalled his observation when the CDM was presented to functional executives and management:

"Many people withdrew in horror when the ERD [CDM] was presented to them."

As the case study evidence on corporate data modelling was one-sided, some effort was made to locate a corporate data modelling success story (see Chapter 9 for a brief discussion on the effort); there was little success. The Shell Group is regarded in some quarters as an exemplar of successful corporate data modelling practice. The findings of this research, however, suggest differently not only for Shell Expro but also for the Group. This is evident in the following response from the principle data management consultant (Shell Group, Shell International Petroleum Co. Ltd., London):

> "We find data models are not a good communication vehicle for top management. This is because managers like to see a view with all the business rules included. Our data models are very generic and not easy to understand."

The case of Rank Xerox UK is also worth mentioning as it was once identified as an exemplar of Information Engineering practice (Davenport and Short, 1990; Denning and Taylor, 1988). A recent paper by Davenport (1994, p. 124) conveys what is appearing to be a familiar story about corporate data modelling:

> "Xerox did data modeling and administration for 20 years, but in the words of the director of information management, 'We got nowhere.' These initiatives were driven by IT rather than by senior business managers; they were always abandoned in favour of specific development projects."

Shell Expro, Thames Water, Rover, Allied Dunbar and Safeway feel that their business area data models effectively serve data management requirements such as data sharing and integrated database implementation, the traditional domain of CDM. Rover and Safeway consider the practice of data management standards with the aid of a data dictionary as a way to enhance the effectiveness of the business area data model set in its corporate data modelling role. The message emerging is that a CDM is not essential or even advantageous, and that data management and integrated database development requirements could be satisfied adequately by an organisation's set of business area data

models coupled with a data dictionary and data management standards. James Martin, the guru of Information Engineering, expressed his thoughts on corporate data modelling and business area data modelling in an interview a few years ago. His views are in synch with the practices and experiences of the case study organisations (Ross, 1988):

> "Ten-plus years of experience with Data Administration clearly indicate that it would be virtually impossible to create a single data model for a very large enterprise. For this reason, information engineering calls for breaking the enterprise into pieces that are small enough to be practical for developing the data models required. This must occur at the analysis level, where modeling of this type takes place. I therefore emphasize business area analysis .... it's sufficiently small to produce a data model."

Business Area/Project Data Model

The case study organisations are unanimous in their support for business area/project data models. A business area data model is often developed at the outset of a project and serves as the project data model, hence the concatenated name 'business area/project data model'. The typical data model is developed by the project team which has primary interest in it. The development is done in consultation with the company's data management group. An appropriate application/database development methodology and a CASE tool, endorsed by the organisation, are used to develop the data model. The main inputs to this task (as experienced by Thames Water, Rover and Safeway) are relevant business models, business system architecture and application architecture, depending on the availability of these models. Allied Dunbar uses the relevant organisation-wide data model in addition to these models to perform this task. In the case of Shell Expro, true business area data models (the EP Data Model) are developed separately at the Shell Group level, and project data models are derived from them at the outset of projects.

The business area/project data models of these companies are characterised by logical data modelling syntax, hard internal data specific to the business area/project, high accuracy, preciseness, detail and complexity. The data model is meant for business

area/project database development, integration of company databases and data management. It is used in the scoping and planning of project work related to application development. The data model's value to application development, in particular to the application development team, is reflected in the following comments:

> "Even if it [CDM] had existed, it wouldn't have helped that much. What my team needed was a project-level data model." - a project manager, Thames Water.

> "It [business area/project data model] prevents re-invention of the wheel and enables the team to work in the same direction." - a senior IT executive, Allied Dunbar.

The theoretical research model includes high-level data models as part of an IA. The case studies suggest business area/project data models to be these high-level data models. The conventional inclusion of corporate data model as part of an IA is not supported by the research evidence. The business area/project data models are perceived to be sufficient to meet the high-level data modelling requirements of project scoping, application/database development and data management. The case studies further suggest that these data models should be developed taking into consideration the organisation's application/ database development methodology, techniques, tools and standards.

5. IT Architecture's Linkage to Information Architecture

In proposing the theoretical research model in Chapter 5, Keen's (1991) approach to IT architecture was chosen to study the relationship between IA and IT architecture. IT architecture was defined as dealing with technology reach and range concepts, while IT infrastructure was understood as the implementation of the IT architecture. Incorporated in the theoretical model was the understanding that IT architecture related to the technologies potentially available (allowed) for implementing an IA, and IT infrastructure specified the technologies readily available for implementing the IA.

Broad IT Architecture Issues

In seeking to understand the relationship between IA and IT architecture, senior IT executives in the five exemplar case study organisations[5] were asked to describe their IT architecture. The IT executives from four of the organisations started off by referring to their installed vendor-based IT infrastructure while the executive from the fifth, Shell Expro, described his company's IT architecture in conceptual terms along the lines of reach and range. These responses reflect the existence of two forms of IT architecture amongst the case study organisations (see figure 7.6). There were some similarities between the two forms: both endorsed Open Systems, client-server architecture and GUI as important technologies; implementations (the IT infrastructure) of both were via strategic relationships/negotiated arrangements with selected vendor(s).

Case →	Shell Expro	Thames Water	Rover	Allied Dunbar	Safeway
Dominant Approach	Deliberate, Top-down	Emergent, Bottom-up	Emergent, Bottom-up	Emergent, Bottom-up	Emergent, Bottom-up
Basis	Group level requirements	Based on Information Architecture	Based on Information Architecture	Based on Information Architecture	Based on Information Architecture
Platform	Based on selected vendor platforms	IBM mainframe centred	Distributed architecture biased to Digital plat-form. Also other selected platforms.	IBM mainframe centred	IBM mainframe centred
The Relevant Information Architecture Model	Application Architecture	Business system architecture & application architecture	Business system architecture & application architecture	Business system architecture & application architecture	Business system architecture & application architecture

Figure 7.4: IT Architecture and its Relationship to Information Architecture

5 BR's IA project recommended the adoption of CCTA's Open Systems framework (MUSIC) as the foundation for the new rail industry's IT architecture. No reference was made to the IT architecture in the development of the IA and vice versa. The status of this recommendation was not clear.

Deliberately Planned IT Architecture

Shell Expro's IT architecture is deliberately planned in a top-down manner at the Group level by recognising the Group's need for maximum global reach and range of technology. The technology decisions are based on the Group's objective to sustain its position as a major player in the global petroleum industry. The decisions recognise existing IT investments and resources, emerging technologies and technology direction. The reach and range recommendations are continually reviewed and updated in the light of business decisions, events and trends and progress in technology. A set of vendor platforms and technologies have been identified to facilitate and harmonise technology implementations across the Group - the "Harmonised Target Environment". The IT architecture recommendations and reach and range specifications cover all Shell companies, facilitating the inter-linking of their computing systems and sharing of IT resources and information across the Group. Shell Expro complies with the Group's decisions on technology; its IT infrastructure is implemented according to Group IT standards.

Shell Expro's information architecture includes a set of business area application architectures (based on the EP Business Model) and a set of business area data models (EP Data Model). The data models are 'logical' in nature and do not depict technology elements. The business area application architectures however are influenced by the company's IT infrastructure on the technologies and resources available for implementing the applications depicted in them. When new technologies and hardware/software resources are required for implementing an application in the IA, these are acquired subject to what is allowed by the "Harmonised Target Environment." The technology aspects of Shell Expro's IA are thus largely driven by its IT architecture. The influence of IA on IT architecture is via feedback and input from Shell Expro to the Group IT function based on the subsidiary's technology experience and unique technology requirements related to its IA.

Emergent IT Architecture

The IT architectures of Thames Water, Allied Dunbar and Safeway are centred on IBM mainframe technology while Rover's IT architecture has a distributed structure with a bias to Digital platform. Conceptually, the IT architectures of all four companies are similar (see figure 7.4). The architectures are based on IT platforms selected on the basis of the technology requirements of critical strategic applications. In this respect, the architectures could be considered to be emergent, having been developed bottom-up using the information architectures related to those strategic applications. The typical list of criteria used in the selection of a platform is as follows: the fit of the platform to the requirements of the critical strategic applications; the long-term business requirements of the company and potential IT applications; the quality of the technology in terms of its maturity, general assessment, openness and sophistication; features of the platform in relation to reach and range matters; reputation of the vendor. The IT infrastructures of these companies have grown, and include products from other vendors and technologies other than those normally associated with the chosen platforms. The growth of an IT infrastructure and enhancement of its associated IT architecture are guided by the core technology. Only technologies and IT products which can be phased in with the core technology are normally considered for adoption/implementation. The four case study organisations maintain that their approaches to IT architecture have not limited them in satisfying the IT requirements of their business or in enhancing the sophistication and quality of their IT infrastructure.

The IA models which are particularly relevant to IT architecture in these companies are the business system architecture and application architecture. Technology which is allowed by the emergent IT architecture, in terms of its reach and range dimensions, help in the identification and selection of new technologies and hardware/software resources for implementing the applications depicted in these models. Where the issue of new technology or resource does not arise, the IT infrastructure defines the technologies and

resources available for implementing the applications. There is thus a cycle on how IA influences and is influenced by the IT architecture and IT infrastructure.

IT Architecture Models

The five case study organisations have two main types of IT architecture models: network architecture and computing system models relating to reach and range respectively. An organisation's network architecture depicts the networking arrangements for inter-linking its computing systems regardless of location or type (see figures TW8, RG8, RG9 and AD7 in Chapter 6); the architecture is defined in terms of communication protocols and technologies. Computing systems are typically classified as work-station, departmental/specialised system and central system and are modelled as a loose coupling of technology components (see figure RG10 in Chapter 6). The loose coupling philosophy is also extended to the inter-linking of individual computing systems.

Though IT architecture is a technology matter, it nonetheless has stakeholders beyond the IT domain, in particular senior management; Keen's (1991) call for senior management involvement in IT matters is relevant here. Technology discussions with senior management need to cover IT reach and range issues and IT infrastructure but without being too technical. The case study organisations use conceptual models of network and computing system for this purpose. A conceptual network model is a high-level graphical model which depicts the company's main computing systems and their linkages (see figures TW8, RG8 and AD7 in Chapter 6), while a conceptual computing system model shows the loose coupling of integral system components (see figure RG10 in Chapter 6). Both these models together help in presentations to management on technology strengths, limitations, potentials and direction, and how these relate to the applications depicted in the business system architecture and application architecture.

6. Discussion: Information Architecture and Organisational Approach

The theoretical research model places information architecture as a complement to the 'organisational approach' form of IS planning (see figure 7.1). One of the tenets of the

theoretical model is that an IA is not a single model but a set of models which should be appropriately targeted and developed (with the target in focus) for it to serve this holistic requirement. The case studies have helped to elucidate this matter.

Components of Information Architecture

The case studies suggest that in an 'organisational approach' IS planning arrangement, the IA should consist of business system architecture, overall and detailed application architecture, and business area/project data model. These models are different in appearance and content but are inter-related. They are not just relevant to an IS planning exercise but are developed and used in an ongoing manner from business/IS planning to project scoping/planning by different teams of people with complementary purposes.

Each IA model has targeted users and serves specific purposes. The business system architecture serves to link the organisational level strategy development and business/IS planning with the functional level planning of IT and other functions. Functional level planning is the source and final destination of business system architecture. The architecture, serving as an overall blueprint for the whole business project, also helps to link business/IS planning to project scoping/planning. While the business system architecture models horizontal integration of functional resources and activities (including those of IT) in the delivery of a strategy, the overall AA depicts the integration of major IT applications for delivering the organisation's integrated information system. This feature of the overall AA makes it a useful tool for informing senior management on IS integration and the IT department's contributions to the organisation. The applications depicted in the overall AA are modelled separately into detailed application architectures. Though conceived during IS planning, a detailed AA is geared towards application development. The business area/project data model is also geared towards application development and, more specifically, database development. It is, however, typically developed during project scoping/planning.

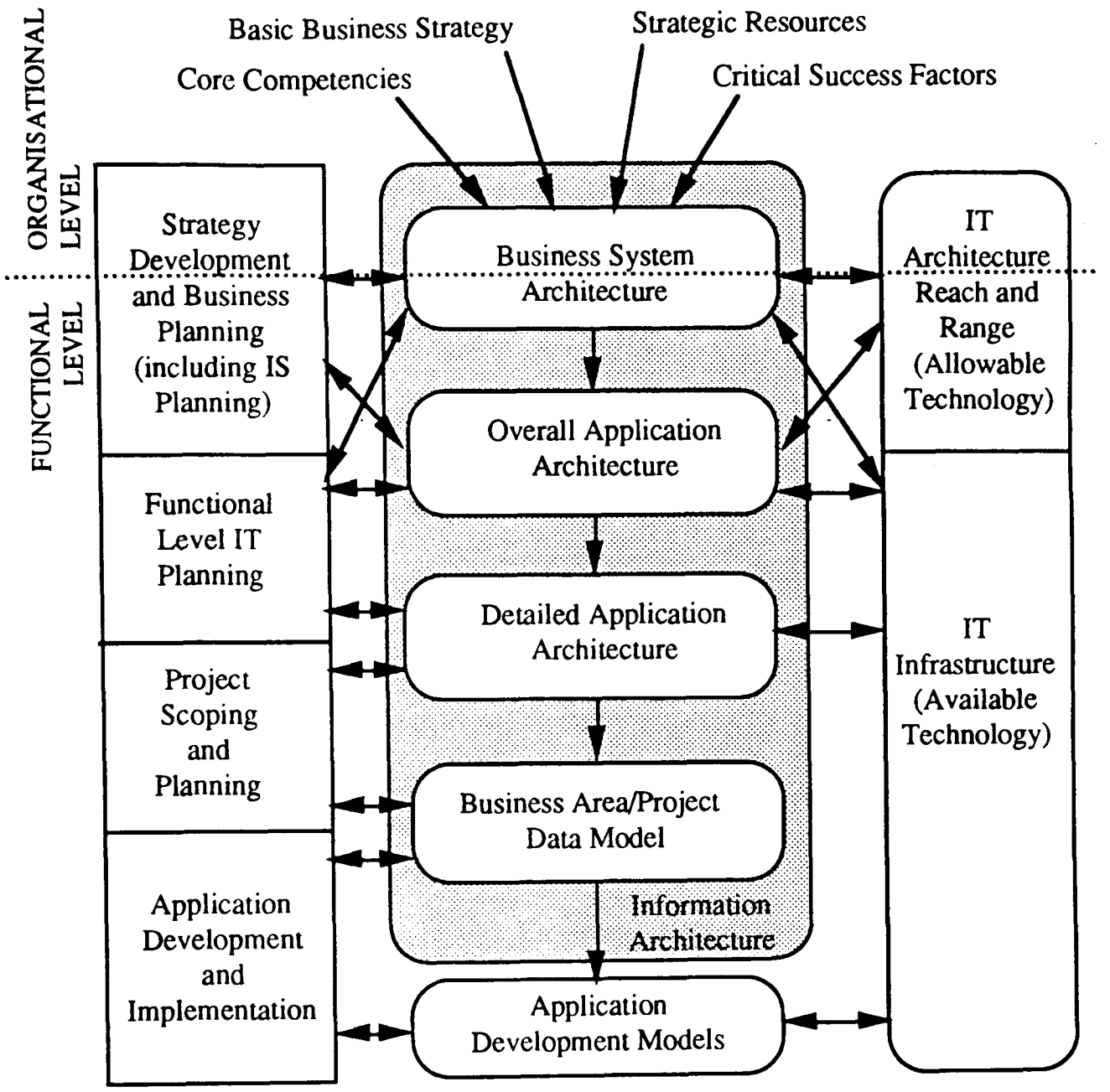


Figure 7.5: Information Architecture/IS Planning -The Emergent Framework

Integration Role of Information Architecture

It can be concluded from the above discussion that there is a set of hierarchically related IA models supporting all the main activities from business/IS planning to project implementation. A model spans at least two activities (see figure 7.5) and is developed in one activity for use in another activity. The set of models, when appropriately targeted and developed, help to vertically integrate activities from strategy development and business/IS planning to application development. The roles played by the business system architecture, application architecture and business area/project data model in various forms of horizontal integration - integrated functional effort, integrated IT applications and integrated databases respectively - have been clarified earlier. Vertical and horizontal integration is central to the 'organisational approach' form of IS planning

(see Chapter 5, figure 5.9), and the case study evidence supports the proposition that information architecture facilitates this integration.

The basis and practical implications of this proposition are modelled in figure 7.5. The figure shows the hierarchy of models and how they relate to the various activities in the 'organisational approach' form of IS planning.

A company's basic business strategy together with the inventory of strategic resources, core competencies and critical success factors serve as key business inputs for developing a business system architecture. These inputs are considered in the light of technology as defined by the company's IT architecture and infrastructure. The business system architecture provides a means for the company's functional units to collectively depict the strategy which they will deliver as a team. A few business system architectures, one per strategic initiative, are thus developed. A business system architecture is relevant to all participating functions. Hence it is not only part of an information architecture but is also part of other functions' plans and blueprints.

In addition to the business system architecture, the IA includes the overall and detailed application architectures and business area/project data models. These latter models are unique to the IT function and serve as blueprints for planning, developing and delivering IT applications consistent with the business system architecture. The models are complementary, serving specific purposes which range from management tasks at the business/IS planning level to technical tasks at the project level. At the application development level, the IA is replaced by application development models (data flow diagrams, logical data models, etc.) which are not part of an IA but which can potentially inherit relevant planning information from the IA.

The IT architecture, defined in terms of reach and range, provides information on technologies allowed by the company's technology plan. This information is necessary for identifying new technologies or technical resources in respect of an IT application. The IT architecture is consulted in the course of developing the business system

architecture and overall AA. New technologies identified in this manner later cause the IA to impact the IT architecture and infrastructure. Information on available technologies and resources, as defined by the IT infrastructure, is considered in the development of the business system architecture and overall AA. There is a two-way relationship in how IA and IT architecture/infrastructure influence each other, though in the first instance it would have likely been the IA which would have determined the core, characteristics and standards of the IT architecture and led to its emergence. This relationship and the specific manner in which it operates further helps to increase the effectiveness of IA as a complement to the 'organisational approach' form of IS planning.

7. Summary

This chapter has analysed data from six case studies. The main message which has emerged relates to IA's role as a tool for integrating business/IS planning and implementation and for serving the various related communication needs. The need for targeting of IA models in this regard has been identified as an important consideration. The consequence of improper targeting has been clarified with reference to British Rail's IA experience.

The evidence from the case studies and IA survey support the theoretical research model in its positioning of IA as an integral part of the 'organisational approach' form of IS planning. The validated research model is expanded in the next chapter into a comprehensive framework for information architecture practice.

Chapter 8: Framework for Information Architecture Practice

- Business System Architecture
- Application Architecture
- Business Area/Project Data Model
- Characteristics of Information Architecture Models
- Generic Information Architecture
- IT Architecture
- IS Modelling Tools and Techniques - Some Current Issues
- Information Architecture: The Parallel in Architecture and Engineering

A theoretical research model for the practice of holistic IS planning with the aid of an information architecture was proposed in Chapter 5. The research model was validated in the last chapter with evidence from the six case studies and the IA survey. The case study analysis concluded with an emergent information architecture/IS planning framework which shows how IA helps to integrate business planning/IS planning, functional level IT planning and project planning/implementation (see figure 7.5, Chapter 7). This chapter seeks to progress from analysis of research data to propositions for practice. The chapter proposes a normative framework for information architecture development and usage (see figure 8.1). The framework, based on the empirical work and extant literature relevant to IA, is derived from the merger of the validated theoretical research model and IA/IS planning model from the last chapter. The framework and associated propositions are discussed below, noting that overall aspects have been explained in Chapter 7 and that some repetition here is inevitable for coherency of discussion.

The framework is particularly applicable to organisations which view IT as a strategic resource that has to be effectively exploited. At the core of the framework is holistic IS planning and implementation. Of the factors related to both IS planning/implementation and IA, organisational behaviour is seen as the most relevant and significant, hence the framework's focus on organisational behaviour. The time and scope of this study has not

permitted explicit consideration of other factors in the research. Nevertheless, the importance and significance of factors such as organisational politics, culture and structure are recognised. Though these factors have not been explicitly addressed, they have been considered indirectly. The study into organisational behaviour issues, in examining management behaviour, communications and requirements, indirectly addresses organisational politics, culture and structure. Earl's (1990, 1993, 1994) 'organisational approach', the foundation on which the framework is built, gives due consideration to these factors.

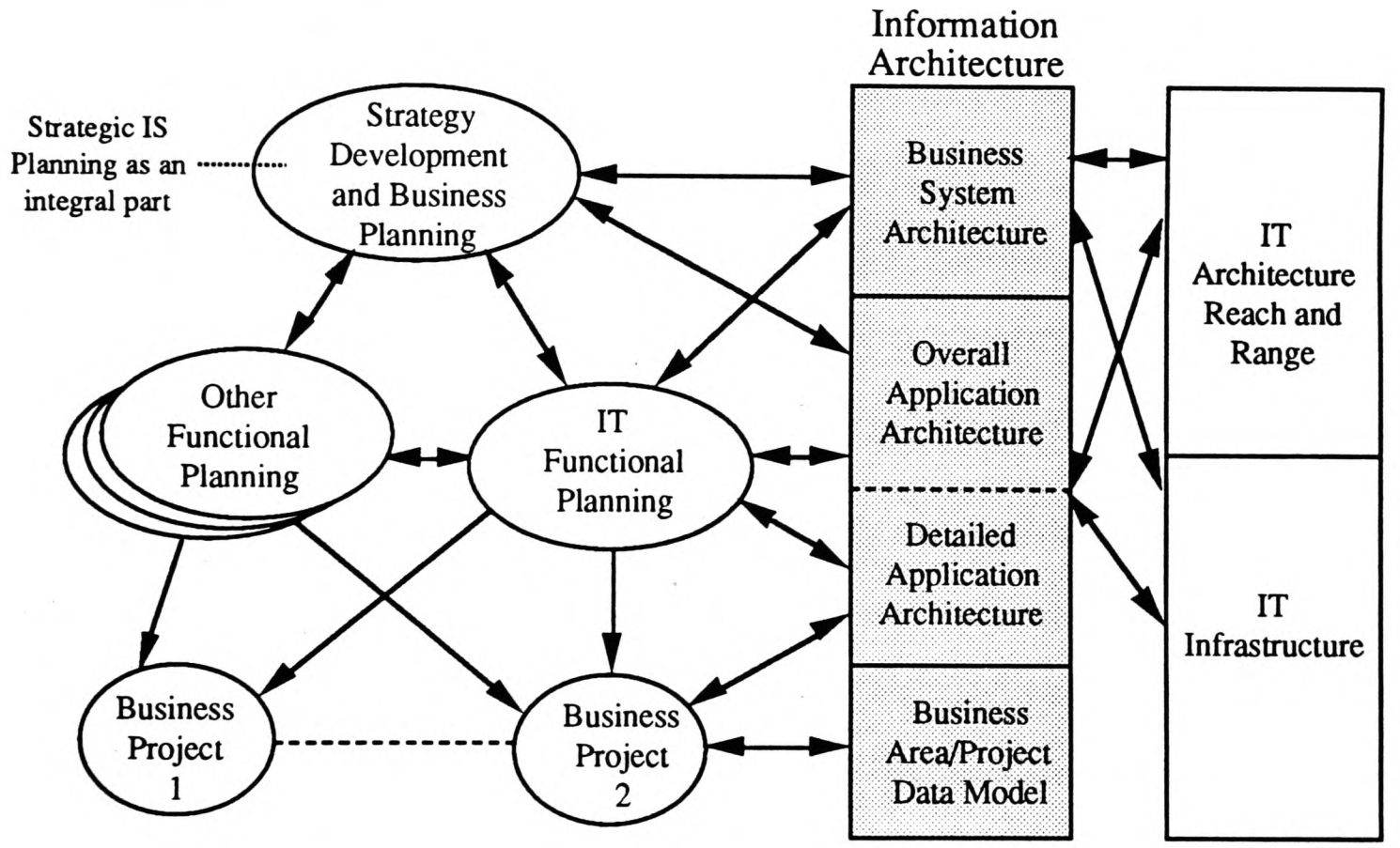


Figure 8.1: Framework for Information Architecture Development and Usage

The IA development and usage framework shown in figure 8.1 is grounded in research and theoretical evidence. Nevertheless it is useful to examine the framework in the light of a recent ISP paradigm, such as that of Ciborra (1992), to assess the framework's robustness and validity. Ciborra argues that strategic IT applications should emerge from the grass roots of an organisation - out of "end-user hacking, computing and tinkering". He contends that innovative applications will be entrenched with the specific culture of the organisation. He concludes that strategic IT applications should be sought in the theory and practice of incremental and radical organisational learning and innovation. A

review of the initial and final development of the framework (see Chapters 5 and 7) and the research evidence (see Chapters 6 and 7) together show that the framework does address Ciborra's arguments and conclusions.

As shown in figure 8.1, the framework depicts IS planning activities at three levels: strategy development and business planning (with strategic IS planning as an integral part); functional level planning by IT and other functions; business projects[1]. These three levels of activity are integrated vertically and horizontally. It is not feasible to comprehensively define an activity at a level without reference to the other levels. Reference also has to be made horizontally to at least a few business functions particularly when it is a high-level activity. The framework positions information architecture as a means to achieve this integration. The IA required for this integration includes a set of business system architectures (one per business system), an overall application architecture, a set of detailed application architectures (one per IT application) and a set of business area/project data models (one per business area/project).

The IA components are progressively developed in an inter-linked manner with contributions from all levels of management. This team-approach helps not only in developing IA models which are better understood and accepted but also in collectively evaluating and ensuring the quality of the IA models. The IA components, particularly the business system architecture and application architecture, are evaluated by relating them to the business strategies and plans. Reference to generic architectures (see below) and industry norms as regards IT application is also of relevance to the evaluation effort.

1. Business System Architecture

As shown in figure 8.1, the business system architecture is positioned as a tool for horizontal and vertical integration of IS planning and implementation. Strategy development and business planning is an ongoing inter-linked effort within which

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1 IT project has been excluded from the framework to keep it simple; IT project is a technical matter largely confined to the IT domain, and the focus here is multifunctional planning and implementation of IT applications in relation to the business.

strategic IS planning is an integrated part. Strategic initiatives emerging from the functions are collectively discussed and deliberated at the functional level with the aid of business system architectures. The architectures are later submitted to senior management for formal consideration. During these functional level activities, members of the senior management team who are also functional heads are likely to become involved in the development of the business system architecture. Hence when the business system architecture appears before the senior management team, the architecture would be familiar to at least some members of the team and not just the IT head. This familiarity with the business system architecture by some members would help in the discussion and enhancement of it by senior management as a team.

Business system architecture is a useful concept for conducting management workshops not just on IT application but also on business strategy in general. Senior management is able to discuss, deliberate and contribute to the business system architecture. Different versions of a business system architecture for a specific strategic initiative are possible. When a business system architecture is approved by senior management, it serves as the blueprint for joint action at the functional level.

Development of Business System Architecture

The development of a business system architecture is typically initiated and facilitated by IT executives; no special methodology is employed. The inputs for developing the architecture are company objectives, basic business strategies, other strategic initiatives (implemented and planned), critical success factors, organisational core competencies and strategic resources. Another input is the awareness on the part of those involved on the opportunities and limitations of available and emerging technologies applicable to the business. The architecture, being essentially a picture of a strategic initiative, is sketched out and improved jointly by the relevant functional executives; it emerges from their contributions and collective understanding and vision. Thus it is dependent on the participants - their knowledge, experience, stakes, interests, personality, motivation, inter-personal relationship and other human factors. Two teams embarking on the same

strategic modelling exercise may thus produce different pictures both of which can be valid. The principle of equifinality from the General Systems Theory is relevant here (Von Bertalanffy, 1950, 1972, 1973).

The characteristics of the participants are perhaps the major determinant of the quality of the architecture. Each participant is expected to be matched in knowledge, understanding and expertise in respect of his area of interest. A participant who is not on par with the others from the perspective of his field is unlikely to do justice to the particular resource/area of interest that he represents. An assertive participant may on the other hand inject a greater role for his area of interest. Unless the team engaged in the development of a business system architecture is balanced in terms of the human resource involved and is facilitated to operate as a cohesive group, it is unlikely that the architecture will be an effective one. The deployment of a balanced team in such a task is a contingent matter based on various factors including organisational culture and practices. For example, a company which practices Total Quality Management concepts is likely to be in a better position to use this approach. Achieving such an effective balance is not an easy matter. Perhaps it is this difficulty which causes organisations to resort to reductionist ways in the planning of information systems; the reductionist ways are typically structured methodologies/techniques which *seek* to deliver objective results.

While the business system architecture helps participants to collectively develop and understand a strategic initiative, it may not be suitable for presentation to senior management in its original from. It is a communication tool and requires to be appropriately re-drawn for this purpose by recognising management's behavioural and communication characteristics (see Chapter 5). The management requirements model presented in Chapter 5 (figure 5.2) is a useful reference for deciding what should be included in the model. The management information characteristics framework, presented in Chapter 5 as figure 5.4 and enhanced below with case study evidence as figure 8.5, is a reference on the form which the model should take.

The case studies suggest that the most appropriate form for a business system architecture, from a senior management perspective, is pictorial (see example shown in figure 8.2). There is no special syntax, convention or format. The focus is semantics and understanding. Consideration of graphics, colour, layout and such aesthetics help in this regard. Whether sophisticated IT-based techniques such as group decision support systems, electronic brainstorming and CASE tools could help in this effort is another matter and requires further research. The evidence from the case studies suggest that business system architecture is very much a manual effort where graphics/diagramming tools are used only in the final stage.

Modelling the Complexities of Business Systems

Development of a business system architecture is very much dependent on 'soft' holistic processes. Reductionist ways such as the much-advocated process-entity matrix and entity diagram/corporate data model are unsuitable for modelling the complexities of strategic business systems. There is too much complexity in modern integrated business systems for reliance on just reductionist techniques. If they are applied, they would inevitably reduce the complexity and produce simplistic solutions which are bound to ignore dimensions of the problem that are not appropriate for handling by the technique. The limitation of matrices, data flow diagrams and data models (the three conventional techniques often employed by IT professionals) in this regard may not often be recognised: a problem/requirement or solution has to be reduced to processes/activities, entities/attributes, relationships and data flows. Other relevant factors - such as strategic resources, core competencies, partnerships/alliances, and generic/specific strategies - cannot be handled by these techniques. These reductionist techniques seek to be objective but the reality is perhaps that there is not *the* perfect business solution which an objective approach could reveal or deliver.

Solutions to a business requirement are contingent on a whole host of factors including time. In addition to those mentioned earlier, this would include the company's long-term and short-term objectives, company's health, organisational culture, organisational

learning capacity, the state of industry, competitors' initiatives, associates/partners' initiatives, etc. Any attempt which does not view a problem/requirement in its entirety could ultimately result in an ineffective solution, if not a failure. As Beer (1979) points out, a complex problem has to be met by an equally complex solution; this is in accordance with Ashby's (1956) Law of Requisite Variety[2]. Fathoming the complexities of modern strategic requirements and developing an effective solution can be done via the interactions of relevant people. This thesis maintains that the business system architecture approach is an effective means for understanding a complex business requirement and modelling an appropriate system to match that complexity. Such a system is bound to be more than just an IT application, regardless of how sophisticated the application may be. This is evident from the business system architecture analysed in the case studies and from the example[3] shown in figure 8.2.

Integration, Differentiation and Fusion

As clarified in the last chapter, functional departments can identify and define their contributions to a strategic initiative with the help of a business system architecture. This architecture later becomes the source from which the functions develop their own unique functional plans and/or blueprints for delivery of their responsibility to the strategy. The various functions develop their functional plans/blueprints in consultation with each other. Such an approach while helping to achieve cohesion and specialisation within functional departments also fosters cooperation and interaction between them; Lawrence and Lorsch (1967) refer to these two functional characteristics as "high differentiation" and "high integration" respectively. This arrangement enables a functional unit to specialise and focus in the discipline where its core competencies give it leverage, and at the same time to cooperate with other functional units in the interest of the organisation.

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2 Ashby's Law of Requisite Variety - Only variety can destroy variety; variety of the controller must be equal to or greater than that of the controlled.

3 This example was used by a vendor in a presentation to a port's senior management on an integrated information system for container terminal operations. I was at that presentation and observed the relatively more positive response from the senior management to that presentation; the vendor won the contract. Some other vendors used IT-oriented models in their presentations; response from the senior management was generally limited; the senior management interacted less with the vendor.

Terminal Operation by Computer

- *Automatic data gathering of containers/ chassis at gate in/out.
- *Inventory control of in-yard containers to and from ships.
- *Making of loading and discharging sequence lists of containers to and from ships.
- *Calculation of ship's stability.
- *Making of receiving and delivery sequence lists of containers to and from freight trains.
- *Determination or checking of yard stacking address of receiving and delivery containers.
- *Making of various lists, reports and others.

Optimum positioning of Transtainer*

Controlling of work instructions to Transtainer*, Tractor and Portainer*

Automatic identification of container's location

Controlling of cargo handling by Transtainer*

Controlling of steering for Transtainer*

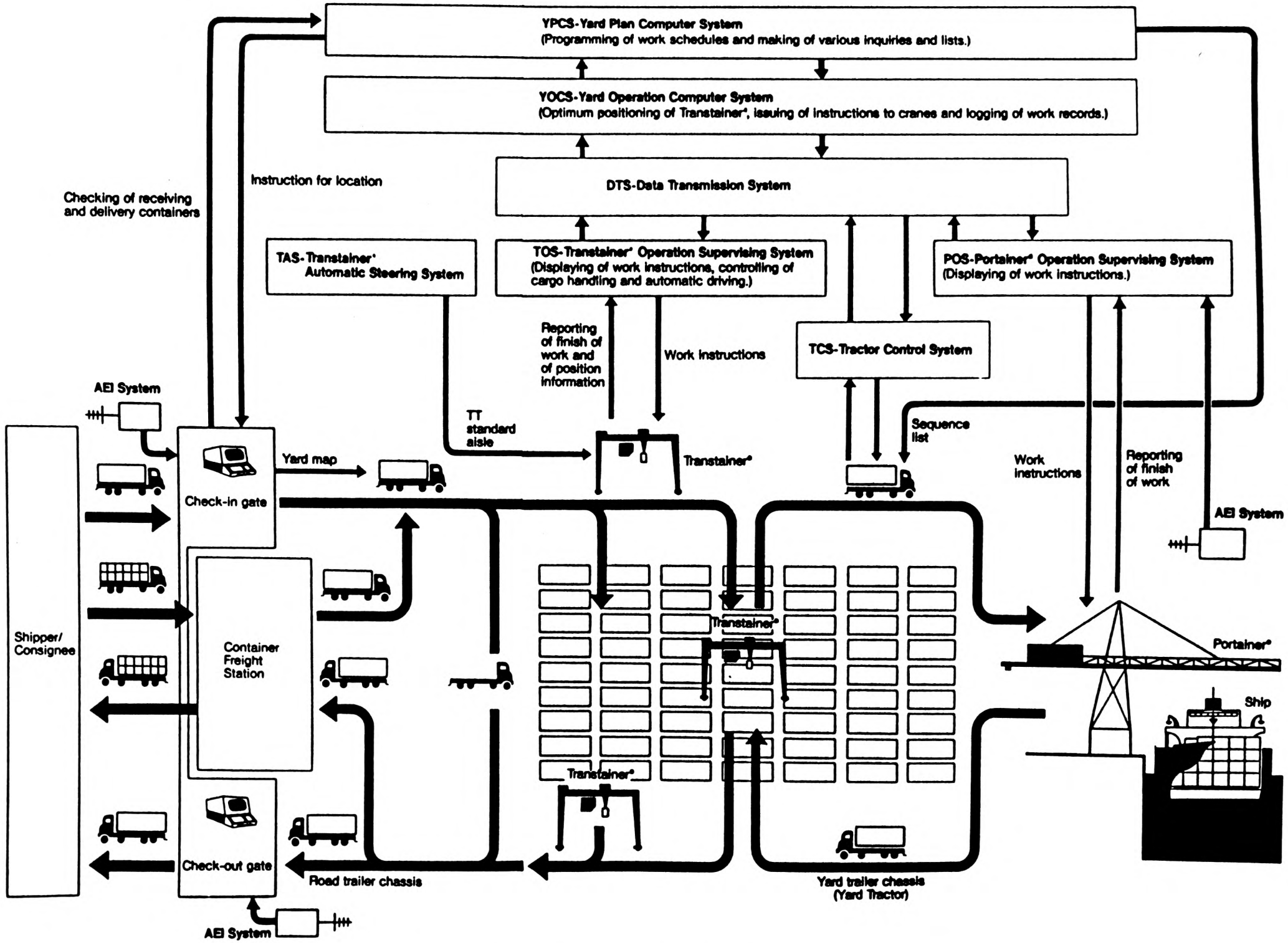


Figure 8.2: An Example of a Business System Architecture: Container Terminal System
(Source: Mitsui Engineering and Shipbuilding)

The business system architecture defines what this specific organisational interest is. It helps to show that the whole is greater than the sum of its parts and that it is the whole which matters most with regard to the organisation's strategic initiatives.

Organisations which are likely to find the business system architecture as a valuable tool are those which seek to fuse their core competencies (Prahalad and Hamel, 1990), strategic resources including IT, management processes, organisational arrangements and other such factors. The research evidence suggests that the positioning of IT as a strategic resource and the according of key function status to the IT function contribute to the effective fusion of IT with the business. From a political perspective, Feeny, et al.'s (1992) work suggests that a healthy CEO/CIO relationship could be another requirement for this IT-business fusion. In general, a more open organisational culture, good internal relationships and proper positioning of the strategic resources are pre-conditions for effective business fusion.

Keen (1993) argues that business fusion is the true source of competitive advantage and that competitors will find it difficult to copy. Components of this fusion, particularly tangible ones such as a strategic IT application, could be copied by competitors (Feeny, 1988) but copying of the fusion itself is another matter. It is unique and contingent and hence may not deliver the same advantage to another organisation which copies it. The principle can be copied but not the implementation. Thames Water's IT director highlights this aspect of business fusion thus:

> "You can't just get competitive advantage from investments in IT. You need the processes, people and culture all in place for exploiting the available technology to gain the competitive advantage. It is difficult for others to duplicate this strategy."

The business system architecture is a tool for modelling the business fusion and maintaining it in synch with the business environment and company goals. Achieving satisfactory fusion is advantageous but not sufficient. It is equally important that it is maintained as otherwise the fusion could prevent the organisation from adapting to

changes. There is always the danger that the complexity which gave an organisation competitive advantage could turn out to be a competitive disadvantage in situations where quick changes are required. The business system architecture, which contributed to the planning and implementation of a system, is a potential tool for continual adaptation of the system and for responding to major changes in the system's environment.

The nature of a business system architecture is such that while it seeks to be holistic it also injects the necessary reductionism into the system. The various elements which it depicts are interlinked such that there is cohesion within subsystems and integration between them but not total fusion which prevents changes to a part without changes to the whole system. The business system architecture facilitates the realisation of effective fusion which can be exploited in a sustained manner. It is asserted that conventional IS modelling techniques such as CRUD matrix, entity diagram/data modelling and data flow diagram are too reductionist and simplistic for this purpose. The reply from the CTU Technical Manager of British Aerospace (Rover's parent company) to questions on information architecture concur with this assertion. The manager, in making specific reference to enterprise modelling and business process reengineering, notes:

> "There has been renewed interest in modelling, under various titles, but most often described under the banner of Business Process Reengineering (BPR). This has led to a search in Europe and the US for better ways of modelling the enterprise. The enterprise models on which the BPR operates need to be much richer than those used by IT professionals which generally only consider function and information."

Business Process Reengineering

Business process reengineering is a business effort which seeks to use the power of IT to redesign business processes radically in order to achieve dramatic improvements in organisational performance (Hammer, 1990). Business system architecture is of relevance to business process reengineering in that it is essentially the same as the business process maps commonly advocated for use in business process reengineering

(Davenport, 1993, 1994; Hammer and Champy, 1993). This is evident from Hammer and Champy's (p. 118, 120, 121) discussion on the subject:

> "Just as companies have organization charts, they can have process maps that give a picture of how work flows through the company. A process map also creates a vocabulary to help people discuss reengineering. ... The process map displays a clear and comprehensive picture of the work ... It shows only high-level processes. But each of these can explode into various subprocesses - usually numbering no more than half a dozen or so - on separate subprocess maps. Together, the process and subprocess maps give a simple but effective picture."

The processes, participants and multifunctional approach associated with business system architecture and the nature of the model itself are characteristic of business process reengineering. The business system architecture and the business process map from business engineering differ more in scope and depth rather than form and content. The business system architecture via its integral position as an IA component thus offers the opportunity to reengineer business pragmatically as part of ongoing IS planning.

2. Application Architecture

A purpose of the IA is to facilitate the IT department's planning and delivery of IT applications. One of the IA components developed and used in this regard is an application architecture set consisting of an overall AA, detailed AAs and optional business area AAs (see figures 8.1 and 8.3).

The overall AA is used in presentations to senior management on the deliverables of the IT function to the business. The model helps management to appreciate and discuss IT's overall contributions. It thus provides a means for management involvement in IT matters and helps to link functional level IT planning with organisational level IS planning. The overall AA is developed by the IT function with emphasis on semantics and easy understanding by senior management. This is done in a bottom-up manner using the business system architecture and organisation's application portfolio as major inputs. No

formal methodology is used. It is just a process of identifying and synthesising the major IT applications indicated in the business system architecture and application portfolio, and depicting them graphically to show their scope and inter-relationships. The case study examples help to illustrate this concept.

As the business area application architecture has not been found to be part of the normal 'organisational approach' to IS planning amongst the case study organisations, it is not included as a standard component of information architecture in the framework for IA practice. It is optional but is nonetheless relevant to IA, as suggested by the evidence from the Rover and Allied Dunbar case studies. Hence it is briefly discussed next.

The typical focused IS planning exercise seeks to locate gaps in IT application, identify new IT application opportunities and consolidate the IT implementation effort for a business area. It is undertaken by IT executives with the help of functional executives from the business area. The exercise often uses an ISP methodology, supported by a CASE tool, and may employ structured techniques such as CRUD matrix. The relevant business system architecture and overall application architecture are used in this exercise to guide and ensure that the business area AA is consistent with the overall organisational IS plan and the identified/implemented strategic applications relevant to the business area (see figure 8.3). The business area AA seeks to be comprehensive. It attempts to model the integration of planned applications (as indicated in the related business system architecture or otherwise), implemented applications and new application opportunities for the business area.

This thesis regards the detailed application architecture as a potentially useful component of IA. The detailed AA can be developed in the occasional focused IS planning/business area analysis exercise, or as part of standard functional level IT planning tasks subsequent to management approval of a business system architecture. Compared to a detailed AA built at the outset of a project, the detailed AA developed in these situations would benefit from IS planning considerations and serve to link IS planning to project implementation. The detailed AA is intended for application development (see figure 8.1)

and is hence targeted at the application development team. The model reflects syntax, detail and other characteristics associated with application development and project work.

The overall AA, relevant business system architecture and business area AA (if the relevant one is available) serve as inputs for developing the detailed AA. The employment of concepts and conventions from the organisation-endorsed application development methodology to develop the detailed AA facilitates the model's usage at the project level. The use of an I-CASE tool to develop the detailed AA enables the reuse of planning data, associated with the detailed AA, in the related application development. While helping to reduce application development effort, such an approach also serves to automatically integrate IS planning with project implementation.

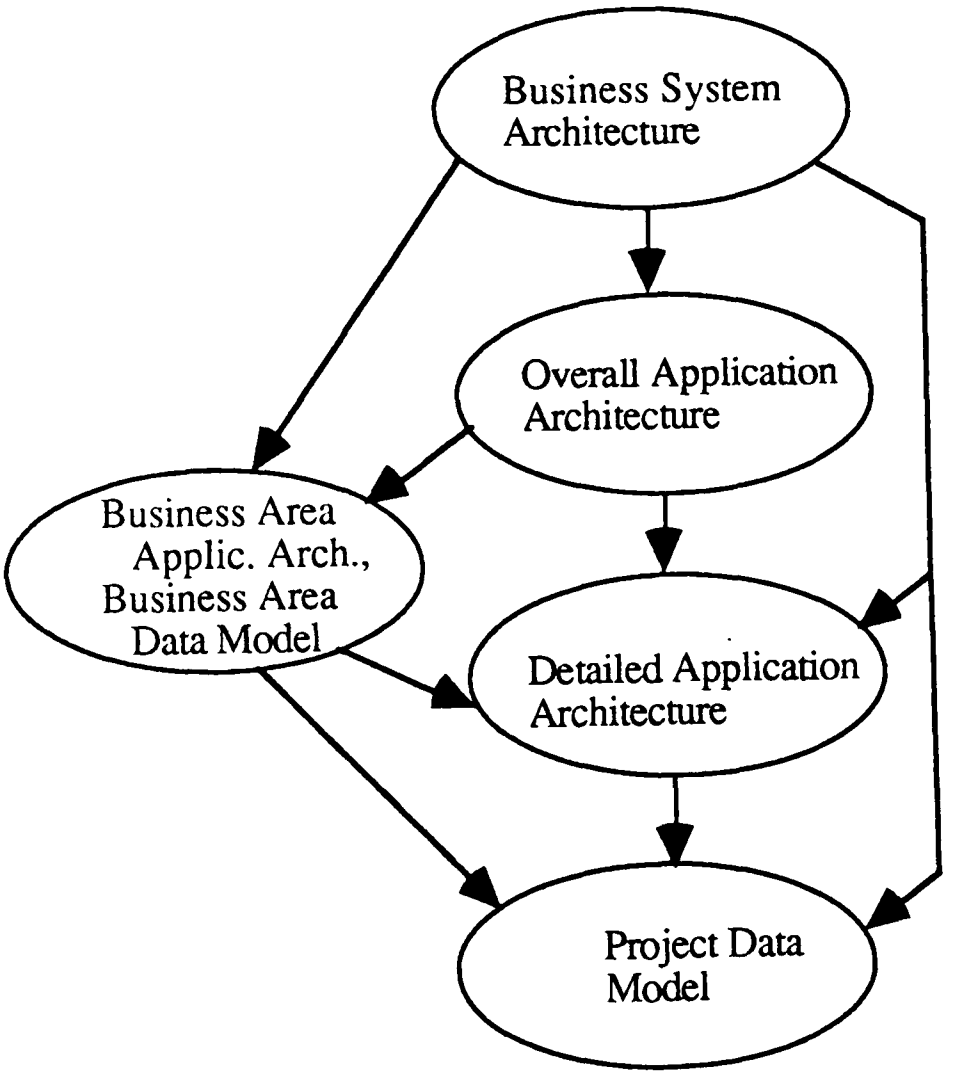


Figure 8.3: Information Architecture Models and Their Relationships

3. Business Area/Project Data Model

As shown in figure 8.3, a business area data model may be developed during focused IS planning/business area analysis. The model is used as or developed into the project data model at the outset of a project if it is readily available. Otherwise, a business area cum project data model is developed at the project planning/scoping stage. Inputs for this task include the relevant detailed application architecture and business system architecture. The business area/project data model is used in project planning/scoping and in application development, particularly in data analysis/modelling and database design tasks. The data model is developed using the data modelling technique and CASE tool endorsed by the organisation as its standard. Usage of an appropriate I-CASE tool has the potential to automatically integrate the planning task with application/database development. The business area/project data models developed for project purposes can collectively serve the requirements of data management and integrated database development, thereby making the corporate data model unnecessary.

4. Characteristics of Information Architecture Models

One of the fundamentals underlying the framework for IA practice (figure 8.1) is that of targeting of models. However, IA practice as advocated by vendors and methodologists such as IBM (1992, 1993), Inmon and Caplan (1992) and Texas Instruments (1991, 1992) appears not to adequately address this targeting requirement. This is reflected in some of their latest prescriptions on IA. In spite of a lack of supporting research evidence, they prescribe process-entity matrices, entity diagrams and the such as business models for use by management. This thesis, while arguing that IA must be targeted, seeks further to offer a framework for guiding the development of the various IA models.

Management Information Characteristics Framework

The various IA models, though complementary, are unique in a number of ways. The research proposes an enhanced version of Gorry and Scott Morton's (1971) management

information characteristics framework to facilitate development of the various IA models (see figure 8.5). This framework encapsulates selected management behavioural issues which are considered to be relevant to IA development and usage (see Chapter 5).

Model	Target Recipient	Characteristics
Business System Architecture	Senior management	Pictorial, little syntax, macro level and holistic for business system, internal and external objects, future orientation, unique, some physical/definite content, evolves, primarily for presentation and discussion
Overall Application Architecture	Senior management	Graphical, little syntax, macro level and holistic for organisation's information system, focus on IT applications, future orientation, unique, definite content, evolves, primarily for presentation and discussion
Detailed Application Architecture	Project management and application development group	Graphical, some syntax (DFD), holistic for specific application, some detail, focus on application's subsystems, future orientation, unique, definite content, some changes possible, specification and documentation
Business Area/Project Data Model	Application development group within project team, and data management group	Graphical, logical data modelling syntax, holistic for business area/project, detailed, focus on business area/project entities, future orientation, unique, explicit content, relatively stable, specification and documentation

Figure 8.4: Recipients and Characteristics of Models

The basis for relating the information characteristics framework to IA is that information architecture is basically a means for recording and communicating information about the business and IT applications to managers (in the broad sense) at various levels of an organisation. The case study data reveals a pattern in the characteristics of IA models; see figure 8.4. The characteristics set out in the figure may appear a little rigid. Nonetheless, they provide a basis for understanding and generalising about characteristics of models in relation to their targeted recipients. It can be seen from the figure that models targeted for senior management use have different characteristics as compared to those meant for

application developers. In relating these characteristics of the models to the management information characteristics continua (see figure 5.4, Chapter 5), it has been possible to develop the framework shown in figure 8.5.

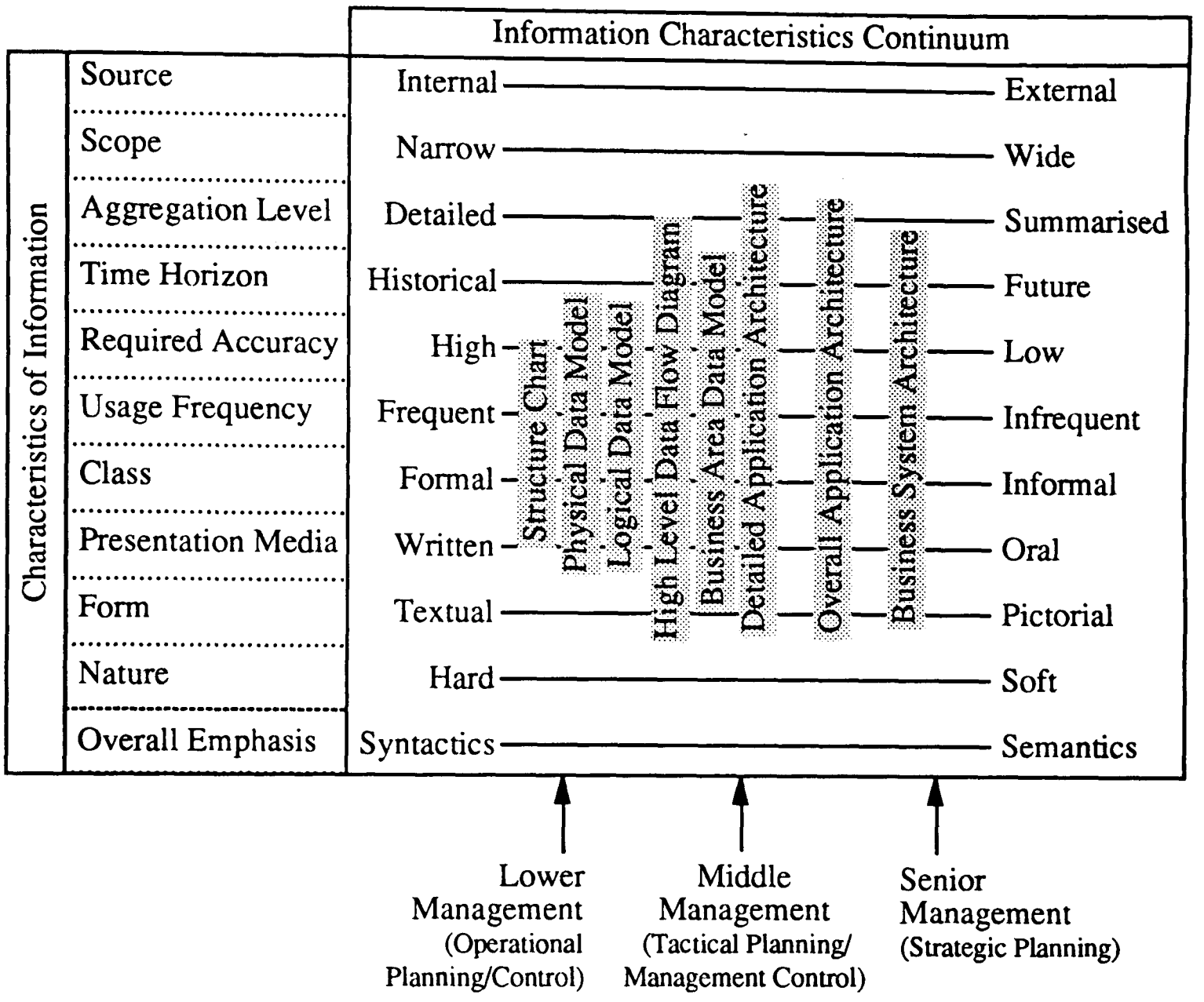


Figure 8.5: Management Information Characteristics Framework

The management information characteristics framework shows that models meant for senior management display characteristics which are more closely associated with the right side of the continua and are consistent with senior management behavioural characteristics (see figure 5.3 in Chapter 5). As models are progressively targeted for lower levels of management, the characteristics of the models gradually shift towards the left on the continua and harmonise with lower level management behavioural characteristics. The British Rail case study provides evidence to show that where a model is not developed in accordance with this pattern, the model can be poorly received by its

intended recipient even though it may contain information relevant to the recipient. In summary, the management information characteristics framework can be described as focusing on syntactics on the left side and semantics on the right side. Stamper's (1987, p. 48, 49, 57, 61) arguments on semantics and syntactics support this categorisation and the contention of this thesis on models and levels of management:

> "... the logical approach, which dominates artificial intelligence, expert systems, database semantics and all the technologically orientated branches of informatics, indulges in fantasies of the kind that are legitimate in mathematical theorizing but not in running business. .... in 1985, the relevant IFIP group initiated a series of conferences specifically focused on database semantics. If one looks closely at all of these one finds the syntactic outlook is dominant. .... doing business involves, even at the lower levels in an organization but especially in the higher levels of management, semantic problem-solving. ... The shifting of semantic consensus in a business is probably of greatest importance at the most senior levels of an organization."

Lessons from the Structured Methodology World

Though this research does not cover application development models, experience suggests that the pattern mentioned above is also applicable to them to some extent. For example, the logical data flow diagram and logical data model developed in the analysis stage of application development, though located on the left of the information characteristics continua in figure 8.5, are more towards the right as compared to the structure chart and physical data model developed in the design stage: IT-users, systems analysts and data analysts are involved in the usage of logical data flow diagrams and logical data models while systems designers, database designers and software developers are involved in the usage of physical data models and programme structure charts.

The structured methodology literature (e.g. Bellin and Suchman, 1990; Gane and Sarson, 1979; ISS, 1991; Page-Jones, 1988; Periasamy, 1990; Yourdon, 1989;

Yourdon Inc., 1993) is explicit on targeting of application development models. There are 'logical' models for use by IT professionals in analysis and in communications with IT-users, and 'physical' models for use in design and development tasks. Within these two sets, there are different levels of models for the different levels of people involved. For example, within the set of 'logical' models, the context diagram is meant for senior functional executives while lower level data flow diagrams are for use in communications with clerical/operations personnel. The context diagram, set at a macro level, is conceptual and depicts the proposed system in its business setting; limited symbols are used. A low level data flow diagram on the other hand includes detailed processes, data stores, controls and exceptions, and employs a larger set of symbols.

Forms of IS Planning Approach and Information Architecture Models

While the framework for IA practice proposed by this thesis has been conceived with the 'organisational approach' as focus, the essence of it is applicable to 'business-led' and other forms of IS planning. The principle is that the IA content should match the IS planning approach identified as being most appropriate for the organisation. The 'organisational approach' benefits from a rich set of IA models while the 'business-led' approach is unlikely to require such a rich set; e.g. as senior management involvement is comparatively less in 'business-led' IS planning, there is a reduced need to develop those models specifically targeted for management presentation. Developing IA models with clear purpose thus becomes important. Equally important is the targeted development of those models regardless of whether they are part of a 'business-led', 'organisational approach' or other forms of IS planning. The management information characteristics framework is a useful reference for developing IA models (or for that matter any model) despite the situation or approach leading to their development.

5. Generic Information Architecture

The research found that the business environment and organisational business process models, where they existed, were somewhat generic. This suggests that organisations

attempting to develop such models could in effect seek out an existing model, perhaps that of a competitor or one published in the literature, and use it after making relevant amendments. As regards IA, Inmon and Caplan (1992, p. 113, 115, 117) contend that generic modelling is applicable to IA component models. They argue:

> "The business of many companies within an industry is often very similar, so why shouldn't the data model for these companies be similar? ... different companies engaged in the same business have very similar data model. In addition, some functions of a company are so similar that, regardless of what industry those companies are in, there is a great similarity between one company and the other. Some areas that vary little from one company to the next include human resource, contracts administration, marketing and sales, and accounting and finance. ... The utility of the generic data model is such that data modelling becomes an exercise in adjustment and tuning, as opposed to an exercise in discovery. ...
>
> There are generic process models that are available. ... generic process models are usually only of value at a non-detailed, high level. These high level models usually have more value to business planning efforts than to system development efforts."

IBM and other leading vendors also contend similarly, hence their recent efforts in developing generic information architecture (or application architecture as they call it) for selected industries such as retailing (IBM, 1985, 1991; Stecher, 1993) and insurance (IBM, 1993a, 1993b). IBM's insurance architecture helps to clarify the nature of these emerging generic IAs and is therefore briefly discussed. The insurance architecture consists of an industry-wide generic data model (covering about 200 items) and function model (in the form of a hierarchy of activities covering about 350 items). The architecture stipulates the development of a workflow model using the two generic models. The workflow model appears like a data flow diagram and is organisation-specific.

It has been mentioned in Chapter 6 (Shell Expro case study) that Shell, other petroleum companies, IBM and other IT vendors are engaged in the development of a generic

petroleum industry data model, the POSC data model. The purpose of this data model is to serve as a common base for software vendors to develop packages to optimally satisfy the major IT requirements of petroleum companies. Shell expects to embrace the POSC data model when it is ready and thereby cost-effectively benefit from the package option.

Not all companies are, however, as supportive of generic data models and IAs as Shell is. Companies such as Allied Dunbar and Safeway contend that generic industry-wide IAs are not suitable for them. They feel that their pursuit of strategic advantage via IT requires them to examine their company's unique situation and develop business solutions accordingly. They acknowledge that some of their IT requirements, mainly in the traditional data processing areas such as personnel and finance, are somewhat generic and hence can be satisfied via generic solutions in the form of software packages. They suggest that generic information architecture may be appropriate for new entrants into the industry or for companies which are not seeking industry leadership.

The message emerging is that a company which seeks strategic advantage via IT in a dynamic industry may not find a generic IA to be of major value (but of course, the company could use it as a reference for developing and evaluating the organisation-specific IA). A leader in a stable industry such as Shell Expro may be able to utilise a generic IA and seek standard IT solutions perhaps because the major IT applications in that industry characterise the industry and key battles for strategic advantage are fought in fields other than IT.

6. IT Architecture Planning

An organisation's IT architecture must be durable and support evolutionary growth. It should facilitate the linkage of computing systems from any part of the organisation and the sharing of IT resources and data across the organisation. The IT infrastructure based on the IT architecture must be capable of handling varied workloads and be consistent in its support of applications.

Fundamental to an organisation's IT architecture is the endorsement of complementary technological standards. Without such standards, the organisation's IT infrastructure is likely to be islands of technology and not an integrated computing system. Islands of technology or improperly conceived/implemented technology can prove to be a competitive disadvantage: today's technology solution can become tomorrow's business problem. The case studies generally suggest adoption of key technology standards in a bottom-up manner. In particular, they advocate implementation of core technologies to anchor the IT standards. The core technology is based on the organisation's critical strategic applications, depicted in an IA or otherwise, and how a particular technology from an established vendor is able to best support them. This often amounts to a mainframe technology which is generally endorsed as an industry standard. Keen (1991) and Simon (1992) support such an IT architecture. Based on the empirical evidence and support from the literature, the framework for IA practice suggests a similar approach to IT architecture planning.

A proactive IT architecture anticipates future IT requirements and information needs based on the organisation's business thrusts, plans and vision (Keen, 1991). A reactive IT architecture alters the IT infrastructure in response to a need derived from a course of business action already planned or engaged in (Davenport and Short, 1990; Venkatraman, 1991). The evidence from the case studies suggests the applicability of both these characteristics to successful IT architecture planning and implementation, and that IA plays an important role in this matter. There is a two-way relationship between IA and IT architecture in the way both these architectures are planned, implemented and used; this is depicted in the framework for IA practice (see figure 8.1).

IT architecture is largely a technical matter, much of which is within the IT function's domain. Nevertheless, there is a need for senior management to be involved to some extent in IT architecture matters (Keen, 1991, 1993). A conceptual network model is a tool for this involvement. It is a high-level graphical network model which depicts an organisation's main computing systems and their linkages (see figure AD7 in Chapter 6

for an example). The model's general characteristics conform more to the right side of the information characteristics framework (see figure 8.5), making it appropriate for use in interactions with senior management. Such a model, together with a conceptual computing system model with similar characteristics (see figure RG10 in Chapter 6 for an example), helps in clarification to management on technological issues and reach and range concepts. Senior management's understanding on these matters is necessary for them to appreciate the technological implications on and of the information architecture.

7. IS Modelling Tools and Techniques - Some Current Issues

This thesis maintains that just because an IT-oriented analysis/modelling technique has been found to be useful in the IT domain, it does not necessarily mean that it would also be useful in the management domain in handling IT-related matters. The research has found that the elevation of techniques such as CRUD matrix and data modelling to the management level does not appear to have delivered the benefits expected on management communication and understanding. In the IT domain, the IT function is relatively free to use what it sees as necessary and appropriate (structured techniques, CRUD matrices, object-oriented concepts, CASE tools, etc.) for efficiently and effectively making its delivery to the business. But where IT needs to interact with other functions and senior management, these models and techniques need to be reassessed before use. This need is duly recognised and addressed in the popular application development methodologies - see earlier discussion on 'Lessons from the Structured Methodology World' under section 4. The need for targeting of models, however, does not appear to receive due attention in conventional development and usage of information architecture. This thesis has proposed a framework for purposeful and targeted information architecture practice.

In proposing the framework for IA practice as part of holistic IS planning (figure 8.1), due consideration has been given to recent developments in IS methodologies, tools and techniques, in particular object-oriented methodologies and CASE tools. The case studies show that object-orientation is being embraced in organisations but this is done in areas which are specific to IT. It appears less likely that object-orientation will impact

business/IS planning at the organisational level because at that level business planning processes/techniques rather than IT-oriented processes/techniques are most applicable. If these business planning processes/techniques could be influenced by object-orientation, then business/IS planning would be consequently affected. The current situation is that object-orientation is confined to the IT domain. Business area data models are being given an object-oriented flavour in Shell Expro, Allied Dunbar and Rover via concepts such as entity supertype/subtype and inheritance. Conscious effort is being made in the five exemplar case study organisations to adopt object-oriented principles such as modularity, inheritance and reusability. Object-oriented software development is seen as being relevant to their implementation of client-server and GUI-based applications.

In the proposed framework for IA practice, neither a formal ISP methodology nor a CASE tool is regarded as being relevant to business/IS planning at the organisational level. However, CASE tools are of use in project scoping/planning, application development and focused IS planning exercises and business area analysis. The usage of CASE is linked to the methodologies/techniques endorsed for these tasks. The use of an I-CASE tool for ISP activities at the IT functional level can contribute to the integration of IS planning with project implementation. The processes, entities, attributes and relationships defined in planning can be automatically reused in related application development tasks which employ the same I-CASE or a compatible tool.

8. The Parallel in Traditional Architecture and Engineering

In the course of this research, it has been noticed there are a number of parallels between IS planning/development and traditional architecture/engineering. Some writers such as Zachman (1987, p. 277) have also made similar observations:

> "In searching for an objective, independent basis upon which to develop a framework for information systems architecture, it seems only logical to look to the field of classical architecture itself. In so doing, it is possible to learn from the thousand or so years of experience that have been accumulated in that field. Definition of the

> deliverables, i.e. the work product, of a classical architect can lead to the specification of analogous information systems architectural products and, in so doing, can help to classify our concepts and specifications."

A traditional architectural effort starts with a gross representation of size, shape, and scope of the building/structure to be built. All the ensuing architectural activities take place within this whole. These activities, performed in stages, produce unique architectural representations for the major stakeholders - the owner, the designer, the builder and the sub-contractor. Each of the architectural representations is different from the others but all are inter-related. The models are developed only to the level of detail and complexity required for the prospective stakeholder to understand and act upon. An architectural representation does not merely display a level of detail greater than the previous one. For example, an architect's plan is not merely the next model with greater detail than the architect's drawings; it contains detailed information as well as new information.

> "It is different in nature, in content, in semantic, and so on, representing a different perspective. ... In short, each of the different descriptions has been prepared for a different reason, each stands alone, and each is different from the others, even though all the descriptions may pertain to the same object and therefore are inextricably related to one another." (Zachman, 1987, p. 281-282).

The parallel in information systems is clear. There is information architecture with its inter-linked component models emerging from planning and a whole set of analysis/design/construction models relevant to application development and software engineering. Different stakeholders are involved. People with different responsibilities, roles and skills work together to realise the whole system. Standards, conventions, project management methods, quality issues, tools, techniques, methods, metrics, contracting/subcontracting, etc. are relevant. As in the case of traditional architecture/ engineering, the IA models progress in stages from a picture of the whole system to detailed specifications for construction of the components: application architecture, business area data model and the whole set of application development models constitute

the drawings and specifications for delivering the IT application. Perhaps the item which now brings information architecture a little closer to traditional architecture/engineering is the business system architecture - it is equivalent to the architect's drawing of a building.

9. Summary

This chapter has presented a framework for practice of IA as part of the 'organisational approach' to IS planning. It has been argued that IA models need to be purposefully developed and properly targeted. An enhanced version of Gorry and Scott Morton's (1971) management information characteristics framework has been proposed to assist the targeting effort. This framework provides guidelines on what an IA model should contain and look like in relation to its targeted recipient. Another important finding of this research is on the positioning of the business system architecture as a key component of IA. The next chapter is the conclusion to this thesis. It revisits the key propositions and contributions, and discusses the implications of these for IA research and practice.

Chapter 9: Conclusion

- Research Findings and Contribution to Knowledge
- Implications for Practice
- Limitations of Research
- Implications for Further Research
- Personal Reflection
- Conclusion

Information architecture is a top information management issue but there is much uncertainty about it. This research hence set out in the first instance to elucidate the general understanding and situation as regards information architecture. A large scale postal survey was conducted to clarify the general position of information architecture. The major findings were as follows:

* *IA is being used to some extent in medium and large organisations, particularly by those which position IT as a strategic/essential resource.*

* *It is perceived as being of value for IS planning and implementation.*

* *Perceptions about the value and usefulness of application architecture and corporate data model (conventional components of IA) vary.*

With this clarification from the survey, the research proceeded to qualitatively investigate the development and usage of IA from a management perspective. Six case studies were conducted. The case study findings and survey results were synthesised with theories from relevant literature. The effort led to propositions on the effective development and usage of information architecture. This chapter summarises these propositions and other contributions[1] of the research and discusses their implications for IS practice. The

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1 Those items which are considered by this thesis as its contribution to knowledge are italicised.

propositions on corporate data model, business system architecture and targeting of models in general are elaborated by virtue of their significance. The chapter concludes by identifying areas where further research is required to advance the understanding and usage of information architecture.

1. Research Findings and Contribution to Knowledge

In a situation of varying interpretation of what an information architecture constitutes and represents, the research proposed its own definition. The following definition, developed from a synthesis of extant literature, has served the research purpose:

> *Information Architecture is a set of high level models which complements the business plan in IT-related matters and serves as a tool for IS planning and a blueprint for IS plan implementation.*

Components and Positioning of Information Architecture

The research evidence while upholding the above definition suggests changes in the specifics of IA. It was provisionally accepted at the beginning of the research that an IA emerges from IS planning and includes application architecture and corporate data model as key components. At the conclusion, the study contends that *an information architecture consists of three inter-related types of models, namely the business system architecture, overall and detailed application architecture and business area/project data model. The models are developed and used in an ongoing manner from business/IS planning to project scoping and implementation.* The IA models have a hierarchical relationship, serve specific purposes and are targeted such that they help to integrate the processes and activities from business/IS planning to project levels. The personnel involved at these levels range from senior management at the business/IS planning level to application developers at the project level. The IA models are developed with the target recipients in focus as the recipients differ in various ways - responsibilities, roles, expectations, behavioural and communication characteristics, skills, etc. An IA, structured and developed thus, facilitates holistic IS planning and implementation. This

thesis hence *positions information architecture as an integral part of Earl's 'organisational approach' to IS planning*, and offers a *framework for the practice of holistic IS planning with the aid of information architecture and IT architecture* (see Chapter 8, figure 8.1). The framework is contingent on the positioning of IT as a strategic resource and the adoption of an IT-business fusion approach.

Information architecture, as found by this research, *is not totally independent of IT*. This proposition however conflicts with the position taken by Brancheau, et al. (1987) and others who view IA as being independent of technology. This thesis argues that IA, in particular the business system architecture, needs to reflect key elements of technology. As contended by Hammer and Champy (1993), if technology is a source of strategic advantage then strategy implementation cannot be conceived and modelled independently of technology. Viewing the same matter in terms of Keen's (1993) business fusion concept, if IT is fused with the business then it is meaningless to model a strategic initiative independent of technology. This however does not mean that the IA also doubles up as an IT architecture. A separate architecture defined in terms of technology reach and range serves the technology architectural requirements; the IA and IT architecture complement each other. *There is a loose link between IT architecture and IA such that one influences the other in an ongoing cyclic manner.*

Characteristics of Information Architecture and other IS Models

One of the major contributions of this thesis is its proposal on *the targeting of IA models in terms of their recipients' behavioural and communication characteristics*. An information characteristics continua, based on the work of Gorry and Scott Morton (1971), has been proposed as a reference framework (see Chapter 8, figure 8.3) for deciding the form and content of not only IA but IS models in general. Essentially, the continua is clustered around 'syntactics, complexity, specification, detail, text and written presentation' at one end, and 'semantics, simplicity, clarification, macro issues, pictorial/graphic and verbal presentation' at the other end. Models closer to the 'semantics' end are meant for senior management while those nearer the 'syntactics' end

are for operational and project level personnel. In developing a model, its purpose and recipient require to be identified first. Reference to the information characteristics continua framework using these two parameters provides guidance on the appropriate form of the model and the characteristics of its contents. IA models which conform to the information characteristics continua are likely to be better received by their recipients. This was reflected in the case studies.

The Case for Exclusion of Corporate Data Model from Information Architecture

This thesis proposes the *exclusion of corporate data model from information architecture* and goes further to suggest that perhaps a corporate data model may not be a necessity even for other purposes. In view of prevailing interests in data-oriented IS planning methodologies and CASE tools, this assertion warrants a brief discussion here.

Many writers such as Everest and Kim (1989), Karimi (1988) and Teng, et al. (1992) regard a corporate data model as the essence of information architecture. Some writers such as Finkelstein (1981, 1991, 1993) are strong advocates of a data-oriented approach to IS planning wherein development and usage of corporate data model is central. Davenport (1993, 1994), McGee and Prusak (1993) and some others are however critical of corporate data modelling. Researchers such as Goodhue, et al. (1988, 1992a) provide empirical evidence highlighting the problems of corporate data modelling. Even James Martin concedes that the concept of a consolidated corporate data model is impractical (Ross, 1988). This thesis argues that corporate data modelling may not only be irrelevant to IS planning but could also be unnecessary for data management and integrated database development. The empirical evidence from the survey and case studies, together with evidence from the literature, lend adequate support to this assertion.

During the course of this research, there were opportunities to occasionally interact with some information management consultants (from Andersen Consulting, CCTA, IBM, LBMS, Nolan Norton and Savant) on the findings that were emerging regarding corporate data model. A few of the consultants were not surprised when informed on the

lack of support for corporate data modelling. They indicated that their observation and experience had been similar. A few others disagreed and claimed that they knew of organisations which were successfully using corporate data models. These consultants were, however, generally unable to provide specific evidence in support of their claim. One of the consultants mentioned the Shell Group but the reality, as revealed in the case study on Shell Expro, was found to be somewhat different.

In addition to these interactions, literature search was carried out in an attempt to locate evidence of successful corporate data modelling practice but this met with little success. (The case of Rank Xerox UK was mentioned in Chapter 7). While it is possible that some organisations may be successfully developing and using corporate data models, the evidence as gleaned from the literature and this research are in unison on suggesting that a corporate data model may not be worth the required development effort. The set of business area/project data models of an organisation is proposed as the pragmatic alternative.

Business System Architecture: Its Link to Business Process Reengineering and Fusion

The study has argued with supporting evidence on the need to *include business system architecture as an integral part of information architecture*. Business system architecture is advocated in some recent releases of IS planning methodologies such as Business System Development Methodology (IBM, 1992) and Information Engineering (Texas Instruments, 1991, 1992) but what is defined by them as business system architecture, typically matrices and entity diagrams, is different from what has emerged in this research. The position taken by this thesis on business system architecture harmonises with the thinking of contemporary information management writers such as Darnton and Giacoletto (1992), McGee and Prusak (1993), and Tapscott and Caston (1993): it is *a graphic business process model depicting the fusion of strategic resources, including IT, to deliver a business strategy*. The business system architecture is similar to the business process maps advocated by Davenport (1993, 1994) and Hammer and Champy (1993) for performing business process reengineering. *The business system architecture via its*

integral position as an IA component thus offers the opportunity to reengineer business pragmatically as part of ongoing IS planning.

An important question relevant to business process reengineering and other major strategic IT efforts is as follows: How can an organisation gain and sustain competitive advantage through IT when it is available equally to all organisations which are prepared to invest in it? In seeking an answer to this question, Keen (1993, p. 17) points to the management dimension. He argues:

> "The wide difference in competitive organizational and economic benefits that companies gain from this information technology (I/T) thus rests on a management difference and not a technical difference. Some business leaders are somehow able to fit the pieces together better than others."

This thesis asserts that the business system architecture is a tool for bringing about the "fit" mentioned by Keen. By adopting business system architecture as a standard component of IA, an organisation is effectively equipping itself to progressively reengineer its business, fusing available resources in an optimal manner according to situation. The resulting system is dynamic and needs to be so if it is to maintain its position relative to its environment; a high-performing system today can become a mediocre system tomorrow due to changes in its environment or within itself. The business system architecture is a means for planning, implementing and managing the system and its evolution. The evolving business system of today is more than just a set of programmes and databases requiring some change.

2. Implications for Practice

The last statement encapsulates the implications of this thesis for practice. A system in today's context is more than just an IT application. The planning and implementation of an IT application requires it to be considered in the context of its larger business system. This research offers to the practitioner a holistic IS planning framework with information architecture as a central feature.

The practitioner considering adoption of the holistic IS planning framework is bound to have a number of questions such as : What does it mean in terms of existing and potential methodologies, tools, skills, models, etc.? What new things are involved? What do I have to reject? etc. The thesis argues that adoption of the framework and associated propositions involves rethinking and repositioning of processes and tasks rather than investing in new tools, techniques and the such. The whole premise of the framework is on focusing and targeting of IA and other models and not that the current planning techniques/models are wrong. This statement even applies to the corporate data model in that the research raises questions not on data modelling per se but on its relevance as an enterprise modelling technique relevant to management. Current skills and investment in data modelling, application architecture development, data flow diagramming, development of matrices, etc. thus maintain their values. With focused development of the various models, the IT practitioner has to make sure that the skills are available when and where they are relevant and needed most. In this regard, it is useful to note that the required skills can be clustered around semantics/synthesis for business/IS planning and syntactics/analysis for function-level IT tasks and application development.

Formal IS planning methodologies have tended to focus on syntactics/analysis at the expense of semantics/synthesis. The methodologies are geared towards IT in spite of claims to the contrary. The IS planning methodologies and techniques are therefore more appropriate for use within the IT domain, serving IT-specific requirements such as development of business area/project data models, application architecture, etc. At the senior management level, the boundaries between strategy development, business planning, IS planning and other organisational level planning begin to blur, and management communication, understanding and interaction take precedence over formal methodologies and techniques. Earl (1990, 1993) aptly refers to the arrangement as the 'organisational approach'. This research has found that conventional IA models, such as the corporate data model and CRUD matrix, are of little relevance to strategy development and business/IS planning. The macro-level pictorial business system

architecture has emerged as an important model relevant to senior management and a complement to the 'organisational approach'.

The business system architecture as proposed in this thesis is one of those tools which can naturally fit into business planning and become part of it. The architecture is simple and there is nothing 'IT' about it except for the IT applications depicted on it. It is nonetheless often initiated and facilitated by the IT department. The IT practitioner needs to examine how a business system architecture can be phased into his department's unique functional level planning/implementation activities and deliverables. He has to examine the relevance of his organisation's methodologies, tools and techniques to business system architecture. In particular, he has to consider how these tools/techniques /etc. could use the business system architecture to develop the application architecture, business area/project data model and models related to application development.

In proposing the holistic IS planning framework, due consideration has been given to current developments in IS methodologies, tools and techniques, in particular object-oriented techniques and CASE tools. Object-oriented techniques and CASE tools are primarily aimed at application development and not at the business at large. They are seen as means for specifying, developing and maintaining software of high quality in an efficient and effective manner. Thus their domain is predominantly IT. It is maintained that unless object-orientation, CASE tools or other such concepts/techniques/tools are applicable across the organisation, they are unlikely to be relevant or find ready acceptance in business planning and other organisational level activities. As it stands, they are of little relevance to business planning and its integrated IS planning. Their domain of usage is application development and maintenance. Just because they have been found be useful in application development, it does not necessarily follow that they will be equally useful in other tasks or areas.

3. Limitations of Research

This research has sought to employ a multifaceted comprehensive approach: a combination of research methods, a multidisciplinary domain, a large survey sample, an interesting set of case study organisations and various resources (academic/research/ commercial/practitioner literature, supervisor's expertise and guidance, information management researchers and scholars, IT vendors/consultants/practitioners, conference/ seminars, Internet, selected computer databases and software, and personal experience). It is contended that the resources used and the eclectic approach adopted are indicative of a reasonable effort the output of which merits consideration. Nevertheless, the findings and propositions emerging from this research need to be viewed in the light of the various limitations which were encountered along the way.

Perhaps the most significant limitation was in the case studies. The case study sample (with the exception of British Rail) was deliberately biased to successful IA practice. This makes generalisation from the case studies improper, hence the formulation of 'propositions' rather than 'theories' on IA. Nonetheless, the nature and richness of the sample support the emergent propositions as being worthy of consideration. The inclusion of British Rail, a case on unsatisfactory IA experience, in the sample offered an opportunity to approach the research from two opposite but converging lines. A case dealing with successful implementation of IT without the aid of IA could have enriched the qualitative investigation further. An attempt was made to identify such an organisation but the attempt met with little success. Another limitation of the sample was that none of the cases was a successful user of corporate data model. Effort was made to include at least a couple of organisations with corporate data models but to no avail. The three case study organisations which had declared in the IA survey that they were using corporate data models apparently did not view them in the conventional sense. Time constraint did not permit the seeking out and inclusion of a corporate data modelling success story. Rank Xerox UK was initially identified as a potential success story and effort was made to get some information. In the course of this attempt, Davenport's (1994) paper

appeared and indicated that Xerox had also joined the ranks of ex-corporate data model users.

There were also limitations in the survey. The survey sample was biased to medium and large organisations and targeted at single respondents, mainly heads of IT. Multiple perspectives from a truly random sample could have been better. Time and financial constraints however did not permit this possibility. These constraints also did not allow a follow-up questionnaire survey based on the initial survey findings. Nevertheless, the large sample size helped to minimise the effects of these limitations.

The lack of adequate research in information architecture has been an overall limitation. A richer base of IA research would have helped to guide this study and triangulate its findings and arguments. Effort spent on investigating some basic issues, such as position of IA, could have been re-directed at the qualitative research in IA development and usage - a few more case studies might have been feasible. The lack of adequate research was particularly felt in areas such as application architecture. The value of past research was evident in the investigation on corporate data modelling: the works of Davenport (1994), Goodhue et al. (1988, 1992a, 1992b), Kim and Everest (1994), Marche (1993) and others were very helpful in the formulation of firmer propositions and recommendations on corporate data modelling.

Though IA is a topical issue, current research in information architecture appears to be minimal. Effort was made via the supervisor's guidance, literature and Internet to identify others engaged in IA-related research. A few were identified but they were from the US; some interaction over the Internet enabled exchange of ideas and views on IA. It would, however, have been advantageous to have also been able to interact personally with a few researchers with similar interests - sharing of experience, exchange of ideas, sharing of notes/data, etc. could have been possible. Nevertheless, such personal interactions were carried out with some Templeton College faculty members and doctoral students on general information management issues and research methodology.

4. Implications for Further Research

Corporate data model is an important feature in contemporary IS planning methodologies, such as Information Engineering and IBM's newly released Business System Development Methodology, and continues to appear in modified forms and names in initiatives from IT vendors/consultants. Generic information architecture for insurance, retailing and other industries are currently available from vendors such as IBM. A key component of these architectures is a generic corporate data model. There is also ongoing effort in industries such as the petroleum industry to develop industry-specific data models. The findings of this research and the evidence from other studies, however, suggest a general state of unsatisfactory corporate data modelling experience. Some writers (e.g. Davenport, 1993, 1994) point out the inadequacy of corporate data modelling (and data modelling in general) in addressing requirements such as external data and information, soft information, mail, personal data, knowledge and expertise. Yet vendors/consultants continue to pursue and promote corporate data modelling. As corporate data modelling remains a topical issue, further research is required in it. One such research could be from the perspective of the vendors and consultants who advocate it, as past research efforts have tended to focus on the corporate data modelling experience of organisations which use it. Such a research could reveal the basis on which the vendors and consultants advocate corporate data modelling and help to answer some key questions on corporate data modelling from another perspective.

With the growing significance of object oriented technology and approaches, it is necessary to assess the implication of these on information architecture. Currently, object oriented concepts are confined to the application development level. New object oriented methodologies are emerging but these are mainly targeted at application development. Some enthusiastic methodologists are seeking to object orientate IS planning but indications so far have not been encouraging. This research does not foresee object orientation affecting IA in so far as business system architecture is concerned. This may however not be the case for application architecture and business area/project data model.

A current approach is to define objects as encapsulating related processes and data (Coad and Yourdon, 1991). The potential implication of object orientation on information architecture is unclear and warrants investigation. Would 'object models' be more appropriate as compared to separate application architecture and business area/project data models? How would it relate to the business system architecture? These and similar questions require research.

CASE tools are being used by some organisations in IS planning and development of conventional IA models - CRUD matrices and other matrices, corporate and business area/project data models, functional decomposition diagrams, and high-level data flow diagrams. The case studies, CASE literature (e.g. Howard and Rai, 1993) and general observation suggest that CASE is not delivering much value to IS planning. Nonetheless, the new generation of I-CASE tools seek to integrate IS planning with project implementation via information architecture (Martin, 1989; Texas Instruments, 1991). The impact of CASE tools on information architecture and their relevance to it as proposed by this thesis require research. Attention is required on the development of business system architecture and what CASE and technologies geared towards general management (such as electronic brainstorming, group decision support systems, etc.) may have to offer in this regard.

The concept of business system architecture is a relatively new one at least in so far as IS planning is concerned. Further research is required to examine the following: business system architecture's optimal form, type and content; effective arrangements for developing, using and maintaining it; the impact of growing IT-literacy amongst business executives at all levels on the development and usage of IA in general and business system architecture in particular. The potential relationship of business system architecture to business process reengineering has been mentioned. This link requires further clarification in view of the increasing attention business process reengineering is receiving.

Is it possible for an organisation to implement its integrated IT requirements without an IA? Many writers argue that it would be like trying to build a skyscraper without a blueprint. Nonetheless it might be possible in situations such as the following: an organisation may be dictated to by industry norms as regards IT application; the organisation's requirements are so basic that standard IT solutions may suffice; the organisation is content with being a follower and duplicates the IT efforts of the industry leader or others. The successful exploitation/usage of IT without the aid of an IA requires investigation to reveal any potential alternative to information architecture.

This research provides evidence that IA and IT architecture influence each other. The study has examined the relationship from the perspective of IA. An investigation into IT architecture could examine the link from the perspective of IT architecture. The evidence would help to shed more light on the relationship between IA and IT architecture.

Keen (1991) calls for a long-term business perspective in the planning of IT reach and range. The evidence from this research suggests that an organisation's reach and range is emergent, influenced by IA and anchored by selected vendor technologies. IT reach and range is thus the consequence of technology choice rather than business vision, but this approach appears not to have resulted in any strategic disadvantage. Keen's IT reach and range concepts require investigation. Such an investigation would help to further elucidate the technological aspects of information architecture.

This research sought to examine the nature and importance of IA from an 'organisational approach' perspective. The 'organisational approach' is not the only form of IS planning nor is it necessarily the right approach for all organisations. The research hints that perhaps 'business led' IS planning is more appropriate for organisations which are in a stable environment. The case study evidence suggests that an IA for a 'business led' IS planning can be less comprehensive. An investigation which examines successful IA practice from perspectives other than the 'organisational approach', in particular a 'business led' perspective, would be complementary to this research.

5. Personal Reflection

This thesis is not the result of an individual's effort but that of a very large virtual team comprising the researcher, his supervisor, scholars from various fields, practitioners, vendors and others. Without taking such a holistic approach, this research perhaps would not have amounted to much. In fact, it could be argued that is impossible for any meaningful research to be feasible without some form of systems thinking. I am a small player in a global dynamic virtual team (see figure 9.1) wherein I believe I have made a small contribution via this thesis.

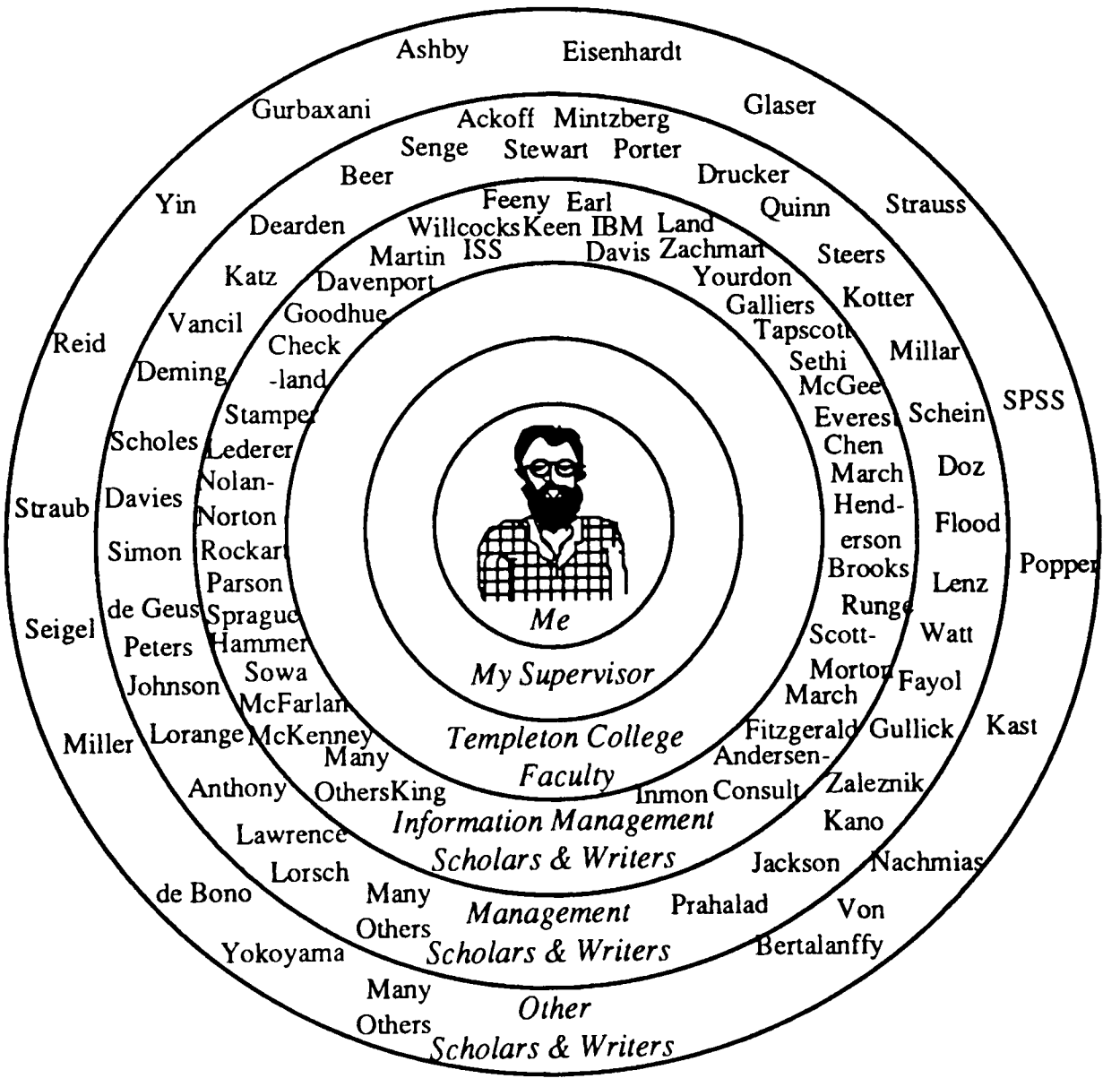


Figure 9.1: The Virtual Team Which Has Delivered this Research

The doctoral study has presented me with a rare opportunity to conduct an in-depth research into a major issue which I had to contend with as a practitioner, which fits in with my future career focus and which is of relevance to the IS community at large. As a researcher, I have been able to study the problem without being part of it. It has been possible and necessary for me to draw on knowledge and theories not only from the IS discipline but also from other disciplines such as organisational behaviour and strategic management. The approach adopted and the conclusions of this research are but the beginning of a new intellectual path for me.

6. Conclusion

This thesis provides empirical evidence supporting the positioning of information architecture as a tool for holistic IS planning and implementation. Information architecture, while helping to foster the cohesiveness of IS planning, also satisfies the necessary reductionist requirements via its set of hierarchically-related component models. The need for a holistic approach is evident in the light of growing dynamism and competition in business. Organisations are increasingly finding it necessary to respond to emerging business threats and opportunities by garnering all available resources including IT and fusing them into requisite strategies. The business system architecture is the tool offered by information architecture for this effort. Though originating from an IT consideration, the business system architecture has more to do with the business as a whole and less to do with IT specifically. For planning tasks which are specific to IT, the information architecture provides application architecture and business area/project data model. These IA models collectively facilitate the progression from business issues to IT specifics in an ongoing integrated manner. Targeting of models is the key message. This message is exemplified in the following saying:

A Picture Paints a Thousand Words, at least in so far as management is concerned.

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Appendix 1: Information Architecture Survey Questionnaire

Section A: Information System Planning

Q1. What is your response to this questionnaire covering? *(Please tick one response).*

(a) An organisation/corporation as a whole (parent organisation) [ ]
(b) A business unit/division operating within a parent organisation [ ]
(c) Both (a) and (b) [ ]

Q2. Information System Planning or ISP for short (also referred to as Information Strategy Planning) is a planning exercise which focuses on the alignment of IT applications with business strategies. The resulting information system plan covers the implementation of IT applications for the organisation over a period of time.

Does your organisation have an information system plan ? (Y/N) _____

If response is "No", please go to Section B.

Q3. How often is information system planning performed as a specific exercise? *(Please tick one response).*

1. Every year [ ]
2. Every 2 years [ ]
3. Every 3 years [ ]
4. Every 4 years [ ]
5. Every 5 years [ ]
6. On rare occasions [ ]
7. As and when necessary with no clear periodicity [ ]

Q4. Is the IS plan maintained on an ongoing basis? (Y/N) _____

Q5. What is the ISP methodology used? *(Please tick all applicable responses)*

1. BSP - Business System Planning (IBM) [ ]
2. Information Engineering (James Martin) [ ]
3. Method/1 (Andersen Consulting) [ ]
4. Nolan Norton Methodology [ ]
5. CSF - Critical Success Factor (Rockart) [ ]
6. Value Chain Analysis (Porter) [ ]
7. In-house methodology [ ]
8. Other methodology: _____ [ ]

Q6. Who are involved in the information system planning process? *(Please circle your responses on the scale: "1=No involvement" to "5=Full involvement").*

1. IT management	1	2	3	4	5
2. Systems analyst and/or other IT development staff	1	2	3	4	5
3. Data administrator	1	2	3	4	5
4. Senior management	1	2	3	4	5
5. Functional management	1	2	3	4	5
6. Business planner or corporate planner	1	2	3	4	5
7. External consultant or vendor	1	2	3	4	5
8. Others: _____	1	2	3	4	5

Section B: Information Architecture

Information Architecture is generally understood to be a blueprint arising from information system planning and which is used for implementing the integrated applications of an organisation. The architecture normally consists of either a Corporate (or Strategic) Data Model or an Application Architecture or both. *(Please refer to Appendix for further clarification .)*

Q7. (a) A Corporate Data Model is a high-level model showing the organisation's business entities and the relationships between them. (The term as used here also covers Strategic Data Model.)

Does your organisation have a Corporate Data Model? (Y/N) _____

(b) An Application Architecture is a high-level framework showing the various applications which make up (or will make up) the organisation's integrated information system.

Does your organisation have an Application Architecture? (Y/N) _____

If response is "No" to both (a) and (b), please go to Section E.

Q8. Who are involved in the development/reformulation (creation) of the Corporate Data Model and/or Application Architecture ? *(Please circle your responses on the scale: "1=No involvement" to "5=Full involvement").*

1. IT management	1	2	3	4	5
2. Systems analyst and/or other IT development staff	1	2	3	4	5
3. Data administrator	1	2	3	4	5
4. Senior management	1	2	3	4	5
5. Functional management	1	2	3	4	5
6. Business planner or corporate planner	1	2	3	4	5
7. External consultant or vendor	1	2	3	4	5
8. Others: _____	1	2	3	4	5

Q9. What situation/circumstance normally leads to the development/reformulation of the Corporate Data Model and/or Application Architecture?
(Please tick all applicable responses)

1. As part of an IS planning process [ ]
2. As part of updating/enhancing an IS plan [ ]
3. Prior to or during an IS project [ ]
4. Prior to major investments in IT [ ]
5. When major changes occur in the IT department [ ]
6. Other situations: _____ [ ]

Q10. What methodology/technique is used to develop/reformulate the Corporate Data Model and/or Application Architecture? *(Please tick all applicable responses)*

1. Business System Planning (IBM) [ ]
2. Information Engineering (James Martin) [ ]
3. Entity relationship diagram/ Logical data modelling [ ]
4. Data flow diagram [ ]
5. Matrices [ ]
6. Other techniques: _____ [ ]

Section C: Corporate Data Model

If you do not develop/use a Corporate Data Model, please go to Section D.

Q11. How frequently is the exercise of developing/reformulating (creating) a Corporate Data Model carried out? *(Please tick one response).*

1. Every year [ ]
2. Every 2 years [ ]
3. Every 3 years [ ]
4. Every 4 years [ ]
5. Every 5 years [ ]
6. On rare occasions [ ]
5. As and when necessary with no clear periodicity [ ]

Q12. Is the Corporate Data Model maintained? (Y/N) _____

Q13. Who are the users of the Corporate Data Model? (Please circle your responses - 1=Not a user; 2=Occasional user; 3=Regular user; 4=Frequent user; 5=Main user)

1. IT management 1 2 3 4 5
2. Systems analyst and/or other IT development staff 1 2 3 4 5
3. Data administrator 1 2 3 4 5
4. Senior management 1 2 3 4 5
5. Functional management 1 2 3 4 5
6. Business planner or corporate planner 1 2 3 4 5
7. Others: _____ 1 2 3 4 5

Q14. How often is reference made to the Corporate Data Model ? *(Please tick one response).*

1. Rarely [ ]
2. Occasionally each year [ ]
3. Occasionally each half-year [ ]
4. Occasionally each month [ ]
5. Occasionally each week [ ]

Q15. Typically, for how long is one version of Corporate Data Model used before it is discarded or replaced with a new one? *(Please tick one response).*

1. 1 to 6 months [ ]
2. 7 to 12 months [ ]
3. 13 to 24 months [ ]
4. 25 to 36 months [ ]
5. > 36 months [ ]

Q16. The following benefits/purposes have been asserted for Corporate Data Model. What is your opinion? *(Please circle your responses on the scale: "1=Not a benefit/purpose" to "5=Major benefit/purpose")*

1. Business modelling tool	1	2	3	4	5
2. Facilitates responses to changes in business	1	2	3	4	5
3. Tool for communication with senior management	1	2	3	4	5
4. Tool for communication with functional management	1	2	3	4	5
5. Tool for communication within IT dept.	1	2	3	4	5
6. Provides rigour to the IS planning process	1	2	3	4	5
7. Facilitates realisation of the integrated IS goal	1	2	3	4	5
8. Blueprint for implementing corporate database	1	2	3	4	5
9. Provides inputs for data analysis/database design	1	2	3	4	5
10. Other benefits: _____	1	2	3	4	5

Q17. The following problems/disadvantages have been attributed to Corporate Data Model. What is your opinion? (Please circle your responses on the scale: "1=Not a problem/disadvantage" to "5=Major problem/disadvantage")

1. Senior management find it complex	1	2	3	4	5
2. Functional management find it complex	1	2	3	4	5
3. Senior management find it irrelevant	1	2	3	4	5
4. Functional management find it irrelevant	1	2	3	4	5
5. It shifts focus of ISP from business to techniques	1	2	3	4	5
6. Development of it extends the duration of ISP	1	2	3	4	5
7. Additional resources are required to develop it	1	2	3	4	5
8. It is difficult to develop	1	2	3	4	5
9. It is difficult to maintain	1	2	3	4	5
10. Other problems: _____	1	2	3	4	5

Section D: Application Architecture

If you do not develop/use an Application Architecture, please go to Section E.

Q18. How frequently is the exercise of developing or reformulating (creating) an Application Architecture carried out? *(Please tick one response).*

1. Every year [ ]
2. Every 2 years [ ]
3. Every 3 years [ ]
4. Every 4 years [ ]
5. Every 5 years [ ]
6. On rare occasions [ ]
7. As and when necessary with no clear periodicity [ ]

Q19. Is the Application Architecture maintained? (Y/N) _____

Q20. Who are the users of the Application Architecture? (Please circle your responses- 1=Not a user; 2=Occasional user; 3=Regular user; 4=Frequent user; 5=Main user)

1. IT management 1 2 3 4 5
2. Systems analyst and/or other IT development staff 1 2 3 4 5
3. Data administrator 1 2 3 4 5
4. Senior management 1 2 3 4 5
5. Functional management 1 2 3 4 5
6. Business planner or corporate planner 1 2 3 4 5
7. Others: _____ 1 2 3 4 5

Q21. How often is reference made to the Application Architecture ? *(Please tick one response).*

1. Rarely [ ]
2. Occasionally each year [ ]
3. Occasionally each half-year [ ]
4. Occasionally each month [ ]
5. Occasionally each week [ ]

Q22. Typically, for how long is one version of Application Architecture used before it is discarded or replaced with a new one? *(Please tick one response).*

1. 1 to 6 months [ ]
2. 7 to 12 months [ ]
3. 13 to 24 months [ ]
4. 25 to 36 months [ ]
5. > 36 months [ ]

Q23. The following benefits/purposes have been asserted for Application Architecture. What is your opinion? *(Please circle your responses on the scale: "1=Not a benefit/purpose" to "5=Major benefit/purpose")*

1. Facilitates responses to changes in business	1	2	3	4	5
2. Tool for communication with senior management	1	2	3	4	5
3. Tool for communication with functional management	1	2	3	4	5
4. Tool for communication within IT dept.	1	2	3	4	5
5. Provides rigour to the IS planning process	1	2	3	4	5
6. Facilitates preparation of specifications for IS project	1	2	3	4	5
7. Provides inputs for application development	1	2	3	4	5
8. Blueprint for integrated application development	1	2	3	4	5
9. Facilitates realisation of the integrated IS goal	1	2	3	4	5
10. Other benefits: _____	1	2	3	4	5

Q24. The following problems/disadvantages have been attributed to Application Architecture. What is your opinion? *(Please circle your responses on the scale: "1=Not a problem/disadvantage" to "5=Major problem/disadvantage")*

1. Senior management find it complex	1	2	3	4	5
2. Functional management find it complex	1	2	3	4	5
3. Senior management find it irrelevant	1	2	3	4	5
4. Functional management find it irrelevant	1	2	3	4	5
5. It shifts focus of ISP from business to techniques	1	2	3	4	5
6. Development of it extends the duration of ISP	1	2	3	4	5
7. Additional resources are required to develop it	1	2	3	4	5
8. It is difficult to develop	1	2	3	4	5
9. It is difficult to maintain	1	2	3	4	5
10. Other problems: _____	1	2	3	4	5

Section E: General Issues on Information Architecture

Q25. Overall, how important is Application Architecture to the way IT is planned, implemented and managed in your organisation? *(Please tick one response).*

1. Irrelevant	[ ]
2. Little use	[ ]
3. Some use	[ ]
4. Significant use	[ ]
5. Absolutely essential	[ ]

Please state your reasons for the response:

Q26. Overall, how important is Corporate Data Model to the way IT is planned, implemented and managed in your organisation? *(Please tick one response).*

1. Irrelevant [ ]
2. Little use [ ]
3. Some use [ ]
4. Significant use [ ]
5. Absolutely essential [ ]

Please state your reasons for the response:

Q27. If you do not currently use an Information Architecture, or use an architecture but have doubts about its value and usefulness, please specify what other instrument/ technique/procedure is being used or may be used instead of it.

Section F: Other IT Issues

Q28. Do you use CASE tool(s)? (Y/N) _____

If "No", please go to question Q29.

For which tasks do you use CASE Tool(s)? (*Please tick all applicable responses)*

1. Information System Planning [ ]
2. Development/Maintenance of Information Architecture [ ]
3. Systems Analysis and Design [ ]
4. Programme Development and Code Generation [ ]
5. Re-Engineering and Reverse Engineering [ ]
6. Prototyping [ ]
7. Other usage: _____ [ ]

Q29. Do you use a formal methodology (such as Yourdon, SSADM, etc.) for systems analysis and design? (Y/N) _____

If "Yes", please specify the methodology: _____

Q30. The following is a list of roles of IT in business. To what extent are these applicable to your organisation? *(Please circle your responses - 1=Not a role; 2=Minor role; 3=Average role; 4=Major role; 5=Prime role)*

1. To gain and/or maintain competitive advantage over rivals	1	2	3	4	5
2. To function in an industry which is increasingly becoming IT-based	1	2	3	4	5
3. To improve productivity and efficiency	1	2	3	4	5
4. To reduce labour and other costs	1	2	3	4	5
5. Other role: _____	1	2	3	4	5

Q31. Does the following statement apply to your organisation? (Y/N)
"IT is useful but optional to organisation's activities and business." _____

If response is "Yes", please go to question no. Q33.

Q32. The following is a list of modes of strategic usage of IT. To what extent are these applicable to your organisation? *(Please circle your responses -- 1=Not a mode; 2=Minor mode; 3=Average mode; 4=Major mode; 5=Dominant mode)*

1. IT is the means of delivering goods and services, i.e. IT is indispensable	1	2	3	4	5
2. Organisation's strategies and operations increasingly depend on IT	1	2	3	4	5
3. IT potentially provides new strategic opportunities to organisation	1	2	3	4	5
4. Other modes: _____	1	2	3	4	5

Q33. (a) What is the total number of staff in the IT department ? _____

(b) What is the organisation's total annual expenditure on IT (capital, operating, staff and other expenses, in millions to one decimal place): £_____

Q34. Please add below any comments that you wish to make.

Appendix 2: Sample of Case Study Questionnaire (Allied Dunbar)

Please state your job designation:_____

Q1. IT roles in an organisation can be grouped under two categories. To what extent are these categories applicable to Allied Dunbar? Please circle your responses on the scale: "1 = Not a role" to "5 = Primary role".

1. Automation: Improve productivity, quality and efficiency of operations 1 2 3 4 5
2. Transformation: Change structure and operation of company and/or the financial/insurance industry in fundamental ways 1 2 3 4 5

Q2. Listed below are five different ways of categorising IS planning approaches. To what extent does Allied Dunbar's IS planning process match each category. Please circle your responses on the scale: "1 = Does not match at all" to "5 = Perfect match".

1. IS planning is centred on management planning, control and administrative procedures for allocation of resources 1 2 3 4 5
2. IS planning depends on use of formal technique(s) and methodology(s) 1 2 3 4 5
3. IS models/architectures are central to the IS planning process 1 2 3 4 5
4. IS planning is driven by Allied Dunbar's business strategies and plans 1 2 3 4 5
5. IS planning is not just driven by business planning but is totally integrated with it, and Management Services participates proactively and reactively in the development of the business strategies and plans 1 2 3 4 5

Q3. The following questions are on extent of IT-related participation/orientation. Please circle your responses on the scale using the keys specified for each question.

1. How would you describe the orientation of Allied Dunbar's IS planning process? (1 = Totally IT-oriented; 5 = Totally business oriented) 1 2 3 4 5
2. To what extent does the user-department get involved in IT matters? (1 = Leave everything to MSD; 5 = Totally lead MSD on matters affecting the line) 1 2 3 4 5
3. To what extent does senior management get involved in IT matters ? (1 = Leave everything to the MSD/line management; 5 = Totally drive IT matters) 1 2 3 4 5
4. What form of interaction exists between MSD and the other depts.? (1=Reactive: MSD only responds to requests; 5=Proactive: MSD always makes the first move) 1 2 3 4 5

Q4. (a) The following questions are on integration related to planning, organisation and operations (i.e. the degree to which joint effort, partnership and multidisciplinary planning/implementation/operation/etc. is the norm). Please circle your responses on the scale: "1 = No integration" to "5 = Totally fused".

1. To what extent are the various divisions/functions integrated? 1 2 3 4 5
2. To what extent *should* the divisions/functions be integrated? 1 2 3 4 5
3. To what extent is the IT element integrated with business strategies? 1 2 3 4 5

(b) The following questions are on integration of applications. Please circle your responses on the scale: "1 = No integration" to "5 = Totally integrated".

4. To what extent are the current IT applications integrated? 1 2 3 4 5
5. To what extent *should* the IT applications be integrated? 1 2 3 4 5

Q5. What is the strategic impact of Allied Dunbar's application portfolio? Please circle your responses on the scale: "1 = Low " to "5 = High".

1. Impact of *existing* IT applications on business strategies 1 2 3 4 5
2. Impact of *planned* IT applications on business strategies 1 2 3 4 5

Application Architecture

Application Architecture refers to the organisation-wide models depicting Allied Dunbar's applications and their interrelationships. The term also includes high level blueprints applicable to individual applications.

Q6. The following benefits/strengths have been asserted for the Application Architecture. What is your experience? Please circle your responses on the scale: "1 = Not a benefit/strength" to "5 = Major benefit/strength". (Please add comment below item.)

1. Useful for Allied Dunbar's business strategy development 1 2 3 4 5
2. Required for IS planning effort 1 2 3 4 5
3. Required for annual IS budgeting process 1 2 3 4 5
4. Facilitates planning/scoping of the IT component of a business project 1 2 3 4 5
5. Facilitates application development and project work 1 2 3 4 5
6. Facilitates evaluation and design of IT architecture 1 2 3 4 5
7. Tool for MS directors to communicate with functional directors 1 2 3 4 5
8. Tool for communication within project team 1 2 3 4 5
9. Facilitates data management 1 2 3 4 5
10. Facilitates integration of current and future applications 1 2 3 4 5
11. Facilitates evaluation/selection/usage of packages 1 2 3 4 5
12. Tool for ensuring the *efficiency* of IT applications 1 2 3 4 5

13. Tool for ensuring the *effectiveness* of IT applications 1 2 3 4 5

14. Other benefits:_____ 1 2 3 4 5

Q7. The following problems/weaknesses have been attributed to the Application Architecture. What is your experience? Please circle your responses on the scale: "1 = Not a problem/ weakness" to "5 = Major problem/weakness". (Please add comment below item.)

1. Senior management find it complex 1 2 3 4 5
2. Senior management find it irrelevant 1 2 3 4 5
3. User-department management/executives find it complex 1 2 3 4 5
4. User-department management/executives find it irrelevant 1 2 3 4 5
5. Project team finds it complex 1 2 3 4 5
6. Project team finds it irrelevant 1 2 3 4 5
7. It is very much of an IT tool rather than a business tool 1 2 3 4 5
8. Its content, convention, detail and presentation do not fit its purpose 1 2 3 4 5
9. Other problems:_____ 1 2 3 4 5

Q8. From your experience, how important is the *Application Architecture* to Allied Dunbar. Please circle your response on the scale: 1 = Irrelevant; 2 = Little use; 3 = Some use; 4 = Significant use; 5 = Absolutely essential. 1 2 3 4 5

Comments:

Corporate Data Model

Corporate Data Model refers to any organisation-wide conceptual data model which depicts Allied Dunbar's business entities and their relationships.

Q9. The following benefits/strengths have generally been asserted for the Corporate Data Model. What is your experience? Please circle your responses on the scale: "1 = Not a benefit/strength" to "5 = Major benefit/strength". (Please add comment below item.)

1. Useful for Allied Dunbar's business strategy development 1 2 3 4 5
2. Required for IS planning effort 1 2 3 4 5
3. Business modelling tool 1 2 3 4 5

4.	Facilitates planning/scoping of the IT component of a business project	1	2	3	4	5
5.	Facilitates application development and project work	1	2	3	4	5
6.	Facilitates evaluation and design of IT architecture	1	2	3	4	5
7.	Tool for MS directors to communicate with functional directors	1	2	3	4	5
8.	Tool for communication within project team	1	2	3	4	5
9.	Facilitates data management	1	2	3	4	5
10.	Facilitates integration of current and future databases	1	2	3	4	5
11.	Facilitates evaluation/selection/usage of packages	1	2	3	4	5
12.	Tool for ensuring the *efficiency* of IT applications	1	2	3	4	5
13.	Tool for ensuring the *effectiveness* of IT applications	1	2	3	4	5
14.	Other benefits:_____	1	2	3	4	5

Q10. The following problems/weaknesses have generally been attributed to Corporate Data Model. What is your experience? Please circle your responses on the scale: "1 = Not a problem/weakness" to "5 = Major problem/weakness". (Please add comment below item.)

1.	Senior management find it complex	1	2	3	4	5
2.	Senior management find it irrelevant	1	2	3	4	5
3.	User-department management/executives find it complex	1	2	3	4	5
4.	User-department management/executives find it irrelevant	1	2	3	4	5
5.	Project team finds it complex	1	2	3	4	5
6.	Project team finds it irrelevant	1	2	3	4	5
7.	It is very much of an IT tool rather than a business tool	1	2	3	4	5
8.	Its content, convention, detail and presentation do not fit its purpose	1	2	3	4	5
9.	Other problems:_____	1	2	3	4	5

Q11. From your experience, how important is the *Corporate Data Model* to Allied Dunbar. Please circle your response on the scale: 1 = Irrelevant; 2 = Little use; 3 = Some use; 4 = Significant use; 5 = Absolutely essential. 1 2 3 4 5

Comments:

Q12. There is no single data model which can be clearly identified as the Corporate Data Model for Allied Dunbar.

(a) Do you think it is *possible* to develop a single consolidated Corporate Data Model?

(b) Do you think it is *necessary* to develop a single consolidated Corporate Data Model?

Overall Assessment

Q13. What is your assessment of the success of Allied Dunbar's *IS planning*? 1 2 3 4 5

Please circle your response on the scale: 1 = Failure; 2 = Some benefits but IS planning is not needed to achieve them; 3 = Has been better than not doing it; 4 = Has been successful but planning can be improved; 5 = Highly successful.

(a) What do you think are the strengths of the current IS planning approach?

(b) What do you think are the weaknesses of the current IS planning approach?

(c) What method/technique/procedure/model/tool/etc. may be used to improve the current IS planning approach in Allied Dunbar?

Q14. Please add below any comments that you wish to make.

Appendix 3: Glossary and Acronyms

Glossary

Activity-Entity Matrix

A table showing the relationships between value activities and entities.

AD/Cycle

IBM's framework for developing applications in the SAA environment. The AD/Cycle framework consists of a set of tools that support the full range of application development activities, plus an application development platform for integrating those tool sets.

Affinity Analysis (in association with the activity-entity matrix)

The closeness between entities is determined by the extent of commonness in their associations with activities: Affinity of E1 to E2 = (number of times E1 and E2 are used together by activities)/(number of times E1 is used by activities). Affinity value > 0.8 is often taken as the basis for clustering of two entities.

Application

An integrated collection of custom-developed or package programmes for supporting the business.

Application Architecture (AA)

A high level model showing the various applications which make up (or will make up) the integrated information system and how these applications relate to each other in terms of the data flows between them.

Application Portfolio

The inventory of applications strategised for implementation according to the balance between demands of the business with supply of the IT resources.

Application Programming Interface (API)

A defined format and process for application programmes to communicate with one another. APIs are used primarily in client-server computing and enterprise computing to allow components of the same environment to be made available to other facilities.

Architecture

The art or science of designing and constructing buildings; the style of a building as regards design and construction; buildings or other structures collectively. (The Concise Oxford Dictionary, 1990).

Attribute

An item of information about an entity; equivalent to a column in a table, or a field in a record. An entity can be assigned several attributes.

Automation (of Business)

Replacing expensive, unreliable human labour and manual processes with sophisticated IT applications to save money, improve quality of output, and make the organisation more effective.

Business Area

Business areas are spheres of activity in relation to a company's products and processes. It is common for strategies to be focused on business areas.

Business Area Analysis

An information analysis technique for understanding and defining the IT application requirements of a business area.

Business Area/Project Data Model

A high-level logical data model of a business area/project. It graphically depicts the entities in the business area/scope of project and their relationships. It is often developed at the outset of a project and serves as the project data model, hence the concatenated name 'business area/project data model'.

Business Function

A group of business activities which together support one aspect of furthering the mission of the enterprise.

Business Model

A model of the things that the business needs to manage and of the business rules governing the behaviour of those things.

Business Plan

A high-level plan used by senior management to direct the organisation and to implement business strategies in the pursuit of organisational goals. The plan includes the IS plan and specifies the expected contributions from the IT function.

Business Process

A task or group of tasks carried out as part of a business function.

Business Process Reengineering (BPR)

Using the power of IT to redesign business processes radically in order to achieve dramatic improvements in organisational performance (Hammer, 1990).

Business Rules

The collection of rules and conventions that govern the methods of conducting a business and define the objectives, goals and services of an enterprise. A rule or convention is a business policy if it is practised by the enterprise continually.

Business System Architecture

A high-level graphic model that shows the integration of strategic resources, including IT, for delivering a business strategy.

Business Systems Planning (BSP)

IBM's (1981) structured IS planning methodology, with CRUD matrix as an important feature, for developing the organisation's IS plan. Information architecture is one of the key deliverables.

Business System Development Method (BSDM)

IBM's (1992) recent IS planning methodology for planning and developing business systems that are integrated across the organisation.

Cardinality

The number of entities of a particular entity type which can participate in an instance of an entity relationship.

CASE (Computer Aided Software Engineering)

One or more software tools, ideally integrated with one another (a single tool with integrated components is referred to as an I-CASE tool), used to aid the software development process at various life cycle stages. The objective is to improve the quality of the product and the efficiency of the process.

CICS (Customer Information Control System)

IBM's general purpose data communications system software aimed at online transaction processing.

Client-Server Architecture

A model of applications and systems design and implementation that distributes required work between client and server systems. Client systems are typically those with which IT-users interact, while servers provide one or more types of services to various clients.

Cohesion

A measure of how closely related the component tasks/elements of an object/system are.

Conceptual Skills

The management skills which relate to systems thinking and the visualisation of the organisation as a whole. (Katz, 1974)

Content Analysis

A technique for making inferences by systematically and objectively identifying specified characteristics of messages. (Holsti, O.R. (1968), The Handbook of Social Psychology, Addison-Wesley, p. 601).

Context Diagram

The highest level data flow diagram of a system. The diagram depicts the system's scope and purpose in terms of its relationship with its environment defined in terms of key external entities.

Contingency Approach

Determining the practices and techniques appropriate in specific situations.

Cooperative Processing

A technical arrangement whereby a computing task is split between a PC/workstation and a larger computer to optimise the strengths of each, specifically the graphical user interface and low cost processing features of the PC/workstation and the data sharing provisions of the larger machine.

Core Competencies

Areas of organisational expertise that are potential sources of strategic advantage.

Corporate Culture

The collective sense of traditions, conventions, and behavioural standards characteristic of a given enterprise. It is determined by organisational structure and by formal and informal human resources, policies, procedures and practices.

Corporate Data Model (CDM)

A high level data model showing the organisation's business entities and the relationships between them.

Coupling

A measure of the strength of the inter-relatedness between two objects/systems.

Critical Success Factors (CSFs)

The limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance of the organisation.

CRUD Matrix

A tabular representation of the relationships between activities and entities of an organisation, with an indication as to whether the type of relationship is 'Create' (C), 'Read' (R), 'Update; (U), 'Delete' (D) or a combination of these.

Data Analysis (IS)

A disciplined approach to analysing the meaning and properties of the data elements independently from the systems that produce and use the data.

Data Analysis (Research)

Quantitative or qualitative analysis of the data collected from field work.

Database Management System (DBMS)

Software which is designed to control and manage a database. It uses a data repository or dictionary to store the structure and definitions of the data.

Data Connectivity

This maximises the effective use of data (current and historical) by making it readily accessible to end-users, and available for viewing, selection and processing by applications in an appropriate form.

Data Dictionary

A computerised catalogue of an organisation's data types. For each data type, it seeks to contain synonyms of name, definitions, structure, source, usage and other relevant information. The dictionary is often linked to the organisation's databases. More recently, the dictionaries are being interfaced with CASE tools.

Data Flow Diagram (DFD)

A graphical representation of the flow of data between the processes of a system. The diagram also shows the data flows to and from the external entities (the ultimate sources and destination of data) and data stores (the organisation's logical repository of data) related to the system.

Data Management

The planning, implementation, administration and control of data stored by an organisation with the aid of IT. It involves, from a management perspective, the standards related to storage and access of data. Central to data management is the assumption that data is a corporate asset, and the focus on integrity and availability of necessary data.

Data Model

A logical map of data which represents the inherent properties of the data (related to the organisation, business area or project) independently of software, hardware, or other physical considerations.

DB2 (Data Base 2)

IBM's relational database management system available on the MVS operating system. Data access is via SQL commands.

Decision Support Systems (DSS)

Decision support systems are information systems and analytical models designed specifically to help managers and professionals to make more effective decisions.

Distributed System

The ability for multiple interconnected computing systems to be operating and serving the specific IT needs of their respective units/divisions within an overall corporate computing system arrangement.

Enterprise Computing

The seamless integration of applications, data, user interface, and other computing resources among distributed heterogeneous systems of varying sizes to serve the information needs of the enterprise.

Entity

An object (person, place, event, thing, etc.) of interest to the enterprise.

Entity-relationship-diagram (ERD)

A specific form of corporate data model. A simple diagrammatic representation of the information structure of an organisation, showing all the entities and their inter-relationships.

Equifinality

Reaching the same result by different means.

Executive Information System (EIS)

A user-friendly information system that provides an executive with customised information on critical success factors and key performance indicators. Its purpose is to organise, analyse, and display information in a way that helps senior managers to get a clearer picture of key trends and events.

Functional Management

Heads and senior managers of functional departments (other than IT).

Graphical User Interface (GUI)

A user interface for a terminal, personal computer or workstation based on graphics, icons, menus, windows and pointing devices.

Grounded Theory

Theory developed without any particular commitment to specific kinds of data, lines of research or theoretical interests. (Strauss, 1990).

Human Skills

The skills which enable a manager to work effectively with others. It is rooted in psychology, sociology and anthropology. (Katz, 1974)

Hypertext

A technique which permits easy search and access of online information in a variety of interlinked ways, whereby one information serves as the base for the next information in a whole chain of search and access facilitated by GUI.

Information Architecture

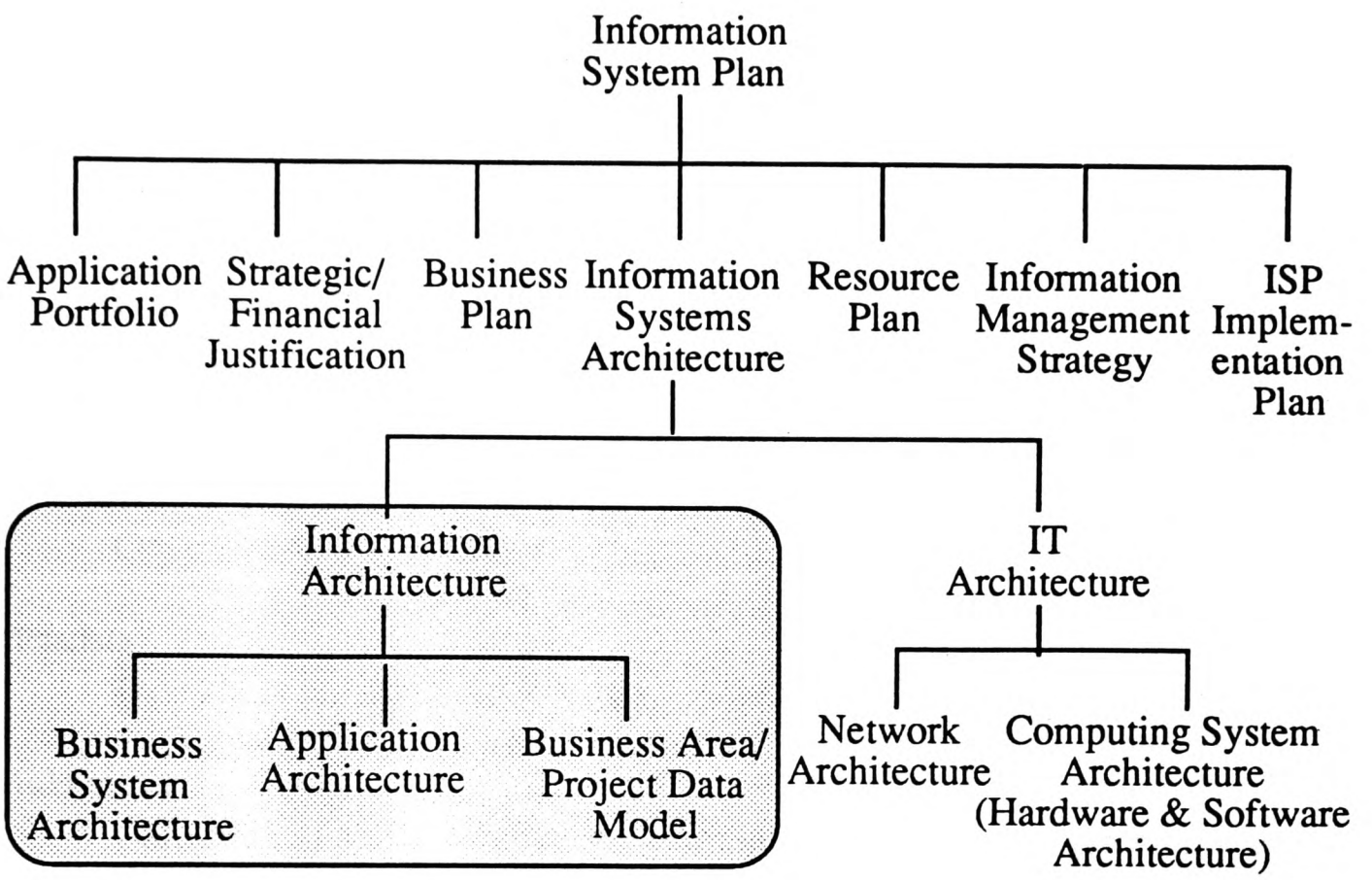
A high level blueprint which is developed as part of IS planning and which provides the foundation for development, implementation and maintenance of integrated applications. The information architecture as proposed by this thesis consists of business system architecture, application architecture and business area/project data model.

Information Engineering (IEM)

A data-driven integrated methodology, first initiated by James Martin, spanning from IS planning to application development and maintenance. It consists of an interlocking set of formal techniques in which data models and process models are built for use in the development and maintenance of applications. IEM is advocated for practice with an appropriate I-CASE tool such as IEF.

Information System Plan

A plan that seeks to include specific goals, business plans/strategies, project descriptions, resources, and schedules for the design, development and implementation of an organisation's information system. (See the figure below.)



Information Systems Planning (ISP)

The process of deciding the objectives for organisational computing and identifying potential computer applications which the organisation should implement. (Lederer and Sethi, 1988, p. 445).

Interoperability

The coordinated operation of heterogeneous information systems with one another. Interoperability may take place at various levels, from data transfer to application-to-application cooperative processing.

International Standards Organisation (ISO)

An international body that provides standards for a number of IS areas.

IT Architecture

The technical architecture which defines the principles, standards and technologies required to plan, develop, deliver, operate and maintain an organisation's IT applications.

IT Management

Head and senior managers of the IT department.

IT Range

Range refers to the degree to which information and IT services can be directly and automatically shared across an organisation's computing system.

IT Reach

Reach refers to the locations an IT platform is capable of linking. The ideal is to be able to connect to anyone, just as the phone system reaches across the world.

IT Steering Committee

The senior management team responsible for overall direction of the organisation's IT strategy and its implementation.

Local Area Network (LAN)

Local area networks link PCs, workstations, servers, printers and other computing resources within a single location such as an office or building. They help to satisfy the growing need for personal computers to send and receive messages, access data bases, share high-speed printers and high-capacity disk storage, and reach outside to other computers via WANs.

Mechanistic Organisation

Organisation that is rigid in design and has strong bureaucratic qualities.

Metadata

Data about an organisation's data, typically stored in a data dictionary/repository.

Middleware

Collection of software solutions to common application programming problems.

MVS (Multiple Virtual Storage)

A dominant mainframe operating system from IBM.

Nonprogrammed Decisions

Decisions made in complex, important and nonroutine situations, often under circumstances that are new and largely unfamiliar.

Object-Oriented Development

An approach to developing software where every component represents an object in the real world, encapsulated with its attributes and its possible actions; objects can be grouped together into classes to facilitate attribute and action assignments.

Open Systems

A technological environment in which components interact with one another through formal consistent interfaces, as contrasted with environments in which a high degree of patchwork is required to achieve interoperability and integration.

Open Systems Interconnection (OSI)

OSI is the principal framework for implementing Open Systems. It is a blueprint that specifies the interfaces for computing systems to be interconnected.

Operational Planning

The process of determining how specific tasks can best be accomplished on time with available resources.

Organic Organisation

An organisation that has a flexible and less-rigid structure permitting adaptation.

Organisational Behaviour

A management discipline that attempts to determine the causes of human work behaviour and translate the results into effective management techniques.

Planning

The process of preparing for change and coping with uncertainty by formulating future courses of action.

Programmed Decisions

Decisions that are repetitive and routine and can be made with decision rules.

Prototype

A preliminary model of a product which is provided to its intended users in order to clarify their needs and to get their inputs before building the final product.

Senior Management

Board members and heads of department.

Software Engineering

A disciplined approach, similar to that adopted in conventional engineering, for transforming identified IT application needs into operational software solution.

SQL (Structured Query Language)

The relational database management language, first developed by IBM and now endorsed as a standard, that is supported by most relational DBMS vendors.

Strategic Applications

Applications which are bonded to business strategies and which directly affect the company's competitive performance.

Strategic Data Model

An organisational level data model that shows only the major entities which are relevant to the organisation's business strategies.

Strategic Planning

The process of determining how to pursue the organisation's long-term goals with the resources currently and potentially available.

Strategy

The pattern or plan that integrates an organisation's major goals, policies, and action sequences into a cohesive whole. A well-formulated strategy helps to marshal and allocate an organisation's resources into a unique and viable posture based on its relative internal competencies and shortcomings, anticipated changes in the environment, and contingent moves by intelligent opponents. (Quinn, 1991)

Structured Analysis

A set of structured techniques, which typically includes data flow diagramming, to identify and define *what* the requirements of a system are.

Structured Design

A set of structured techniques to design and specify *how* the system requirements will be developed and delivered.

Support Applications

Applications which are essential for or contribute to internal processes but which do not have direct strategic implications.

System Flowchart

A graphic tool for depicting a computer system in terms of its inputs, outputs, jobs, job steps, intermediate files and physical devices.

Systems Application Architecture (SAA)

A set of IBM software interfaces, conventions, and protocols that provide a framework for designing and developing applications that are consistent across systems.

Systems Thinking

The ability and inclination to view organisational activities holistically, with a recognition of connections, relationships and interdependencies. (Feeny, 1993)

Technical Skills

The management skills which underpin analytical ability and involve methods, techniques, processes and tools. (Katz, 1974)

Theoretical Sampling

A sampling technique which prescribes attention to theoretical relevance and purpose in sampling decisions.

Top Management

Board members

Total Quality Management (TQM)

The management approach which advocates continuous improvement (*kaizen*), focus on the customer and deliverables, and advancing the organisation's interests via a common understanding of organisational goals and strategies.

Transformation (of Business)

Deploying IT to fundamentally change the organisation and/or industry for strategic reasons.

Triangulation

The process of collecting and double checking findings using multiple sources and modes of evidence.

User Management

Same as "Functional Management". This term is used to emphasise the fact that they are managers of departments which use IT.

Walkthrough

The review by a group of people to understand and improve a product or something of mutual interest.

Wide Area Network (WAN)

A wide area network links geographically separated computing systems. WANs involve transmission facilities far more complex than local area networks.

Workstation

A piece of self-contained computing equipment that provides an IT-user with access from their workplace to the applications, data and computing facilities of the organisation.

List of Acronyms

AA	Application Architecture
BSP	Business Systems Planning (methodology)
CASE	Computer Aided Software Engineering (tool)
CCTA	Central Computer and Telecommunications Agency
CDM	Corporate Data Model
CRUD	An activity-entity matrix; relationships shown - Create, Read, Update, Delete
CSF	Critical Success Factor
ERD	Entity Relationship Diagram
GUI	Graphical User Interface
I-CASE	Integrated Computer Aided Software Engineering (tool)
IA	Information Architecture
IEF	Information Engineering Facility (CASE tool)
IEM	Information Engineering Methodology
IEW	Information Engineering Workstation (CASE tool)
ISA	Information Systems Architecture
ISO	International Standards Organisation
ISP	Information System Planning
ITA	Information Technology Architecture
LAN	Local Area Network
SAA	Systems Application Architecture
WAN	Wide Area Network

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