Development and support of complex information systems in emergent organizations: structures, processes and governance

Richard Kingsford
University of Wollongong

Development and Support of Complex Information Systems in Emergent Organizations: Structures, Processes and Governance

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Richard Kingsford

MInfoTech (Hons) (*Wollongong*), MA (*WAust*), BA, BSc (*Qld*)

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CERTIFICATION

I, Richard Kingsford, declare that this thesis, submitted in fulfilment of the requirements for the award of Doctor of Philosophy, in the School of Information Systems and Technology, University of Wollongong, is wholly my own work unless otherwise referenced or acknowledged. The document has not been submitted for qualifications at any other academic institution.

Richard Kingsford

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ABSTRACT

This thesis examines issues related to the effective development and ongoing support of complex computer-based information systems (IS) in emergent organizations. An emergent organization is one in which features of its internal and external environments are emergent – that is, continually changing, but generally not as a result of deliberate strategy. On this basis many organizations are emergent. Emergence assumes that the business requirements for information systems change continually, and that systems are regularly adapted to their changing environments.

The thesis explores the structures, processes and IS governance which can result in optimum system development and support in emergent situations. It includes a case study which investigates the development and technical support of systems in an emergent organization with diverse business operations. The thesis draws attention to the role of system maintenance within the support function, and this can represent a large investment of skilled human resources. It was found that knowledge of complex information systems also plays a key role in effective development and support processes.

The case study used mainly qualitative research methods and adopted an interpretive approach. It was found that in the organization studied, certain structures, processes and modes of thinking related to information systems had evolved over many years. These were in harmony with, and reinforced the generation and use of the largely tacit knowledge of systems gained through long experience. These structures and processes included an implicit IS governance framework. In turn they provided effective support for system development and support, and hence for the business of the organization. The associated knowledge processes and understandings formed a key part of the organizational culture in relation to information systems and IS services.

During the study, the enterprise implemented substantial changes to its organizational IS structures and processes. These changes initially appeared to be soundly based, and were intended to improve the efficiency and quality of IS services to customers. The interrelated changes included the introduction of rigorous processes for project management; a goal of

having an adaptable and portable IS workforce; and the structural separation of system development from system maintenance.

It is shown that the organizational changes were not accompanied by full consideration of the existing structures and processes which applied in the organization. These included relevant 'knowledge' principles related to the appropriate recognition and use of tacit knowledge, and to the precepts of the implicit IS governance. Thereby the changes inadvertently acted to fragment knowledge of information systems, and to undermine the effective utilization of IS tacit knowledge. They also disturbed the implicit IS governance framework, and reduced the effectiveness of support for systems and business operations. The changes served to underscore the informal but critical role of knowledge of systems. This knowledge was effectively utilized via long-standing organizational structures and processes which had engendered relationships of knowledge sharing, collaboration and trust.

Inferences are drawn relating to structures, processes and IS governance in emergent organizations which rely on complex information systems to support their business operations. The thesis extends the level of knowledge in these areas. Some subsidiary inferences are drawn relating to change management and human resource management in organizations that rely on complex systems.

Keywords

information systems, system development, system maintenance, emergent organizations, business-technology alignment, organizational structure, organizational culture, IS governance, knowledge processes, tacit knowledge

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DEFINITIONS OF KEY TERMS

Brief definitions of key terms as they are used in this thesis are given below. A more complete Glossary of terms is provided at the end of the thesis.

brown field	organizational situation in which typically computer-based systems have long existed, and any new systems or enhancements must work within the constraints of existing systems and accumulated production data; see also *green field*
business	that part of an organization which is directly responsible for fulfilling the purpose of the organization; the basic reason for existence of the organization; may refer to a specific area of an organization in regard to a certain business function
business function	area of responsibility of an organization related to fulfilling one or more of its aims; e.g. customer records, accounting, ordering etc
business needs	broad requirements for one or more related information system(s), expressed in business terms
business process	a process used by a business area to support the fulfilment of an aim of the organization; may include the use of information system(s)
business requirements	specific requirements for an information system, expressed in business terms which can be translated into system specifications; generally documented
change management	management of significant change(s) in an organization, such as to organizational structure or processes; methodology used to manage such change(s)
community of practice	community of 'knowers' who share both their work and interpersonal discussion of it, and so acquire, maintain and enhance their informal knowledge about the work, and also identify and discuss potential improvements; can enable organizational processes to be effective; used specifically in this thesis to refer to a co-located IS community which focuses on one or a few related systems, and interacts intensively on a regular basis
complex information system	information system used by an organization which is regarded as complex by IS staff, users and/or managers; system which is difficult and time-consuming to develop extensive knowledge of; there is no precise division between 'complex' and 'simple' systems
critical system	information system which an organization relies on totally, and which must remain available to users and work properly; also called business-critical system, mission-critical system or key system
emergent organization	organization in which features of its internal and external environments such as structure, policies, regulations, decision processes etc are emergent and dynamic; emergence implies not stemming from any deliberate strategy or initiative; the emergence may be gradual and continuous

emergent system	information system in an emergent organization; assumes that business requirements are continually changing, and that the system is continually adapted to its environment, and so continually evolves
ethnography	approach drawn from social-cultural anthropology, generally used to study the culture, structure and/or processes of a group or organization
explicit knowledge	knowledge which can usually be readily articulated and documented; relatively easy to transfer to other people
federated governance	governance model in which coordinated decision making involves both a centre and outlying units; similar to the federal governmental system of some nations, in which certain decisions are made at federal level and others are the responsibility of states
formal organization	visible aspects of an organization such as goals, strategy, plans, resources and formal structure; see also *informal organization*
governance	system by which an organization is directed and controlled; framework, or set of rules or guidelines that determine the distribution of roles, responsibilities, decision-making, accountability, resources and processes in an organization; governance guidelines may be explicit or implicit
green field	organizational situation in which computer-based systems are implemented to support business processes which previously had no computer support; see also *brown field*
human resources	persons employed by an organization; may include ongoing (‘permanent’), temporary and contract employees
informal organization	implicit or ‘hidden’ aspects of an organization such as culture, values, beliefs, attitudes, behavioural norms, power, politics and informal structure; informal aspects typically have strong influence on actions and decisions; see also *formal organization*
information system	system used to support certain business requirements related to information, typically entailing information acquisition, processing, storage, transfer and/or display; typically a human-technological system which includes significant computer-based component(s)
interpretive research	research approach typically associated with the social sciences and ethnography, which generally attempts to understand and interpret phenomena through the meanings assigned to them by people closely involved with those phenomena
intuition	tacit knowledge derived from mental models based on long experience, dependent on context, and not based on linear cause-consequence thinking; such mental models are often founded on deep understanding, and are so internalized and thought about so often from so many perspectives that typically they cannot easily be explained in simple cause-effect language; generally not able to be clearly articulated or documented
IS	information systems; may refer to the development, support, use and/or study of information systems; may refer to the IS organization
IS culture	organizational culture of the IS organization

IS governance	governance framework relating to information systems in an organization; subset of IT governance
IS/IT governance	IT governance with an emphasis on its significant IS component
IS organization	that part of an organization which develops and maintains information systems, in particular their software aspects, and supports the technical operation of systems; also IS group
IS services	services provided by the IS organization related to development, maintenance or support of information systems; generally provided to customers internal to the organization; some services may be provided to external customers
IT governance	governance framework relating to IT in an organization
IT organization	that part of an organization which supports information technology; also IT group
key system	information system which an organization relies on totally, and which must remain available to users and work properly; also called critical system, business-critical system or mission-critical system
knowledge	fluid mix of framed experience, values, contextual information and expert insight that provides a framework for evaluating and incorporating new experiences and information; knowledge may be either, or simultaneously, a 'thing', a 'process', an 'action' and/or a 'flow'; substantial amounts of knowledge originate naturally in interactive social processes; often embedded in organizational routines, processes and norms
knowledge ecosystem	complex set of interactions among people, process, technology and content within an organization, or a significant organizational component; the components of a knowledge ecosystem may include its objectives, strategic intent, organizational context, culture, specific enablers (activities, tools, techniques), networks and communities
knowledge management (KM)	management discipline that seeks to improve the quality of knowledge processing within an organization
knowledge process	social process involving the production, diffusion and/or use of knowledge; evolves naturally within an organization, without necessarily any explicit imposition of a knowledge management framework
knowledge processing	social process found in all organizations, covering the production, diffusion and use of knowledge; act of performing knowledge process(es)
legacy system	computer-based information system which typically has long existed in an organization, and which the organization relies upon to support critical business function(s); also called heritage system
methodology	formal documented method or standard procedure for undertaking a certain set of actions and achieving a certain outcome; often refers to system development or project management; often mandatory if applied by an organization

organizational culture	system of shared ideas, concepts, rules and meanings that underlie and are expressed in the way people live and work in an organization; cultural values, beliefs, assumptions and norms are usually deep-seated and often long-established
organizational structure	arrangement of groups, networks, roles, responsibilities and people in an organization; may refer to either formal configuration, or significant informal arrangements
participant observation	approach in which the observer is also a participant immersed in the relevant culture or organization, and studies it in detail from the point of view of its own members
peer review	review of a system deliverable produced by a team, undertaken by peers from the same team and other team(s); part of quality assurance process
procedure	specific rules of good practice for a particular process (usually documented); may involve business, IS or both; may be mandatory
process	means of achieving a certain output or result; generally refers to a regular or recurring need; often includes a set of actions; not necessarily rigidly specified; may or may not be documented; may apply to business and/or IS
production data	data stored in a computer-based information system and used by business staff to help perform business processes; also ‘live’ data
project	logical array of activities intended to achieve a certain objective which may include the delivery of a product; has a defined start and finish, is not ongoing; may refer to a project team
project management	process or procedure used to manage a project; sometimes documented as a methodology
resources	manageable assets of an organization, including financial, human, physical and other resources; may include tangible and intangible elements; may include knowledge resources
stakeholder	any individual or group that can affect, or is affected by, decisions regarding the area of interest
system	bounded entity set up to support certain requirements; includes defined input(s), processes and output(s); interacts with its environment via input(s) and output(s); may include human and/or technological component(s)
system change	requested change to a system; requires update of system specifications to keep them current; a change is generally requested by business, but may be requested by IS
system development	process or procedure used to develop a system; generally includes analysis, design, build (construction), testing and implementation of the system; sometimes documented as a methodology
system documentation	set of documents relating to an information system from an IS perspective; may include business requirements, design documentation, system specifications and system test plans; see also *user documentation*

system enhancement	enhancement to a system requested by business – generally larger and/or more complex than a system change; requires update of system specifications to keep them current
system error	error in the operation of a system; mismatch between operation of system and current specifications; does not require update of system specifications; an error may be identified by either business or IS
system knowledge	knowledge about an information system, often including both technical and business-related knowledge
system life cycle	life of a system including sequential stages of development (including analysis, design, build, testing and implementation), operation (including maintenance and support), and retirement; the 'operation' stage may be protracted
system maintenance	includes corrections of errors, changes and enhancements to a system
system product	significant part of a system, typically implemented into production at a given time as a system release
system release	implementation into production of a system or a significant part of a system; may include a set of accumulated changes or enhancements
system specifications	document(s) specifying how a system fulfils its business requirements through technological means
system support	includes system maintenance, and other technical assistance with the operation or effectiveness of a system as required
tacit knowledge	includes practical 'know how' of a function which for most people lacks explicit, detailed awareness of how it is achieved (such as riding a bicycle); may be partly or largely inexpressible; often difficult to transfer to other people; also called implicit knowledge
$tacit_1$ knowledge	tacit knowledge which could potentially be codified (articulated and/or documented) and made explicit, but often is not
$tacit_2$ knowledge	tacit knowledge which is rarely able to be fully codified (articulated and/or documented), and so can rarely be made explicit
transaction	procedure undertaken by a user or a system to enter, update or extract data from a system at an elementary level, e.g. entering a customer's details, updating an order etc
transaction processing	refers to handling a number of transactions, usually in sequence; generally implies a large volume of transactions in a given period
user documentation	set of documents relating to an information system from a business/user perspective; may include business requirements, user instructions and/or training manual; see also *system documentation*
work around	alternative business procedure to enable users to avoid or bypass a known system problem or error; sometimes documented

ARRANGEMENT OF THE THESIS

This thesis is arranged as described below.

Chapter 1 provides a brief introduction to the thesis, and a summary of its research aims. This is followed by an outline of the scope of the thesis, and a brief overview of the thesis.

Chapter 2 outlines the research approach, research design, research questions and the methods used. It also discusses theoretical and practical concepts related to the qualitative research methodology. These include the interpretive anthropological concepts and methods applied in the case study, primarily culture, ethnography and participant observation.

Chapter 3 discusses the concept of information systems governance from a theoretical viewpoint, and gives a survey of relevant literature. Chapter 3 includes consideration of specific key points relating to the case study (these are expanded in Chapter 5).

Chapter 4 provides a literature survey of relevant knowledge principles, processes and theoretical approaches, and discusses these in terms which are later applied in more detail in Chapter 5. Chapter 4 includes preliminary references to specific key points relating to the case study (these are expanded in Chapter 5).

Chapters 5 and 6 together describe and analyze in detail the extended case study around which the thesis is centred. Chapters 5 and 6 respectively address mainly the situations 'before' and 'after' the organizational changes to IS structures and processes that were initiated during the case study. Chapter 5 draws extensively for analytical purposes on the relevant principles, processes and theoretical concepts which were introduced in Chapters 3 and 4 (see above). Chapter 6 focuses more on the organizational changes and their outcomes. A brief overall summary of the case study is provided in Chapter 6, focusing on significant points and findings.

Chapter 7 reviews the research aims and methods, draws inferences from the analysis of the case study, provides an overall summation of the thesis, discusses its conclusions, identifies some practical recommendations for organizations – especially emergent organizations – which rely on complex information systems, and makes suggestions for further research.

References cited in the thesis are then listed, and a glossary of terms used in the thesis is provided.

For most chapters, an attempt has been made to make the chapter complete in itself as far as possible, as advocated by Perry (1994). The main focus of each chapter is generally related to some key points of other chapters. Therefore in order to better describe the context, some chapters include references to concepts also discussed in other chapters.

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Chapter 1 RESEARCH AIMS AND OVERVIEW OF THESIS

This chapter provides a brief introduction to the thesis and a summary of its research aims. The scope of the thesis is outlined. This is followed by a concise overview of the thesis which includes an outline of the case study, an introduction to some key concepts applied in the thesis, and a summary of general recommendations based on the thesis.

1.1 Introduction

This thesis examines issues related to the effective development and support of complex information systems in emergent organizations. The thesis draws attention to the place of system maintenance, and this can represent a substantial investment of expert human resources. It was found that knowledge of complex information systems also plays a key role in effective development and support processes. In the enterprise studied in detail, certain structures and processes which had evolved over many years reinforced the generation and use of the largely tacit knowledge of systems, gained mainly through long experience. These structures and processes included the implicit IS governance framework. In turn, the structures, processes and systems knowledge effectively underpinned IS development and support, and hence the organization's business.

The case study used qualitative research techniques including interpretive anthropological methods, primarily ethnography and participant observation. During the study, the enterprise introduced substantial changes to its organizational IS structures and processes. These did not adequately consider the existing structures and processes, nor established principles related to knowledge and knowledge processes. Thereby they acted to undermine the effective utilization of systems knowledge, to disrupt the implicit IS governance, and to reduce the efficiency of IS development and maintenance. The changes served to underline the informal but critical organizational role of systems knowledge. Some inferences are drawn regarding IS governance and knowledge processes in organizations – especially emergent organizations – which rely on complex information systems. One inference is that it may be misguided, and result in

inefficiency and diminished quality of IS services, to segregate the development and maintenance of complex systems into disparate functional areas.

1.2 Research Topic and Objectives

The research topic of the thesis is the effective development and support of complex computer-based information systems in emergent organizations. An emergent organization is one in which features of its internal and external environments are emergent – that is, continually changing, but not as a result of any deliberate strategies. The emergence of any aspect may be either sudden and (often) large-scale, or gradual and (often) in continual small increments. The emphasis in the thesis is on continuous, incremental change. The evidence suggests that for a long time many organizations have been subject to frequent if not continual emergent changes in their environments, and many have adapted effectively to the changes in an ongoing way (e.g. March 1988). The business requirements for many information systems are therefore also likely to be continually emergent (e.g. Purao and Truex 2004). Emergence assumes that the requirements for information systems change continually, and that as a result systems are regularly adapted to their changing environments. Therefore ongoing maintenance of systems can be both necessary and beneficial.

Truex, Baskerville and Klein (1999) in a significant article, "Growing systems in emergent organizations" address the issue of system development and support in emergent environments. They propose that such systems should be subject to ongoing, integrated processes of development, modification and enhancement, in order to continually adapt the systems to their changing business requirements. They write:

> "We propose a.. view that assumes systems should be under constant development, can never be fully specified and, like the organizations for which they are built, are subject to constant adjustment and adaptation.. The goal of [IS development] is to preserve all existing IS applications by continuously enhancing and modifying these to match organizational requirements.. The IT organization that supports emergent organizations must value system adaptation.. most of the organization's important development activities are merged with its maintenance activities.." (Truex et al. 1999: 121-122)

The thesis examines this proposition in detail by means of an extended case study focusing on information systems in a large emergent organization with diverse business operations. The study investigates the development and ongoing support of complex systems in this organization, and finds strong support for the 'emergent systems' proposition given above.

The emergent systems development approach incorporates a continuous redevelopment process, and considers the interwoven and mutually interdependent nature of an information system and

the organization. Emergence continues past the deployment of an information system, and the processes of design and redevelopment continue to encompass what has traditionally been referred to as 'maintenance'. The approach sees contemporary organizations as emergent and continually changing, along with their information systems. Both the system and the organization are malleable and in a constant state of flux. A fundamental assumption of the approach is the symbiotic relationship between an information system and the organizational context. The emergent systems development approach has been characterized as a fundamental shift from 'traditional' system development practices to a continuous redevelopment process (Purao et al. 2003; Purao and Truex 2004; Truex et al. 1999). The case study research demonstrates that in an organization in which business requirements are continually emergent, effective structures and processes for handling emergent system development and support can evolve naturally over the years. Organizational emergence, both in general and in relation to information systems, is discussed in more detail in section 7.3.

The case study was conducted in a large organization which from the perspective of its information systems was primarily a transaction processing enterprise – referred to in this thesis as 'TPE' (a pseudonym). For reasons of confidentiality the organization is not named in the thesis, nor are any persons identified. The focus of the thesis is on TPE's information systems, none of which are identified by name. A detailed case study was undertaken by the researcher, who worked in TPE during the relevant period and thus had good access to empirical material. The initial primary aims of the research were to gain understanding of the nature of TPE's information systems, and of the organizational structures, processes and IS governance arrangements required to effectively develop and support the systems. The research soon moved on to also examine certain organizational changes which were intended to improve the efficiency and quality of delivery of IS services to business customers, and to align IS more fully with business. Though unexpected, these substantial changes targeted the very IS structures and processes which were the focus of research, and so it was appropriate to include study of the changes and their outcomes as part of the research. The changes also served to highlight the ways in which the earlier structures and processes, including knowledge processes had effectively supported TPE's information systems.

The research explores the structures, processes and IS governance which can result in optimum system development and support in emergent situations. It was found that knowledge of complex information systems, especially tacit knowledge, also plays a key role in effective development and support processes. The research draws attention to the significant role of

system maintenance within the support function. Bennett and Rajlich (2000) advocate that more research is needed on software maintenance:

> "Despite the large expenditure, little is known about the empirical nature of software maintenance.. much more empirical knowledge about software maintenance and evolution is needed, including process, organization and human aspects.." (Bennett and Rajlich 2000: 76, 85-86)

The research therefore investigated areas which include:

- the role of organizational structures, processes and IS governance in the development and support – including maintenance – of complex information systems in emergent organizations;
- the role of systems knowledge and knowledge processes in the development and support of complex information systems in emergent organizations;
- the part played by organizational culture in the aspects noted above; and
- in the case study in particular – the organizational changes, and their impacts and outcomes.

The specific research questions which were addressed are discussed in Chapter 2.

The research topic relates in general to the long-standing issue of aligning information systems with organizational business needs (e.g. Dampney and Andrews 1991; Henderson and Venkatraman 1993). Andriole (2004) refers to this issue, and comments that by and large 'separatist' models have prevailed for the past two decades. Such models have sought to organize technology to better support business, but essentially have not resulted in their closer integration. This demonstrates that business-technology alignment is not a trivial problem, and in general it has not been 'solved', even after decades of research and practice. The sub-title of Dampney and Andrews' paper (1991) – "the growing alignment of information systems and the business" – seems premature. Andriole (2004) argues for inclusive models which more closely integrate business and technology decision-making within new governance styles. This thesis describes an effective, inclusive IS governance approach in regard to the main focus of the research, namely the development and ongoing support of complex information systems in emergent organizations.

The case study examined a 'brown field' organizational situation, in which most of the 'terrain' had long been 'built on' with computer-based systems. Any new systems, or enhancements to existing systems had to work within the constraints of existing legacy systems, and conform with accrued production data. Such a situation is in contrast to a 'green field' site, in which computer systems are implemented to support business processes which previously had no

computer support. Hamilton (2005) observes that 'green field' systems development, on which the IS discipline first built its foundations (e.g. Somogyi and Galliers 1987), is becoming progressively less significant as the business environment moves ever closer to full automation. However academic IS research focusing on 'brown field' situations is still relatively new (e.g. Clear 2005; Truex et al. 1999), and this thesis makes a significant contribution to the level of knowledge in this important and topical area.

In regard to knowledge of systems and related knowledge processes, these aspects of the thesis fit within the general framework of the 'dynamic theory of organizational knowledge creation' (e.g. Nonaka 1994; Nonaka et al. 2000), which takes a social processual perspective on knowledge. Effective knowledge is often closely linked with action, rather than simply connoting facts or elements. Organizational knowledge underlies and is embedded within social processes. Knowledge, particularly tacit knowledge, is fluid and emergent through interactions, is continually updated and refined, and is not fixed and stable. Knowledge is constituted and manifested through social processes (e.g. Orlikowski 2002; Styhre 2003).

The research approach used mainly qualitative techniques, centred on a detailed, extended case study which adopted interpretive methods. Case studies are commonly used in IS research (e.g. Benbasat et al. 2002; Cavaye 1996). The case study research was qualitative, an approach well suited to gaining understanding of information systems in organizational settings (e.g. Myers and Avison 2002; Trauth 2001; Walsham 2002). In particular, an ethnographic approach can provide deep understanding of a complex organizational context (e.g. Myers 1999). The use of ethnography in IS research has been advocated by various writers (e.g. Harvey and Myers 1995). The ethnographic approach combined with an extended case study was ideally suited to investigating the research topic, which centred on complex information systems in emergent organizations. The use of anthropological methods in studies of organizational behaviour has been recommended by various writers (e.g. Schwartzman 1986). Research was therefore undertaken utilizing two of the principal methods of social-cultural anthropology: ethnography (e.g. Pelto and Pelto 1978) and participant observation (e.g. Spradley 1980). The case study approach was interpretive, that is, it aimed to interpret phenomena through the meanings understood by those closely involved with them (e.g. Klein and Myers 1999; Walsham 1993, 2002). The interpretive approach was well-matched to participant observation, which also aims to understand a culture or organization from within. As a participant observer, the researcher had good access to rich empirical data.

The qualitative, interpretive research techniques used in the case study are discussed further in Chapter 2.

1.3 Overview of the Thesis

The remainder of Chapter 1 provides an overview of the thesis, and introduces some key concepts which are used. These are discussed further in late chapters. Kingsford and Dunn (2006) also provide an earlier summary of some of the main elements of the thesis.

1.3.1 Scope of Thesis

This section provides a summary of what is included in the scope of this thesis, and what is excluded.

The research aims to better understand the organizational IS structures, processes and governance needed to effectively develop and support complex information systems in emergent organizations. In order to do this, the research also investigated IS organizational culture. The thesis is primarily a study of information systems in a broad sense, without focusing on the details of any particular system. The term *process* is defined here as 'a means of achieving a certain result, generally relating to a recurring need.' A process often includes a set of actions, and it may or may not be documented. A process is not the same as a *procedure*, which here refers to specific rules of good practice for a particular process, which are usually documented.

The research includes study of development and support processes – including maintenance – without going into the technical details of these processes. The thesis includes consideration of the role of systems knowledge and related knowledge processes. It does not focus on knowledge management in the sense of a formal management discipline that seeks to improve the quality of knowledge processing in an organization. The thesis does not consider knowledge management approaches which are supported by technological products. The thesis makes use of relevant 'knowledge' theories and literature, but it does not aim to make a significant theoretical contribution to these areas. However it offers a detailed example of the value of knowledge and knowledge processes within a certain context.

The research includes study of project management processes in general, without going into the details of any particular project. The thesis considers human resource management as it is

applied to the development and support of information systems, but not more widely. The thesis investigates organizational change management in a broad sense. However it does not cover lower-level change control processes as they are applied to information systems.

The scope of the thesis does not include any significant focus on IS strategy, strategic management or strategic planning. Nor does it cover planning for information systems, either for individual systems, or collectively in the sense of planning for an information systems portfolio. Nor does it cover measurement, monitoring and reporting on IS work, except in a general sense. The scope of the thesis does not include business processes, or the operation and use of systems, except in a general way. The thesis does not cover the processes of identifying business needs or analyzing business requirements for systems, except at a broad level. The thesis does not address specific technical or technological issues, except as passing references. The thesis does not address financial management or budgetary matters.

1.3.2 Knowledge Processes

The systems knowledge and knowledge processing aspects of the thesis fit within the general framework of the 'dynamic theory of organizational knowledge creation' (e.g. Nonaka 1994; Nonaka and Takeuchi 1995; Nonaka et al. 2000), which maintains that organizational knowledge is created and updated through continual social interaction between tacit and explicit knowledge. The theory proposes that effective knowledge is often closely linked with action and practice, rather than knowledge simply connoting things, elements, facts or dispositions. The theory takes a social processual perspective on knowledge, that is, organizational knowledge is constituted and manifested through interactive social processes (e.g. Orlikowski 2002; Styhre 2003). Knowledge underlies social practices, is embedded and emergent within social processes and interactions, and is therefore distributed among people. Knowledge, particularly tacit knowledge, is fluid and emergent through social interactions, is continually updated and refined, and is not fixed and stable. In sum, knowledge is "an ongoing social accomplishment, constituted and reconstituted in everyday practice" (Orlikowski 2002: 252).

Some details of the proposed workings of the 'dynamic theory of organizational knowledge creation' (e.g. Nonaka 1994; Nonaka et al. 2000) have been criticized, however the details are not relevant to this thesis. Such criticisms have also been rare. For example, Bereiter (2002: 175-179) considers that Nonaka's model does not explain how expertise actually develops. Gourlay (2006) criticizes Nonaka's proposed mechanisms for the transfer, creation and conversion of forms of knowledge, such as tacit to explicit, and vice versa. However this thesis

does not systematically address such mechanisms. In fact Nonaka (1994: 350) suggests that further work is necessary to validate the mechanisms – work which is largely yet to be done (Gourlay 2006: 1421). The general framework of Nonaka's theory remains relevant and is strongly supported by many writers (e.g. Choo and Bontis 2002). In fact Gourlay (2006: 1432) notes that of 1093 citations of Nonaka and Takeuchi (1995) between 1995 and 2004, only six appear to entail criticism.

McElroy (2002) sees *knowledge processing* as a social process found in all organizations, covering the production, diffusion and use of knowledge. The thesis follows McElroy (2002) in making a distinction between knowledge processing and knowledge management (KM), which is a formal management discipline that seeks to improve knowledge processing. This distinction can be useful, however it is possible to have effective *informal* KM alone within an organizational context. In general, there is a need to understand how knowledge actually works within an organization, before any strategy is adopted which may disrupt fundamental knowledge processes. If the processes work well, it can be wise not to disturb them. This is demonstrated in the case study of this thesis, in which certain changes resulted in the disruption of informal but crucial knowledge processes.

Tacit knowledge includes complex accumulated expertise and practical 'know how' which is partly or largely inexpressible. Tacit knowledge is largely embedded within and shared via social processes such as personal interaction (e.g. Marling 2004). There is extensive debate about whether tacit knowledge can be effectively codified for ease of transmission between people (e.g. as discussed by Davenport and Prusak 2000). There is often tension between capturing the rich tacit knowledge that has great potential value to an organization, and the difficulty of representing that knowledge. Complex tacit knowledge, developed and internalized over a long period, is often impossible to reproduce in a document or transmit easily. Such knowledge may incorporate so much accrued and embedded meaning that its 'rules' can be impossible to separate from how individuals act.

Knowledge often works via flexible guides to action that develop through long experience (e.g. Davenport and Prusak 2000). Those with knowledge can see patterns in new situations and respond appropriately. They can size up a complex issue quickly without going through definable processes, or even being able to explain their reasoning. Leonard (2005) refers to knowledge gained through long experience as 'deep smarts':

> "people with deep smarts can be indispensable.. their particular.. expertise is based on long, hard-won experience. They are the go-to people known for their swift, seemingly intuitive judgments.. Deep smarts are, by their nature, contextual: Experts are often

> unaware of how they solve certain problems and cannot readily bring up a mental list of all possible strategies and outcomes. Their deep smarts are activated by the situation at hand.. much of the expertise is tacit.. Deep smarts can't really be transferred. They must be re-created through the process of guided experience..” (Leonard 2005)

Koskinen (2003) notes that *intuition* derives from mental models based on long experience, and is dependent on context. In the case study, system experts often had to make rapid intuitive leaps of reasoning. Complex system problems demanded urgent rectification – there was often no time for meticulous analysis. Experts were in high demand for problem resolution, and also to mentor others. Davenport and Prusak (2000) note that providing ready access to people who hold tacit knowledge can be more efficient than trying to codify and transmit that knowledge. In the study, prior to the organizational changes it had been possible for IS staff to gain ready access to system experts. However there was little understanding at executive level of how important this was, and the level of access to experts was substantially reduced by the changes.

Much knowledge acquisition in workplaces occurs informally through collaboration and ‘on the job’ mentoring. Davenport and Prusak (2000) note that people usually gain much of their knowledge via *face-to-face* meetings with their close neighbours, rather than distant, less accessible and more uncertain sources. Miranda and Saunders (2003) similarly find that face-to-face communication favours information sharing and creation of meaning.

Davenport and Prusak (2000) describe ‘communities of knowers’, brought together by common interests, who frequently share expertise and solve problems together. When such groups hold enough knowledge in common to collaborate effectively, their ongoing dialogue often generates new knowledge. Such *communities of practice* (Wenger 1998) can enable organizational effectiveness. A group’s collective knowledge can make possible greater achievements than individuals can accomplish by themselves.

The understanding of communities of practice has much in common with the conceptualization of ‘knowledge ecosystems’. For example, Standards Australia (2005b) proposes that an organization, or a significant organizational component, may be seen as a knowledge ecosystem that consists of a complex set of interactions among people, process, technology and content. Such a knowledge-based organization considers people and their knowledge as a primary asset (this is discussed further in Chapters 4 and 5).

Constructivism in education and learning is relevant to understanding the situation of the TPE case study. Constructivist principles are based on the concept that learning is an active process through which learners can generate or ‘construct’ new, context-based understandings based on

their existing knowledge plus their individual capacities and experience, acting in conjunction with social and cultural factors (e.g. Jonassen 1991; Newby et al. 1996). Constructivist learning typically entails 'learning by doing' (e.g. Honebein et al. 1993), often involving collaborative work among people, or active 'on the job' mentoring. Constructivist principles require active participation by people in the creation of new understandings. This usually requires 'problem-based learning' approaches, with learners solving problems which are complex and realistic, by undertaking authentic tasks (e.g. Boud and Feletti 1997).

In summary, Tsoukas and Vladimirou (2001: 991) write, "Managing organizational knowledge does not narrowly imply efficiently managing hard bits of information but, more subtly, sustaining and strengthening social practices." Davenport and Prusak (2000) caution that knowledge, or its effective sharing and use may not survive an organizational upheaval because of the organic connection of knowledge to particular people, processes and contexts. Disruption of work processes, environment or relationships may dislocate knowledge networks. In the case study, the networks of shared system knowledge were disrupted by the organizational changes, with adverse outcomes.

1.3.3 Outline of Case Study

The research was conducted within a large enterprise, 'TPE'. The case study used qualitative research methods for the most part, including the interpretive anthropological methods of ethnography and participant observation. These techniques enabled the researcher to gain rich data and deep insights within the context of study. The initial research aims were to understand the nature of TPE's information systems, and the processes and knowledge needed to effectively support them. The study focused on the IS organization of TPE, that is, the organizational unit which focused on the development and support – including maintenance – of information systems, in particular their software aspects.

During the extended case study, the IT executives introduced substantial changes to the structures and processes of the IS organization, which were intended to improve the efficiency of IS services to business customers. The changes appeared to be soundly based and yet ultimately were largely unsuccessful. The research also aimed to explain this outcome. It is shown that the changes unintentionally fragmented systems knowledge, undermined its effective use, disrupted the implicit IS governance framework, and so reduced the efficiency of systems support. Inferences are drawn relating to structures, processes and IS governance in emergent organizations which rely on complex information systems to support their business

operations. Some subsidiary inferences are also drawn regarding change management and human resource management in organizations which rely on complex systems.

1.3.3.1 Information Systems

Since the 1970s TPE had relied heavily on IT to support many of its diverse business operations. It had some 530 information systems, around 400 of which were regarded as significant. About 50 were mission-critical systems supporting key business functions. Many of the critical systems were large and complex. Their average age was 12 years, with some being more than 20 years old. TPE depended almost totally on its critical systems to function effectively. All TPE's systems were subject to ongoing processes of error correction, minor and major changes and enhancements, and rarely, full redevelopment. There were frequent administrative changes needed, shifts in the environment of TPE, and also significant policy and regulatory changes which were less frequent but often substantial. The business needs of any given functional area, the related business processes and their computer-based system counterpart typically co-evolved as a holistic information system.

TPE was an 'emergent' organization (Mintzberg 1979; Mintzberg and Waters 1985), in that features of its internal and external environments such as structure, organization, policies, rules, regulations, decision processes and so on had long been continually emergent and dynamic. In this context, 'emergence' implies not stemming from any deliberate strategy or initiative by the organization. The organization continually adjusted to changes in its environment, although such changes were often relatively small. Accordingly, TPE's information systems were also continually adjusted and adapted to match the organizational corrections, and to conform to the changing environment.

The knowledge domain of the study included the situated systems knowledge acquired and used by IS staff who worked on key systems. Most of the systems had been developed through collaboration among IS and business staff. The IS staff were generally analysts, designers or programmers. Some of the more capable were 'system specialists'. Often these people had many years of experience in developing and supporting complex system(s) for a particular business function. Usually the expertise of specialists lay mainly in just one, or a few related systems. TPE depended heavily, but not exclusively, on specialists to collectively provide effective systems support. As an illustrative example, the staff newspaper carried the story of a widely regarded system specialist who left TPE after 30 years, whose 'expertise in [system x] was legendary.'

From the earliest years of IT in TPE most of its systems had been developed and supported in-house. To achieve this, from the early years largely separate *system teams* were set up, each one typically focusing on a business function and its small set of related system(s). Such a system team would generally undertake the development of the initial release of a system (taking a year or two), usually following a system development life cycle approach, including broad stages of analysis, design, build, test and implementation. The system team would then typically progress to simultaneously doing maintenance (including error correction and minor changes), and substantial enhancements requiring further major system releases. To many people this seemed to be the natural evolutionary path for a system team. Many system teams had remained fairly stable over the years. Often a nucleus of experienced staff stayed in a team and provided a core of essential knowledge. To effectively fulfil its role, each system team established a close relationship with a small *business support team* in the corresponding business area. A business support team represented the needs of a much larger set of the users of a system (often thousands of users). When users encountered system errors, urgent correction was usually essential. If not rectified promptly, a major error could have serious financial impacts. The 'system team' structure allowed deep understanding of a system by IS staff, and a high level of responsiveness to business needs. Commitment to quality customer service and a dedicated work ethic had become entrenched as fundamental values within the IS culture. The term 'IS culture' is used to refer to the culture of the IS organization (this is discussed further below). The strong work ethic generally meant that requests from business for IS support were rarely refused. This was sometimes expressed by staff in the form of a maxim: 'The [IS organization] never says "no".'

Within a system team, some staff developed great expertise in the system, mainly through long experience in both development and maintenance. This knowledge was situated, that is it generally applied to one system and its related structures and processes. Much knowledge was tacit, and typically gained through collaboration and 'on the job' coaching. For most staff, only a minor part of the knowledge was gained through formal training, or by studying system documentation. Formal training in a system was usually only quite basic. System documentation was often incomplete or outdated, often due to pressure of time (compare Glass 2003). In any case the complexities and continually changing details of a large system could rarely be fully captured by documentation alone. In TPE the full set of knowledge about a system was both tacit and explicit. The key explicit knowledge was centred on the program code, supplemented by limited documentation. But the explicit knowledge was embedded within a much larger dynamic matrix of knowledge, both tacit and explicit.

Maintenance coincides with the phase of active use of a system, which is often the longest and most significant phase. The average IS organization spends more time and effort maintaining systems than developing new ones (Nosek and Palvia 1990). Maintenance including enhancements typically consumes 40 to 80 per cent of the software life cycle (Glass 2003). In TPE many systems had spent around 80 per cent of their lives in maintenance. In general, the most difficult maintenance task is thoroughly understanding a system, taking roughly 30 to 50 per cent of each practitioner's time on an ongoing basis (Bennett and Rajlich 2000; Glass 2003). Many TPE systems were complex and most were in state of continual change, which exacerbated the maintenance task. This also highlighted the need for sharing information among team members, and collaboration in understanding a system. Effective collaboration on a complex system issue generally entailed a small group of people sitting together to discuss it, usually clustered around a computer monitor so that they could simultaneously view the relevant details.

Successive problems in a system were rarely of the same type, and usually required good system knowledge to resolve. Typically a system specialist could not explain how they identified the root cause of a problem, or knew exactly where it lay. Problems did not often recur in the same part of a system, and a specialist would sometimes comment that they had not looked at a certain area of code for years. This made long experience in a system valuable. This type of tacit knowledge was rarely codifiable, and difficult to communicate to others without long mentoring. An expert's mental models were typically so internalized that they could not readily explain them, for example, one said of a complex problem, 'I somehow just knew what it was about, it was intuitive.'

In TPE, part of the knowledge domain relating to a complex system included fully understanding the relevant *business* requirements supported by the system. This included knowing exactly how the logic of a system interacted with business processes, and how this supported business objectives. These complex and interlocking areas were often poorly documented, and knowledge of them was largely tacit. The specialists in particular had good understanding of a system's integrated and holistic nature, and could bridge the gap between IS and business well.

Somewhat similar situations have been addressed in the IS literature. For example, Hasan (2003) applies action research to the design and use of information systems with the aim of better understanding the development process, as well as the organizational issues that the

information system is designed to address. A case study, where this systems development research method was used, is described to illustrate the method. Hasan (2003) proposes that some cases of information systems development can be considered knowledge creating activities, and, in such cases, information systems development can be a legitimate research method. In these cases not only is knowledge created about the development process itself but also a deeper understanding emerges about the organizational problem that the system is designed to solve.

In TPE there was further socially-generated tacit systems knowledge. Typically there were many possible ways in which a system could be designed and implemented. This included both initial development of a system and subsequent major enhancements. The options were usually worked out collaboratively through a long series of interactive workshops, with both technical and business participants. Although the main outcome of a workshop was usually documented (such as a design), this was not so for the process of considering the potential benefits and drawbacks of alternative approaches, and the reasons why certain options and compromises were chosen. These often became relevant in later discussions.

The shared knowledge about a system was typically generated and updated through long interaction, distributed within a community of practice. Particular aspects of system knowledge often became manifest in the context of dialogue about an issue, for example, a complex error. The full set of knowledge about a system was also subject to continual change in response to evolving business needs. All these aspects of knowledge about a system meant that it was common for a newcomer to spend years developing sufficient expertise to deal proficiently with all demands. IS practitioners would sometimes say of novices, 'But they *don't know the history* of [system y].' This included the (usually) undocumented history of system discussions held over many years.

From the earliest years of IT in TPE, the localized experience of IS practitioners was valued by business. Within a system team, there were staff with long experience in any part of the system. There was advantage for a practitioner to have worked on all aspects, including development and maintenance. The knowledge of these staff could be applied as required in the team. For example, it was of value for developers to be fully aware of maintenance needs, as they would then build a more supportable system. The system team structure took full advantage of the creative synergy of having all types of system expertise 'under the one roof'.

The implicit understanding of how best to manage the development and maintenance of complex systems had evolved in TPE over about 20 years. This understanding had been associated with organizational structures and processes which optimized the ability to effectively manage systems. The processes were centred on the informal management of systems knowledge. This entailed tightly-knit communities of practice focused on system knowledge. Within these communities, co-workers resolved problems through interaction, and created and updated system knowledge. Collaboration typically entailed face-to-face meetings at short notice. Koskinen (2003) notes that trust facilitates the efficient sharing of tacit knowledge. In TPE the long-term commitments of IS staff had over time built up effective relationships of trust and knowledge sharing. These processes had influenced the cultural assumptions and behaviours of many IS staff. However the pivotal role of the communities of practice received little recognition or support from IT executives.

1.3.3.2 Organizational Changes

After many years of having a 'system team' structure, the IT executives introduced changes to the IS organization intended to achieve greater efficiency in IS service delivery. The executives were concerned about high IT costs, which they believed were largely high maintenance costs. It was a defect from their perspective that the maintenance of a system was typically integrated with development. This meant it was difficult to accurately identify maintenance costs, and so problematic to reduce them. The executives therefore introduced interrelated changes which appeared to be soundly based. These included: the introduction of rigorous processes for project management; system development and major enhancements to be undertaken by newly-created project teams; a goal of having an adaptable and portable IS workforce; and the structural separation of system development from system maintenance. The cost of maintenance would then be made more visible, and could subsequently be minimized. The changes were endorsed by external management consultants, and enacted within the formal IS governance framework.

A dedicated maintenance branch was set up and divided into teams, each supporting a diverse range of systems. In two years this branch had grown by 70 per cent, more accurately reflecting the full cost of maintenance. However in many cases the maintenance teams had lost direct access to their former system specialists, many of whom were now inaccessible in project teams in different areas. After the restructure, the project teams which were set up worked on new developments (which were rare), and major enhancements to existing systems. Each project team focused mainly on one system or a small set of related systems – just as the earlier system

teams had done, but with maintenance now excluded. Within a year many project teams had implemented products with substantial errors, causing crises for maintenance. This stemmed from both lack of appreciation of maintenance needs, and a desire to build systems as rapidly as possible, regardless of potential future problems. It would have been of greater benefit to TPE if the 'project' and 'maintenance' teams had been able to collaborate fully, and did not have to compete for access to dispersed experts.

In most cases the split between projects and maintenance resulted in the respective teams becoming physically separated, often in different buildings. This greatly reduced the scope for direct interaction. A typical comment was, 'We used to have our resident [system z] expert on tap, but now he's across town doing something completely different.' As noted, people usually gain most of their knowledge from face-to-face communication with near neighbours. Effective collaboration on complex system issues typically entailed a small number of people gathering to discuss them. Some executives had demanded that collaboration across teams cease. In many cases this was effective, but in some cases the local team managers encouraged continued covert collaboration, thereby underlining its ongoing value.

Even when a system expert who had been moved elsewhere could still be contacted for help, their specific system knowledge inevitably declined over a year or so, and this was exacerbated by continual changes to the system. For such reasons, in several parts of the IS organization geographically remote from the central executives, the split between projects and maintenance was never fully made. The formal reporting lines were changed, but the synergy was retained of having close links among staff with all kinds of experience and expertise in a system. Such action was based on awareness of the need for effective knowledge processes, including sharing and creating system knowledge through social processes of interaction.

There had been a large amount of staff reallocation at the outset of the restructure. This highlighted the problem of placing people with limited experience into a maintenance team where expertise in a complex system, often new to them, was demanded. The view of some executives was that the necessary knowledge could be transferred from an expert to a novice as a quantity, rather like pouring water into a bucket. A 'knowledge transfer' policy was therefore instituted, but it was found to be largely ineffective. Tacit knowledge is often not amenable to easy codification and transmission. Many beginners were unable to 'come up to speed' in a system, even after some years. An executive commented that the staff in one maintenance team had been 'working on [system w] for two years, but they still can't handle any really hard problems.' Most novices faced a prolonged learning curve, exacerbated by limited access to

experienced coaches. The result was that the overall effectiveness of system support was reduced.

The tendency to conceive of knowledge as an entity is prevalent because many are concerned with its codification, to facilitate transfer (compare Styhre 2003). This view tended to prevail among the executives. In TPE, the study showed that knowledge was in fact shared, but only to the extent necessary to support a system. To go beyond this, and to achieve easy, rapid transfer of complex system knowledge to novices was quite a different matter.

The organizational restructure imposed a separation between maintenance and projects, and so a formal procedure was later instituted to help manage the interfaces. Accordingly a 'warranty' procedure was introduced, which aimed to ensure a smooth handover of new products from projects to maintenance, and ensure that any initial problems were resolved by the project team for an agreed 'warranty period' after implementation. However there were many problems experienced with the warranty process, most of which stemmed from tension between maintenance and project teams. To a large extent this reflected the different perspectives of maintenance and project teams, brought about by the restructure. Significantly, it also reflected the disruption of the former tightly-knit communities of practice each focused on system knowledge, and the resulting fragmentation of such knowledge.

Early in the restructure many staff had expressed their doubts that the changes would be workable. Many also felt that their hard-won system knowledge was no longer valued. Even four years after the changes there were still problems evident in the ability of the IS organization to efficiently support systems. The fact that the changes were even partially effective was largely because most staff had a strong cultural ethic of providing quality service, and worked hard to compensate for what they saw as misguided reforms. Limited surveys which were utilized also suggested that the changes were largely unsuccessful. Significantly, several years after the changes there were tentative moves in some parts of the IS organization to reintegrate development and maintenance.

1.3.3.3 Information Systems Governance

The *IT governance* of an organization comprises the set of rules or guidelines that determine the division of IT roles and responsibilities, and how decisions on IT are made (e.g. Broadbent 2005; Weill 2004; Weill and Ross 2004). IT governance is a subset of corporate governance, and the two are interrelated. A Gartner Group survey in 2003 of senior management IT

priorities placed IT governance in the top three **(**Broadbent 2003a). IT governance refers to the patterns of authority for key IT activities, including IT infrastructure, IT use and project management (Sambamurthy and Zmud 1999). IT governance is about assigning decision rights, and an accountability framework that encourages desirable use of IT (e.g. Weill et al. 2003). It requires knowing what decisions have to be made at the intersection of IT and business, specifying who has input to the decisions, and who makes them. IT governance is also seen as a mechanism for addressing the wider problem of matching business requirements with technology planning, and IT governance is a critical success factor for enterprises (e.g. Weill 2004; Weill and Ross 2004).

The *IS governance* of an organization is a significant subset of the IT governance framework, and comprises the framework, or set of rules or guidelines for governance of information systems (e.g. Dallas et al. 2002; Korac-Kakabadse and Kakabadse 2001). IS/IT governance has traditionally been seen as a controlled, executive-level framework for decision-making (e.g. Raphaelian 1995). However a number of recent writers have emphasized that effective IS/IT governance should take into account the needs of multiple stakeholders, that is, any individual or group that can affect, or is affected by, decisions regarding corporate IT (e.g. Korac-Kakabadse and Kakabadse 2001). IS/IT governance should therefore focus on the structure of the relationships and processes needed to develop and control IS/IT resources. It has also been argued that successful enterprises should integrate their IS/IT governance with strategies and culture, in order to attain business objectives and optimize their use of IT. In particular, decisions related to the initiation and implementation of IS projects, and their contribution to overall business strategy should fall within the IS/IT governance. Effective IT governance requires the strategic integration of business and IT decisions, with collaborative relationships among key stakeholders (e.g. Korac-Kakabadse and Kakabadse 2001; Ribbers et al. 2002).

The IS governance of TPE consisted of both formal and informal components. The formal IS governance essentially entailed a hierarchical structure of executive and managerial positions supported by formal groups, committees and processes. Prior to the organizational changes, the formal framework was supplemented by an effective informal or implicit IS governance framework. The ‘system team’ structure and processes – covering both system teams and business support teams – represented the core of the implicit IS governance, and this included related knowledge processes. Because of their entrenched and long-standing nature, the system team structure and the implicit IS governance were integral components of the organizational structure and culture, insofar as they related to IS. The implicit IS governance framework had evolved naturally with the system team structure and processes over many years, and it closely

reflected the values of the IS organizational culture. The ground rules of the IS culture were deep-seated and long-established, in the manner of cultural beliefs. The IS culture implied that the system team structure and the implicit IS governance were widely accepted by members of the culture. Cultural values are fundamental, and are typically seen by members as being part of the 'natural order of things'.

The organizational IS restructure in TPE imposed changes based on criteria bearing little relation to the fundamental values of the organizational culture and the IS culture, or the tenets of the pre-existing IS governance framework, including knowledge structures and processes. The case study demonstrates that to be effective, IS governance should include careful consideration of organizational culture, structure and relevant knowledge structures and processes. The thesis focuses on information system development and support, and it is shown that an IS governance agenda should include the considerations given above, and should also examine the pre-existing IS governance framework, including both its formal and implicit aspects. These steps are necessary in order to formulate an IS governance framework which will actually achieve improvements in IS service delivery. In general, the thesis demonstrates the benefits of close investigation of underlying cultural patterns and structures, as these can have substantial impacts on the ultimate effectiveness of organizational change initiatives.

Effective IT and IS governance are closely linked to the achievement of greater competitive advantage for an organization. For example, IT governance has been seen as "the organizational capacity to control the formulation and implementation of IT strategy and guide to proper direction for the purpose of achieving competitive advantage for the corporation" (Van Grembergen and Saull 2001). It is strongly in the interests of any organization to pay close attention to the quality and efficacy of its IT and IS governance agenda.

1.3.4 Summary

The understanding of how best to develop and maintain complex systems had evolved in TPE over many years. It entailed structures and processes centred on system teams and communities of practice. Each community of practice focused on the knowledge, especially tacit, needed to support a system effectively. However the crucial contribution of communities of practice to the efficient running of TPE was little recognized by executives. Their contribution and the underlying role of knowledge of complex systems were disrupted by the organizational changes. The members of a community were then typically fragmented, often physically separated, and with different roles. The former integrity of each community and its immediacy of interaction

were largely lost. The changes reduced the level of access to system experts to help rapidly resolve complex issues. They also introduced far-reaching reforms to structures and processes that had evolved naturally over many years. Essentially the changes disrupted long-held cultural values, and attempted to alter ingrained behaviours. The earlier structure of system teams, each of which undertook all development and maintenance on a system, better supported organizational needs. An inference is that it may be inefficient to segregate the development and maintenance of complex information systems into different functional areas in an organization, especially in a situation of continual emergent changes in the environment.

The case study focused in detail on one large emergent organization, and so its findings cannot be widely generalized. The researcher also observed in lesser detail the IS organizations of 15 other enterprises, all of which were emergent. The majority had a 'system team' or similar structure which integrated development and support for each system, suggesting that this can often be an effective arrangement.

Agarwal and Sambamurthy (2002) suggest that there is no single 'best' IT organizational structure, because IT needs to respond to the unique environments in which it exists. Critical roles are often ignored in organization redesign. An important consideration is to identify what works well, and work *with* it, and not against it. This was borne out in TPE by the disregard of the role of communities of practice and system specialists. The executives also did not adequately consider the knowledge processes centred on the specialists, and consequently failed to define effective replacement processes.

In TPE the evidence affirmed that local specialist system knowledge was necessary and valuable. But the executives did not seek to understand how this knowledge actually worked 'on the ground', resulting in the unintended disruption of crucial processes and links. This points to a more general need to gain understanding of the knowledge in an organization and how it operates, before initiatives are adopted which might disrupt it.

Systems and system knowledge often confer competitive advantages, and warrant careful consideration (e.g. Blount et al. 2005; Boisot 1998; Dampney and Andrews 1991; Galliers et al. 1995). The study implies that organizations which rely on complex systems should examine their system knowledge, and consider what structures, processes and HRM arrangements are necessary to sustain it. It is advisable to perform these steps well before embarking on organizational reform or redesign.

In general the study indicates that for an organization to adequately fulfil its objectives, it must consider all essential aspects in the shaping of its governance strategy. This applies as much to the organization's IS governance as it does to overall governance (e.g. Kingsford 1998; Kingsford et al. 2003). For organizations which develop and maintain information systems, the IS governance strategy needs to include consideration of how best to ensure effective information systems planning, development, maintenance and support. The IS governance strategy should therefore include at least broad consideration of important aspects such as IS organizational structure, processes, human resources, knowledge and skills. These often include social-cultural issues as significant components. All related elements should be considered in an integrated way at the level of IS governance. It is not sufficient to relegate some aspects to be decided later in an isolated and reactive manner, such as IS organizational structure, knowledge processes and HRM arrangements. If all aspects are not considered together at the level of IS governance strategy, the organization risks compromising its ability to achieve its business goals, and hence its competitive position.

In recognition of the findings drawn from the case study, the following is a summary of general recommendations based on the conclusions of the thesis (these are discussed further in Chapter 7):

Recommendation 1

> *IS governance should include consideration of how best to ensure effective information systems planning, development, maintenance and support. It should include detailed consideration of organizational culture, structure and human resources, and also knowledge structures and processes. It should examine any pre-existing IS governance framework, including both formal and implicit aspects, and consider whether such a framework already effectively supports IS processes. The last point applies especially to implicit aspects in emergent organizations.*

Recommendation 2

> *When planning any significant organizational strategy, it is important to investigate and understand how existing knowledge processes and informal knowledge management operate within the organization first, before any strategy is adopted which might inadvertently disrupt the implicit knowledge processes, or the culture in which they are embedded. This applies especially to implicit aspects in emergent organizations.*

Recommendation 3

> *The HRM function should consider the structures, processes, knowledge and capabilities needed across the organization, and ensure that they support the achievement of organizational objectives. This includes shaping effective structures and processes for the development and maintenance of information systems – both present and future. The HRM function includes creating and sustaining environments to support learning; acquiring and sharing knowledge; nurturing communities of practice; and supporting the nexus among learning, knowing and doing in work contexts.*

Recommendation 4

> *Organizations which rely on complex information systems and undertake software development and/or maintenance should examine their systems knowledge and how it operates. They should consider what is needed to effectively sustain the generation, sharing and use of system knowledge, and what arrangements fit best within the organizational culture. This includes informed consideration of organizational structures, processes and HRM arrangements. Critical roles should be identified and considered. It is important to identify what currently works well, and work with it, not against it.*

Recommendation 5

> *The need to provide ongoing support and maintenance for complex information systems may not be compatible with a 'pure' project management structure, especially in emergent organizations. It may be more effective to integrate the development and maintenance of complex systems into a common organizational arrangement.*

Chapter 1 gave an introduction to the thesis, outlined its research aims, and provided an overview of the thesis in summary form. The following chapter outlines the research approach and methodology, and discusses related concepts which were applied in the case study.

Chapter 2 RESEARCH APPROACH, DESIGN AND METHODS

This chapter outlines the research approach and design, including the research problem and questions, and the research setting and the methods adopted. Related theoretical and practical concepts are also discussed. The case study applied qualitative research techniques including interpretive anthropological methods, primarily ethnography and participant observation. These are discussed further below.

2.1 Research Problem and Research Questions

The initial aims of the research were to understand the structures, processes and IS governance which can result in optimum system development and support in emergent organizations. The research draws attention to the role of system maintenance within the IS support function, which can represent a large investment of skilled resources. It was found that knowledge of complex information systems, especially tacit knowledge, also plays a key role in effective development and support processes. Fairly early in the TPE case study, the IT executives introduced substantial changes to organizational IS structures and processes, which were intended to improve the efficiency and quality of delivery of IS services to business customers, and to align IS more fully with business. Though unexpected, the organizational changes addressed many of the same structures and processes that were the focus of the case study, and so it was appropriate to examine the changes as an integral part of the study. The changes ultimately also served to highlight the ways in which the earlier structures and processes had effectively supported TPE's information systems. The interrelated changes included the introduction of rigorous standards and processes for project management; a goal of having an adaptable and portable IS workforce; and the structural separation of system development from system maintenance.

The organizational changes in TPE were generally supported by literature, for example two of the key ideas were sound project management methods (e.g. advocated by Cotterell and Hughes 1995), and an adaptable IS workforce (e.g. Dove 2001; Highsmith 2002). In TPE these concepts were applied relatively uncritically and in isolation from other factors such as social-cultural and knowledge aspects. The changes logically implied the question, what is the outcome when such concepts are applied to an emergent organization which relies on large-scale use of IT and complex information systems to support its business goals? The changes

initially appeared to be soundly based and yet ultimately were largely unsuccessful. The research therefore aimed to answer the key questions:

a. What organizational structures, processes and IS governance result in optimum development and ongoing support – including maintenance – of complex information systems in emergent organizations? How do they operate? How is organizational culture involved?

b. What is the role of systems knowledge and knowledge processes in the development and support of complex information systems in emergent organizations, and how do they operate? How is organizational culture involved?

c. What are the outcomes when the principles of rigorous project management and an adaptable and portable IS workforce are applied relatively uncritically to an emergent organization with complex information systems? How and why do such outcomes eventuate?

The case study of the thesis addressed these key research questions. In general, the questions aimed to better understand the relationships within TPE among information systems, related structures and processes, IS governance, knowledge of information systems, and organizational culture. The research questions are answered in an integrated manner in Chapters 5, 6 and 7.

2.2 Research Setting

A number of writers have observed that research into IT and IS in organizations has increasingly encountered the limits of the 'scientific' approach, given the generally social nature of the field (e.g. Fitzgerald et al. 1985: 5-7; Galliers 1992: 162; Land 1992:12). In a similar vein, Van Maanen (1979) advocates the use of qualitative methods in organizational research. The research approach of the thesis therefore draws explicitly on qualitative anthropological methods, which have value in investigating social and cultural contexts. Accordingly, detailed investigation within the organization studied was undertaken utilizing two of the principal qualitative research methods of social-cultural anthropology: ethnography (e.g. Pelto and Pelto 1978) and participant observation (e.g. Spradley 1980). These techniques allowed the researcher to become immersed in the context of study, and so enabled the acquisition of comprehensive case material and in-depth understanding within the context.

Some writers advocate that for qualitative research, a researcher should outline their relevant previous experience, to help clarify the prior knowledge and perspectives they bring to the study (e.g. Denzin and Lincoln 1994a). The researcher in fact had professional training and experience in social-cultural anthropology, ethnography and participant observation (Kingsford 1982; also quoted in Horton 1994), and had also applied various aspects of such approaches and

methods to IS research (e.g. Dunn and Kingsford 1999; Kingsford 1998; Kingsford et al. 2003; Kingsford and Dunn 1999). The researcher also had 25 years' professional experience in IT and IS in a variety of organizations. Approximately the first half of this entailed working on applied aspects of system design and development; the second half focused more on areas such as IS management, strategy, policy, project management and change management. The researcher was able to use to advantage the knowledge gained and lessons learned from prior research and work experience, in undertaking the current IS research project.

A detailed, extended case study was conducted in a large enterprise which had been in existence for many decades: 'TPE'. The researcher worked in TPE during the case study. Therefore the researcher was well-placed to observe the IS situation at first hand, and had a level of access to empirical data not generally available. The case study focuses on certain events which took place in TPE over a period of five years, and also refers where appropriate to earlier formative influences in the organization and its environment. Major IS organizational changes were introduced in the second year of the study, and their effects were observed at first hand over a period of four years.

2.3 Research Methodology

2.3.1 Qualitative Research Methods

Qualitative research methods were originally developed in the social sciences to facilitate the study of social and cultural phenomena. Qualitative methods are now widely practiced as a means of understanding how people view themselves and the social-cultural milieus in which they live and/or work. Qualitative research essentially involves methods of data collection and analysis that are non-quantitative (e.g. Flick 1998; Huberman and Miles 2002; Lofland and Lofland 1984; Miles and Huberman 1994; Taylor and Bogdan 1998; Van Maanen 1983). Generally, qualitative research is characterized as the attempt to obtain an in-depth understanding of the meanings and 'definitions of the situation' presented by the people within a setting of focus, rather than quantitative 'measurement' of their characteristics or behaviour (e.g. Wainwright 1997). The aim of understanding the meanings of the people within a setting does not preclude also studying their actions. Ethnography is a prime example of qualitative research methodology. Ethnography is derived from social-cultural anthropology, and from this perspective, Geertz (1973, 1983) and Van Maanen (1988) provide introductions to ethnographic research methods. Various writers have also advocated the application of qualitative methods to organizational research (e.g. Mason 2002; Morey and Luthans 1984). Thirty years ago it could

be observed that, "There have been few observational studies of what organizations actually *do*... observations of actual behaviour are rare" (Campbell 1977: 51). From this relatively recent start, there have since been quite a number of studies of specific organizations or industries (e.g. Charlesworth et al. 1989; Knights and Morgan 1995).

Many writers accept that the research location and setting of a qualitative research project can influence the direction the project actually takes. For example, Jorgensen (1989) refers to a number of qualitative studies focused on everyday experiences, where the researcher was in a 'fortuitous' position or location to study a given phenomenon, and how it unfolded. Jorgensen (1989) advocates that:

> "While the researcher may have a theoretical interest in being there, exactly what concepts are important, how they are or are not related, and what, therefore, is problematic should remain open and subject to refinement and definition based on what the researcher is able to uncover and observe." (Jorgensen 1989: 18)

Wainwright (1997) cautions that in qualitative research there can be a risk that "the analysis will slide into either a top-down deductive approach in which a pre-existing theory is simply legitimated by the selective and biased use of ethnographic data, or else into a superficial and particularistic account of the views of respondents." Therefore a compromise is advocated:

> "The solution to this dilemma lies in ensuring that the analysis is informed by both strands of inquiry.. The researcher does not set out to test a pre-conceived hypothesis, nor is an entirely open-ended approach adopted, instead the researcher begins by observing the field of study, both as a participant observer and as a reviewer of academic literature. From the synthesis of these sources a research agenda emerges that can be pursued, again, by a mixture of observation and theoretical work.. Background reading is essential, but which texts are relevant, and therefore, worth including in a report or publication, only becomes apparent towards the end of the research process, and the literature review should continue throughout the project as the ethnography raises new themes for analysis. Similarly.. the sequence of hypothesis – data collection – analysis, is not clear cut or linear, but an ongoing and dialectical process." (Wainwright 1997)

Complementing this, Hammersley and Atkinson (1983: 234) argue that "participant understandings.. are a crucial source of knowledge, deriving as they do from experience of the social world. However, they are certainly not immune to assessment, nor to explanation. They must be treated in exactly the same manner as social scientific accounts." The general research approach advocated by Wainwright (1997) and Hammersley and Atkinson (1983) was adopted for the case study of the thesis, as outlined further in this chapter.

A number of writers have discussed the issue of whether a particular qualitative study can be taken to be representative of similar situations, and whether its findings can be generalized to wider settings. Some argue that the primary focus is the particular situation under study:

> "The goal is not to produce a standardised set of results that any other careful researcher in the same situation or studying the same issues would have produced. Rather it is to produce a coherent and illuminating description of and perspective on a situation that is based on and consistent with detailed study of the situation." (Ward-Schofield 1993: 202)

Some doubt the possibility of generalization of a qualitative study from one situation to the next (e.g. Lincoln 1990: 68). However Wainwright (1997) observes that "there remains an often almost hidden claim that the behaviour found in the study will shed some light on the behaviour of others, even if this explanatory range is limited in time and space." It is further argued that it is possible for a study to have implications for other similar situations, and thereby to be capable of some level of generalization:

> "The aim of the qualitative researcher is not to produce a representative and unbiased measurement of the views of a population, but to deepen his or her understanding of a social phenomenon by conducting an in-depth and sensitive analysis of the articulated consciousness of actors involved in that phenomenon.. in the hope of finding fresh insights and new ways of understanding a particular phenomenon.. The use of 'thick description' to boost the generalisability of a qualitative study is important, but generalisability depends not just upon detailed description of a phenomenon, but on revealing the social relations that underpin it." (Wainwright 1997)

The case study of this thesis adopted this perspective. While it focuses primarily on in-depth study, 'thick description', detailed analysis and understanding of a particular organizational situation, it also aims to shed light on the more general structures, processes and relationships that underpin that situation. It therefore has some degree of applicability to similar situations in other settings. These points are discussed further below, and in Chapter 7.

2.3.2 Case Study Approach

The research used mainly qualitative methods, centred on a detailed, extended case study which adopted an interpretive approach. The case study is a common method used in IS research (e.g. Alavi and Carlson 1992; Benbasat et al. 2002; Cavaye 1996; Orlikowski and Baroudi 1991). A case study is an empirical inquiry that aims to understand a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident. Case studies entail detailed analysis of particular situations and/or events, and the relationships within and among them. A case study is especially appropriate when 'how' or 'why' questions are posed, and when the investigator has little control over events occurring within the context of study (Hamel et al. 1993; Stake 1995; Yin 1981, 2002). All of these conditions applied to the research, and so a case study approach was appropriate. In particular, the phenomena under investigation – the structures, processes and IS governance needed for the

development and support of complex information systems in emergent settings – were not separate from the organizational context, and in fact were integrated into it.

The selected case study situation was complex and wide-ranging, and it required prolonged, intensive research to properly understand and analyze. In order to address the key research questions given above, it was necessary to observe and study the relevant organizational structures, processes and cultural aspects in detail and at first hand. Prior to the case study, it was known to the researcher from previous IS experience that the study's areas of focus would almost certainly be embedded within a wider setting of complex, entwined structures, processes, networks and connections (e.g. Geertz 1973), which could be expected to require extensive effort to fully understand and document. It was therefore appropriate to focus mainly on a single extended case study, rather than (for example) smaller studies across many organizations, which would inevitably have reduced the level of detail accessible in each study, lowered the potential to fully comprehend each context, and introduced a risk of superficial observations and comparisons. Fielding (1993: 158) observes that "it is also important to note that another problem is much less remarked in the [qualitative research] literature, though it may be more common. This is the problem of 'not getting close enough', of adopting an approach which is too superficial and which merely provides a veneer of plausibility for an analysis." The research approach adopted aimed to 'get close enough' to the setting to properly understand the phenomena observed. Nevertheless as part of the research project, some other smaller studies, undertaken either directly or indirectly by the researcher, were utilized in a limited way for purposes of comparison. These are referred to in Chapter 7.

The case study research was qualitative, which is an appropriate way of gaining understanding of information systems in organizational settings (e.g. Benbasat et al. 2002; Kaplan and Maxwell 1994; Lee et al. 1997; Myers and Avison 2002; Trauth 2001). In particular, an ethnographic approach can provide deep understanding of a complex organization and its context (e.g. Myers 1999). Accordingly, the use of ethnography in IS research has been advocated by various writers (e.g. Harvey and Myers 1995; Pettigrew 1985). Ethnographic research is thus well suited to providing IS researchers with rich insights into the social, cultural and organizational aspects of complex information systems. Empirical examples of the application of ethnographic techniques to IS research include Davies (1991), Orlikowski (1991) and Suchman (1987). Randall et al. (1999) use ethnographic techniques to interpret the organizational and cultural context of legacy information systems in a bank. In fact Avison and Myers (1995) even discuss the potential role of anthropology as a source discipline for IS, including the significant role of organizational culture. The ethnographic approach, combined

with an extended case study, was therefore ideally suited to investigating the research topic and problem described above, which centred on complex information systems in emergent organizations.

The case study technique has also been depicted as "an attempt at describing the relationships which exist in reality, usually within a single organization" (Galliers 1992: 151). That is, case studies typically focus on examining 'what is', as opposed to 'what should be'. However it is acceptable as part of the analysis for the researcher to speculate how the situation within the case study setting may have varied if alternative action had been taken from a different perspective. This technique is utilized to a limited extent in the thesis (Chapter 7). However it was not possible to take this concept further, for example in the form of 'action research' which can aim to combine investigation with practical improvements (e.g. Baskerville and Myers 2004; Baskerville and Wood-Harper 1996; Reason and Bradbury 2001). Action research was not within the scope or objectives of the study, and the researcher also had little influence within the organization studied, and so was unable to significantly affect events within its context.

2.3.3 Interpretive Research

Berger and Luckmann (1990) provide a general introduction to the interpretive perspective in social science. Geertz (1973, 1983) discusses the interpretive approach in social-cultural anthropology. Interpretive researchers work on the assumption that access to reality (either given or socially constructed) is through social constructions such as language, shared meanings and interpretations, symbols, rituals and other patterned behaviours. Interpretive studies are typically associated with the social sciences and ethnography, and generally attempt to understand and interpret phenomena through the meanings assigned to them by people closely involved with those phenomena. The interpretive approach is therefore well-matched to participant observation, which also aims to understand a culture or organization from within – that is, it tends to take an insiders', or 'emic' perspective, as opposed to an outsiders', or 'etic' perspective (e.g. Morey and Luthans 1984).

Case study research can be, and often is interpretive (e.g. Walsham 1993). The case study research of the thesis was interpretive, that is, it included an aim of interpreting phenomena through the meanings understood by those closely involved with them. Klein and Myers (1999) and Walsham (1993, 1995, 2002) provide overviews of the interpretive perspective as applied to IS studies and research. In general, interpretive methods in IS research are "aimed at producing an understanding of the context of the information system, and the process whereby the

information system influences and is influenced by the context" (Walsham 1993: 4-5). Examples of the application of interpretive approaches to qualitative IS research include Boland (1991), Walsham (1993) and Wilkins et al. (2001).

2.4 Anthropological Concepts and Methods

Key anthropological concepts and methods which were necessary to understand and interpret the TPE case study are organizational culture and participant observation. These are further discussed below, and also referred to as required in Chapters 5, 6 and 7.

The techniques of ethnography and participant observation are of value in investigating questions in social and cultural contexts. Ethnographic methods aim to interpret a culture or organization by means of 'thick description' of the complex fabric of everyday structures, processes and discourse. In this vein, Geertz (1973) writes:

> "Believing, with Max Weber, that man is an animal suspended in webs of significance he himself has spun, I take culture to be those webs, and the analysis of it to be therefore not an experimental science in search of law but an interpretive one in search of meaning.. In anthropology.. what the practitioners do is ethnography.. What defines it is the kind of intellectual effort it is: an elaborate venture in.. "thick description".. What the ethnographer is in fact faced with.. is a multiplicity of complex conceptual structures, many of them superimposed upon or knotted into one another, which are at once strange, irregular, and inexplicit, and which he must contrive somehow first to grasp and then to render.. Doing ethnography is like trying to read (in the sense of "construct a reading of") a manuscript – foreign, faded, full of ellipses, incoherent, suspicious emendations, and tendentious commentaries, but written not in conventionalized graphs of sound but in transient examples of shaped behavior.. Cultural analysis is (or should be) guessing at meanings, assessing the guesses, and drawing explanatory conclusions from the better guesses.. So, there are three characteristics of ethnographic description: it is interpretive; what it is interpretive of is the flow of social discourse; and the interpreting involved consists in trying to rescue the "said" of such discourse from its perishing occasions and fix it in perusable terms." (Geertz 1973: 6-10, 19-22)

This is a good summary of the situation encountered in TPE, as in many cultures, and of the approach taken to interpret it. To properly interpret it, there was no viable alternative to an anthropological approach. Detailed investigation was therefore carried out utilizing two of the principal research methods of social-cultural anthropology: ethnography (e.g. Pelto and Pelto 1978; Spradley and McCurdy 1972) and participant observation (e.g. Spradley 1980).

2.4.1 Organizational Culture

A number of writers have noted that organizations typically have both formal and informal aspects (e.g. French and Bell 1999; Senior and Fleming 2006). The formal elements include visible goals, structure, strategy, plans and resources. The informal aspects include culture, values, beliefs, attitudes, behavioural norms, power, politics and informal structural groupings. French and Bell (1999) express this division as an 'organizational iceberg', in which the formal elements are visible above the surface, while the informal components are mainly hidden beneath the surface (see Figure 1 below). Although largely hidden, the informal aspects typically have a powerful influence on behaviour, decision-making and actions undertaken within the organization. Some elements have both formal and informal components – for example, structure and governance. Organizational culture comprises a key part of the informal organization, along with informal structures, networks and governance (these are discussed in other chapters).

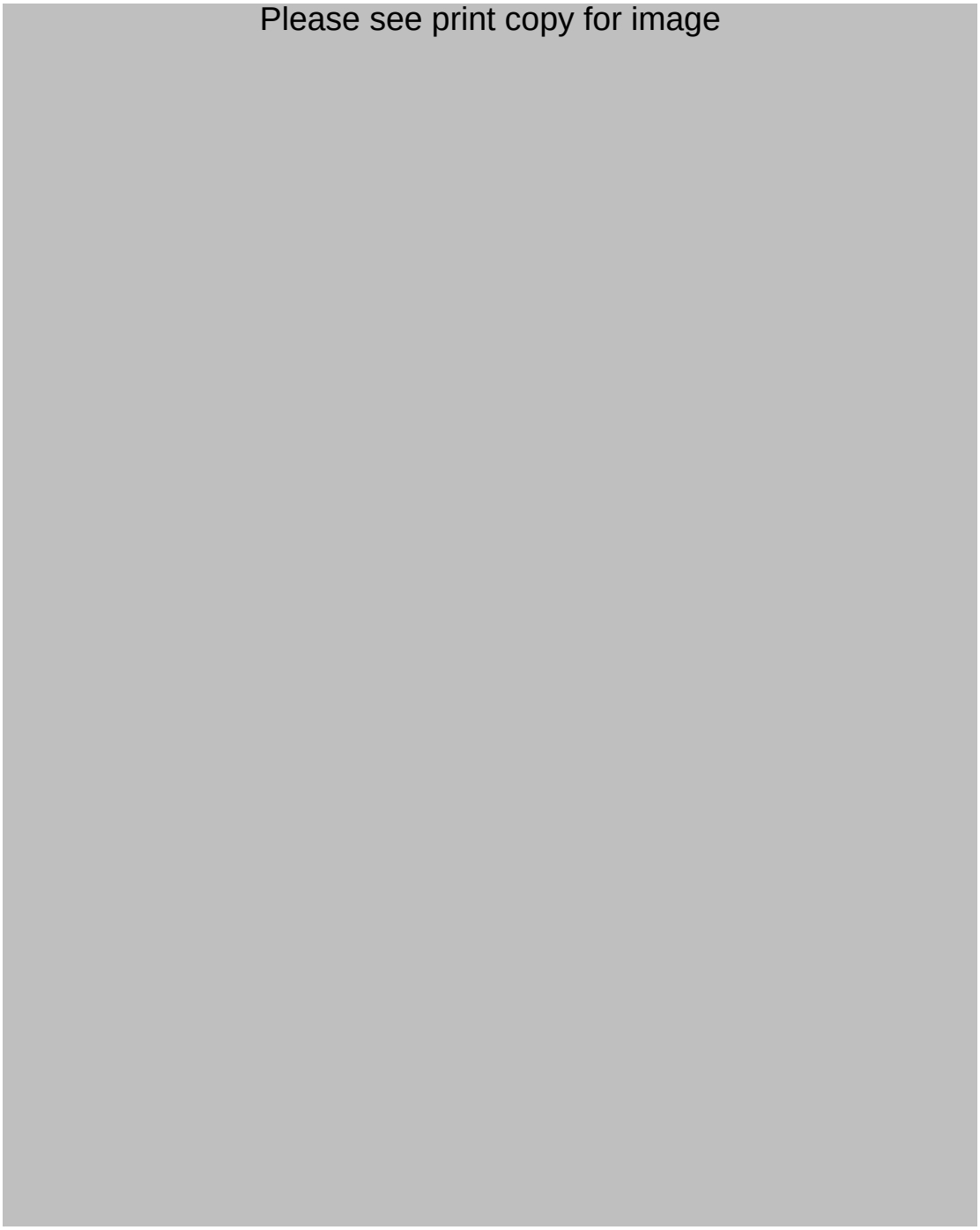

Figure 1. Informal Organization (adapted from French and Bell 1999)

The concept of organizational or corporate culture has drawn on earlier insights taken from the anthropological study of the cultures of human groups (e.g. Foster 1969; Geertz 1973; Kluckhohn 1957), in terms of defining culture in general as a patterned set of behaviours, customs, rituals, symbols, beliefs, values and stories, within a broader environmental setting (e.g. Beauvais et al. 2001; Bellingham 1990; Boisot 1987; Deal and Kennedy 1988; Louis 1985;

Pheysey 1993). These patterns are not necessarily static, but may evolve over time to adapt to changing environments. Within the anthropological approach, the social organization and structure of a group are generally seen as being closely related to or part of its culture. A significant aspect of culture relates to the social groupings which exist, how and why their members interact with one another, and what implications this has for the wider group. Another significant aspect of culture relates to the distribution of status and power within the group, including decision-making power.

Organizational culture is seen as comprising systems of shared ideas, concepts, rules and meanings that underlie and are expressed in the way people live and work in organizations (e.g. Keesing and Strathern 1998). An important element of this understanding is that cultural values are shared by many members of the organization, and are transmitted to and absorbed by new members in order for them to be fully accepted into, and to operate effectively within the organization. That is, organizational culture has a powerful influence on the beliefs and behaviour of its members. The notion that an organization could possess a distinctive culture in a manner similar to that of other groups in society has developed over the past fifty years. For example, Jacques (1951) cogently described organizational culture as:

> "The customary or traditional ways of thinking and doing things, which are shared to a greater or lesser extent by all members of the organization and which new members must learn and at least partially accept in order to be accepted into the services of the firm." (Jacques 1951: 251)

Duncan (1995: 180-181) notes that organizational culture may include shared mindsets (such as values, norms, understandings, assumptions and ascribed meanings), physical aspects (such as artifacts), rituals (including ceremonies and other meaningful patterned behaviour), symbols, organizational stories (such as histories, legends and myths), and culture heroes, that is, highly respected figures within the group, past or present. Rituals and other patterned behaviour often serve to reinforce key values and assumptions of a culture. Highly respected persons such as 'founding fathers' can become an integral part of a culture, and can be a focal point around which various aspects of the culture may coalesce. Such 'culture heroes' may be central in some organizational histories and legends, and these can act to reinforce cultural understandings and behaviours. The elements of a culture are often strongly influenced by its history and the shared experiences of its members (e.g. Trice and Beyer 1993: 6). Conversely, the culture of a group is often a formative influence on the events which contribute to its history.

As understood within cultural anthropology, the values, beliefs and assumptions of a culture are deep-seated and usually long-established. Cultural elements are not superficial or trivial, and

only rarely recently introduced. To include superficial fashions as a significant part of 'culture' has little explanatory worth, in the anthropological model. For example, it may be appropriate to include 'quality customer service' as a significant, long-established value of the organizational culture of a firm with a long history of satisfied customers, but it may not be appropriate to do so for an organization which has only recently introduced compulsory 'customer service' training for employees.

Because the components of a culture are deep-seated and entrenched, they are highly resistant to change, and significant cultural change normally occurs only very slowly – typically over generations. In this context a 'generation' refers to the average length of tenure of members of an organization – for instance this might be 10 to 20 years. This also implies that significant, embedded changes to the culture of an organization can normally be made by its leaders only with great difficulty, in the absence of major turnover in the membership of the organization (e.g. Viljoen 1994: 480-486).

The importance of fit between technology strategies and organizational culture has been demonstrated (e.g. Gallivan 1997). Some writers have proposed that aspects such as organizational culture and other social aspects of organizations are related to, or influence the design, development and management of information systems (e.g. Ali et al. 2002; Butterfield and Pendegraft 1996; Dunn and Kingsford 1999; Kingsford et al. 2003; Myers 1999). This was found to apply in general in the case study, and is referred to further in Chapters 5 and 6.

Organizational culture was introduced in this section. The case study of this thesis focuses in particular on the culture of the IS organization (this is discussed further in Chapters 5 and 6). The next section introduces a key technique of social-cultural anthropology which was utilized in the case study, participant observation.

2.4.2 Participant Observation

Key field techniques of social-cultural anthropology are ethnography and participant observation (e.g. Jorgensen 1989; Spradley 1980). Participant observation was first developed for the ethnographic study of non-Western cultures (e.g. Geertz 1973; Malinowski 1927), as "the conscious and systematic sharing, in so far as circumstances permit, in the life activities, and on occasions in the interests and affects of a group of persons" (Kluckhohn 1940). It can equally be applied to organization and industry studies (e.g. Britan and Cohen 1980; Chapple 1941; Gardner and Moore 1964; Gregory 1983; Warner and Low 1947), and to studies of IT in

organizations (e.g. Prasad 1997). The use of participant observation and anthropological methods in studies of organizational behaviour have been recommended by a number of writers (e.g. Sayles 1973; Schwartzman 1986; Van Maanen 1979).

Participant observation requires an observer to also be a participant immersed in the relevant culture or organization, and to study it in detail from the point of view of its own members. That is, the approach tends to take an insiders' viewpoint, or 'emic' perspective. The researcher must be prepared to investigate and critically analyze the unquestioned, 'taken for granted', usually undocumented (and often unarticulated) assumptions, values and behaviour of the members of the culture. The researcher is concerned primarily with the meaning and significance of events as interpreted within the culture, and not necessarily their frequency (Van Maanen 1979). Or as Wainwright (1997) observes, "it is the quality of the insight that is important, rather than the number of respondents that share it." That is, interpretive qualitative research is emphasized, as opposed to quantitative research.

The interpretive approach aims to understand a culture or organization by means of ethnographic 'thick description' of the complex fabric of everyday structures, processes and discourse (Geertz 1973) – as opposed to the 'thin description' which may result from a survey spread across many target groups. Ethnography based on participant observation and thick description often uses to good effect narratives, vignettes, anecdotes and quotation of pertinent comments to illustrate deeper aspects of the culture, structure, values and processes of a group, and also as representations which are typical of more widespread views and opinions among members of the culture. The approach of Geertz (e.g. 1973) essentially aims to interpret cultural meanings as understood by the members of a culture themselves, from their perspectives. This has also been described as a symbolic-interpretive perspective (e.g. Hatch 1997: 217-220; Schutz 1967), as it focuses on interpretation of the symbolic importance of cultural traits and phenomena (Alvesson and Berg 1992: 4).

The fundamental anthropological concepts needed for the TPE case study, organizational culture and participant observation, were outlined in the sections above. These concepts were applied in the case study and are referred to further as necessary in Chapters 5 and 6. The next section focuses on the actual research techniques adopted for the case study.

2.5 Techniques Adopted for the Case Study

The research techniques adopted and applied in the TPE case study are discussed in more detail in the following sections. These include the methods of participant observation used, and the iterative process of data collection, analysis, literature review, drawing inferences and conclusions, and progressive write-up. Related topics are also discussed, namely validation of the case study material, and generalizability of the case study findings.

2.5.1 Participant-Observer Techniques Used

The researcher undertook the TPE case study as a participant observer 'embedded' in the organization, so gaining access to rich empirical data not generally available. A participant observer functions as an instrument in a qualitative study (Schwartzman 1986: 241), which implies that he or she might also influence the research setting to some extent. In the TPE case study, the influence of the researcher was minimal. At the time of the case study, the researcher was a mid-level manager working in the IT organization. The IT organization included about 17 executives and 130 peer level mid-level managers (the numbers varied during the study). The influence of each of the executives was far greater than that of the researcher, and the collective influence of the peer level managers was much greater than that of the researcher. In sum, the researcher had very little effect on the organization or the course of events, at the level at which the case study was focused.

Even when a largely insiders' or 'emic' perspective is adopted, it is also important for a qualitative researcher to maintain a degree of detachment from the situation of study, in order to collect and interpret data as impartially as possible, without being overly influenced by the setting and its problems (e.g. Fielding 1993: 158; Spradley 1980). This entails achieving a balance between closeness to and detachment from the situation. In the TPE case study, the researcher necessarily had to work quite closely with other participants, but was also able to maintain a level of detachment largely through not having long experience in the organization, unlike many of its members. It was a feature of this organization that many employees had worked in it for many years or decades, and often saw their work and its setting as a major and integral part of their lives. For example, an employee who left after 30 years working in TPE remarked, 'I think of [TPE] as my home, and its people as family.' The researcher was able to avoid such a level of close identification with the organization, and so was able to remain fairly impartial.

Participant observation requires detailed understanding of the culture or organization. Various methods can be used to achieve this, typically including close observation of processes and events, extensive open-ended discussions, examination of records and to some degree, surveys. In the TPE case study, the position of the researcher allowed good access to relevant employees and other sources of information. Surveys were utilized only to a small extent, as they often have limited ability to reveal deep-seated, largely unarticulated assumptions and beliefs, unless combined with in-depth discussion and observation.

Participant observation enables access to significant empirical data, and also requires detailed understanding of the assumptions, values and behaviours of the members of the group studied. In the TPE case study, various methods were used to achieve these aims, including:

a. close observation of actions, processes and events;
b. extensive informal, mainly open-ended discussions with managers and staff at most organizational levels, often utilizing active listening;
c. actively listening to employees' narratives, anecdotes, recollections, views, opinions, comments, career biographies, organizational histories and stories;
d. participation in numerous formal and informal meetings, discussions, seminars and workshops;
e. detailed examination of written reports including records of workshops, agenda and minutes of meetings, electronic mail (e-mail) messages, memoranda, documented strategies, plans, policies, procedures and guidelines, role statements, annual reports, reports of professional surveys, and a range of other documents and publications internal and external to TPE; and
f. to a limited extent, utilization of small-scale surveys.

Interviews and discussions were either unstructured, that is, without any predetermined questions; or semi-structured, that is, guided by some predetermined topics but not highly structured (e.g. Flick 1998: 76). Formal structured interviews were not used.

The processes of obtaining information from the various sources were generally guided by the key research questions as defined above, but were necessarily also flexible and open-ended to some extent. The essence of qualitative research is seen by many as its flexibility – such researchers have been referred to as 'bricoleur' because they undertake research by using and adapting whatever is immediately available, in a flexible way (Denzin and Lincoln 1994b: 2). It has also been suggested that:

> "Adjusting the design as you go along is a normal, expected part of the qualitative research process.. Such flexibility is much better than persisting in a design that is not working well or that doesn't allow you to pursue unexpected insights." (Rubin and Rubin 1995: 44)

The TPE case study was adjusted as necessary as it progressed, for example, to take advantage of the opportunity for in-depth study of the imposition of unexpected organizational changes.

Silverman (1998) suggests that some qualitative IS research has unnecessarily limited itself to the study of participants' meanings, often by focusing on the technique of open-ended interviews. Silverman (1998: 9-11) notes that some qualitative research underrates the value of data gathered from naturally occurring situations, but rather focuses on individual's private experiences of organizational life. Such an approach can overlook much information about how people interact. Silverman (1998: 3) proposes that the particular strength of qualitative research is its ability to focus on actual practice *in situ*, looking at how organizations are routinely 'enacted' – that is, to focus on how people 'do things' rather than how they 'see things'. Silverman (1998: 12-18) however detects 'hopeful signs' that some qualitative IS research utilizes a wider range of methods than open-ended interviews. Silverman (1998: 13-16) cites an example of research by Suchman (1987), which focuses on the mechanics of everyday human-computer interaction and practice in a given context. Silverman (1998: 16) considers that Suchman (1987) "avoids the.. assumption that there is a stable organizational or institutional order, separate from everyday interaction, that participants can reveal in interviews." Silverman (1998: 18) also cites a study by Schwartzmann (1993), which suggests including study of work meetings in order to gain more information about organizational routines and practice (Schwartzmann 1993: 43).

For the case study of this thesis, the range of methods that were used are identified as a. to f. above. They included not only open-ended discussions, but significantly, close observation of actions, processes and events, as well as participation in meetings and workshops, and examination of their records. Most of these methods were intended not only to understand how people 'see things', but also to gain detailed information about how they 'do things', and how they interacted with others in the organization. Silverman's criticism (1998: 9-11) does not apply to this case study.

Silverman (1998: 6) also suggests that a focus on participants' meanings via open-ended interviews, to produce 'context-dependent' insights, may entail a difficulty in that such insights may not be able to be generalized to other contexts. It is shown below (section 2.5.4) that there are significant problems with generalizabilty as a goal *per se*. In contrast, Lincoln and Guba (1985: 119-125) suggest that the reader of a study made in one context can potentially apply 'naturalistic generalization' or 'transferability' to another particular context, based on their

personal experience. Detailed case studies are a good way of providing the understanding needed by a reader: "if you want people to understand better.. provide them with information in the form in which they usually experience it. They will be able.. to derive naturalistic generalizations that will prove to be useful extensions of their understandings" (Lincoln and Guba 1985: 120). A researcher should provide sufficient information about the original context to enable a reader to judge its potential for transferability to another context. The best way of providing such information is by 'thick description' of the original context (Geertz 1973). The case study of this thesis adopted this approach, as noted above.

2.5.2 Iterative Data Collection, Analysis, Literature Review and Write-Up

The TPE research used an iterative process adapted from Miles and Huberman (1994) for data collection, analysis, literature review, drawing inferences and conclusions, and progressive write-up (documentation). This is illustrated in summary form in Figure 2 below. Coffey and Atkinson (1996: 2) similarly advocate that in qualitative research, substantial analysis should be undertaken simultaneously with data collection. In the TPE case study, the empirical material obtained was progressively analyzed to identify emerging patterns and insights, and also to suggest further questions and lines of inquiry where appropriate, in line with accepted ethnographic practice (e.g Foster 1969; Geertz 1973, 1983; Pelto and Pelto 1978; Van Maanen 1988). Also, wherever possible evidence from multiple sources, including empirical data and literature, was used to help validate particular lines of inquiry, discerned patterns or findings as they unfolded.

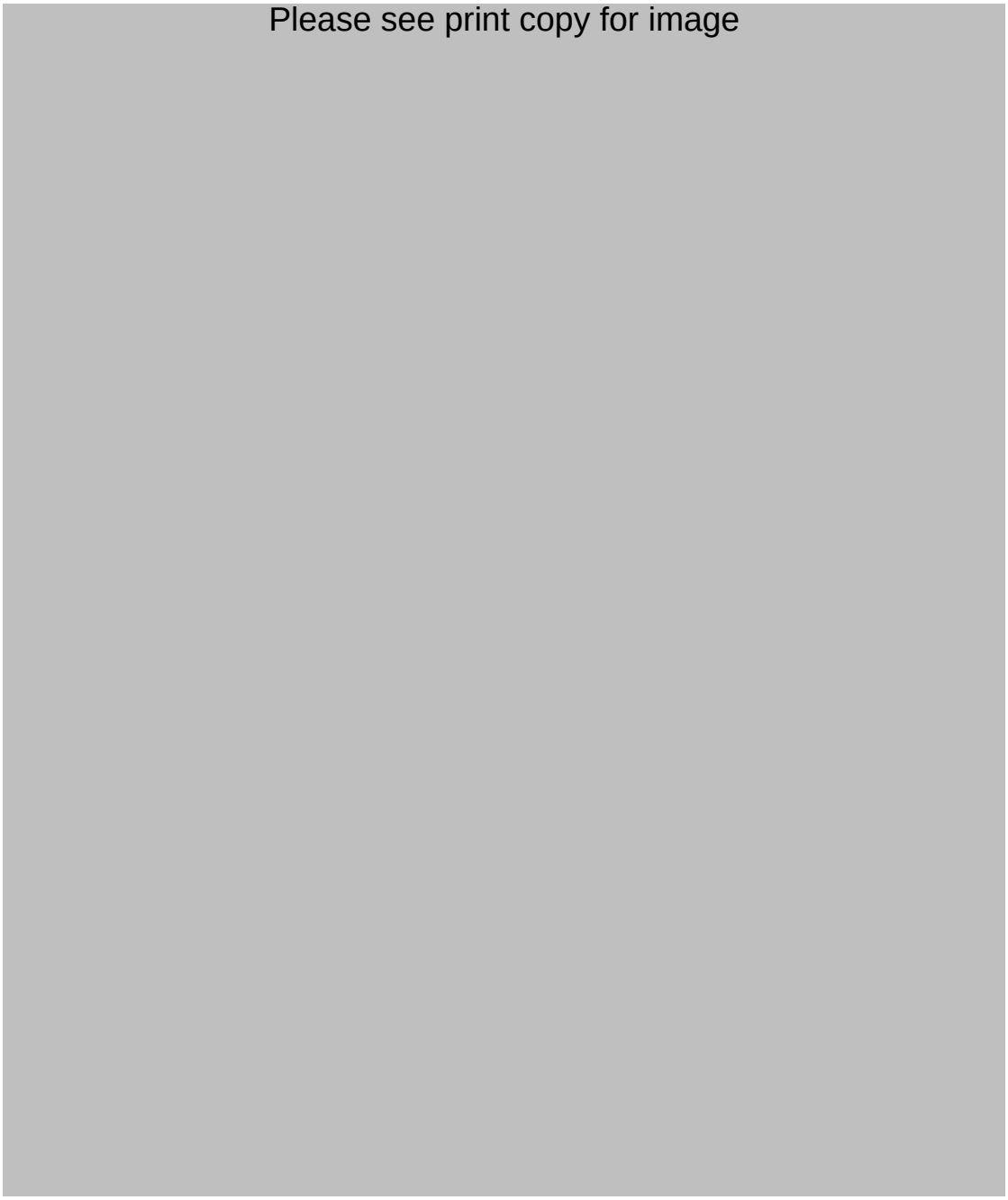

Figure 2. Iterative Process of Data Collection, Analysis, Literature Review and Write-Up (adapted from Miles and Huberman 1994)

Miles and Huberman (1994) discuss the philosophy of, and provide practical guidance for conducting qualitative research (see also Huberman and Miles 2002). The summary process shown in Figure 2 represents a similar approach, with progressive literature review also highlighted as a significant part of the overall process. As noted, in the case study the process was iterative – there was no linear sequence from literature review, data collection, analysis, and

on to conclusions and write-up. Feedback from the various stages was used to inform and guide 'previous' stages, and to adapt or adjust them as necessary. Thus progressive analysis and review of the data collected was used to refine and reduce the body of data. In turn, this was used to guide further data collection. Similarly, progressive review of literature and theory was used to refine data collection, and to inform the process of analyzing the data. Simultaneously, data display and write-up of findings were progressively documented in draft form. Observed trends, and tentative inferences and conclusions were periodically drawn from the data and its analysis, in conjunction with relevant literature. These were progressively included in the draft write-up, which became on ongoing 'work in progress' throughout the study. Again, the trends, and tentative inferences and conclusions were used to inform the 'previous' stages of data collection, literature review and data analysis, and to modify them where necessary. As well, the progressive write-up was used to inform the data analysis and reduction, and so also data collection as appropriate.

At the outset of the research, a preliminary literature review was undertaken, guided by the initial expectations the researcher had of the case study situation, as noted. For example, it was reasonably expected that it may be necessary to review literature and theory in broad areas such as IS governance, IS management, project management, and systems development and maintenance. In the light of the situation studied, it soon became apparent that the literature on 'knowledge principles' was also relevant, and to some extent other areas such as organizational change management and human resource management. The literature review thereby evolved with the case study. Moreover, even within one area of literature such as 'knowledge principles', the focus of the literature review evolved with the case study, as certain areas of 'knowledge' study – such as 'communities of practice' – became more relevant than others. The literature review was therefore necessarily iterative, and formed an ongoing, integral part of the research process.

The case study data – or empirical material – was collected from the various sources noted above (listed as a. to f.), mainly in electronic, hard copy or handwritten form. In TPE – as in many large organizations – there were typically many simultaneous, interwoven IS-related activities. It was necessary to limit the scope of data collection to ensure its manageability. The data collection was therefore guided in general by the research questions stated above. However it was also necessary for the researcher to remain flexible in terms of which IS areas were most closely associated with the research questions, given the typically high level of inter-connectedness of aspects of IS in an organization. In some cases this meant that new categories

of data had to be added, in other cases collection of data in certain categories was discontinued for practical reasons (see below).

Data was collected during fieldwork over a period of about five years. The research was undertaken part-time, and therefore data collection was not continuous. Various types of data were collected on any given day or week. The data was then sorted into logical categories – this was typically done every few weeks. Further analysis and review of the data were progressively undertaken, with substantial advances in this about every two months. This was typically done in conjunction with supplementary literature review. In all, during the period of study data was collected in at least 50 broad categories, many of them inter-related. The data categories which were eventually incorporated into the study included:

- IS/IT organization and structure;
- IS/IT organizational culture;
- IS/IT governance;
- IS management;
- IS project management;
- information systems;
- systems design and development;
- systems support, including maintenance;
- retirement of systems;
- IS quality management and peer reviews;
- systems knowledge and related knowledge processes;
- IS communities of practice;
- organizational changes and change management;
- interfaces among projects, maintenance and business;
- warranty processes; and
- human resource management.

The set of data categories evolved over the course of the study. During the study, some new categories were identified and added in the light of emerging data, such as 'systems knowledge'. In some cases, data categories were either merged or split as a result of progressive data analysis or literature review – for example 'systems knowledge' also gave rise to the related category 'IS communities of practice'. Some categories were later deemed not highly relevant to the study, as a result of ongoing analysis and review. Such categories were largely dropped in order to keep the scope of the study manageable, and these included:

– IS/IT strategy and strategic planning;

- IS/IT tactical planning;
- IS/IT portfolio planning and its management;
- IS/IT measurement;
- IS/IT monitoring and reporting;
- IS/IT policies, standards, procedures and guidelines;
- business functions;
- business processes and business rules;
- business needs and business requirements;
- requirements analysis and requirements management;
- commercial off-the-shelf systems;
- systems change control;
- systems operation and use;
- e-business;
- databases and their management;
- technical and technological issues; and
- financial and budget management.

Selected data from some of these categories was retained as necessary in the progressive write-up, but usually only in a general way or as passing references. This does not imply that such categories are irrelevant to the field of IS – just not highly relevant to this particular study. The final data categories chosen for inclusion in the study were all related to one another for the purposes of the study. Similarly, the areas of literature and theory included in the study were also related to the selected categories of data, and hence related to each other. For example, IS governance is thereby related to systems knowledge (discussed in Chapter 3).

As noted, periodically the data analysis and review, in conjunction with the ongoing literature review, were used to update the draft write-up of data and findings (in electronic form) – this was done progressively, with substantial updates every few months or so. Observed trends, and tentative inferences and conclusions were also periodically drawn from the data and analysis, in conjunction with relevant literature. These were progressively included in the draft write-up, which was an ongoing 'work in progress'. After many iterations the draft ultimately became the thesis, as also advocated by Zuber-Skerritt and Knight (1986). The trends observed, and tentative inferences and conclusions drawn were also used to guide further data collection as necessary, and so in turn additional data analysis and literature review. The further data analysis and review were in their turn used to refine the inferences and conclusions, and so on, iteratively. The draft write-up inevitably remained fairly incoherent and incomplete for much of

the case study, and only became more cohesive and integrated in the final years of the study. The structure of the thesis reflects the iterative process of its development. Aspects of data, analysis, literature, theory and conclusions are also presented in a way aimed at providing the best comprehension and readability. This often means that the thesis interleaves material in these various categories as appropriate, with the aim of co-locating closely related concepts and findings. However there are also some discrete sections in the thesis which for convenience present literature and theory in a given area in a more self-contained way, such as 'IS governance' and 'knowledge principles and processes' (for example, Chapters 3 and 4).

Hammersley and Atkinson (1983) similarly see progressive writing-up as an integral part of the analytical process of a qualitative study. They identify several valid approaches to writing-up, noting that hybrid approaches are also legitimate. The approaches include the 'chronology' – which is temporally organized, reflecting the development of the phenomenon under study, rather than the research process; and 'narrowing and expanding the focus' – in which the analysis moves backwards and forwards between specific observation and consideration of broader issues. The method adopted in writing up the case study was a combination of these two approaches. Where appropriate, a general chronology of events under study was presented, such as for the organizational changes and their outcomes. Also, where appropriate the write-up moved back and forth between specific observations and consideration of broader structural, processual and theoretical issues and inferences, and relevant literature sources.

In general, a thesis based on qualitative research is a unified text based on data drawn from both field study and literature, combined to produce a coherent document. As noted, Wainwright (1997) observes that the process of qualitative research is typically not clear-cut, but ongoing and 'dialectical'. References to literature continue throughout the research, as the empirical data raises new or modified themes for analysis. This thesis consists of material drawn from the case study, interwoven 'dialectically' with literature and theory. It has been suggested that qualitative research should link "assertions, findings, and interpretations, and so on to the data themselves in readily discernible ways" (Schwandt 1997: 164). This thesis aims to achieve this largely by co-locating related empirical data, findings and interpretation wherever possible. Also, just as apt statements from the data are used in the thesis to illustrate important themes, key quotations from the literature are often also given to illustrate general concepts. In the thesis, mainly shorter quotations from both data and literature are used, with occasional longer quotations being used when their significance warrants. Atkinson (1992) demonstrates the value of the use of longer quotations in qualitative research. For both data and literature, direct quotations are generally preferred, as being the best representation of a particular view.

2.5.3 Validation of Case Study Material

In regard to the general validity of a qualitative study, one criterion proposed is the amount of time spent in the field, with longer time implying greater validity. The general question of validity is related to 'trustworthiness' of the research (e.g. Lincoln and Guba 1986). One aspect of 'trustworthiness' is 'prolonged engagement', that is, the "investment of sufficient time to achieve certain purposes; learning the culture.. testing for misinformation.. and building trust" (Lincoln and Guba 1986: 290, 301). Prolonged fieldwork allows more extensive data to be collected. Also, incorrect data can tend to be corrected over time, as it becomes subject to further scrutiny and a wider range of sources. As a 'rule of thumb', a significant ethnographic study should ideally aim for a minimum of about two years full-time in the field (Professor Ronald Berndt, pers. comm.). The TPE case study entailed an extended period in the field – about five years, part-time – and so validity is supported on this criterion.

In regard to the validation of data collected in qualitative research, some writers advocate the use of quantitative techniques, for example, related to the number of sources which 'say the same thing' (e.g. Kelle 1995). However others see it is as misguided to apply quantitative criteria of validity to qualitative data. On this argument, in qualitative research what counts most is the quality of an insight (e.g. Van Maanen 1979). Some advocate a compromise, for example it has been suggested that an element of data may be taken as valid if at least two sources confirm it and no sources contradict it (e.g. Miles and Huberman 1994: 131). This was applied in the case study as a general 'rule of thumb', where applicable. Also as noted, evidence from multiple empirical sources was used to help validate particular lines of inquiry, patterns and findings. Where possible, data was also cross-referenced to relevant literature. Literature sources can lend support to some aspects of data, and the thesis demonstrates instances of this. Alternatively, in cases where data and literature differ, well-attested data can be used to challenge or refute literature sources, and the thesis demonstrates some instances of this. For example, the case study material challenges the view that computer-based systems typically become more unreliable, and harder and more expensive to maintain as they age (discussed in Chapter 5).

In some cases it was necessary to critically assess the 'quality of an insight' alone, rather than attempt to quantify the level of support it may receive. For example, a key aspect of the case study was to assess whether the major organizational changes had beneficial outcomes or otherwise. This had to be assessed largely as a qualitative judgment, by drawing on facts,

observations, opinions, inferences and conclusions from both case study and literature. In regard to this, it was noted above that ideally a researcher should declare their relevant prior perspectives (e.g. Denzin and Lincoln 1994a). On this point, the researcher initially agreed with and supported the organizational changes, since they appeared to be reasonable and logical. However it became apparent as the case study unfolded that the changes had led to substantial organizational problems, and that this situation warranted closer examination.

Inferences and conclusions are typically drawn from the data collected in a case study, in conjunction with relevant literature. The validity of such inferences depends largely on the validity of the data, as discussed above. Inferences drawn from data may also be related to causality, that is, whether certain observed results are caused by particular events or situations. It has been argued that qualitative evaluation is capable of assessing causality "as it actually plays out in a particular setting" (Miles and Huberman 1994: 10). That is, it is possible to demonstrate causal relationships within a certain context, provided the observations and data are detailed enough, and recorded over a sufficiently long period. Therefore detailed 'thick description' of a situation can allow reliable inferences to be drawn, and this position was taken in the case study. For example, it was shown that the organizational changes had resulted in significant problems. Some authors further suggest 'auditing' of qualitative research findings by other parties as another means of validation (e.g. Schwandt 1997). However Miles and Huberman (1994: 440) observe that auditing may apply in some cases, but that its use is restricted to major or 'high-stakes' studies.

2.5.4 Generalizability of Case Study Findings

Lincoln and Guba (1985: 110-125) discuss the extent to which the findings of research in a particular context may be generalized to other contexts. They note that some authors consider that an enquiry should be such that its results can be broadly generalized to other contexts, and that such generalizations then become context-free assertions of enduring value (Lincoln and Guba 1985: 110-112). There are flaws in this proposition, and in fact there are viable intermediate positions lying on a continuum between detailed knowledge of a particular context and generalizability to other contexts (Lincoln and Guba 1985: 112-119, 122). The flaws include the fact that if linkages among the elements of a situation are not fixed and stable, then its interpretation may not be generalizable to other situations. There can also be multiple possible generalizations that account for a given set of particulars. A generalization may at best be a relative or probabilistic statement, not an absolute. Another problem is that a

generalization may 'decay' – at one time it can describe a situation well, but this may change (Lincoln and Guba 1985: 112-119).

Lincoln and Guba (1985: 123) suggest that there are often factors that are unique to a particular situation, locale or series of events that can prevent wide generalization. Nevertheless, another individual may be able to apply the findings to a different context, based on their personal knowledge and experience of the contexts. Lincoln and Guba (1985: 123-124) ask what is the basis for such transferability from one context to another? Clearly the degree of transferability depends on the level of similarity between two contexts. Lincoln and Guba (1985: 119-125) suggest 'naturalistic generalization' as a viable approach for the reader of a study. This was first proposed by Stake (1978):

> "Case studies will often be the preferred method of research because they may be epistemologically in harmony with the reader's experience and thus to that person a natural basis for generalization." (Stake 1978: 5)

Lincoln and Guba (1985) note that case studies can be a powerful means of building the understanding of a reader in empirical and intuitive ways, based on their personal and direct experience: "if you want people to understand better than they otherwise might, provide them with information in the form in which they usually experience it. They will be able, both tacitly and propositionally, to derive naturalistic generalizations that will prove to be useful extensions of their understandings" (Lincoln and Guba 1985: 120). A researcher cannot specify what other contexts a study might be applied to by other persons. However the researcher should provide enough information about the original context to enable another person to make an informed judgment about possible transferability to another context. The best way of providing such information is by 'thick description' of the original context, following Geertz (1973). The research for this thesis adopted this approach.

Lee and Baskerville (2003: 224) suggest that the potential for generalizability is sometimes seen as limited because a generalization is mistakenly expected to be a proven statement, rather than initially a well-founded but as-yet untested hypothesis. Lee and Baskerville (2003: 230) note that the interpretive research approach does not place special emphasis on generalization, but does allow generalization to other settings. However the only way to fully establish a proposed generalization in a new setting is for it to survive an empirical test in that setting (Lee and Baskerville 2003: 241).

The principal aim of the thesis is to describe in detail a specific organizational situation, primarily in order to be able to provide a credible analysis and interpretation of it. In regard to

the ability of the research to be able to be generalized to other similar situations, Ward-Schofield (1993) observes that the goal of qualitative research is *not* to produce a standardized set of results that another researcher studying the same issues would produce. Rather the primary goal is "to produce a coherent and illuminating description of and perspective on a situation that is based on and consistent with detailed study of the situation" (Ward-Schofield 1993: 202). As regards potential transferability to other situations:

> "If there is to be transferability, the burden of proof lies less with the original investigator than with the person seeking to make an application elsewhere.. The responsibility of the original investigator ends in providing sufficient descriptive data to make such similarity judgements possible." (Lincoln and Guba 1986: 298)

A qualitative researcher should aim to demonstrate the validity of the analysis within its context by providing a detailed 'thick description' of the setting (Geertz 1973). Moreover, sufficient detail should be included for a possible alternative 'reading' of the original context to be constructed by another researcher, if they consider it justified (Wainwright 1997). Such situations occur in ethnographic research (e.g. Contu and Willmott 2003; Freeman 1986; Kingsford 1982). In other words, a qualitative researcher should strive to do their utmost to demonstrate the validity of their analysis on its own terms by providing as detailed a description as possible, while acknowledging that a future researcher might arrive at different conclusions. However any possible future reinterpretation is beyond the scope of a study. This perspective was adopted in this thesis.

The primary aim of the thesis is to give a detailed and coherent description of a particular organizational situation, analyze that situation and provide a credible and supportable interpretation of it. Specific inferences and conclusions are drawn from the case material analyzed, in relation to its context (Chapters 5, 6 and 7). Some general inferences are also drawn from the conclusions of the research, mainly in the form of recommendations for 'good practice' and suggestions for further research (Chapter 7). The thesis also introduces and considers some limited comparisons with other similar organizations, but it is emphasized that any inferences drawn from such correlations cannot be extended too far (Chapter 7).

This chapter outlined the research setting and research methodology, and discussed related concepts and approaches which were applied in the context of the case study. The qualitative, interpretive research methods adopted and applied in the TPE case study were discussed and justified in the sections immediately above. The following chapter considers another key concept related to the research – information systems governance.

Chapter 3 INFORMATION SYSTEMS GOVERNANCE

This chapter discusses the concepts of IT governance and information systems governance from a mainly theoretical viewpoint, and provides a survey of relevant literature. The concepts are applied to the case study in Chapter 5.

3.1 Introduction

Strassman (1990, 1997) points out that in general, expenditure on IT by organizations does not necessarily generate positive returns. There is little correlation between the amount spent on IT and corresponding business outcomes. Many organizations continue to make large investments in IT without worthwhile returns. Both high and low IT spending levels can be associated with either inferior or superior results. Even when IT investments are profitable, they often still fall well short of their original expectations (Strassman 1990, 1997).

Murphy (2002) also addresses the question of whether IT investments result in productivity gains. Murphy (2003) provides a cogent summary of key arguments of Murphy (2002). Murphy (2003) observes that:

> "If IT investments improve productivity, those industries making the most-intensive use of IT should show higher productivity growth than industries that use IT less intensively. Yet, evidence of such a pattern at an industry level remains mixed at best. Official output measurements for IT-intensive *service* industries actually indicate *declining* productivity from 1990 to 1997, while some research actually shows a negative relationship between IT spending and corporate performance." (Murphy 2003: 2)

Murphy (2002) concludes that:

> "Obtaining business value from IT investments continues to be among the top concerns of CIOs and CEOs, as evidenced by Gartner's annual survey of business and information technology executives. As they approve large and ever-growing expenditures on IT initiatives, executives are unsure when, or even if, there will be a return on these investments.. Despite all of this, we know that IT has also produced tremendous benefits." (Murphy 2002: 2)

The term *governance* (or *corporate governance*) refers to the system by which organizations are directed and controlled (Clarke 2004; Standards Australia 2005a), based on the set of decision rights and accountabilities between groups of people (Broadbent 2005). Corporate governance aims to ensure quality decisions are made concerning all corporate assets (Weill and Ross 2004). Governance is the framework, or set of rules or guidelines that determine the distribution of roles, responsibilities, decision-making, accountability, resources and processes in an organization (e.g. Andriole et al. 2004; Davies 2002; Korac-Kakabadse and Kakabadse

2001; Standards Australia 2005a; Tricker 1984). Governance is "not a synonym for management" (Broadbent 2005).

3.2 Information Technology Governance

The *IT governance* of an organization comprises the framework, or set of rules or guidelines for governance of IT. Broadbent (2003a) notes that IT governance is not synonymous with IT management: IT governance is about decision rights, whereas IT management is about making and implementing specific IT decisions. IT governance effectively combines three components: what decisions need to be made, who makes them and how they are enacted (Broadbent 2003a). The IT governance framework may be explicitly formalized and documented, or it may be implicitly understood by members of the organization, or there may be some combination of the two (e.g. Andriole et al. 2004; Korac-Kakabadse and Kakabadse 2001; Marshall et al. 2005; Patel 2002; Ribbers et al. 2002; Sambamurthy and Zmud 1999; Standards Australia 2005a; Van Grembergen and Saull 2001; Weill et al. 2003). Broadbent (2003a) observes that just as corporate governance has been fraught with challenges in recent years (e.g. Clarke 2004), so too has IT governance.

Effective IT governance embraces and integrates both IT and business. IT governance is seen as the assignment of decision rights especially at the intersection of business and IT, and the accountability framework needed for effective IT processes and use (Broadbent 2002, 2005; Korac-Kakabadse and Kakabadse 2001; Marshall et al. 2005; Patel 2002; Ribbers et al. 2002; Standards Australia 2005a; Weill et al. 2003). IT governance links IT decisions with company objectives, and monitors performance and accountability (Weill 2004; Weill and Ross 2004). Broadbent (2003b) comments that effective IT governance arrangements have a real impact on business goals, and involve collaborative decision-making between business and IT executives. IT governance is the "glue that links an executable business strategy with an executable IT strategy" (Broadbent 2005). The role of IT service providers is normally included in the IT governance framework. The role of customers in influencing IT decisions may in some cases also be a significant part of the governance.

Weill et al. (2003) sees IT governance as embracing an accountability framework that encourages desirable behaviour in the use of IT. A 'desirable behaviour' is one that is consistent with the organization's mission, strategy, values, norms and culture. According to Weill et al. (2003) and Weill (2004), effective IT governance requires thoughtfully combining its two key components:

- IT domains, which are the areas where decisions need to be made at the intersection of business and IT, and
- IT governance styles, which specify who has input to the decisions and who makes the decisions.

Weill (2004) proposes that:

> "Top-performing enterprises proactively seek value from IT in at least five ways: (1) they clarify business strategies and the role IT plays in achieving them, (2) they measure and manage the amount spent and the value received from IT, (3) they design organizational practices to fit IT to their business strategies, (4) they assign accountability for the organizational changes required to benefit from new IT capabilities, and (5) they learn from each implementation, becoming more adept at sharing and reusing IT assets." (Weill 2004: 1)

Strassman (1997) points to a conceptual gap between IT and business that must be bridged to enable organizations to succeed. McHugh (2007) notes that such deficiencies in business-IT alignment have long existed:

> "Academics have touted the need to align technology with business since the 1960s. The issue has made the top ten concerns of management since the 1980s. Despite band-aid after band-aid, alignment issues perpetuate, perhaps because the band-aids don't deal with root causes." (McHugh 2007)

McHugh (2007) observes that attempts have been made by organizations to try to correct such deficiencies:

> "In the mid 1980s, the concept of 'participative management' led to experimentation with matrix reporting and cross-functional teaming.. Generally, matrixed roles have been used to enable business-IT alignment. Most commonly, an IT expert with good interpersonal skills is positioned by IT management to insinuate IT into the business function. It's much rarer to see an expert in the business function put into a matrixed role by a functional manager in order to insinuate the business into IT. Unfortunately, alignment requires outreach, education and decision rights from both sides *in equal measure*." (McHugh 2007, italics in original)

Murphy (2002) sees some hopeful moves in organizations towards improved business-IT alignment through better-integrated structures and processes, and suggests that "there is little doubt that businesses and society are struggling to adapt work patterns and processes. This suggests that those organizations that do manage to adapt will gain greater returns" (Murphy 2002: 3).

Andriole (2004: 6-7) also emphasizes the business-technology connection, and comments that "it's impossible to talk about technology governance without also talking about business and management governance.. [and] it makes no sense to talk about business without simultaneously talking about technology." Andriole (2004) refers to arguments for business-technology alignment which have prevailed for the past two decades, and comments that by and large these

are 'separatist' models which have sought to organize technology to support business (e.g. Dampney and Andrews 1991; Henderson and Venkatraman 1993), but essentially have not argued for or resulted in their closer integration. The greater need is for inclusive models which closely integrate business and technology decision-making (Andriole 2004: 15). Similarly, Roberts (2006b) suggests that:

> "IT governance is evolving to ensure that multilevel, multidisciplinary teams pursue business-IT links. Many enterprises have developed their IT governance model to oversee their IT delivery strategy. Principles are set for the IT organization, and decision rights are clarified for IT architecture, infrastructure, business applications and investments" (Roberts 2006b).

Van Grembergen and Saull (2001) also see a close link between IT governance and IT strategy, with both being capable of achieving competitive advantage for an organization. IT governance is seen as the organizational capacity to control the formulation and implementation of sound IT strategy, and a guide for proper direction to attain competitive advantage (Van Grembergen and Saull 2001). Sambamurthy and Zmud (1999) see IT governance arrangements as patterns of authority for key IT activities in firms, including IT infrastructure, IT use and project management (Sambamurthy and Zmud 1999: 261). The last two areas mentioned reinforce the fact that IT governance includes information systems as a key component, for any organization in which systems form a substantial part of its IT.

3.3 Information Systems Governance

The *IS governance* of an organization is therefore a significant subset of the IT governance framework, and comprises the framework, or set of rules or guidelines for governance of information systems (e.g. Dallas et al. 2002). Appropriate definitions of IS governance can be inferred by substituting 'IS' for 'IT' in the various definitions of IT governance given above. The term 'IS/IT governance' is used to mean IT governance with an emphasis on its significant IS component. Korac-Kakabadse and Kakabadse (2001) see IS/IT governance as a critical factor for enterprise business success, and a mechanism for addressing issues that fall under the general umbrella of 'matching business requirements with technology applications', in planning for the future. Broadbent (2003b) notes that the principles of an organization's IT governance usually need to be validated by business executives, and similarly for decision rights about business applications (information systems). The focus in this thesis is on IS governance, especially aspects associated with the development and support of information systems, as opposed to wider aspects such as the planning for and use of information systems.

IT governance has traditionally been seen as a controlled, top-down, executive-level framework for decision-making (e.g. Patel 2002; Raphaelian 1995). A typical statement of the 'control' or 'command' model is:

> "The purpose of IT governance is to keep IT operations under control, such that the resources – both dollars and people – are spent and used to meet the organization's strategies and objectives. It's an integral part of enterprise governance and consists of leadership, organizational structures, and processes. It is the responsibility of the corporate leadership to define and implement a system that will ensure the integrity of IT across the corporation." (Davis 2004: 43)

Criticisms of this model have been made, for example, "firms that shift decision making closer to the frontlines will prosper through better decisions" (O'Farell 2004: 55). Highsmith (2004) also comments:

> "To be successful, new IT governance models need to be more than an exchange of 'command' authority from IT to the business units. To create a high-performance IT organization with the agility (which by my definition includes the ability to balance flexibility and structure) to survive in the turbulent future, we need to address the fundamental nature of both organizational structures and the behaviors of the individuals – executives, managers and staff – who populate those structures." (Highsmith 2004: 51)

Highsmith (2004) goes on to propose that the key to achieving such high performance lies in participative relationships and collaboration within and among groups, for example:

> "the participants [also] need to establish relationship rules: their rules of engagement.. following are examples of relationship rules that guide group interaction:
> - Groups should participate in any decision that impacts their work.
> - Decisions should be made as collaboratively as possible.
> - The participants have the right to self-organize into other subteams to carry out specific results.
> - Conflict needs to be resolved as cooperatively as possible."
>
> (Highsmith 2004: 51)

On similar lines, a number of recent writers have emphasized that effective IS/IT governance should take into account the needs of multiple stakeholders, that is, any individual or group that can affect, or is affected by, decisions regarding corporate IT. For example, Korac-Kakabadse and Kakabadse (2001) see IS/IT governance as including the determination of requirements for corporate IS/IT investments, taking into account the needs of stakeholders. This includes decisions related to the initiation of information systems projects, the implementation of these projects and their contribution to business strategy. IS/IT governance should therefore focus on the structure of the relationships and processes needed to develop and control IS/IT resources and achieve the enterprise's goals.

To be effective, IS/IT governance requires good mechanisms for communicating and sharing information. For example, Korac-Kakabadse and Kakabadse (2001) argue that successful enterprises should integrate the needs of customers, business partners, vendors and other constituents, and rely on effective sharing of information in order to differentiate themselves from the competition. Broadbent (2003b) notes that effective IT governance entails good communication methods and mechanisms. Broadbent (2003b) comments that good communication mechanisms "reinforce the fact that IT governance really matters to both business and technology executives. The key message is to engage, engage, engage; but with a clear purpose, linked to specific enterprise goals and desirable behaviours, backed by both business and IT metrics." Weill and Ross (2005) conclude that when senior managers take the time to design, implement and communicate IT governance processes, companies get more value from their IT.

Successful IS/IT governance entails involving all stakeholders and genuinely seeking their input. For example, Weill (2004) comments that:

> "Good IT governance draws on corporate governance principles to manage and use IT to achieve corporate performance goals. Effective IT governance encourages and leverages the ingenuity of all enterprise personnel in using IT, while ensuring compliance with the enterprise's overall vision and principles. As a result, good IT governance can achieve a management paradox: simultaneously empowering and controlling." Weill (2004: 3)

Effective IS/IT governance requires collaborative business and technology decision-making. For example, Korac-Kakabadse and Kakabadse (2001) suggest that IS/IT governance needs to enable managers and suppliers to develop integrated business and IS/IT plans that allocate responsibilities and accountabilities, prioritise and organize IS/IT initiatives – taking into account business needs – and track performance and outcomes. Ribbers et al. (2002) similarly suggest that effective IT governance requires the strategic integration of business and IT decisions, with collaborative relationships among all key stakeholders (see also Stewart 1995). Ribbers et al. (2002) discuss a case study investigation of large complex organizations, and examine the design and effectiveness of IT governance processes. The results indicate that effective IT governance processes are characterized by strategic integration of business and IT decisions, and building collaborative relationships and shared understanding among stakeholders.

3.4 IS Governance, Knowledge, Organizational Structure and Culture

3.4.1 IS Governance, Knowledge and Trust

Some writers acknowledge that successful IS/IT governance requires effective knowledge sharing processes. For example, as noted Sambamurthy and Zmud (1999) see IT governance as patterns for key IT activities including IT infrastructure, IT use and project management. Project management is seen as requiring a blend of knowledge of IT infrastructure capabilities with knowledge associated with the conceptualization, acquisition, development and deployment of information system applications. Sambamurthy and Zmud (1999) note that organizational efficiencies often arise from the effective sharing of appropriate IT-related knowledge and expertise (compare Winter 1987). In a similar context Walz et al. (1993) discuss knowledge acquisition, sharing, and integration in a software design team. That is, relevant knowledge is seen as a key factor in system development, and by implication should be considered as part of IS/IT governance, along with knowledge processes.

Strassman (1997) proposes that instead of treating IT as just a capital asset, the focus should be more on what effective management can accomplish using IT, with the cooperation of knowledge workers. Strassman (1997) argues that in today's economy of the knowledge worker, success does not depend on the size of an organization's IT budget, but rather on the quality of the organization's information and the effectiveness of its use. Rowlands (2007) discusses this in a review of Strassman (1997):

> "The return on investment in information technology can be measured in terms of the value of the information. For today's knowledge workers the value of information is measured by the degree to which they understand the full *context* of critical information.. Knowing the appropriate context for information supports the effective use of information assets within a business, which logically leads to an optimized return on investment in technology. In the information economy raw data is just noise while data and information in the proper context translates to a strategic advantage." (Rowlands 2007)

Effective IS/IT governance also entails collaborative partnerships. For example, Sambamurthy and Zmud (1999) see effective IT governance as requiring the development of partnerships among IT and business across an organization. Such partnerships reflect the realization that relevant knowledge and political authority for IT-based innovation are dispersed across an enterprise. Partnerships are required to integrate these dispersed pockets of knowledge and authority. Such partnerships encourage the formation of trust among business and IS managers, so that they are willing to jointly explore prospects for IT innovation in the firm, assume risk for

innovation, and undertake leadership for projects. In a similar context, Cooprider and Victor (1993) discuss the significant contribution of shared knowledge to IS group performance.

As noted in Chapter 1, effective knowledge sharing is facilitated by relationships of trust (e.g. Koskinen 2003). Trust builds up over time, and long shared experience enhances both trust and knowledge transfer (e.g. Lindskold 1978; Nonaka and Takeuchi 1995). As seen, many IS staff in TPE had built up long-standing relationships of trust and knowledge sharing, often within communities of practice. Broadbent (2002; 2003b) sees effective leadership and thoughtful IT governance as helping to create and nurture trust. Trust in turn promotes organizational effectiveness, so further encouraging desirable behaviour in the use of IT. Effective governance also helps enterprises deal with complexity, in part by nurturing trust and hence knowledge sharing (Broadbent 2002; 2003b). Broadbent (2003b) comments, "It's about making sure the right people have responsibility for key decisions and that there is a lot of input from others. IT governance that is thoughtful and transparent fosters trust. And trust in turn will give CIOs much greater 'degrees of freedom' and build their credibility bank."

3.4.2 IS Governance, Culture and Structure

The importance of fit between technology strategies and organizational culture has been demonstrated (e.g. Gallivan 1997). It has been argued that successful enterprises need to integrate their IS/IT governance with their strategies and culture, in order to attain business objectives and optimize their use of IT (e.g. Korac-Kakabadse and Kakabadse 2001). Patel (2002) notes that any IT governance mechanism should be rooted in business logic. However IT governance is more than the simple application of IT to business activity, but rather a complex fusion of IT with business activity, business partners, suppliers and customers (Patel 2002). Patel (2002) refers specifically to IT governance strategies for 'e-business' (business supported by internet technologies), but the statement is also applicable to IT governance in general. More broadly, Patel (2002) sees IT governance in essence as addressing how to design and implement effective organizations by creating flexible IT and IS structures and processes.

IS/IT governance is often seen as pervading much of an organization, and so linked to both organizational structure and culture. In regard to the inter-relationships among governance, culture and structure, some pertinent general comments include:

> "The governance agenda should be defined around your specific activities and interpreted through your culture and, ultimately, your organizational structure.. It's impossible to talk about how to govern without talking about organizational structure and culture.. Organizational structure, culture, and governance are all related.. activities, policies,

> procedures, regulations, and organizational structures are influenced by corporate cultures.. companies should convert governance requirements into realistic matches among their requirements, structures and cultures." (Andriole 2004: 22, 35, 36)

On similar lines, in developing IT governance arrangements it is recommended that IT be evaluated in the context of the environment in which the organization operates, and the aspirations of the organization (Standards Australia 2005a). Responsibilities are to be assigned for detailed planning and control of how IT is used, and for allocation of resources. For IT plans to best fit the evolving needs of the organization, they should be developed as an integral part of the business planning process. This better ensures that initiatives are feasible given the organization's situation, and that realizable benefits can be gained. IT governance should also require that IT use respects human factors. This entails attention to the current and evolving needs, including communication and cultural needs, of all 'people in the process', including people who deliver and operate IT as much as those who use it and depend on it, in the future as well as the present. In this context, customers and suppliers are as important as internal users and IT specialists (Standards Australia 2005a).

A number of writers see IT governance as consisting only of *explicit* guidelines. Such writers generally argue in favour of having formal rules of IT governance, to avoid any misunderstandings (e.g. Davis 2004; Raphaelian 1995; Tunick 1996). However a key insight of the definition given by Shipley (1995) is that it includes the *implicit* or informal guidelines which often comprise a significant portion of the IT governance framework which can operate in practice. Even in cases where formal rules do exist, it is often the unwritten, implicit rules which are drawn on in making key decisions. Shipley (1995) notes that many organizations develop formal IT governance guidelines from the top down, but in so doing may not acknowledge the significant decision-making power of organizational subunits. Such decision-making power may form an integral part of the organizational structure and culture. That is, key attributes of the structure and culture may have considerable influence on the style of IT governance which applies in practice. Therefore in order to fully understand the existing IS/IT governance framework of an organization, it is often necessary to first understand the organizational culture and structure.

Murphy (2003) addresses the issue of IT governance, and also recognizes the importance of people and their actions in implementing effective governance:

> "People, the way they act and interact, are central to the achievement of benefits from IT investments. They need the best tools and techniques as well as a set of principles that determine the way decisions get made and conflicts get resolved at all levels, from senior management to technicians, within traditional hierarchies and across business boundaries.

> Gartner refers to such a set of principles as governance. Without effective governance, people will take shortcuts, the loudest voice will win the day, *ad hoc* decisions will be made, accountabilities lost, and lessons from successes and failures will not become part of corporate wisdom." (Murphy 2003: 14)

Despite acknowledging the importance of people and their interactions in enabling governance, Murphy (2003) tends to focus more on the necessary *formal* roles and structures within IT governance, for example:

> "Some key governance roles [are]..
> IT Council.. Defines strategy, and sets ground rules and priorities for IT expenditure..
> IT Investment Board.. Ensures that potential IT investment proposals and opportunities are thoroughly analysed..
> Office of Architecture and Standards.. Ensures that corporate architectural and business value standards are comprehensively addressed..
> Project Office.. Brings best practices in project management." (Murphy 2003: 14)

While formal structures and roles such as these are important within the overall IT governance framework, they tend the overlook the fact that there can frequently also be a significant informal component of IT governance, and in practice this may be its most effective aspect.

3.4.3 IS Governance and Emergence

Patel (2002) notes that IT governance has traditionally been identified with planning and direction. However modern organizations cannot be viewed solely as planned and directed entities. There is evidence that organizational structures and processes can be dynamic and emergent, and so can the process of IT governance. IT governance includes being open to unexpected requirements or emergent information. In this context, 'emergence' implies not stemming from any deliberate strategy or initiative by the organization. Emergent structures, processes or requirements may materialize suddenly, or evolve gradually over a long period of time. Patel (2002) observes that this approach is based on the literature on emergence in organizations and its corresponding effect on IS development and IT governance (e.g. Mintzberg 1979; Mintzberg and Waters 1985; Patel 1999; Pawson et al. 1995; Truex et al. 1999). Patel (2002) notes that in terms of IS development, research reveals that developers need to consider the emergent information and knowledge needs of the organization. Similarly, the IS/IT governance framework should be able to cater for emergent knowledge needs.

Broadbent (2005) notes that business strategy now often continually emerges, and in order to be effective businesses should be able to rapidly sense and respond to emergent imperatives. Broadbent (2005) comments, "That's where the need for strong systems of governance comes in. The ability to integrate business and IT can exist only when clear and robust systems of IT

governance also exist – systems that will allow your organization to make well-informed decisions, and make them faster. It's about being agile" (Broadbent 2005).

Weill (2004) suggests that, "All enterprises have IT governance. The difference is that enterprises with effective IT governance have actively designed a set of IT governance mechanisms (e.g. committees, budgeting processes, approvals, IT organizational structure, chargeback, etc.) that encourages behaviours consistent with the organization's mission, strategy, values, norms and culture" (Weill 2004: 3). However statements of this kind – advocating the active design of IT governance – can underestimate the extent to which an organization may have effective informal or implicit IT governance mechanisms, which have emerged naturally from the framework of its corporate culture, structure, values and norms.

Kingsford et al. (2003) discuss a case study of an organization in which it is shown that the IS governance which operated in practice was largely implicit and emergent, and was significantly shaped by organizational culture and structure (see also Kingsford 1998). In this case study, the most influential features of the IS governance were implicit, as opposed to more explicit and openly acknowledged aspects, which in practice had less influence. Much of the implicit IS governance framework emerged from the organizational culture and natural structure (that is, the structure which had evolved naturally over many years), fitted well within both, and reinforced their tenets. These were in fact emergent strategies (e.g. Mintzberg and Waters 1985). They did not stem from any deliberate initiative or plan by the organization, but were shaped by its culture. The process by which the implicit IS governance strategy came to be widely adopted within the organization (in the absence of any formal strategy promulgated by management) was related to the informal learning of values and assumptions within the culture, among its members. The implicit ground rules of this IS governance framework were deep-seated and long-established, and highly resistant to change, as cultural values so often are.

This chapter discussed the concepts of IT and information systems governance from a theoretical viewpoint. These concepts are applied to the situation of the case study in Chapter 5. The following chapter considers in more detail the knowledge principles, processes and theoretical approaches which are relevant to the thesis.

Chapter 4 KNOWLEDGE PRINCIPLES AND PROCESSES

This chapter provides a literature survey of relevant knowledge principles, processes and theoretical approaches, and discusses these in terms which are later applied more specifically in Chapter 5. Chapter 4 also includes preliminary references to some key points relating to the case study, which are expanded in Chapter 5.

4.1 Knowledge

The aspects of knowledge which are pertinent to this thesis are outlined below. Knowledge has been defined in general terms as follows:

> "*Knowledge* is a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of knowers. In organizations, it often becomes embedded not only in documents or repositories but also in organizational routines, processes, practices and norms." (Davenport and Prusak 2000: 5-6)

Knowledge is often intuitive and may therefore be difficult to capture in words or fully understand in logical terms. Davenport and Prusak (2000: 6) note that to be most effective, knowledge should be close to action, that is, any action or decision resulting from a particular area of knowledge should closely follow the acquisition or creation of that knowledge. Conversely, action can lead to the acquisition of related knowledge. The value of knowledge can be evaluated by the quality of the actions or decisions to which it leads. For example, "[better] knowledge can lead to measurable efficiencies in product development and production" (Davenport and Prusak 2000: 6).

4.2 Knowledge Processes

A number of writers have advocated a stronger focus on people issues in the general field of knowledge processes and knowledge management (KM). For example, "It now appears clear that knowledge management professionals must focus on people-related KM and its relationships to enterprise performance to a greater degree than many have considered important or necessary" (Wiig 2004b). While it is true that the entire topic of 'knowledge' is essentially people-related, a particular sub-discipline of KM has emerged in recent years which is more focused on technological aspects, such as the use of software packages to support KM. This

technological sub-discipline is not the focus of this thesis, which following Wiig (2004a, 2004b) focuses primarily on people-related issues in knowledge processes.

McElroy (2002) sees *knowledge processing* as a social process found in all organizations, covering the production, diffusion and use of knowledge. McElroy is one of the authors who draw a distinction between knowledge processing and knowledge management, with the latter being seen as a management discipline that seeks to improve the quality of knowledge processing within an organization. This thesis follows McElroy (2002) in making a distinction between knowledge processing and knowledge management. Such a distinction is often useful, however it is possible for effective informal or implicit knowledge management to operate in an organization, without any formal, management-initiated KM program. In fact 'knowledge processing' and 'implicit knowledge management' are essentially the same concept. This thesis uses the terms 'knowledge processing' and 'knowledge processes' to refer to processes which have evolved naturally within an organization, without any explicit or formal imposition of a framework by management. It is demonstrated by the case study of TPE that there is a need to investigate and understand the knowledge processes within an organization first, before any formal strategy is adopted which may have the effect of disrupting vital processes. If the knowledge processes are working well, and fit well within the organizational culture, it may be wise not to disturb them. This is demonstrated in the case study, in which certain executive-led organizational changes resulted in the disruption of crucial knowledge processes, with adverse consequences (this is discussed further in Chapters 5 and 6).

4.2.1 Tacit Knowledge

Polanyi (1957) proposed a distinction between *tacit* and *explicit* knowledge. Tacit knowledge includes practical 'know how' of a function which for most people lacks explicit, detailed awareness of how it is achieved, such as riding a bicycle. Davenport and Prusak (2000: 70) note that knowledge in organizations ranges from the complex, accumulated expertise that resides in individuals' minds and is partly or largely inexpressible, to more explicit and structured content. Knowledge is typically instrumental in creating competitive advantage for a firm (e.g. Boisot 1998). Tacit knowledge is often a valuable component of such knowledge. Tacit knowledge has been estimated at around 80 per cent of all knowledge (Marling 2004: 8) – although this is necessarily an approximation, since knowledge is difficult to quantify.

Tacit knowledge is internalized through experience, and shared with others largely through social processes such as interpersonal interaction and collaboration (e.g. Marling 2004). Tacit

knowledge, and the meaning inherent in it may be generated or constructed via social processes. Such meaning and interpretation are typically situated within particular social contexts (e.g. Berger and Luckmann 1990; Garfinkel 1967). Shared meanings can be created intersubjectively, that is, by a collectively subjective process among several people, rather than just in the mind of an individual (Miranda and Saunders 2003; Schutz 1967).

Particular knowledge is not necessarily either tacit or explicit, but any instance of knowledge may lie somewhere on a spectrum between 'pure' tacit and 'pure' explicit (Koskinen 2003). Davenport and Prusak (2000: 70, 183) refer to the extensive debate about whether tacit knowledge can be effectively captured, codified and transmitted between people. Various strands of this debate have been addressed by different writers (e.g. Augier and Vendelo 1999; Baumgartner and Payr 1995; Dampney et al. 2002; Goh 2002; Haldin-Herrgard 2000; Selamat 2004). In particular, Dampney et al. (2002) note that tacit knowledge may often consist of articulable and inarticulable subsets, that is, often only part of a body of tacit knowledge is able to be articulated in such a way that it can be communicated easily and effectively to another person.

Considerable effort has been devoted to identifying various possible ways of articulating tacit knowledge (Snowden 2002). Davenport and Prusak (2000: 81-82) note that audiovisual and multimedia technologies may have some potential to capture a meaningful fraction of an expert's tacit knowledge, making the tacit explicit. Such knowledge may also be communicated effectively to others using images, narratives, metaphors or analogies, which can in some circumstances impart a rich understanding of a situation in a human context (e.g. Nonaka et al. 2000). However as Polanyi (1957) writes, it is often the case that "we know more than we can express." In other words there is often a key part of any body of knowledge which is resistant to easy capture, codification or transmission. Davenport and Prusak (2000: 70) conclude that there is often tension between the benefit of capturing the rich tacit knowledge that has the greatest potential value to an organization, and the difficulty of representing that knowledge effectively (compare Augier and Vendelo 1999; Haldin-Herrgard 2000). Complex tacit knowledge, developed and internalized by knowers over a long period of time, is often impossible to effectively reproduce in a document or database. Such knowledge may incorporate so much accrued and embedded meaning that its 'rules' can be impossible to separate from how individuals act.

4.2.2 Knowledge and Intuition Gained Through Experience

Knowledge often works through flexible guides to action that develop over long experience (Davenport and Prusak 2000: 10-11). Those with knowledge can see known patterns in new situations and can respond appropriately. They do not have to build an answer from scratch every time. Those with knowledge can size up a situation quickly without going through a definable process, or even necessarily being able to explain their reasoning. So knowledge can offer speed; it can allow its possessors to deal with situations quickly, even very complex ones that could baffle a novice. Knowledge can also deal with complex, real-life issues:

> "..managers recognize the importance of real-life knowledge or ground truth.. the detail and meaning of real experiences because they understand that knowledge of the everyday, complex, often messy reality of work is generally more valuable than theories about it.. knowledge's ability to deal with complexity." (Davenport and Prusak 2000: 10-11)

Leonard (2005) refers to knowledge gained through long experience as 'deep smarts':

> "..people with deep smarts can be indispensable.. their particular brand of expertise is based on long, hard-won experience. They are the go-to people known for their swift, seemingly intuitive judgments. Such experts differ from their less experienced colleagues in having the ability to view a problem at a system level and yet dive into the details when necessary – and identify a familiar pattern.. Deep smarts are, by their nature, contextual: Experts are often unaware of how they solve certain problems and cannot readily bring up a mental list of all possible strategies and outcomes. Their deep smarts are activated by the situation at hand.. Since so much of the expertise is tacit – that is, not articulated or documented – and because it therefore exists mostly in the heads and hands of the experts, it can't be readily shipped from one brain to another.. Deep smarts can't really be transferred. They must be re-created through the process of guided experience.." (Leonard 2005)

In the TPE case study, it was found that high priority problems in mission-critical systems required urgent rectification – there was often insufficient time for comprehensive step-by-step analysis and meticulous formulation of solutions. An expert practitioner often had to make rapid intuitive leaps of reasoning which could bewilder a less experienced person. Such experts were in high demand for the rapid resolution of problems, and to act as consultants and coaches to assist less experienced staff. However the organizational changes which were introduced acted to reduce the ready availability of experts and their knowledge (this is discussed further in Chapters 5 and 6).

Leonard (2005) refers to the "seemingly intuitive judgments" of experts, as noted above. Koskinen (2003) notes that intuition derives from mental models based on long experience, is dependent on context, and is not based on linear cause-consequence thinking. Cooper and Sawaf (1997) suggest that the mental models are often founded on deep understanding based

originally on explicit knowledge. The elements of such models are so internalized and have been thought about so often from so many perspectives that typically an expert cannot easily explain the details in simple cause-effect language, and so the models become largely tacit knowledge. Reber (1989) in fact sees intuition as the end product of tacit knowledge acquisition, and tacit knowledge represents the 'core of intuition'. In the context of this thesis, it is not significant whether intuition is originally based on the acquisition of explicit knowledge, on the development of tacit knowledge, or on some combination of both processes. From the available studies, it is probable that intuition can arise from initial exposure to some explicit knowledge in a given subject area, followed by the subsequent development of further tacit knowledge in the same area. In the case of TPE it was apparent that the intuition of expert practitioners was based on a combination of explicit and tacit knowledge of information systems (discussed further in Chapter 5).

As noted above, Leonard (2005) refers to the re-creation of 'deep smarts' in other people by a process of 'guided experience'. Similarly, Davenport and Prusak (2000: 72, 102) note that providing ready access to people who hold tacit knowledge is more efficient than trying to capture, codify and then transmit that knowledge. Knowledge transferred by means of a long, interpersonal mentoring or coaching relationship is likely to give the receiver a large amount of detailed and subtle knowledge over time (Davenport and Prusak 2000: 102). During the study in TPE, little formal attempt was made to codify the complex tacit knowledge of the system experts, beyond the use of some basic documentation and simple presentations. These did little to effectively transfer much knowledge to others, apart from occasional limited transfer of introductory knowledge to newcomers to a team. There was evidence that the use of other techniques such as the use of different media may not have been very useful anyway, given the complexity of the IS knowledge domain. For example, an attempt to share knowledge of a system by audiovisual means was found to be largely unsuccessful, and the technique was abandoned. In this case much effort was put into producing a video of some aspects of a system, but it was found to represent such a small part of the knowledge needed that it came to be seen as misleading. It also fairly quickly became outdated. Prior to the organizational changes, it had been possible for other staff to gain direct and ready access to system experts and their knowledge. However there was little understanding at executive level of how valuable this was, and the level of access to experts was substantially reduced by the changes (this is discussed further in Chapters 5 and 6).

4.2.3 Knowledge Acquisition, Sharing and Generation

Most knowledge acquisition and transfer in workplaces occurs by informal means, that is, it is undertaken outside any formal classroom environment, or the equivalent. Much knowledge is typically gained by 'on the job' experience, often through constructivist 'learning by doing' (e.g. Hannafin et al. 1997; Honebein et al. 1993). 'Learning by doing' may involve collaborative work among employees, and/or 'on the job' mentoring or coaching. A study undertaken in the USA estimated that around 70 per cent of all occupational learning in workplaces is achieved by such informal means (Caruso and Gentry 2005: 21).

Davenport and Prusak (2000: 41) note that people usually gain much of their knowledge via *face-to-face* meetings with their organizational neighbours in close physical proximity, rather than accessing distant, more uncertain sources. Miranda and Saunders (2003) similarly found that face-to-face communication with its accompanying intersubjective construction of meaning favours greater depth in information sharing, compared to the use of non-interactive media with lower social presence such as e-mail or paper-based documents. Conversely, Koskinen (2003) observes that physical separation creates communication barriers, cooperation becomes difficult, and knowledge sharing is hampered. As Weick (1995) puts it, "If people want to share meaning, then they need to talk about their shared experience in close proximity to its occurrence and hammer out a common way to encode it and talk about it" (Weick 1995: 188).

Goh (2002: 24) suggests that inadequate knowledge transfer is perceived as a problem by many organizations. However Davenport and Prusak (2000: 53) note that 'knowledge' as a concept is as much an act or process, as an artifact or thing that can be transferred. Snowden (2002: 101-102) sees knowledge as both a *thing* and a *flow*. Stacy (2001) in fact argues that knowledge is not a 'thing', or a system, but an ephemeral, active process of relating. Knowledge is contextual and situated, and is best communicated among people within a context of shared experience (Snowden 2002). Cavaleri (2002) sees knowledge as dynamic and emergent, and held within and between people. Substantial amounts of knowledge originate naturally in informal interactions among employees. Due to their origin within the socio-cultural milieu of an organization, knowledge creation and use are only ever partially controllable by management action or decree. It is accepted in this thesis that knowledge may be either, or simultaneously, a 'thing', a 'process', an 'action' and/or a 'flow', and that substantial amounts of knowledge originate naturally in interactive social processes.

McAdam and McCreedy (1999) identify four levels at which organizational knowledge may be located: the individual, the work group, the organization, and knowledge shared or held in common between organizations. The principal focus in the TPE case study is on knowledge held within work groups and individuals. As noted in Chapter 1, Davenport and Prusak (2000: 66) describe 'communities of knowers', brought together by common interests, who usually talk, share expertise and solve problems together. When groups or networks of this kind share enough knowledge in common to be able to communicate and collaborate effectively, their ongoing conversation often generates new knowledge. Such groups are often 'communities of practice', which provide a mechanism for knowledge within a particular context – especially tacit knowledge – to be held, transferred and created (e.g. Brown and Duguid 1991; Lave and Wenger 1991; Wenger 1998; Wenger and Snyder 2000). The concept was originally developed by Lave and Wenger (1991) in a study of situated learning by certain apprentices. In such groups, co-workers share both their work and interpersonal discussion of it, and so acquire, maintain and enhance their informal knowledge about the work, and also identify and discuss potential improvements. The 'communities of practice' approach includes focus on the social interactive dimensions of situated learning, a subject that has also received attention in related organizational research (e.g. Boland and Tenkasi 1995; Gherardi et al. 1998).

Communities of practice can in fact enable organizational processes to be effective, even if the communities and their contributions are not officially acknowledged. As noted in Chapter 2, the informal components of an organization, even if unrecognized, can have a powerful influence on behaviour, decision-making and actions undertaken within the organization (e.g. French and Bell 1999; see Figure 1 in Chapter 2). Such components can include informal communities of practice. Recent discussions suggest that if acknowledged, communities of practice can be cultivated and leveraged by management to create or enhance strategic advantage for an organization (Roberts 2006a; Saint-Onge and Wallace 2003; Wenger et al. 2002). However effective communities of practice cannot simply be established by managerial decree (e.g. Roberts 2006a: 625). What management can do is to facilitate the natural emergence of communities of practice, and actively encourage any communities that do emerge – for example, by providing a climate of support for interactive and collaborative processes.

Communities of practice are seen as tightly-knit groups 'that have been practising together long enough to develop into a cohesive community with relationships of mutuality and shared understandings' (Lindkvist 2005: 1189). Wenger (1998) identifies shared practice as the primary source of coherence of a community. Members of a community interact closely with one another, establishing norms and relationships through mutual engagement. Engagement is

achieved by doing things together, such as talking and producing artefacts. The processes of a community of practice are typically also aligned with other processes beyond its boundaries, so facilitating wider effectiveness (Wenger 1998: 72-84). Interaction among members typically extends beyond the workplace – to shared social activities, for example (e.g. Handley et al. 2006; Wenger 1998). Wenger (1998) further develops a model of the processes of communities of practice. Within a community, meaning is negotiated through processes of participation and 'reification' (Wenger 1998: 55). Reification is the process of giving form to experience by producing objects: 'Any community of practice produces abstractions, tools, symbols, stories, terms, and concepts that reify something of that practice in a congealed form' (Wenger 1998: 58-59).

The existence of a community of practice may not necessarily be obvious to its members, or as Wenger (1998: 125) puts it, 'a community of practice need not be reified as such in the discourse of its participants'. Communities of practice are also not necessarily static. They can evolve over time as new members join and others leave. The boundaries between communities of practice may not be fixed, but flexible, shifting and porous, and so can be difficult to identify (e.g. Roberts 2006a: 625). However some types of communities of practice may be quite stable. For example, Grabher (2004) found that certain software groups studied gave priority to the accumulation and 'sedimentation' of their particular knowledge, and tended to remain stable in their membership over time (Roberts 2006a: 630).

Whether their composition is flexible or stable, communities of practice often have an unmistakeable ongoing reality. Wenger (1998) notes that a community of practice displays key characteristics which typically include:

- Sustained mutual relationships which entail trust;
- Shared ways of engaging in doing things together;
- Rapid setup of a problem to be discussed;
- Knowing what others know, what they can do, and how they can contribute to an enterprise;
- The ability to assess the appropriateness of actions and products;
- Specific tools, representations, and other artefacts;
- Local lore and shared stories; and
- A shared discourse reflecting a certain perspective on the world.

(adapted from Wenger 1998: 125-126)

An important element of an effective community of practice relates to relationships of trust among members. Empirical evidence suggests that trust leads to higher levels of openness between co-operative partnerships, thereby facilitating effective knowledge transfer (Wathne et al. 1996). Without trust, members of a community of practice may be reluctant to share knowledge. Such trust generally requires time to develop, implying a need for relative stability over time (e.g. Roberts 2006a: 633). Relationships of power among members of a community may also shape social interactions, and may influence the degree of trust among those engaged in knowledge transfer (e.g. Roberts 2006a: 627-628).

In Lave and Wenger's (1991) study of situated learning, novice members of a community of practice gradually move from its periphery to a position of full participation as they learn from skilled practitioners and develop their knowledge. Members with full participation have a more significant role in the community, and therefore are likely to have more influence in the negotiation of meaning and the creation of new knowledge (Roberts 2006a: 627). Other writers address the role of power relationships within communities of practice. For example, Contu and Willmott (2003) develop Lave and Wenger's (1991) model by examining an ethnographic study of certain technicians. They reinterpret the technicians' practices largely in terms of relationships of power within a corporate hierarchy (see also Roberts 2006a: 627).

Communities of practice were originally identified as quite small-scale, informal groups of people who work in close proximity in fairly narrow vocations (Lave and Wenger 1991). More recently, this has been extended to communities of practice with large memberships – for example, some with up to 1500 members, and dispersed globally (Wenger et al. 2002: 115). However Roberts (2006a: 630) argues that there is surely a significant difference between these two types of communities of practice, and asks, "Is it really possible to apply exactly the same principles to these two communities?" It is suggested that it is not, and that in some respects large distributed communities should be viewed as a collection of communities, each of which may exhibit the identifying characteristics of a community of practice as discussed above (Roberts 2006a: 630).

The concept of community of practice has also been extended to 'virtual' communities. For instance, in a study of communities of practice in a high-technology firm, groups connected via the internet exhibited many characteristics of communities of practice, but the members had typically never met (Roberts 2006a: 631). However as Wenger (1998: 131) argues, such arrangements typically reduce participation in the complexity of situations and their local meanings. Roberts (2006a: 631) suggests that although close, effective relationships are usually

accomplished through face-to-face interaction, they may also be achieved through means of IT and/or individual mobility. It is argued that for the case study of this thesis, face-to-face interaction of people working in close proximity was the principal mode, and was the primary source of the cohesiveness of a community. In fact, interaction via technical means and/or individual mobility were not capable of achieving significant levels of participation or cohesion (as discussed above and in Chapter 5).

Roberts (2006a) notes that communities of practice are still an evolving approach to knowledge management:

> 'Over the coming years, as communities of practice are applied and studied in an increasing number of organizational contexts, we will gain a deeper understanding of the strengths and weaknesses of the approach. Notwithstanding its current limitations, the communities of practice approach does provide us with a means to explore the transfer of tacit knowledge in a social context. In this sense, it provides a valuable alternative to the knowledge management tools focused on the codification of knowledge.' (Roberts 2006a: 636-637)

Communities of practice are essentially social configurations. One useful general definition is that they are "self-organising, sense-making entities, which adopt common practices, tools, symbols, signs, artifacts, stories and histories as they mature and evolve. Rich conversation, discussions and interactions.. allow knowledge to flow and surface" (Standards Australia 2005b: 45). The concept of communities of practice has much in common with that of knowledge ecosystems. For example, Standards Australia (2005b) proposes that an organization, or a significant organizational component, may be seen as a knowledge ecosystem that consists of a complex set of interactions among people, process, technology and content (see also Davenport and Prusak 1997). The components of a knowledge ecosystem may include its objectives, strategic intent, organizational context, culture, specific enablers (activities, tools, techniques), networks and communities (Standards Australia 2005b: 8-10). Communities of practice may fit within a broader organizational structure which may also be conceptualized as a knowledge ecosystem (discussed further in Chapter 5).

Cecez-Kecmanovic et al. (2003: 99-102) note that when individuals have a history of working together which involves sharing of knowledge and experiences, cooperative interpretation of situations, exploration of problems and development of mutual understandings, then such socially interactive processes can result in the co-creation of new inter-subjective meanings and collective knowledge, which can transcend the knowledge of individuals. The collective knowledge of a group can be valuable to an organization, and may enable achievements not possible at the level of individuals. Davenport and Prusak (2000: 38, 43) note that knowledge

networks tend to update their collective knowledge as conditions change, because they consist of people more or less continually in communication with one another. One necessary condition for the creation of new knowledge is 'redundancy' – shared information that allows individuals to 'invade' one another's boundaries and offer advice and new perspectives (Davenport and Prusak 2000: 43; Nonaka and Takeuchi 1995).

An organization's knowledge is a social construct built out of the collective experiences of its workforce and the talents it rewards (Davenport and Prusak 1997; Davenport and Prusak 2000: 64). Styhre (2003) similarly argues for a social processual perspective on knowledge. Knowledge is manifested and brought into action through social practices and events, and is simultaneously given expression through the concepts being invoked. Knowledge is a fluid construct that captures a multiplicity of practices and undertakings, but is also dependent on a shared language framework to denote such practices. Knowledge is more about what underlies social practices, and is embedded and entangled in social interactions, and therefore distributed and dispersed. Knowledge is fluid and emergent through interactions, continually being updated and refined, and not fixed and stable (Styhre 2003). Similarly, Orlikowski (2002) writes:

> 'Knowledgeability or knowing-in-practice is continually enacted through people's everyday activity; it does not exist "out there" (incorporated in external objects, routines, or systems) or "in here" (inscribed in human brains, bodies, or communities). Rather, knowing is an ongoing social accomplishment, constituted and reconstituted in everyday practice. As such, knowing cannot be understood as stable or enduring.. [Knowing] emerge[s] from the situated and ongoing interrelationships of context (time and place), activity stream, agency (intentions, actions), and structure (normative, authoritative, and interpretive). Because these capabilities are continually generated in recurrent action, continuity is achieved and preserved..' (Orlikowski 2002: 252)

Tsoukas and Vladimirou (2001: 991) therefore advocate, "Managing organizational knowledge does not narrowly imply efficiently managing hard bits of information but, more subtly, sustaining and strengthening social practices." The converse of this may be stated as, 'If social practices related to organizational knowledge are not sustained and reinforced, organizational knowledge processes will be weakened.'

4.2.4 Constructivist Learning and Generation of Knowledge

Constructivism in education and learning is relevant to understanding the situation of the TPE case study. Constructivist principles are based on the concept that learning is an active process through which learners can generate or 'construct' new, context-based understandings based on their existing knowledge plus their individual capacities and experience, acting in conjunction

with social and cultural factors (e.g. Duffy and Jonassen 1991; Jonassen 1991; Kingsford and Dunn 2002; Molenda 1991; Newby et al. 1996). Constructivist insights are often applied to education, but they were developed more generally from studies of how people acquire knowledge in group settings, and so can be applied in contexts other than formal education. In TPE, constructivist principles emerged naturally within the processes of sharing knowledge about information systems, and were not deliberately or consciously applied as a teaching or learning technique.

In the constructivist model, learners construct meaning through experience and social processes such as communication and interaction. Shared meanings are generated through social processes within a particular community, and represent a negotiated consensus of the best knowledge available in a given context (e.g. Duffy and Jonassen 1991; Jonassen 1991; Tam 2000). Constructivist learning typically entails 'learning by doing' (e.g. Hannafin et al. 1997; Honebein et al. 1993). 'Learning by doing' may involve collaborative work among people, and/or active 'on the job' mentoring or coaching. Constructivist principles require active participation by people in the creation of their new understandings. This usually requires that learners be faced with relevant problems which are both complex and real (or at least realistic), and which require solution by undertaking authentic tasks. This is in accord with 'problem-based learning' approaches (e.g. Boud and Feletti 1997). Constructivism sees the role of the 'teacher' as more that of guide or mentor, rather than instructor. Purnell et al. (2004) discuss an example of social construction of knowledge mediated by a certain collaborative technology, which demonstrates that knowledge creation and exchange are situated in shared group activity.

Constructivism contrasts with the approach which sees learners as passive recipients of relatively stable, objective knowledge which is independent of individuals and their interpretations. The latter is sometimes referred to as the 'objectivist' or 'instructivist' model (e.g. Tam 2000; Willis 1995; Winn 1993). In practice, the models of constructivism and objectivism may be seen as the ends of a continuum along which many learning approaches lie (Greening 2000). Typically, objectivist methods may be more appropriate for entry-level learning by people with little pre-existing knowledge, while constructivist approaches can have value for higher-level learning by people with relevant prior experience (Feng 1995). Nevertheless, relying on objectivist methods for entry-level learning has distinct limitations in many situations. These points are discussed further in Chapter 5.

The constructivist approach is in accord with the model which sees much of reality as being socially constructed within particular contexts (Berger and Luckmann 1990). A version of this

model is the theory of the social construction of technology (Bijker et al. 1987; Dunn and Kingsford 2001; Kingsford and Dunn 1999; MacKenzie and Wajcman 1987), which acknowledges that both social and technical factors may influence the design and use of technological systems, albeit that the technical factors are usually also situated within a certain social context. Similarly, the constructivist generation of meaning within a technological context is necessarily a social process.

There are various models of constructivism, although most share similar basic principles. The approach most relevant to the TPE case study acknowledges that both socially-constructed and objective realities can exist in a given context, and that at least some aspects of many situations are likely to be 'factual' in a concrete sense, especially in technical situations (compare Feng 1995). This model is considered apt for higher-level learning. It is also seen as appropriate for vocational and applied professional training, and learning via situated cognitive experiences. It regards people as active participants in their own knowledge creation, through acquiring and placing new information within their existing conceptual schemata, and interpreting and organizing it into meaningful patterns. This implies that effective learning by people may be achieved partly by objective instruction where appropriate, and partly by generation through collaborative processes of new, context-based understandings.

In terms of the TPE case study, both objective and socially constructed realities existed. The archetypical objective reality relating to an information system was its program code. There were also many socially constructed realities relating to a system. These included the various possible ways in which a system could be designed, the benefits and drawbacks of alternatives, the reason why one option was chosen, and how the final decision satisfied business needs. The optimum way of sharing such knowledge among the members of a community of practice (often based on a system team), and their learning of new understandings was through constructivist social processes of interaction, dialogue and collaboration. These aspects are discussed further in Chapter 5.

4.2.5 Knowledge Frameworks and Models

Bines (1992) argues that the dominant approach in professions in the twentieth century was *technical-rational* (or 'technocratic'), covering both the acquisition of knowledge and its application to cases and problems. The technical-rational model sees problems analyzed and solved objectively through the application of logic and expert knowledge (Lester 1995; Selamat 2004). An alternative, often more appropriate model is the *creative-interpretive* model, in

which problems are seen as inter-connected, networked and divergent, and more amenable to constructive resolution through reflection, synthesis, consideration of alternatives and situational interpretation of meaning, in addition to 'rational' analysis and logic where necessary (Lester 1995).

Along similar lines, Styhre (2003: 33-36) notes that much of the knowledge management literature has a *functional* basis, that is, knowledge is often treated as a functional resource or entity which can be managed rationally to the benefit of an organization (compare Alvesson 2001:865; Tsoukas 1996). Within this model a linear spectrum is often seen extending from data, to information, and on to knowledge (e.g. Boisot 1998). For example, Liebeskind (1996: 94) sees knowledge as "information whose validity has been established through test of proof". The tendency to conceive of knowledge as accumulated and reformulated data or information is prevalent because many writers are concerned with the codification of knowledge, to facilitate its transfer. However Styhre (2003: 33-34) notes that there is no simple linear progression from data to information to knowledge, but rather there are "bifurcations, ruptures, crises, digressions" in the spectrum. In any case both data and information are often complex constructions in themselves, and may also be socially shaped, for example, an organization's corporate data model may be influenced by social factors (e.g. Kingsford and Dunn 1999; Munro 2001).

Mathiassen and Pourkomeylian (2003) identify two knowledge management frameworks which may apply in organizations: the 'codification' or 'cognitive' model in which tacit knowledge can be codified, transferred and reused, and the 'personalisation' or 'community' model in which tacit knowledge is socially constructed and shared via dialogue and collaboration. They propose that an organization should decide which KM model better reflects its business situation and strategy, with the possibility that a mix may be appropriate. In a similar fashion, Hansen et al. (1999) suggest that an organization should consider the questions:

a. does it provide standardized services *or* customized services?
b. does it have well-defined services *or* innovative services? and
c. do people rely on codified (explicit) *or* personal (tacit) knowledge to solve problems?

If the answer to each question is the first option, the organization should consider the 'codification' / 'cognitive' model, otherwise the 'personalization' / 'community' model may be more appropriate, again with the possibility of a blend.

Such studies can appeal at a superficial level in that they seem to offer some certainty to managers in deciding how best to implement KM strategies in their organization. However such studies can also tend to overlook the extent to which implicit KM frameworks may operate via knowledge processes which can emerge naturally within a given organizational context and culture, without conscious imposition of any particular framework. In the TPE case study, some aspects of each of the options above were observed, and some elements of each type of KM framework were present. However neither TPE nor the case study focused on any deliberate organizational choice or imposition of a KM model. Rather, the case study examined IS knowledge processes as they had actually evolved within TPE, how they operated effectively prior to the organizational changes, and how they were disrupted by the changes (this is discussed further in Chapters 5 and 6).

As seen implicit KM frameworks may operate via knowledge processes which emerge naturally, without conscious imposition. It is possible for effective implicit KM to operate in an organization, without any formal management program (compare McElroy 2002). Christensen and Bang (2003) report on such a case, and analyze it through various epistemological perspectives, that is, theories of the method or grounds of knowledge (Von Krogh and Roos 1995). These include an 'artifact-oriented' epistemology focused on explicit knowledge (in documents, reports and the like), and a 'process-oriented' epistemology focused on both explicit and tacit knowledge and their interactions (e.g. Earl 1997; Nonaka et al. 2000). It was found that the 'artifact-oriented' epistemology (explicit knowledge) had only limited explanatory potential:

> "Within artifact-oriented epistemology, knowledge management is focused on the type of knowledge which may be explicated, formalized and ultimately codified. Knowledge management activities within this epistemology involve a kind of codification strategy meaning that knowledge is treated in data processing systems using as much information as possible to present the most precise equivalent to reality as possible. At this point, the critical reader would question how other employees might make use of the codified knowledge as they might have a hard time figuring out the meaningful relations in the information because they do not know the context in which it was created." (Christensen and Bang 2003: 122-123)

The process-oriented epistemology (focused on both explicit and tacit knowledge and their interactions) generally had greater potential for interpreting and understanding the organizational situation (Christensen and Bang 2003). This approach was also generally applicable to the TPE case study, as discussed further in Chapter 5.

4.2.6 Fragility of Knowledge Frameworks

Davenport and Prusak (2000: 55-56) note that knowledge, or its effective sharing and use may not survive an organizational upheaval because of the organic connection of knowledge to particular people, processes and contexts. A disruption of work processes or networks may disrupt a knowledge culture. Davenport and Prusak (2000) observe that:

> "..no less real losses may result from changes in the work environment. Organizational size, focus, management, and intangibles like trust and atmosphere may change in ways that disrupt the knowledge culture.. The tendency of knowledge to thrive only in the environment where it develops is one of its advantages." (Davenport and Prusak 2000: 56)

Knowledge networks can be fragile. In the case of TPE, the networks of shared knowledge about information systems, and the related knowledge processes were disrupted by injudicious executive action (this is discussed further in Chapter 5).

This chapter considered the knowledge principles, processes and theoretical approaches which are relevant to the thesis. The following chapter applies these principles and concepts in greater detail, in the context of detailed discussion of the case study.

Chapter 5 CASE STUDY – PART 1

Taken together, Chapters 5 and 6 describe and analyze in detail the extended case study around which the thesis is centred. Chapters 5 and 6 respectively address mainly the situations 'before' and 'after' the organizational changes to IS structures and processes that were initiated during the case study. Chapter 5 draws extensively for analytical purposes on the relevant principles, processes and theoretical concepts which were introduced in Chapter 3 (IS governance) and Chapter 4 (knowledge principles and processes). Chapter 6 focuses more on the organizational changes and their outcomes. A brief overall summary of the case study is provided at the end of Chapter 6, focusing on significant points and findings.

5.1 Introduction

Detailed case study research was undertaken in a large emergent organization which from the point of view of its information systems was primarily a transaction processing enterprise: 'TPE'. The organization performed many other operations besides transaction processing, but at the time of study these operations had relatively little IS support. The case study applied qualitative research techniques including interpretive methods drawn from social-cultural anthropology, primarily ethnography and participant observation. The initial aims of the research were to understand the structures, processes and IS governance which can result in optimum system development and support in emergent organizations. Both the case study and the research drew attention to the role of system maintenance within the IS support function, which can represent a large investment of skilled resources. It was found that knowledge of complex information systems, especially tacit knowledge, also played a key role in effective development and support processes. The research aimed to understand the relationships within TPE among information systems, associated structures and processes, IS governance, knowledge of information systems, and organizational culture.

During the extended case study, the IT executives introduced substantial changes to the structures and processes of the IS organization, which were intended to improve the efficiency of IS services to business customers, and to align IS more fully with business. These initiatives included the introduction of rigorous standards and processes for project management; a goal of having an adaptable and portable IS workforce; and the structural separation of system development from system maintenance. The changes initially appeared to be soundly based and

yet were largely unsuccessful. The research also aimed to explain this outcome. It is shown that the changes unintentionally fragmented systems knowledge, undermined its effective use, and so reduced the efficiency of systems support. Some inferences are drawn relating to issues in organizational structure, processes, IS governance and knowledge processes in emergent organizations which rely on complex information systems to support their business. One inference is that it may be misguided, and result in inefficiency and diminished quality of IS services, to segregate the development and maintenance of complex systems into disparate functional areas. Some subsidiary inferences are drawn relating to change management and human resource management in organizations with complex information systems.

5.2 The Organization and its Information Systems

TPE had been in existence for many decades. The organization had a diverse range of business functions and operations, with many of them managed by one or more of about 15 largely discrete lines of business (the number varied over the period of study). The overall organizational structure could be described as function-based (e.g. Marchewka 2003: 77-79). TPE was also a 'traditional' organization in the sense that many of its business functions had not materially changed, at least in broad outline, for much of its history. The associated business processes and operations had evolved in their details over the years, largely as a result of continual, mostly small changes in both the internal and external environments of TPE. This had fairly often resulted in emergent changes to the structure of the lines of business. This usually involved the creation of a 'new' line of business by merging or splitting existing lines. Typically such changes occurred about once annually. Very occasionally a completely new business function was added, and sometimes this entailed an entirely new line of business being created. One such event occurred prior to the case study. Also, very occasionally a business function was completely dropped. But the basic underlying business aims and purpose of TPE – its raison d'etre – had remained largely unchanged over much of its existence. TPE as an organization was conscious of its history, and several times during the study the staff newsletter ran stories of the earlier years and reminiscences of past executives and other employees.

In common with many organizations, TPE had started using computers in the early 1960s, and since the 1970s had relied heavily on IT to provide support for many of its business functions. TPE had around 400 significant computer-based information systems, at least 50 of which were mission-critical systems which supported key business functions. Transaction processing systems predominated, including both on-line (including web-based) and batch systems. Generally the critical information systems processed high volumes of transactions in short

periods of time, typically days or weeks. Many of the critical systems were large and complex, and collectively they occupied many millions of lines of code. One estimate put the total at around 40 million lines of code covering only about 25 of the larger systems. The systems supported a high level of complex transaction processing for both internal and external customers, covering a wide range of transaction types. Many transactions were subject to a variety of exceptions to 'standard' processing, which all had to be dealt with. In many cases such exceptions were coded into and handled by the relevant system, which resulted in even greater complexity. The strong transaction-processing emphasis stemmed from the history of TPE. It still applied at the time of study, although several other types of systems had been adopted or were emerging, including decision support, executive support and expert systems.

Most of the critical systems were at least several years on from their initial development, and many were 5 to 15 years old. Some systems were older, with several being over 20 years. The average age was around 12 years. The older systems were often described as legacy or heritage systems, or even 'dinosaurs' by some IT executives, in recognition of the fact that they were based on technologies and methods generally regarded as outdated in the IT industry. However the staff who used and maintained the critical systems rarely employed such pejorative terms, and in fact usually objected to them. Rather they understood that most of the systems were used on a daily basis, and that the organization depended almost totally on its systems to function effectively and achieve its business objectives. As such the systems were seen as being still highly relevant to current operations and hence very much 'alive', despite their age.

The value which TPE placed on its information systems is indicated by the fact that up until the end of the study, neither systems development nor maintenance was ever outsourced, in the sense of assigning substantial responsibility to an external supplier (e.g. Lacity and Hirschheim 1993). Individual contractors were increasingly employed from about 1990 onwards, to assist with system development and support. In such cases a contractor typically worked in a team alongside ongoing staff. (The term 'ongoing staff' refers to staff employed in an ongoing capacity, and not subject to termination at the end of a period. The term 'internal staff' includes ongoing staff and contractors.) At the time of study, contractors comprised about 24 per cent of the IS workforce. In all such cases it was a mandatory requirement that opportunities to give the work to ongoing staff were to be considered first, before employing a contractor. Each contractor was engaged to perform tasks at the direction of a TPE manager. Contractors were employed for specific periods, typically twelve months. However many contractors had been re-engaged repeatedly for long periods, many for five years or more. Often in this time a contractor would work on the same system, or on related systems. Some contractors had

worked in TPE for ten years or more. Moreover, in many cases a contractor had in earlier years been an ongoing TPE employee. In some cases a TPE contractor became an ongoing employee. Such cases further highlighted the typical longevity of many TPE employees. The salary of a contractor was typically around 1.5 to two times that of an ongoing employee, but contractors had no paid leave and few work-based benefits. Apart from pay and conditions of employment, there was essentially little difference between ongoing staff and contractors in the work they performed or their role in the IS organization.

In a few cases, a commercial software company had been employed to assist in a more substantial way in developing a system. In most such cases the company's personnel worked in a team with TPE staff. However overall, it was clear that TPE valued the role of internal staff in the development and support of its information systems. This was in contrast to its policy for support of technical infrastructure such as hardware, networks and desktop computers. TPE had substantially outsourced this support to an external service provider prior to the case study, and it remained so during the study. However the outsourced functions were still directed by TPE managers, and also many technical infrastructure support staff remained internal to TPE. The infrastructure outsourcing policy was clearly not an abdication of control to an external party.

Most of TPE's critical systems had survived largely intact for years, albeit subject to frequent, often relatively small changes. A pertinent general comment relating to the IT industry is:

> "There's a myth in our industry that we change software every five or seven years. But the real systems, the ones that really drive our business, do not get changed every year. They don't get changed every ten years. [For example,] the air traffic control system [in the USA] is more than 20 years old." (P. de Jager in Radio National 1997)

Worldwide, some accounting systems have lasted 30 to 40 years, and 10 to 20 years is common in manufacturing (McKenney et al. 1995; see also Kingsford and Dunn 1999). Sometimes the survival of an older system was necessitated by the failure of a project intended to redevelop it, but often there has also been a seeming reluctance to replace old systems which meet their core business needs. When business users know that a system still meets operational requirements, they often resist proposals to replace it. Users often have no particular interest in whether or not a system is based on the latest technology, as long as it meets their needs. This general situation applied to the history of systems in TPE.

Most of TPE's IT hardware items and support technologies (such as operating systems, programming languages and system development tools) had been regularly updated or replaced over the years. However many of TPE's information systems were long-lived. As Glass (2003:

116) puts it, "Old hardware becomes obsolete; old software goes into production every night." This refers to the fact that many older systems are batch processing systems, or have major batch components, which are run mainly outside business hours. All TPE's systems were subject to ongoing processes of error correction, minor and major changes and enhancements, and rarely, complete redevelopment. There were frequent administrative changes needed, shifts in the environment of TPE, and also legislative or policy changes which were less common but usually more substantial. In some cases successive changes to various parts of a system had been made using different support technologies (such as programming languages), which complicated the process of maintaining the system.

Typically a system was most subject to errors in its operation in the early months or years after its development or major enhancement. A genuine 'error' is a mismatch between the operation of a system and its current specifications, often due to coding faults introduced in the development process. After this time, typically the rate of genuine errors tended to decline, and a system became relatively more subject to ongoing requests for minor changes. Good practice requires that a 'change' to a system entails updating the system specifications to keep them current (this was not always done in TPE, as discussed further below). However many minor changes could be seen as 'potential errors spotted early', that is, errors identified before they caused the system to produce incorrect results. Typically, business staff became aware of an impending discrepancy between the system and its business environment, caused by shifts in the environment. As such there was often little difference in practice between errors and minor changes. Changes generally allowed longer time for response. However both errors and minor changes were part of maintenance, and required similar work by the IS organization. Attempts in TPE to quantify the rates of errors and minor changes usually foundered on the lack of clear distinction in practice between them. In general, the outcome of work on both errors and changes was to keep a system well-adapted to ongoing shifts in TPE's business environment. Business requirements, business processes and their system counterpart typically co-evolved as an integrated unit. In some cases a system was driven by changing business needs, and in others a system itself helped to shape evolving business needs and processes. Occasionally, technical limitations to modifying a system constrained the ability to adjust it to desired business changes – sometimes in such cases, business requirements had to be adapted to technical necessities. In general a state of mutual influence or symbiosis existed between a set of business requirements and its corresponding information system.

Truex et al. (1999) suggest that many contemporary organizations can be said to be in a state of constantly seeking stability, while never achieving it. Such organizations can be seen as

'emergent', implying that features of their organization – social structures, relationships, policies, rules, decision processes and so on – are continually emergent (compare Mintzberg 1979; Mintzberg and Waters 1985). Truex et al. (1999) comment that:

> "The important idea here is that the organization is in a continuous state of adjustment. While these are often very subtle adjustments, the process is one that is very hard to stop. And, like the tectonic plates beneath the earth's surface, the motion is continuous no matter what the surface appearance may be" (Truex et al. 1999: 119).

This is a reasonably good description of the organizational context of TPE, which continually adjusted and adapted to changes in the internal and external environments, although these changes were more often small than large. It was widely accepted that TPE's information systems also needed to be continually adjusted to match the organizational corrections. For many systems such corrections were needed frequently, in some cases almost daily. There was evidence that this situation had prevailed for much of the previous 20 years.

In terms of information systems, TPE was a 'brown field' site, as opposed to a 'green field' site, drawing on an analogy with the property industry. In a 'green field' organizational situation, systems are implemented to support business processes which previously had no computer support. In a 'brown field' site, typically the terrain has long been 'built on' with computer-based systems, and any new systems or enhancements must work within the constraints of existing 'legacy' or 'heritage' systems, and also conform with accrued production data. Academic IS research focusing on 'brown field' organizational situations is still relatively new (e.g. Clear 2005; Truex et al. 1999), and this thesis makes a significant contribution to this area. Most of TPE's key business functions had been in a 'brown field' state since the 1980s, with some dating from the 1990s, and a few from the 1970s. As regards the comparison with a 'brown field' site in the property industry, a closer analogy would be to a century-old heritage hotel which must be continually renovated to meet the ever-changing requirements of modern customers and evolving regulations, while retaining all of the heritage features seen as desirable, which are themselves subject to changing preferences. As an even more realistic analogy, the heritage hotel is set within a precinct of historic buildings, all of which are continually updated to meet customers' needs, while maintaining the overall coherence of the precinct.

Larsen (1998) proposes that some time after a system is developed, a gap between business needs and their technical implementation will tend to appear and increase over time, with associated greater need for maintenance, until pressures mount for the termination and replacement of the system. Similarly, Marchewka (2003) suggests:

> "Eventually, the system becomes part of the organizational infrastructure and becomes known as a legacy system. At this point, the system becomes very similar to a car. Let's

> say you buy a brand new car. Over time, the car becomes less and less new, and parts have to be replaced as they wear out. Although, a system does not wear out like a car, changes to the system are required as the organization changes.. As the owner of an older or classic car, you may find yourself replacing part after part until you make the decision to trade in the old junker for something newer and more reliable. Similarly, an organization may find itself spending more and more on maintaining a legacy system. Eventually, the organization will decide that it is time to replace this older system with a newer one that will be more reliable, require less maintenance and better meets its needs. Subsequently, a new life cycle begins." (Marchewka 2003: 15-16)

However such analogies can seriously underestimate the extent to which business requirements and their system counterpart can co-evolve, as seen. In fact Swanson and Dans (2000) found that older systems in general were not necessarily associated with greater maintenance effort. In TPE, no widening gap between business needs and their technical counterpart was evident for many older systems. In fact the oldest system (over 25 years old, with around 3.5 million lines of code) was widely regarded as one of the most stable large systems, with a relatively low error rate and associated low need for maintenance, although like most of TPE's systems, it required ongoing minor changes to keep it well-adapted to its environment. Swanson and Dans (2000) also found that larger systems tend to be longer-lived. This may perhaps be due to the substantial investment they represent, and consequently a possible reluctance of management to discard them given their potentially high cost of replacement. It may also be due to the fact that large systems typically incorporate many complex business requirements, and so the organization may depend on them more (Swanson and Dans 2000). They might therefore have greater visibility and enjoy greater organizational and management support than smaller systems. Kling and Iacono (1984: 1225) observe, "systems live and develop through the energies of their promoters.." If there are many 'promoters' of a system in both business and IS areas, in particular powerful promoters, then there can be strong pressures for retention of the system.

This situation applied to many of the older and larger key systems in TPE. In contrast some relatively new systems did not enjoy widespread support, and in some cases earned a reputation for poor reliability early in their lives. In one particular case, a large system implemented just before the study had a long series of problems in production. Whenever a serious problem was encountered, a bulletin was issued to all affected users and IS staff, often to advise of an alternative business procedure to avoid the problem (termed a 'work around'). There were hundreds of such bulletins issued for this system over several years. Often when yet another bulletin was received, employees would make ironic or disparaging remarks.

5.3 Knowledge Domain – Information Systems in TPE

The knowledge domain which is the subject of the case study included the situated IS knowledge acquired and used by many staff who worked on mission-critical key systems which supported TPE's business functions. These areas included customer records, accounts, ordering, payments, refunds, debt collection, prosecutions, loans, risk management, other financial functions, workflow, correspondence, personnel, payroll, work recording and many other more specialized functions.

Most of TPE's systems had been developed in-house over the years by processes of collaboration among IS and business staff. There were around 700 IS staff, not including associated business staff who often also had substantial experience in their respective information systems. The IS organization itself was situated within a larger IT organization of around 1600 employees. The IS organization focused on the support of information systems, and in particular their software aspects. The remainder of the IT organization focused more on the support of hardware, technical infrastructure, communications networks, configuration management, training, IT security, IT architecture and other technical services, as well as overall strategy, planning, governance, human resources and management of IT.

TPE was dispersed across about 20 cities and towns across the country, and it also had a presence in other minor locations. TPE was largely directed and controlled from its head office, however many management functions were delegated to the regional offices. The lines of business did not correlate with geographical location. The IT organization was regarded as one line of business. Of all locations, the head office city had the largest number of employees (several thousand), however two other major cities had similar numbers. The employees in the head office city were located in 10 office buildings, some of which were up to 20 km apart. The office buildings in some regional cities were similarly separated. The purpose of the wide dispersal of offices was to locate business staff as close as possible to the external customers of TPE, who were distributed across the country.

The term 'IS staff' is used in this thesis to refer mainly to employees who performed technical work on information systems involving their development or support, including maintenance. These people were mainly either analysts, designers, programmers or staff who combined these roles in various ways. There was often little precise distinction among roles. The analysts were often specialists in the business aspects of a particular system, or a small number of related systems which served a functional area. In many cases such people had long prior experience in

the relevant business area, working with the business requirements and business processes of the system. Team managers and administrative support staff comprised other subsets of IS staff. Some of the more experienced IS staff were referred to as 'system specialists'. Typically these people had many years of experience, sometimes decades, in developing and supporting key system(s) in a particular business functional area. Often the expertise of such people lay primarily in just one large and complex system, or a small set of related systems. TPE relied heavily, but not exclusively, on such people to collectively provide effective support for systems.

Many organizations depend to a large extent on experts for the successful performance of much of their most complex work. For example, Harris (2006b) makes the general comment:

> "The most-complex processes and requests are relegated to experts – knowledgeable people who are skilled in analyzing a problem or opportunity, gathering relevant data, making decisions and taking appropriate actions. Thus, organizations are increasingly dependent on knowledge work and workers. People involved in knowledge work understand the domain of their responsibility; shape their domain; understand the people and information that are potential resources in that domain; and have the education, experiences, intuition, knowledge, intelligence, skills and authority to act within the domain." (Harris 2006b)

There were around 700 IS staff. This included 9 IS executives and about 60 mid-level team managers. About 460 ongoing staff at lower levels made up the remainder, plus about 170 contractors. There were around 500 technical staff and about 115 analysts (including designers). All numbers varied somewhat over the course of the study, reflecting in part the organizational changes. In general there was a high retention rate of staff in TPE, and this included a fairly high rate for IS staff. Around 60 per cent of TPE employees were aged over 40 years, and the proportion of IS staff was similar. The turnover rate in TPE was fairly low – around five per cent per annum overall – and this was similar for IS staff. There was evidence from staffing reports that this general situation had prevailed for many years. Around 60 per cent of IS staff had at least ten years service in TPE, while about 30 per cent had 20 years or more. Some had 30 years service or more. Around 70 per cent of IS staff worked in the head office city, while the rest worked in regional cities or towns. About 60 per cent of IS staff were male, while about 48 per cent of staff in TPE overall were male. As an example of the longevity of some IS staff, the TPE staff newsletter carried the story of a person who left TPE after 30 years, whose 'expertise in [system x] was legendary.'

From the earliest years of IT in TPE most of its information systems had been developed, maintained and supported largely in-house, by internal staff. In some cases external software companies had been engaged to assist in development, and in a few cases a commercial 'off the

shelf' (COTS) product had been purchased and customized with the aim of satisfying a business need. However TPE's experience with COTS products was mixed – there had been a few successes and some failures. The principal model had been in-house system development, followed by ongoing maintenance and support, also performed in-house. TPE clearly gained greater benefit from in-house development. Systems had generally followed a 'life cycle' process including sequential stages of development (including analysis, design, build, testing and implementation), operation (including maintenance and other support), and in rare cases, retirement.

To undertake in-house development, maintenance and support, *system teams* had often been set up in TPE from the early years, each one typically focusing on a business functional area and the small set of related system(s) which supported it (see Figure 3 below). In rare cases a system team would support more than one functional area, but in such cases the functions were closely related. A system team was typically known as the '[system x] application team', '[system x] development team' or just '[system x] team'. Such a system team would generally undertake both initial development of the first release of a system (typically taking a year or two), and then usually progress to do ongoing maintenance and minor changes, and also substantial enhancements requiring subsequent major system releases. A system team would often also provide technical operational support as necessary, for example, managing the batch processing for a system. To many people this seemed to be the natural evolutionary path for a system team.

There were around 45 key system teams observed at the outset of the case study. This number equated approximately to the number of critical systems. Most of these system teams were located in the head office city (about 35), while the others were in regional cities (about 10). There were in fact more system teams in TPE, and these teams supported a good number of the remaining systems (some 300 more). These other teams were more widely dispersed within TPE, and were not observed closely as part of the case study. Some did not belong to the formal IS organization, but did perform IS functions. The key system teams which were observed ranged in size from about 40 team members (the largest) down to 4 (the smallest). The average size was around 9 members.

Prior to the early 1980s, TPE had provided preliminary professional training for technical IS staff on an 'in-house' basis. After this time, new starters were required to have either tertiary qualifications or 'equivalent technical experience'. As the years passed, new starters with only 'equivalent experience' became fewer. At the time of study, most technical IS staff had tertiary

qualifications in IT, generally including undergraduate degrees or graduate diplomas. A small number had masters degrees in IT.

Overall, the majority of IS staff were from English-speaking backgrounds (ESB). Around 40 per cent of the technical IS staff were from a non-English-speaking background (NESB), with English as their second language. The majority of such staff were from, or had parents originally from eastern and southern Asian countries, including China, India, Pakistan, Sri Lanka, Vietnam, Cambodia and other south-east Asian countries. In some system teams the proportion of staff of NESB was around 50 per cent or more. In many cases the staff of NESB were technically competent, but a reasonable number had some degree of difficulty with spoken and/or written English, as compared with people having English as their first language. This had implications for communication. Face-to-face interaction was often more effective than alternatives in imparting and receiving information accurately, and in developing shared knowledge and understandings among people (this is discussed further below).

Each system team generally undertook regular rituals, that is, meaningful patterned behaviour. These included team meetings, usually held weekly, in which work-related matters were discussed. Typically the rituals also included regular social and team-building gatherings such as morning teas, often held fortnightly; team lunches, generally held every one to three months; and more substantial events such as Christmas parties. In recognition of the number of employees of NESB, many teams also shared regular meals with various national dishes. Some teams added other regular social events such as barbecues, table tennis, bowling or theatre evenings. The common themes of these regular ritualized events were to foster communication and interaction among team members in a convivial environment, and so to bolster the cohesiveness and morale of the team. Such rituals acted to reinforce the precepts of the IS organizational culture, in particular as regards effective collaboration among IS staff, and regarding the significant role which the system teams played in the delivery of services by the IS organization. The social rituals also provided opportunities to further share, sustain and augment knowledge about the system(s) supported by a team.

The system teams had been in existence for at least 20 years. For most of this time the IT organization of TPE (which included the IS organization) had been led by a highly respected executive (‘James’, a pseudonym) who had worked in TPE for 35 years, and had ‘come up through the ranks’ of IT. James had worked in IT at its outset in TPE, and could clearly recall the installation of the first mainframe, and the systems which had been developed to run on it. He was appointed as CIO in this early period of computing. Subsequently James presided over

many substantial achievements and milestones in TPE's IT and IS. James was held in high regard by most IT employees, and this was understood to be backed up by solid experience and expertise.

When James retired, a major social function was held in his honour, which a large number of past and present employees and their partners attended, as well as many people from other organizations. The associated staff newsletter story referred to him as 'a man of the people.' It included, 'Literally hundreds of colleagues, family and friends turned out to give retiring [James] a memorable farewell.. the event was both moving and entertaining. [James] was regaled, as was the audience, with anecdotes of his life including work, family and even school days.. It was clear from the speeches and a video especially compiled and shown on the evening that [James] is a gentleman who will be missed by many from the corridors of [TPE].' James's career and achievements were summarized at the time in the newsletter, and were also displayed on panels for employees to read and reflect on. These included the comment, 'The life and times of [James] are shown through his own words and tributes from people across the country.' For his part, James's remarks included, 'Throughout my career I've had the privilege of journeying through the history of technology in [TPE] – it's been a fascinating window, when we see where we are today.. The work might be hard but the behaviour and ethics of the people are very strong.. I will always remember the sheer hard work.. and the hours of meetings and debate.. My fondest memories will always be around team situations – discussing problems, working out solutions, sharing frustrations and finally making the required breakthrough.. Who knows where the future might lead [TPE] but it has made a great start.'

As noted, highly respected figures such as 'founding fathers', and stories about them, can become an integral part of a culture, and can be a focal point around which various aspects of the culture may coalesce or crystallize. In this sense, James could justifiably be regarded as a 'founding father' of IT and IS in TPE. He had contributed materially to the shaping of TPE's IS organization and its culture. He had also become identified in the minds of many IS staff with the organizational structures and processes which had prevailed for over 20 years – later referred to by some staff as 'the old way'. Of particular significance were James's references to the strong IS ethic of 'sheer hard work', and the frequent collaborative team process of exhaustive discussion and resolution of problems (these are discussed further below).

The timing of James's departure at the outset of the organizational changes was seen by many IS staff as significant. Some staff believed that James had opposed the changes, but that his views had not prevailed with other IT executives. For example, one said:

> 'I reckon that if [James] was still around, we'd still be doing things the old way, it made a lot more sense. I think he tried to stop them making the changes, but they wouldn't listen. He probably thought he might just as well retire. But he didn't really have to retire, he probably just decided it wasn't worth staying on, with them not taking much notice of him.'

Although developed separately for the most part, TPE's systems were not independent 'islands of automation', and the interconnections among them were extensive and complicated, and subject to complex and subtle problems. When such problems occurred, communication across teams was necessary. However it still made sense right up until the time of the study to retain for the most part largely separate system teams, each focused on just one or a few related systems. This structure allowed deep understanding of a system and its interfaces and a high level of responsiveness to business needs. The advantages of such a structure are discussed further below. Other processes and structures had been developed to control changes made to a system which could also impact on other systems. IS practitioners from one system team sometimes had to interact with another team to understand the nature of a complex error, and to agree on the best way to resolve it. Such changes were often coordinated by processes operating at a level higher than the system teams. (Change control processes were not addressed in detail in the case study.) The reality in TPE was predominantly a structure of system teams each focused primarily on their 'own' system(s).

To effectively fulfill its required role, each system team established a close relationship with a *business support team* in the corresponding business area of the organization, and typically a strong partnership developed over time (see Figure 3 below). The business support team was usually a fairly small group which represented the needs of a larger set of users of the relevant system(s), often up to thousands of users. The business support team would set up processes to elicit requirements from their user constituency, and would assess and filter them, often in collaboration with their IS counterparts until the requirements were realistic and achievable by IS. This would include both initial development of a system, and its subsequent maintenance and enhancement as business needs evolved and errors surfaced. In the case of major errors in a system discovered by users, urgent correction was usually essential. If not promptly rectified, a serious system error could result in an operational crisis for business, sometimes almost immediately, or within a day or so. The financial impacts on TPE could be severe.

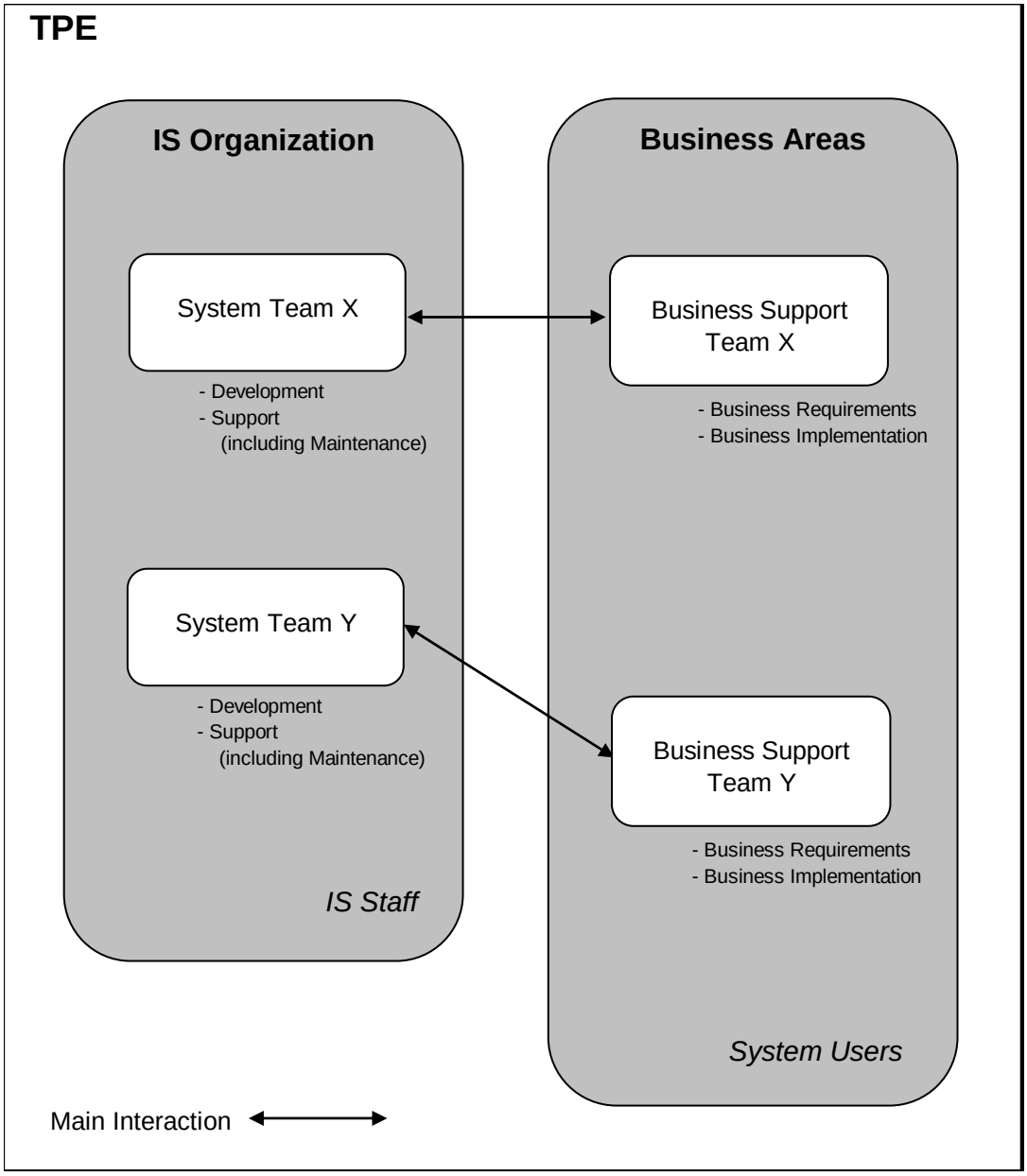

Figure 3. System Organization before Restructure (Simplified)

Figure 3 shows a simplified version of the structure of the IS organization, as it applied before the restructure. In practice the structure was more complicated, and there were more interconnections and contacts among teams, set up for a variety of purposes, and often transient. For example, sometimes a complex error would involve several systems, and interaction was necessary among several teams which did not normally communicate (as discussed above). However Figure 3 shows the most significant, ongoing types of linkages that prevailed on a day-to-day basis.

As noted, most system teams (about 80 per cent) were located in the head office city. However most business support teams were located in regional cities and towns, which were up to thousands of kilometres from head office. There they were physically closer to the majority of their respective system users, who were in turn close to their external customers. This meant that although members of a system team had to interact with the corresponding business support team, this interaction was often not as close and direct as within the system team itself. Each system team was usually co-located in open-plan office accommodation. Team members typically worked at modular desks placed in parallel rows, which thereby facilitated face-to-face communication and interaction within the team.

Throughout this era, which typically had lasted for many years (sometimes decades) for any one system, both the system teams and the business support teams had remained fairly stable. Team composition would inevitably change gradually over time, often through movement of less experienced or junior staff. However often a nucleus of more experienced staff typically remained in a system team over the years, and provided a solid core of knowledge which enabled the provision of good support for business. Quality customer service and hard work had become entrenched as fundamental aims and values within the IS culture. In most cases a system team worked closely with its corresponding business support team, and they shared a common focus on a business function and the system(s) that supported it. When necessary, a system team would work for extended hours on nights and weekends and put in much extra effort to deliver a product on time, or to resolve a problem as quickly as possible.

Over time, each system team and business support team had typically developed its own processes to facilitate communication and collaboration between the teams. Such processes had often evolved unique aspects for any given pair of teams, largely because there was little need for consistency with the processes of other teams. For example, some business support teams had their own way of requesting and recording work requests, and of tracking progress on them. The method of submitting work requests could vary from a simple verbal approach to a formal documented request in a workflow system. Tracking progress on work requests could vary from ad hoc contacts, to regular formal meetings, to formal reports in a spreadsheet or database system. The wide variation in processes of managing work had little effect under the system team structure, but it had adverse impacts after the organizational changes (this is discussed further below).

The close relationship between a system team and the business support team meant that generally everyone cooperated to deliver quality products and services in a timely manner, to best support the business operations of TPE. In this respect long-term relationships counted for much, including both the prolonged stability of a system team and its extended association with a business support team which was generally also quite stable. In some observed cases, an analyst moved from a business support team to a system team, and this tended to reinforce the relationship between teams. In the ways described above the structure of the system teams had created good alignment between IS and business. The overall 'system team' structure is taken here to include the corresponding business support teams. Essentially it comprised part of a primarily functional, or function-based organizational structure (e.g Marchewka 2003: 77-79). That is, a structure in which responsibility for delivery of the IS outcomes for a given business function, including development, maintenance and support, was shared between a business functional area and the corresponding system team, and these areas worked closely together.

As noted, many of TPE's critical information systems were large and complex. To a considerable extent their complexity stemmed from the complexity of the corresponding business functions. Many business support staff had spent years developing their knowledge of a particular business function and its business processes, and understanding how they were supported by information system(s). The knowledge of a system held by business staff was typically focused mainly on detailed knowledge of inputs and outputs, with only broad knowledge of the system's internal processes. This underlined the fact that the business functions and business processes were themselves complex. The business complexity was also illustrated by comments from staff in call centres which provided information and assistance to external customers of TPE. For example, a business executive had written in a staff newsletter:

> '..[business] staff in [offices A, B and C] are assisting [call centres] and arrangements are under way to train [office D and office E] staff in [business function x].'

In reply to this statement, a call centre employee wrote:

> 'I would presume that [the business executive] has never answered a call in a [call centre] environment such as ours in his entire career. I would presume he has never had to strive to master a particular topic, for example [business function y] which can take years, and beg for quality training, only to be denied.' [TPE staff newsletter]

The emphasis of the case study was on the IS organization, and it did not have a major focus on business support areas. However there was indicative evidence that knowledge of business functions was generally acquired by business staff through means other than formal training or documentation. The reference above to a lack of 'quality training' in a business function reflected the fact that knowledge of complex business functions – and how they were supported

by systems – was more often acquired over long periods of time through constructivist methods such as 'learning by doing' and 'on the job' mentoring. This was a parallel to the way in which detailed knowledge of information systems was acquired by IS staff largely through constructivist methods (this is discussed further below).

The IS literature has historically focused more on system development, often seemingly reluctantly conceding maintenance a place as the last phase in the system life cycle (Boehm 1981; Larsen 1998; Swanson and Dans 2000). Academic teaching practice has shown a similar tendency (e.g. Truex et al. 1999). But maintenance coincides with the phase of active use of a system, which is often the longest and the most important phase to an organization. Many systems have long active lives. In some organizations, systems outlive the tenures of the people who use and maintain them by a wide margin (Swanson and Dans 2000). Over the entire duration of the case study in TPE, only two key systems were observed to be retired, and these were regarded as fairly minor ones. Even when a system was 'retired', in fact in most cases its business functionality was transferred to another system. This was done either by developing a new system, or incorporating the functionality into an existing system via major changes or enhancements.

The process of retirement observed for one system was prolonged. From the time when it was first proposed within IS until its final retirement, the process took over four years. The first, failed attempt to retire the system occurred shortly after the organizational restructure. A newer system with almost the same functionality was by then available. Extracts from relevant e-mail messages sent by various staff are given below. These illustrate some of the issues surrounding the first attempted retirement:

> Project manager A [system p team]: 'Thought it's time to issue an official statement to ensure we are all on the same wavelength about the status of [system p]. A special [system p] steering committee has met and made the following decisions:
> - [system p] will be retired..
>
> Although currently some lines of business are considering delaying the retirement, it does not alter the decision..'
>
> Contractor B (release management): '..whilst this has not been through the [joint business-IS planning group], and I am not clear on why the retirement of [system p] is so urgent, there is an air of finality in the message..'
>
> Project manager C: '..I'm not sure that it is corporately responsible to make these types of decisions unilaterally, without at least understanding the impacts on stakeholders..'

> Contractor B: '..I have not received any official notice of change.. it will need to go through the [business-IS planning group]. I completely agree with [manager C] and I unofficially raised concerns with [the business-IS planning group] when I first heard of this.. a great deal more stakeholder involvement is required..'
>
> Executive D: 'Given that all this is happening outside of any other agreed process, I'm not sure how to progress. Can we have the [system p] decision (and steering committee – as they are acting way out of corporate expectations) reversed?'
>
> Executive E: 'I am aware that there have been some "gaps" in understanding who the users of [system p] are.. Could we work with [manager A's] team from both a business and application perspective to ensure we fully understand the implications of retirement..'
>
> Executive D: '..the process has a few issues within it. There are [system p] users in [line of business F] who rely on the system, and at this stage are unaware of the transition to another system for their use.. The process issue is that we have a committee making decisions on a corporate basis at a business and IT level which cut across the role and scope of the [business-IS planning group].. I suspect that decisions of this nature need some other representation beyond those already on the [system p] committee..'

These exchanges illustrate the difficulty of first gaining a complete understanding of who the actual users of a system were, and then gaining their informed support to retire the system. They also illustrate some of the confusion which prevailed regarding the proper role of a project team and its steering committee, shortly after the organizational changes. The actions of the project team and its steering committee came into conflict with the IT executives, and with corporate processes for approving major IT work. This included new project work, and also – as the example illustrates – system retirement. However it had not been made clear to the project or its steering committee that the executives wished to exercise control over retirements, and that this also needed approval by the joint business-IS planning group.

Despite the fact that it was emphasized to users that there was an equivalent newer system available, at least two surveys of users of the older 'system p' (there were several thousand users in all) showed that there was still widespread support for 'system p'. It was clear that familiarity and proficiency with the older system were key factors in its retention. Eventually the IS organization withdrew it from use for most employees, on the grounds that its underlying platform had to be upgraded. It was added that this time there was no funding for a corresponding upgrade to the application software, and so the system had to be retired. It was likely that if the IS organization had not taken this stance, the system would have survived for even longer. Despite the explanation, the process of finally retiring the system was still difficult and protracted.

The average IS organization spends more time and resources maintaining existing systems than developing new ones (Nosek and Palvia 1990). Maintenance including enhancements typically consumes 40 to 80 per cent (average 60 per cent) of the software life cycle and software costs, and as such, is often the most important life cycle phase of software (Glass 2003: 115). In TPE, few exact records had been kept but the proportion of maintenance was generally high. Many systems had spent more than 70 to 80 per cent of their lives in maintenance, and in some cases more than 90 per cent. Overall, maintenance costs were estimated at around 75 per cent of total software costs. After initial development, the work on a system was largely maintenance. Glass (2003: 117) notes that enhancements are responsible for roughly 60 per cent of maintenance costs. Although again accurate records had not been kept, this was approximately true for TPE. Maintenance is taken here to include minor and major changes and enhancements to a system, as well as error correction. In rare cases a system was fully redeveloped, but often the corresponding business functions and broad business needs remained much the same, and it was mainly technological aspects which were updated. Such actions essentially constituted a major enhancement to a system.

Clearly maintenance was very important to TPE, and the resources needed for it demanded management attention. Equally, maintenance is an important subject of general enquiry, and warrants attention. More than half of an organization's 'new development' effort may actually be allocated to develop systems to replace existing systems and largely replicate their functionality, rather than to build completely new ones (Swanson and Dans 2000). In the terms of this study, such work is tantamount to major enhancement, which is a form of maintenance. Over the duration of the case study in TPE, only three or four systems which might be seen as 'new' were developed. However most of these 'new' systems were based largely on existing business functionality and partly on existing systems. Only two systems could be classed as mainly, but not completely, new.

In the two years prior to the case study, about five genuinely new systems had been developed in response to new business needs. Around ten years prior to the study, there had been a surge of system building which saw about 14 new critical systems developed over about five years (from about 8 to 13 years prior to the study). Only about three key systems were retired between this period and the case study. Two key systems were retired during the study. Five new key systems were developed just prior to the study, and two during the study. This suggests that over a period of about 18 years, around 21 new critical systems were developed, and five were retired. This implies a net gain of about 16 key systems in 18 years, or an annual growth rate of around 0.9 systems. This suggests a long-term growth of around one critical

system per year. This is in general agreement with the fact that there were around 50 critical systems in TPE after around four decades' use of IT.

Truex et al. (1999) suggest that in the past, IT designers in general strove to create stable information systems with primary goals that included low maintenance and long life spans. They also propose that:

> "there is a need to radically rethink the way in which IS are developed. Rather than viewing information systems development (ISD) as a series of projects each having a clear beginning and end, [organizational] emergence calls for a continuous redevelopment perspective.. [this] implies the creation of an ISD environment that is optimized for high maintenance rather than low maintenance" (Truex et al. 1999: 118).

In the case of TPE, up until the time of the IS organizational restructure, low maintenance systems were not necessarily a primary goal of system designers. On the contrary, it was intended that maintenance and enhancement of systems would be ongoing, and would be provided at the level – often substantial – which was necessary to support emergent business needs. In fact there was a 'continuous redevelopment perspective' optimized for the actual level of maintenance needed for each system. This was based on the system team structure, which as seen included system teams which were well matched to the integrated development and maintenance needs of systems.

Truex et al. (1999) also comment that:

> "Under emergent assumptions, the analysis of IS applications must be continuous. Since the organization is emerging, the fundamental IS must continuously change and adapt.. Analysis activities.. are an ongoing service of the organizational ISD [IS development] group.. The results of this ongoing analysis are continuously fed into the maintenance activities.. Under this goal, analysis is not a component of an ISD project, but an ongoing ISD organizational maintenance activity" (Truex et al. 1999: 120-121).

Essentially this situation applied in TPE. The analysis work which was done within system teams served the purposes of both development and maintenance, and in fact it was often difficult to distinguish these as separate components. In the context of TPE, the 'emergent systems model' of Truex et al. (1999) was confirmed by the case study.

Khan et al. (2001) note that software development and maintenance may be seen as logically separate processes, but are often interrelated and interdependent. The processes often intersect to a considerable degree. This was the case in TPE, at least prior to the major changes made during the study. The knowledge that was needed for development and maintenance respectively also had significant overlaps (this is discussed further below). A number of writers have discussed the role of various forms of knowledge in software development and

maintenance. For example, Guindon (1990) and Robillard (1999) discuss specific processes entailed in capturing the knowledge of business requirements which has to be embodied in software during its development. This is one aspect of the knowledge of systems addressed in this thesis. Another aspect is the role of knowledge in software maintenance. For example, von Mayrhauser and Vans (1995) discuss various tasks associated with maintenance, and the nature of the knowledge required for them. They note that to enable effective maintenance, programmers require good knowledge of existing programs. Clear (2005) and Solway et al. (1988) make similar points.

Within a system team, some staff developed high levels of knowledge and expertise in the system supported, mainly through long exposure to development and maintenance tasks. This knowledge was situated, that is it applied to one system, or a few related systems, together with their associated concepts, structures and processes. Much (but not all) of this knowledge was tacit, and typically gained through direct experience working on the job, through constructivist learning (e.g. Honebein et al. 1993). Much knowledge was gained via collaborative work and 'on the job' mentoring. For most such staff, only a minor part of the knowledge could be gained through formal training or audiovisual presentations, or by studying a system's documentation. Formal training in a system was relatively rare, usually fairly superficial and useful mainly for beginners. As noted earlier, 'objectivist' or 'instructivist' learning methods entail individuals being provided with relatively stable, objective knowledge. However this is generally suitable only for some limited entry-level learning. In TPE the documentation of systems was often incomplete or out of date, and so misleading. Some audiovisual documents and records of 'lessons learned' existed, but were mostly either introductory or incomplete.

In general as regards 'lessons learned' from disasters or other problems, Disterer (2002) notes that there may be considerable social barriers to articulating and documenting failures, often through fear of adverse consequences for employees. This was generally the case in TPE, although outright system development failures had been quite rare. However there was a reluctance to document problems experienced in systems development or maintenance. After the organizational restructure, development projects were required to produce progress reports, but few were frank in regard to problems encountered. TPE occasionally purchased a commercial 'off the shelf' product with the aim of meeting a business need. On one such occasion observed, the project was considerably less successful than anticipated. An usually comprehensive set of project reports provided a record of progress and problems with this project. Initially the reports were available to staff on the intranet. However even before the

project ended, all reports were removed, ensuring that there was no further material available from which to draw lessons from the difficulties encountered by the project.

For many older TPE systems little current documentation existed. IS staff seemed reluctant to prepare good system documentation or keep it updated, often due to pressures of time (compare Glass 2003: 123). In TPE, even if good documentation for a system had once existed – as in some cases – it often seemed to become too difficult to keep it fully maintained over the years: many IS staff commented that it was simply 'too hard' to catch up. In sum, the organizational reality for many systems was that accurate, complete and current documentation was unavailable. In any case the complexities and subtleties of a large system often could not be captured in documents alone, and could only rarely be fully imparted via documentation.

A possible contributing factor to the generally poor state of at least some system documentation observed was related to urgent major work undertaken by the IS organization over several years just prior to the case study, resulting from legislative imperatives. This entailed the development of new key systems and substantial changes to existing systems. In this context, adherence to good standards and full systems documentation for some systems may have slipped significantly for the sake of expediency, in the face of imposed tight deadlines and limited IS resources. A few samples were observed of system documentation produced before the legislative work, however it was not possible to confirm that the documentation of any such system had matched the state of the system's code at that time. Regarding the legislative changes, an IS staff member said:

> 'When those changes were done, the [system y] team was caught up in the frenzy to meet the deadlines. This put great pressure on the [system y] team as well as other teams to simply get the deliverables produced and out the door, regardless of quality, and regardless of keeping the documentation up to date.'

Numerous examples were observed of the inability to capture and codify complex aspects of systems work. For example, in one instance a programmer was asked to document the process for handling a certain complicated type of urgent maintenance. Several attempts were made, but only a general outline was produced, which was not very useful. In defence it was said that every case was different and had to be assessed on its own terms, and acted on in different ways. The only way to fully understand the process was to actually do it. The knowledge of the process was largely tacit, and it could not be successfully codified in a form that a newcomer to that process could pick up and use to learn and perform the role. For example, the programmer said:

> 'I tried to write it all up as a general procedure, but I kept on coming up with more and more exceptions and detours, and different conditions that you just have to be able to deal with when you're doing this job. It was going on and on for ever, and it would've finished up filling volumes. That is, if anyone could write it. Let alone if anyone would ever read it. I had to call a halt. There wouldn't be time for anyone to read it anyway. You just have to be able to do it quickly when it's needed, not read about it.'

As noted, the most difficult and time-consuming task of software maintenance is gaining a thorough understanding of the existing product. In many cases this has to be done in part by studying the source code, since the documentation is usually outdated. Bennett and Rajlich (2000: 82) suggest that program comprehension consumes more than 50 per cent of maintenance resources, and is therefore a valuable commodity. Moreover, "Pragmatically, if several representations of software exist (e.g. documentation, design, source code), it is only the source code that is maintained, and the other representations become inconsistent and are no longer trusted" (Bennett and Rajlich 2000: 83). These situations generally applied in TPE, where the large systems tended to be structurally complex, which complicated the maintenance task and entailed greater effort (compare Kemerer 1995; Swanson and Dans 2000). This also underlined the need for discussion and sharing of information among the members of a system team, and collaboration in understanding a system and resolving problems. Effective collaboration on a complex system problem or other issue typically entailed a small number of people assembling to discuss it, usually around a computer screen where all could simultaneously view the code or other relevant material.

Randall et al. (1999) in a study of legacy information systems refer to the typical difficulty of implementing even apparently small or simple changes to critical production systems:

> "'..the complexity of any change or where a change, though relatively straightforward, would have to be made in many areas of the system to be effective. As one member put it: '..It's not just sophistication but also implications. Apparently small changes may have major implications'. This statement is not necessarily an indication of the unwillingness of those responsible for the development of the system to make appropriate changes. It is equally likely to be an indication of just how difficult it is to modify systems which are already in use and upon which the work depends, not to mention the problems of technical complexity. In significant respects, problems such as these are as much organisational as technological.." (Randall et al. 1999: 15)

In TPE, successive problems in a system were rarely of the same type, and usually required very good knowledge of the system to interpret and resolve quickly. Some problems were extremely complex, and some resisted correction for a long time. In such cases it was generally up to business as to whether they could live with a problem, or whether it had to be rectified promptly. Sometimes a difficult problem was deemed not critical, and was left with inexperienced programmers to work on. It could languish there for months, until investigated

by a system specialist, who would often solve it in a few days. Typically a system specialist was unable to explain how they identified the root cause of the problem, or how they knew where it lay. Problems did not often recur in the same part of a system, and a specialist would sometimes comment that they had not needed to look at a certain part of a system's code for several years. The systems collectively had many millions of lines of code, and so this made long experience in particular systems, and the resulting extensive knowledge of them valuable. This type of tacit knowledge was rarely able to be codified, and could be difficult to communicate to others, except via long mentoring processes involving constructive 'learning by doing'. A system expert's mental models were typically so internalized that they could not readily explain them. For example, one said of a complex problem:

> 'I can't really explain how I knew what caused this error. I somehow just knew what it was all about, it was sort of intuitive. I think I probably put two and two together from some other problems a bit like it that I'd seen before. I worked on one of them a few years ago. That time it took me longer to work it out. It was a bit easier this time around. After all, I've been looking after [system z] for over 10 years now. I should know a fair bit about it by now. But if had to do a proper write-up of this problem, I think I'd be in trouble. I can probably tell you about it, but even then it's not likely to be the full story.'

For similar reasons, Glass (2003) asserts that software maintenance is a more difficult task than development. Engel (2002) also refers to:

> "..the 'heroes' of maintenance.. the smartest, most talented and best educated programmers. They take on the hardest jobs, and often the most necessary ones.. Maintenance programmers don't have the luxury of failure; they have to support users who need the work done, and they usually need it done right now.. Maintaining a program is like trying to spot all the typos in the entire Lord of the Rings series.. the difference between the Right Thing and the Wrong Thing is usually a matter of intuition, developed over years of practice. The maintenance programmer can often tell with his or her aesthetic sense where a problem is likely to be.. You have to know or be able to quickly learn everything that every programmer who ever worked on the [system] knew." (Engel 2002: 1-2)

Intuition derives from mental models based on long experience, is dependent on context, and is not based on linear cause-effect thinking (Koskinen 2003). Reber (1989) sees intuition as the end product of tacit knowledge acquisition. Cooper and Sawaf (1997) however suggest that the mental models which are the basis of intuition are often founded on deep understanding based on *explicit* knowledge. This is not necessarily contradictory, since full knowledge of a given subject may have both explicit and tacit components. In TPE the intuitive problem-solving of IS specialists was based on a combination of explicit and tacit knowledge. The elements of their mental models were so internalized and thought about so often from so many perspectives that typically the specialist could not explain the details in simple terms.

In TPE, part of the knowledge domain relating to a complex system included understanding the relevant *business* objectives and business requirements which were supported by the system. This included knowing exactly how the logic of a system interacted with the business area's manual processes and operations, and how this supported TPE's business objectives. Again these complex and interlocking areas were usually undocumented, and knowledge of them was mostly tacit. In many cases a system specialist would know more about these aspects than the staff in the corresponding business area. This often resulted in a system specialist having to assist the business area to accurately describe a problem or define a change. For example, one IS analyst said:

> 'Sometimes the business people don't really know how [system w] works, at least internally. They know what they put in and what should come out, but quite often they don't know exactly what goes on inside. There's a lot of testing for different things, and a lot of different processing for different conditions. But they often don't see that. Generally our better [IS] people know a lot more of the full picture about the system.'

Some staff with little practical experience of IS, including some IT executives considered the computer-based part of a system as 'standing alone', that is, distinct from how and why it was used in business. However they often failed to appreciate the significant level of integration of the two parts, and the holistic nature of an IS. This was usually much better understood by the IS practitioners, in particular the system specialists. The specialists were valuable knowledge brokers, or 'crossover' people who could effectively bridge the gap between IT and business, even though their expertise was slanted more towards IT.

A further part of the knowledge domain relating to a system included the undocumented, tacit knowledge of the relevant social networks associated with that system, and who, where and how to access information and facilitate any action needed – 'how to get things done'. This included knowledge of the structure, personnel and procedures of the business support team related to a system, and also of the various other IT areas which provided services related to a system (such as database services, change control, testing, implementation, infrastructure, and so on). The wider set of knowledge about a system included knowledge generated mainly through interactions with many other people and areas, built up over an extended period. This knowledge also was generally not codified, or codified in a rudimentary way. Most of it was constructed and updated via social processes and experience over time.

Some writers see the main goal of software development as the capture of the (often tacit) knowledge of system requirements, through collaborative processes, and its codification in explicit form as programs. For example: "The very idea in software engineering is to explicate knowledge in the form of programs to be executed on computers and software engineers spend

great efforts specifying programs and models..” (Mathiassen and Pourkomeylian 2003). However such an interpretation represents only a limited and partial view of how information systems are generally developed and maintained. In fact programs are typically only one part of an information system which embodies a much wider range of knowledge, as discussed above. In TPE the full set of knowledge about a particular system was partly explicit and partly tacit. There were some, largely explicit standards and procedures which applied to both development and maintenance, such as standards for quality assurance reviews. The key explicit knowledge about a system remained centred on its program source code, which in many cases was the only completely current aspect of the system at any time, although it was also subject to frequent change. The code was supplemented by explicit documentation which was of variable quality, and usually incomplete and out of date. The code was in fact embedded within a dynamic, multi-dimensional matrix of knowledge about the system, both explicit and tacit. This is discussed further in the next section.

5.3.1 Types of Tacit Knowledge of Information Systems

Dampney et al. (2002) notes that tacit knowledge often consists of both articulable and inarticulable subsets. In TPE, the full set of knowledge about a system was partly explicit, but its most significant part was usually tacit. The tacit knowledge comprised two types: *tacit*$_1$ and *tacit*$_2$. The *tacit*$_1$ type consisted of knowledge which conceivably could have been fully codified and made explicit, but generally was not. The *tacit*$_2$ aspects were rarely able to be fully codified, for all practical purposes. Just as tacit knowledge and explicit knowledge lie on a spectrum of knowledge types, tacit$_1$ and tacit$_2$ knowledge also were not sharply distinct types, but overlapped to some extent.

Tacit$_1$ knowledge included understanding of system and user documentation, definitions of interfaces and business requirements (where not fully documented), how the system logic interacted with business processes and supported business objectives, and other potentially codifiable information. That is, tacit$_1$ knowledge was potentially explicit knowledge. The tacit$_1$ knowledge was usually not fully documented, often due to resource constraints, but significantly also related to the fact that the existing social, interactive processes of using and sharing such knowledge worked quite well without the need for full, explicit documentation.

Often a considerable amount of tacit knowledge about a system was generated via social processes. For example, typically there were many possible ways in which a system, or a significant enhancement to it, could potentially be designed, built or implemented. These were

usually worked out collaboratively through interactive workshops, often with both technical and business participation. Although the outcome of a workshop was usually documented and therefore explicit (such as a design), the same often could not be said for the process of considering the benefits and drawbacks of various alternatives, the reasons why certain options were settled on, the compromises made, and how the final decision was expected to satisfy business requirements and support business objectives. Many participants in these processes held such understandings as $tacit_2$ knowledge. That is, for all practical purposes it was not possible to fully codify. The complete shared knowledge of what was agreed as the optimum approach for developing or enhancing a system was often constructed and updated through lengthy intersubjective processes. Much of this knowledge remained tacit, including both $tacit_1$ and $tacit_2$.

As another example, knowledge about changes to a system, and resolution of errors in the system was often tacit. The cause and location of a complex error were sometimes the subject of $tacit_1$ knowledge generated via interactive processes. That is, it could potentially be documented, but often was not. However knowledge of the nature and resolution of a complex error or a change was often $tacit_2$ knowledge constructed inter-subjectively. This included knowledge of how to go about resolving complex errors and making changes, including where to look given a wide range of possibilities, what signs to look for, how to understand the interfaces and interconnections, how to make corrections and changes, and what the potential impacts were on other areas. Much of this remained $tacit_2$ knowledge.

In some cases, there may be a dispute over the nature of an error and its impact on business, whether it was able to be bypassed by an alternative business procedure (or 'work around'), or even whether it was a genuine error at all. Sometimes reported errors were later deemed to have stemmed from misunderstandings by users about a system's intent. Such errors were often genuine 'usability' errors – although not logic errors, they often required attention by IS. In some cases users failed to follow operational procedures, resulting in apparent errors. In such cases there may have been an error in the overall information system, but it lay more in the business process part rather than the system logic. The history of such discussions about a system often constituted an important part of the overall understanding of the system, but it was largely $tacit_2$ knowledge. For example, a system specialist said:

> 'A lot of argy-bargy often goes on about supposed errors in [system z]. The business people sometimes try to make out that there's a system error that's got to be fixed urgently. When we look into it properly we find out that the error's more on their side. In other words it's in their hands as to whether their results come out right or wrong. It's not always an error in the code. Sometimes they don't quite remember what they originally asked for in the system. Or what official changes have since been put in. Or

> sometimes the original business people have moved on, and the new ones have different ideas. But we have to go by what was intended in the design. Unless they can make it an official change request, and that gets approved. In any case, they can often get around an error, or what they see as an error. It's not always the end of the world. Though sometimes you wouldn't know it. We've seen a lot of this over the years. Sometimes the same old thing keeps coming around, year after year. You need to have a good memory to keep on top of it all, or you might get snowed under.'

Moreover, the resolution of an error could take various forms. In the case of a complex logic error, it was quite common for a system team to implement a temporary solution entailing emergency changes to production ('live') data, rather than corrections to the underlying logic. Sometimes such changes had to be regularly repeated for months, before the logic error was fully understood and could be corrected, or there was time to do so. In such cases the nature of the 'resolution' of an error was more a mutual understanding reached among a select few IS and business staff, and not necessarily widely shared. In TPE, knowledge about the resolution of a particular problem was typically socially constructed via intersubjective processes, not amenable to full documentation – often related to the quite widespread reluctance to document – and thus $tacit_2$ knowledge.

In both the development and maintenance of a system, the deliverables which were progressively produced (such as designs, programs, test plans and so on) were subject to review in accordance with TPE's standard quality assurance procedures. This 'peer review' of a deliverable was performed by colleagues who had not been directly involved in its production (e.g. as advocated by Wiegers 2002). Reviewers were typically from both the same system team and from other, often related teams. Most participants had some degree of knowledge about the deliverable under review. The review meetings served the purpose of both constructively criticizing and so leading to improvement of the deliverable, and also sharing further knowledge about it among the participants. The peer reviews thereby facilitated for participants the social construction and updating of tacit knowledge about the system through interactive processes. As noted, groups which share enough knowledge in common to be able to communicate effectively can generate further knowledge. A necessary condition for this is 'redundancy' – shared information that allows individuals to 'invade' one another's boundaries and offer new perspectives (Nonaka and Takeuchi 1995). These conditions applied to TPE's quality review process, and this was one mechanism of sharing tacit knowledge about a system more widely.

In all, the tacit knowledge about a system was usually distributed across a number of people within social networks. It was usually both generated and transferred in the context of

interaction and dialogue about a system. As such it was largely socially constructed knowledge (e.g. Berger and Luckmann 1990; Bijker et al. 1987; MacKenzie and Wajcman 1987; Miranda and Saunders 2003). It was often also usually manifest at any given time mainly in the context of interaction about a particular issue relating to part of a system, such as a design issue or an urgent error or change. Moreover the full set of knowledge about a system was subject to continual change in response to business needs, correction of errors and administrative changes.

As noted earlier, constructivism in learning is relevant to better understanding the TPE situation. People are active participants in their own knowledge creation, through acquiring and placing new information within their existing conceptual schemata, and interpreting and organizing it into meaningful patterns. Constructivist approaches often acknowledge that both socially-constructed and objective realities can exist within a given context, and that some aspects of many situations are likely to be 'factual' in a concrete sense (e.g. Feng 1995). In TPE as seen, both objective and socially constructed realities existed in regard to an information system. The archetypical objective reality was the program code, but there were also many socially constructed realities relating to a system. These included the various possible ways in which a system could be designed or enhanced, the benefits and drawbacks of alternatives, the reason why one option was chosen, and how the final decision was expected to satisfy business needs. Effective learning and generation of knowledge within a system team was achieved partly by objective instruction – especially relating to explicit knowledge – and partly by the creation of new understandings through social processes – especially relating to tacit knowledge.

5.3.2 Models of Knowledge of Information Systems

As noted, in the technical-rational model, problems are seen as being analyzed and solved objectively through the application of expert knowledge and logic (Lester 1995). The dominant approach to date in many professions has been technical-rational, especially in scientific and technical professions including IT (e.g. Bines 1992). When the general topic was raised with some IT staff in TPE, including some executives, the approach they said they preferred amounted to analytical and logical, or technical-rational. However what people say overtly may differ somewhat from their actual behaviour. As discussed above, IS staff frequently exhibited behaviour which involved creative and interpretive aspects such as discussion, information sharing and collaborative problem-solving. A more appropriate model for such a situation is often the creative-interpretive model, in which problems are seen as inter-connected, and amenable to resolution through interaction, discussion, consideration of alternatives, situational interpretation and synthesis, as well as via logical analysis when necessary (Lester 1995). The

creative-interpretive model often applied more in practice in TPE, and was often more relevant, despite the seeming dominance of the technical-rational approach. For example, an IS mid-level manager said:

> 'We've always been taught that IT needs a logical and analytical approach. This goes back to the education of most of our techos. Most of them were recruited on the basis of being able to demonstrate analytical skills in some way. So we've got this situation where analytical skills are quite heavily stressed. They were taught to think that way. But I've noticed for a long time now that a purely analytical approach doesn't always work that well. In fact I'd say that the "soft" methods are often more important.'

The creative-interpretive model is in harmony with the processual perspective on knowledge (e.g. Styhre 2003). In this perspective, knowledge is manifested and brought into action through social interactive processes. Knowledge underlies social practices, is embedded and entangled in social interactions, and is therefore distributed and dispersed. Knowledge is fluid and emergent through interactions, is continually updated and refined, and is not fixed and stable. In sum, Orlikowski (2002: 252) sees knowledge and knowing as "not a static embedded capability or stable disposition of actors, but rather an ongoing social accomplishment, constituted and reconstituted as actors engage the world in practice."

5.3.3 Value of Knowledge of Information Systems

All of the above aspects of knowledge about a system meant that it was common for a newcomer to a team to spend many months, and often years in developing sufficient expertise in a system to be able to deal proficiently with all demands received from business. For example, an IS practitioner said in regard to newcomers to a system team:

> 'They've usually got their qualifications, and their basic technical ability is mostly alright, but they *don't know the history* of [system y]. It often takes them a long time to get up to speed about what's been happening with [system y]. A lot goes on that you have to know about, but no-one writes it all down. They just have to pick it up by working on [system y] and listening to what people around you can tell you about it, and try to get them to work with you and talk to you whenever they can. They're always busy of course, so the best thing to do is to tackle some jobs yourself, and keep on asking other people for help whenever you get stuck or you don't know what's going on. That way you gradually start to pick up what you need to know. And if you're lucky you'll eventually become an asset to the team. Instead of the opposite.'

This referred in part to the novice's lack of knowledge of the (usually) undocumented history of many and varied discussions about the system, held over many years. Few people could simultaneously hold good knowledge of more than just one or two related complex systems, especially since most were subject to ongoing changes. Moreover if a person was moved to support a different system, their effective knowledge of the earlier system would inevitably fade

over time until it became marginal. For all of these reasons the most competent and valuable IS staff had often spent many years, and sometimes decades working on one business functional area. In many cases they had seen different underlying technologies and technical platforms come and go, while the broad business needs of their area remained largely unchanged. It was clear to many people that there was benefit for TPE in maintaining continuity in the knowledge and expertise of IS staff within a business functional area, across technological changes. Knowledge of technologies was seen as important, but not as important as information system knowledge. Purely technical knowledge was also seen as being more readily able to be acquired and updated through formal training, combined with relevant work experience. Laudon and Laudon (1994: 419) refer to a similar situation: experts in commercial software products of the multinational company SAP can take years to properly understand all the complexities of a single product. (SAP was founded in 1972 as Systems Applications and Products in Data Processing.) For example, an expert in one SAP module such as financial accounting is not necessarily expert in any other modules. Koskinen (2003) also notes that empirical studies have similarly revealed the importance of experience in particular areas of engineering as a source of valuable tacit knowledge.

From its earliest years of IT, TPE had generally recognized and valued the experience gained and the knowledge held by its IS staff, and movement between system teams and so across business functions was fairly infrequent (although it did occur). For many of the systems it took years to gain the level of understanding needed to deal promptly and efficiently with all urgent problems that arose, and to respond effectively to priority requests from business for changes. Within any one system team, there was typically someone available with long experience and expertise in any aspect of the system. The knowledge held by these staff could be applied as required in any part of the team, to guide, mentor or collaborate on either new development, problem resolution, changes or enhancements. In some cases there was a section of a team dedicated to ‘maintenance’, but even then its staff had easy and direct access to the collective experience and knowledge of the full team, when needed. Also, the ‘maintenance’ staff typically were able to move between maintenance and development tasks. If a maintenance programmer needed career diversification, system development opportunities were generally available. The structure of each system team took full advantage of the creative synergy made possible by having all types of expertise about a system ‘under the one roof’.

Koskinen (2003) notes that knowledge creation through long experience, and its ongoing sharing require the sustained commitment of those involved. Good remuneration and conditions encourage commitment, but genuine dedication derives more from work which is seen as

interesting, challenging and fulfilling, and is also seen and acknowledged by others as worthwhile and valuable (e.g. Nonaka and Takeuchi 1995; Senge 1990). In TPE, the work of IS practitioners was highly valued by business, who quite frequently sent messages of thanks for the successful resolution of problems and other achievements. For example, one message received from a business manager read in part:

> 'Could you please pass on our sincere thanks to all of your team members who contributed to the resolution of the problem we experienced last weekend. We are aware that many of you had to work on the weekend, including some for most of Saturday night. In particular we want to thank [A] and [B], who we know put in an effort well above and beyond the call of duty.'

Koskinen (2003) also notes that trust facilitates the efficient sharing of tacit knowledge. Trust builds up over time (Lindskold 1978), and long shared experience involving face-to-face dialogue enhances both trust and knowledge transfer (compare Nonaka and Takeuchi 1995). In TPE the often long-term commitments of IS staff had built up effective relationships of trust and knowledge sharing. Similarly the long-term relationships between a system team and its corresponding business support team had built trust and effectiveness. However these relationships were not quite as close as those within a system team, largely because business support teams were often located in regional centres, while most system teams were in the head office city.

5.3.4 Communities of Practice in TPE

In TPE, typically the most effective IS work unit was an informal, somewhat fluid team – a community of practice – within a formal system team (as introduced in Chapter 4). The term 'community of practice' (e.g. Lave and Wenger 1991; Wenger 1998) is used specifically in this thesis to refer to a co-located group or network of people which focused on one system, or a few related systems, interacted intensively on a regular basis, and thereby enabled organizational processes to be effective. The implicit understanding of how best to manage the development and maintenance of complex information systems had evolved naturally in TPE over a period of more than 20 years. This understanding had been associated with the natural evolution of organizational IS structures, processes and ways of thinking which optimized the ability to effectively manage complex systems, and to provide good support for the related business operations. The structures and processes were centred on the effective informal management of tacit knowledge of the complex systems, gained through experience. This entailed tightly-knit communities of practice, each one usually located in a system team and focused on the knowledge needed to support the system, or set of related systems. A community of practice refers to a group of co-workers who shared and discussed their work; resolved problems via

interactive processes; created, maintained and enhanced knowledge of a system; and also identified and discussed potential improvements. The primary source of the coherence of a community lay in its shared practices, as noted by Wenger (1998). Relationships of trust and openness among members were also an important element, thereby facilitating effective knowledge sharing, as observed by Wathne et al. (1996). Collaboration typically entailed face-to-face meetings at short notice, usually involving system specialists.

The IS communities of practice in TPE tended to be informal groups generally not recognized or acknowledged by executives. As noted in Chapter 2, the informal components of an organization can have a powerful impact on action and behaviour in the organization (e.g. French and Bell 1999; see Figure 1 in Chapter 2). In TPE, such components included the informal communities of practice. These communities of practice had not been set up artificially, or by any deliberate management action such as a knowledge management (KM) initiative, but had evolved naturally over many years within TPE's 'system team' environment. The communities of practice ranged in size from up to about 25 within a large system team, down to two or three. Some communities of practice crossed system teams, although generally remaining within one business functional area (such as accounting).

In TPE, the interlocking set of concepts that constituted the information systems culture implied that members of that culture saw the way in which their systems were developed and maintained as constituting part of widely accepted structures and processes which had evolved naturally over the years within the organization. These structures and processes incorporated the implicit IS governance arrangements, which included the system team structure and the communities of practice. This IS framework had evolved naturally over many years, and it reflected the values of the IS organizational culture. The IS framework was in fact an emergent strategy (e.g. Mintzberg and Waters 1985). It did not stem from any deliberate strategy promulgated by management, but was shaped by the culture, values and norms of the organization. Emergent structures and processes can evolve gradually over a long period of time. Patel (2002) observes that this understanding is based on the literature on emergence in organizations, and its implications for IS development and IS governance (e.g. Mintzberg 1979; Mintzberg and Waters 1985; Patel 1999).

The process by which the IS framework came to be widely adopted within TPE (in the absence of any formal strategy) was related to the informal learning of values and assumptions within the IS culture, among its members. The implicit ground rules of the IS framework were deep-seated and long-established, as cultural values often are. The last point is attested by numerous

anthropological studies. For example, Geertz (1973) observed, "Believing, with Max Weber, that man is an animal suspended in webs of significance he himself has spun, I take culture to be those webs" (Geertz 1973: 6-10). Cultural values and beliefs are deep-seated and fundamental, and are typically seen by members of the culture as being part of the natural order of things, and are rarely questioned.

In TPE's IS organization, a community of practice typically included a small number of specialists in the relevant system, plus others who were actively involved in current issues related to the system. A novice to the system may be a member of a community of practice, and in fact this was an effective way for such people to learn more about the system. Novices gradually moved from the periphery to greater participation as they learned from more experienced practitioners and developed their knowledge, as observed by Lave and Wenger (1991). If the current issues were mainly technical, the community would include technical staff, and possibly exclude analysts. However if the current issue was analysis or design of a new system component, the community would typically include analysts. But a community of practice was not necessarily constituted by occupational type. For example, a community which focused on particular design issues for a system may include some technical staff but exclude other designers working on different aspects of the same system. For a large system, in some cases there was a distinct, ongoing community of practice for one part of the system, and another community for another part. Such communities often overlapped to some extent, typically by having one or more system specialists in common.

The composition of a community of practice was therefore somewhat fluid, but not to the extent that it was simply a temporary 'task group' formed to handle a problem, and then disbanded. A community had an ongoing life and reality of its own, even though its membership could change in small increments over time. A community of practice was typically manifest as a group through its meetings. This often entailed the cumulative membership of smaller meetings held over time. A meeting typically related to a common theme about the system, for example, the design of specific new functionality, or a complex problem. Often members of a community – not necessarily all members – assembled in an informal gathering to discuss a current issue. Such meetings were typically held at a member's desk, assembled around a computer monitor. Larger groupings sometimes convened in a meeting room or similar area, at times with the use of computer and projection equipment to achieve the same effect as clustering around a monitor. However this required more pre-organizing and was less common. A community member commented:

> 'We often get together to try and work out what we need to do on [system w]. It might be a change that we have to design, or it might be a difficult error. When we look at the problem and work on it together, we have more understanding of it and better insight, and we can move ahead faster and find the best solution. When we all get together, it's basically like the whole being greater than the sum of the parts.'

As noted in Chapter 4, the collective knowledge of a group of co-workers can transcend the knowledge of individuals, and enable achievements not possible at the level of individuals (e.g. Cecez-Kecmanovic et al. 2003). A community of practice was often also manifest as a group in social gatherings. As seen, a system team undertook regular bonding rituals such as morning teas, lunches and other social activities. At such events members of a community of practice, typically a sub-set of the system team, would often be observed talking together as a group about their work and sharing system knowledge. Interaction often extended beyond the workplace. Similarly, Wenger (1998) found that, referring to an insurance community: '..they do not cease to be claims processors at 5 o'clock. Their participation is not something they simply turn off when they leave' (Wenger 1998: 57). In one case observed in TPE, the members of a community of practice met for coffee or lunch almost daily, and the principal topic of discussion was nearly always the current issues with their system. This community often also met socially on weekends. One community member remarked:

> 'We often do talk shop a lot, but there's nothing wrong with that. There's not actually a lot we have in common outside of our work. The conversation just seems to gravitate naturally to [system y].'

One long-standing community of practice had developed around the oldest critical system, system x. This large community of around 20 members held regular meetings which brought together staff who had a strong interest in system x. At these meetings current issues, problems and directions relating to system x were raised and discussed. Agreement was often reached on necessary action to be taken to resolve current issues. It is significant that this community of practice was one of only a few which were observed to survive the IS organizational changes relatively intact, and continued to meet regularly throughout the study. After the changes, the meetings were attended by selected staff from three or four teams (varying over time) which had a common interest in system x, including both project and maintenance teams. After the restructure, agreement was often reached at the community's meetings about action to be taken by different teams to resolve problems. This community of practice essentially drew on the force of its history and the weight of tradition, and simply continued to meet regularly, in effect defying the IT executives' edict. However it was significant that although system x was large and mission-critical, it was relatively stable and not prone to many crises, as noted. This was fortunate, as meetings of the community were only scheduled in advance, and after the

restructure there was little opportunity for all members to meet informally at short notice. One community member commented:

> 'We just kept on holding meetings like we've always done, or at least for as long as I can remember, or anyone else I know. I think it may have been questioned once or twice by some of the head honchos, but we ignored it. If they want us to keep on supporting [system x] properly, we just have to keep on meeting to work out what needs to be done about things that come up. The meetings aren't very tense like some in this place. It's more like a club. We have a pretty good time. But we always get everything done that has to be done. There's not a lot of arguments, and hardly ever any bad feelings.'

After the organizational restructure, members of a project team were sometimes observed to continue to discuss their work in the context of social activities. However members of a maintenance team were rarely seen to have substantial work discussions in social contexts. This was largely because a typical maintenance team was obliged to support numerous diverse systems – sometimes up to 12 or more – and therefore many team members lacked common ground for work-related discussion with each other. So this opportunity to share, sustain and enhance system knowledge was largely lost. Also lost was much of the opportunity for social rituals to enhance interaction through work-related discussion among many of the members of a team. This consequently reduced the opportunity to improve cohesiveness and morale in a maintenance team, and also reduced the opportunity to foster effective collaboration as a key aspect of the IS organizational culture.

The TPE communities of practice were not the same as formal 'teams' as understood within TPE. In TPE a team was defined as 'a small group of people cooperating for a common purpose' (TPE team work guidelines). Members of a team 'must know what they are there for, and must also perceive themselves as an entity.' A team possesses 'machinery by which the team acts as a unit.' A team has two main role categories: 'team leader' and 'team member'. Typically the team leader 'issues instructions and the members carry them out.' The team leader's role includes 'coordinating, motivating, encouraging and providing direction.' A 'self-managing' team is possible, where the team leader provides 'open leadership'. However in such a case, the team leader 'remains accountable for team performance'. Moreover, it was cautioned that if such a situation were to occur, 'the deliberate absence of a leader.. gives rise to power struggles and weakening of links to the wider organisation' (TPE team work guidelines).

The IS communities of practice in TPE each had a common purpose, but each one tended to be an informal group, usually lacked clearly identifiable or consistent leadership, often lacked any 'machinery' to act as a unit, and so was not a 'team' as defined within TPE. Nevertheless these communities of practice had quite a lot in common with high-performing teams as described by

various writers (e.g. Tuckman 1965; Woodcock 1989). For example, Woodcock (1989:15-22) discusses four stages of team development and maturity, ranging from the undeveloped group, to the experimenting group, to the consolidating group, to the mature group. In a 'consolidating' group, the operating methods of the group are critically examined by its members, and improvements are usually agreed on and achieved collaboratively. In this stage, the group considers the purpose and objectives of tasks, openly discusses the available options, and evaluates outcomes in order to improve future effectiveness. In Woodcock's 'mature' group, the positive characteristics of the consolidating group are retained, and flexibility becomes more the keynote. Leadership is defined by the situation rather than by protocol. Openness, cooperation and continual review of results become part of the group's way of life (Woodcock 1989:15-22).

TPE's IS communities of practice had much in common with both the 'consolidating' and 'mature' groups (Woodcock 1989). For example, typically there was no formal leader, but 'leadership' was defined by context. Often whoever knew most about the current issue took a technical leadership role, as necessary. Problems were often solved collaboratively, and openness and cooperation were fundamental. Potential solutions were discussed openly, and possible outcomes were evaluated to help contribute to future effectiveness. One system specialist said:

> 'When we need to, we just sort of come together naturally to deal with the latest issue with [system y]. Generally it wouldn't be all of us, just the people who are most directly involved at the time. This can include someone who's being mentored. All told, there'd probably be up to about 12 who could be involved in some way. But usually only about three or four concentrate on an issue at any given time. There's usually no real leader as such, it's generally whoever knows most about the current problem who takes the lead. This is sometimes me, but certainly not always.'

The communities of practice in TPE were generally in accord with Highsmith's (2004) proposal that high performance can be achieved via participative relationships and collaboration within and among groups (as noted in Chapter 3). For example:

> "..examples of relationship rules that guide group interaction:
> - Groups should participate in any decision that impacts their work.
> - Decisions should be made as collaboratively as possible.
> - The participants have the right to self-organize into other subteams to carry out specific results.
> - Conflict needs to be resolved as cooperatively as possible." (Highsmith 2004: 51)

A community of practice could be seen as a cooperative sub-team which self-organized for specific purposes as required, and made decisions and undertook related work collaboratively.

Also in regard to high-performing teams, Harris (2006a) comments:

> "Teams are fast becoming the preferred mechanism for accomplishing work. Teams represent a new work 'force' that relies on collective intelligence and expertise plus collaborative interaction as the means to achieve synergy. That is, a team is capable of accomplishing more than the same group of individuals working alone.. Organizations must continue to rely on individual workers, of course; however, enabling high-performing teams is a new organizational imperative. In AM [application management] and IT, we have traditionally delineated individual responsibilities so rigidly between process, software and business experts that we lose much of the opportunity for true collaboration, learning and leveraging collective expertise. Organizations that manage applications work with blended communities (virtual teams) of business, process, software and other experts can better fulfill overall requirements and often resolve problems or issues faster and better." (Harris 2006a)

Supplementing these points, Harris (2006b) adds:

> "..teams [have] collective ability to complete work more reliably and with higher quality than individuals working alone.. During the past five years, empirical studies began to show the value of teaming, especially in systematic work. Among the measured benefits are increased quality plus organizational and individual productivity. Teaming also increases team cohesion and alignment with objectives.. In addition, when teams are given increased decision-making and work redesign authority, productivity increases even more.. Collaboration and teaming build on productivity; they give individuals or organizations the capability to connect with each other, and enable people to combine efforts and improve the quantity and quality of work.. Collaboration increases the strength of these relationships by enabling interactions that can increase in complexity and richness over time. At its best, collaboration enables discovery, knowledge creation and innovation in all individual, team or group relationships." (Harris 2006b)

Other writers make similar points (e.g. Dunn and Kingsford 2001; Humphrey 2000; Katzenbach and Smith 1993; Kingsford and Dunn 2002). In effect TPE had recognized these principles and put them into practice many years earlier. In TPE, the opportunity for true collaboration, learning and leveraging collective expertise about a system had been realized to the fullest extent within each system team. To a somewhat lesser degree a similar opportunity had extended to the relationship between a system team and its corresponding business support team, in some respects so creating a 'virtual team' in the terms of Harris (2006a). However typically the physical separation between a system team and a business support team had reduced opportunities for full collaboration, full use of collective expertise and joint team learning. This was largely because such opportunities in relation to a system depended quite strongly on the availability of face-to-face communication and interaction, as seen.

As noted, collaboration within a community of practice typically entailed face-to-face interaction. As seen, around 40 per cent of technical IS staff were of non-English-speaking background (NESB), rising to around 50 per cent in some teams. In any given system team there were typically around five to ten first languages spoken, but the common language of the

workplace was English. In many cases staff of NESB were technically competent, but a reasonable number had some level of difficulty with spoken and/or written English. This meant that staff of NESB often had different levels of awareness and understanding of system and organizational issues, as compared to staff of ESB (English-speaking background).

These factors tended to reinforce the need for and the value of face-to-face communication within a community of practice. Face-to-face interaction was often more effective than alternatives such as written and telephone communication, in imparting and receiving complex information accurately and fully, and in developing shared knowledge and understandings within a community. This was largely because in a face-to-face context, 'active listening' could more readily take place. That is, complex messages could be more easily repeated in a different way to clarify their meaning, especially if there was any doubt about their effective transmission. Also in a face-to-face situation, the 'body language' of participants could be more apparent, in some cases acting to signal any lack of understanding of messages (e.g. Argyle 1990).

In somewhat similar circumstances in health education, Ladyshewsky (1996) observes:

> "During communication sessions it is useful to have the student of a NESB paraphrase the feedback back to the [instructor]. If the student cannot reflect back the correct interpretation then the message has been misunderstood and must be repeated in a different way.. I get them to paraphrase back ... and it often reveals that they have not understood the information. I then have to go back, take out my colloquialisms.. find different words and it does help to improve comprehension.. use of the English language is also filled with various idioms and colloquialisms which are not part of a student's vocabulary if they are from a NESB. It is important, therefore, to be aware of the language one is using when speaking and to try and use more general terms.. Not all.. Asian students will face the same dilemmas. Language proficiency, exposure to Western culture and practices will obviously influence the degree of success." (Ladyshewsky 1996: 6-8)

Somewhat similar situations occurred within TPE's communities of practice. Communication issues between staff of NESB and ESB were fairly common. However issues in English communication between staff of NESB with different first languages were also fairly common, such as between Chinese and Indian. The current technical leader within a community of practice could also be of NESB, and could have some difficulty imparting complex information to other community members of both ESB and NESB. This situation continued to apply for many staff of NESB, even after they had worked in TPE for up to ten years or more. Of course after some years of interacting closely, the members of a community of practice generally became more familiar with each others' idioms and accents, and communication was more effective. Also, there was generally some, albeit limited, movement of staff among system

teams, and so occasionally new staff entered a team, including staff of NESB. All of these factors underlined the benefits of face-to-face communication, which had continued as a long-standing practice within system teams, and essentially became an integral part of the IS organizational culture.

There was evidence that the proportion of technical IS staff of NESB had risen from around ten per cent some ten years before the study, and also (anecdotally) that there had been far fewer staff of NESB twenty years before the study. This indicates that although face-to-face interaction was obviously beneficial for TPE's communities of practice, it was not the proportion of staff of NESB which had led to this style of communication emerging as a preference in the early years of the 'system team' structure. The process for newcomers in a team – whether of ESB or NESB – to gradually learn a system was best served by face-to-face interaction within a community of practice, bearing in mind that it could take several years to achieve proficiency. Clearly face-to-face interaction was of value in its own right as a means of sharing information effectively and accurately, and of building shared knowledge among the members of a community. However the disruption of the communities of practice brought about by the organizational changes acted to reduce the level of face-to-face communication, with negative consequences (this is discussed further below).

As discussed in Chapter 4, communities of practice are essentially self-organizing, sense-making, social configurations which adopt common practices, tools, symbols, stories and histories as they evolve. Their use of rich conversation, discussions and interactions allows tacit knowledge to flow and surface (e.g. Standards Australia 2005b: 45), and also enables the creation of new knowledge. The concept of 'community of practice' has much in common with that of a 'knowledge ecosystem', which consists of a complex set of interactions among people, process, technology and content. The components of a knowledge ecosystem may include its objectives, strategic intent, organizational context, culture, specific enablers (activities, tools, techniques), networks and communities (Standards Australia 2005b: 8-10). Communities of practice may fit within a broader organizational structure which may also be seen as a knowledge ecosystem. In the case of TPE, the IS communities of practice were essentially components of the broader system team structure, which was in effect also a knowledge ecosystem (discussed further under Information Systems Governance below).

In summary, the communities of practice, and in general the related IS structures, processes and assumptions had evolved as an integral part of the IS culture to the extent that they influenced the associated behaviours and values of most staff working in the area of IS. However the

pivotal role of communities of practice in the effective support of systems and related business operations received little official recognition or support at executive level.

5.4 Information Systems Governance in TPE

As introduced in Chapter 3, the *IT governance* of an organization comprises the set of rules or guidelines that determine the division of IT roles and responsibilities, and how decisions on IT are made (e.g. Weill and Ross 2004). IT governance is about assigning decision rights, and an accountability framework that encourages desirable use of IT (e.g. Weill et al. 2003). It requires knowing what decisions have to be made at the intersection of IT and business, specifying who has input to the decisions, and who makes them. IT governance is also seen as a mechanism for matching business requirements with technology planning, and IT governance is a critical success factor for enterprises (e.g. Weill and Ross 2004).

The *IS governance* of an organization is a significant subset of the IT governance framework, and comprises the framework, or set of rules or guidelines for governance of information systems (e.g. Dallas et al. 2002; Korac-Kakabadse and Kakabadse 2001). IS/IT governance has traditionally been seen as an executive-level framework for decision-making (e.g. Davis 2004). However effective IT governance requires the strategic integration of business and IT decisions, with collaborative relationships among key stakeholders. Effective IS/IT governance should therefore focus on relationships and processes. To be successful, enterprises should integrate their IS/IT governance with their strategies and organizational culture (e.g. Korac-Kakabadse and Kakabadse 2001).

The IS governance of TPE consisted of both formal and informal components. These are outlined in turn below. It is shown that in practice there was an effective informal or implicit IS governance framework which applied prior to the organizational changes, based on the system team structure. This framework had evolved naturally with the system team structure over many years, and it closely reflected the values of the organizational culture and structure.

5.4.1 Formal IS Governance

As noted, formal IS/IT governance has traditionally been seen as a controlled, executive-level framework for decision-making (e.g. Raphaelian 1995). A typical statement of the ‘control’ model of IT governance is, “The purpose of IT governance is to keep IT operations under control, such that the resources – both dollars and people – are spent and used to meet the

organization's strategies and objectives. It's an integral part of enterprise governance and consists of leadership, organizational structures, and processes" (Davis 2004: 43). The formal IT governance which applied in TPE, and its subset of IS governance, essentially entailed a hierarchical structure of executive positions supported by formal groups, committees and processes. At the apex the chief executive officer (CEO) ultimately authorized all IS/IT investments and resources, but IS/IT was only one of the CEO's many responsibilities. There were about 15 senior executives below the level of the CEO, who all reported to the CEO. Some of these senior executives had responsibility for more than one line of business, of which there were about 15. The senior executives included a chief information officer (CIO), who had full-time responsibility for IT and hence IS. The CEO, the CIO, and the other senior business executives formed a 'TPE executive committee' which met regularly as the peak leadership body of TPE.

The CIO led the IT organization, which consisted of seven groups each led by an IT executive at the level just below the CIO, who all reported to the CIO (see Figure 4 below). These groups included IS; infrastructure support; strategy and policy; planning and monitoring; security; human resources and administrative support. There were about 17 IT executives in the IT organization, but not all were group leaders. The IT organization had about 1600 staff, of which the IS group was the largest, at around 700. The next in size were infrastructure support at about 400, and human resources at about 150. The other groups were all smaller. Of the 1600 staff in the IT organization about 390 were contractors, with about 170 of these being in the IS group.

An 'IT executive committee' consisted of the CIO plus the other seven IT executives, and this committee met weekly or as required to consider and discuss significant IT status and other IT issues, and make decisions on actions to be taken. One of the IT executives was in effect the chief information systems officer (CISO). The CISO led an IS organization which resided within the IT organization, and consisted of eight IS branches each led by an IS executive at the next lower level (see Figure 4). The CISO plus these eight IS executives formed an 'IS executive committee', which met weekly to discuss and consider IS status and significant IS issues, and make decisions. The IS organization and its eight sub-groups varied in structure and composition over the course of the study, largely reflecting the imposition of the organizational changes and the split between projects and maintenance.

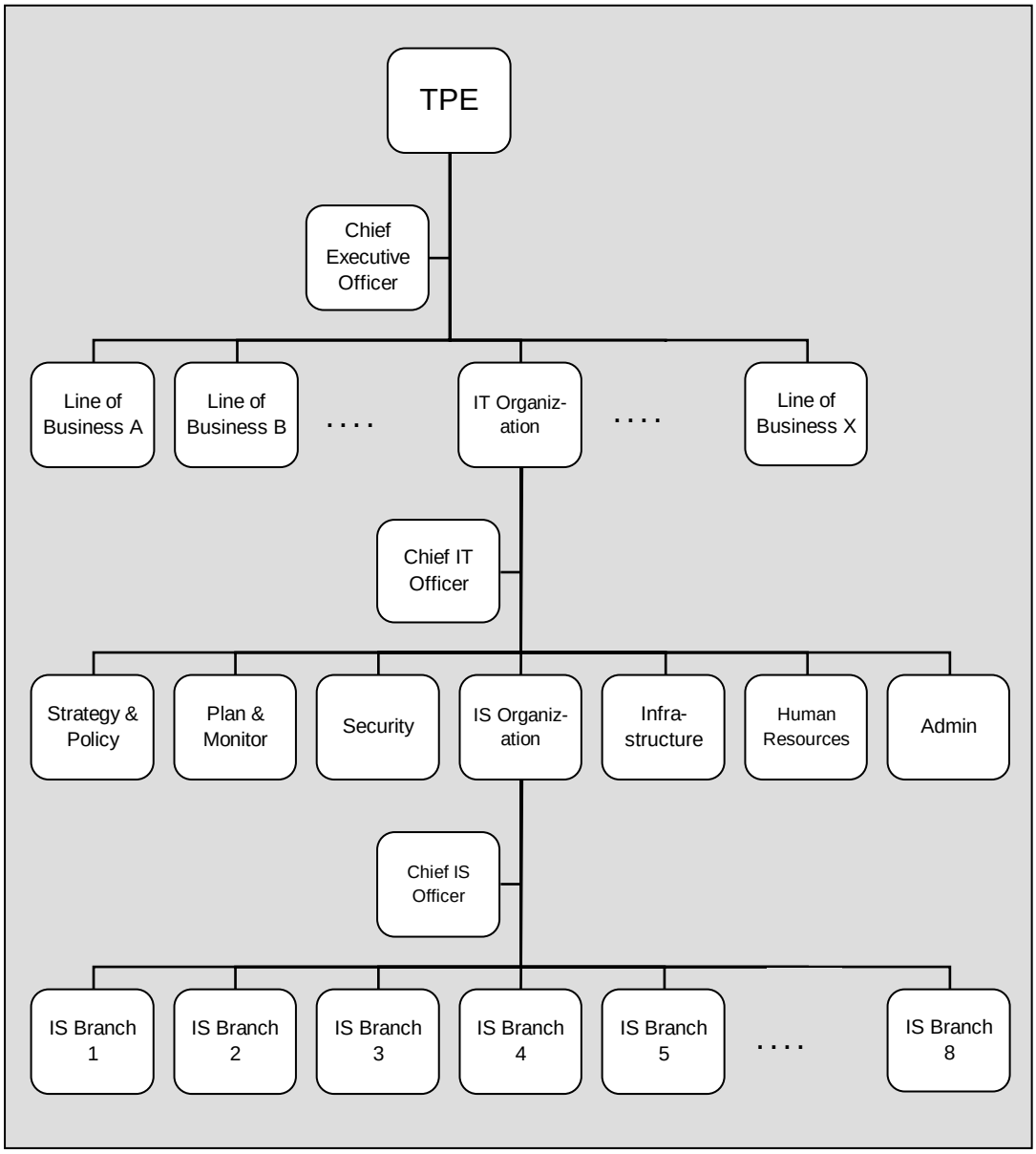

Figure 4. Structure of TPE, showing IT and IS Organizations

Each of the seven groups of the IT organization consisted of a varying number of teams, each of which was managed by a team leader who was a mid-level manager. In the whole IT organization there were around 130 such teams, while in the IS organization there were about 60 teams (the actual numbers varied somewhat over the duration of the study).

The formal IS governance processes were mainly hierarchical. Decisions tended to be made at successive levels in the organizational structure. Each decision typically affected mainly the organizational grouping at the level the decision was made. In the IS organization, system teams which had aspects in common were grouped into a branch, which was led by an IS

executive. For example, one branch contained five system teams which all supported systems used primarily by one line of business. A branch typically had three to six system teams, with each team being led by an IS mid-level manager. Usually the IS executive of a branch met weekly or as required with the branch's mid-level team managers in the form of a branch management committee, to consider and discuss significant issues related to the branch, and make some formal decisions affecting the branch. For example, a branch management committee made decisions about work procedures relating to the branch, and the allocation of newly recruited staff to the branch. However many formal decisions affecting a branch were made by the IS executive, either unilaterally or in conjunction with the IS executive committee.

A system team often had a number of sub-teams, to focus on different aspects of the work of the team. Typically a system team had around two to four sub-teams, each led by a lower-level sub-team manager. A mid-level team manager typically met once or twice per week with the sub-team managers of the team, in the form of a team management committee. This committee discussed significant matters relating to the team, and made decisions involving the team. For example, one team management committee made decisions about the allocation of resources within the team. In turn, each sub-team manager generally met regularly with the members of their sub-team, often weekly. In most cases a mid-level team manager also held periodic meetings with all system team members, typically every one to three months. Such full-team meetings were generally focused more on sharing organizational information than on making decisions.

Decisions on what IS development work would be approved and undertaken were made by a joint business-IS planning group. Early in the study this was a committee which met regularly, with business and IS representation at executive level; later it became an organizational unit in its own right. In both situations the group was supported by administrative staff and communication processes which sought to tap into TPE's diverse lines of business to ascertain their business needs for information systems development and major enhancements. The group then did its best to evaluate and prioritize the competing sets of business needs, the total estimated cost of which almost always exceeded the available budget. This thesis does not focus on the information system planning process, but it was fraught with difficulties and conflict. As discussed earlier, the business-IS planning group also considered issues relating to the retirement of systems, although such events were rare.

TPE's 14 or so other lines of business were structured in similar ways to the IT organization, with hierarchies of business executives, managers and staff. Some differences were that there

were far fewer contractors, and considerably fewer staff of NESB in business areas. Within many of the lines of business there were business support teams which aimed to understand and represent the needs of users of certain information systems (often many users), who were frequently spread across many lines of business. A business support team typically interacted with one or more IS teams, and collectively they made decisions at the day-to-day, operational level, sometimes involving the leaders of the respective teams, but more often simply made among team members.

The formal IS governance framework included regular monitoring and reporting to the IS executives on the status, progress and key issues of IS teams. This reporting was generally coordinated by the planning and monitoring group of the IT organization, as part of its role for all of IT.

Weill (2004) proposes that "top-performing enterprises proactively.. measure and manage the amount spent and the value received from IT." A small IT quality assurance (QA) section was part of the formal IT/IS governance framework. This section, located within the planning and monitoring group, sought to provide some level of assurance that all teams in the IT organization correctly followed corporate policies, standards and procedures, and where applicable, local procedures. The aim was to help ensure the quality of products or deliverables produced by IT teams, and their value to TPE. The QA section's work was based on a program of sampling the products and procedures of teams, rather than attempting to check and confirm all the work of all teams. The QA section reported their findings to the CIO and the other IT executives.

As part of the quality assurance process, it was required that peer reviews of all key system deliverables produced by IS teams should be undertaken. These reviews were carried out by peers of the producer, drawn from within the same team, and also from other, generally related team(s). The key deliverables included project plans, system designs, specifications, program modules (code), and test plans. The aim of the peer review process was to provide assurance as far as possible that the deliverables were accurate and complete, within the limits of the knowledge of the reviewers. The specific results of reviews stayed within the team concerned, and were not escalated to executives. The peer review process had the added benefit of sharing knowledge about systems more widely among people involved with that system, and also generating new knowledge where applicable, through processes of interaction.

5.4.2 Informal IS Governance

As noted, formal IS/IT governance has traditionally been seen as a controlled, executive-level framework for decision-making. However informal or implicit guidelines often comprise a significant portion of the IS/IT governance framework which operates in practice (e.g. Shipley 1995). Even in cases where formal rules do exist, it is often the unwritten, implicit rules which are drawn on in making key decisions. Organizational structures including an implicit governance framework may emerge over time against the backdrop of an organization's culture and environment (e.g. Kingsford et al. 2003; Mintzberg 1979; Patel 1999).

In TPE, despite the fact that a formal, executive-led IS governance framework did exist, there was also an influential, informal level of IS governance which operated. Korac-Kakabadse and Kakabadse (2001) argue that successful enterprises should integrate the needs of customers, business partners, vendors and other constituents, and rely on effective sharing of information in order to differentiate themselves from the competition. Ribbers et al. (2002) suggests that effective IT governance requires the strategic integration of business and IT decisions, with collaborative relationships among key stakeholders. Weill (2004) comments that, "Effective IT governance encourages and leverages the ingenuity of all enterprise personnel in using IT, while ensuring compliance with the enterprise's overall vision and principles. As a result, good IT governance can achieve a management paradox: simultaneously empowering and controlling" (Weill 2004: 3). O'Farrell (2004) similarly comments, "firms that shift decisionmaking closer to the front lines will prosper through better decisions" (O'Farrell 2004: 55). This occurred to good effect in TPE, in that in practice much collaborative decision-making occurred within the 'system team' structure, although the IT executives did not acknowledge its full extent. In fact the executives had not consciously shifted decision-making closer to the 'front lines', but this situation had emerged over time as an integral part of the 'system team' structure and the informal IS governance framework (discussed further below).

Prior to the organizational changes, there were about 45 key system teams. This number approximately equaled the number of critical systems. There were in fact more system teams in TPE, and these teams supported a good number of the remaining systems (some 300 more). Some did not belong to the formal IS organization. The key system teams which were observed ranged in size from about 40 to 4 team members, with an average of about 9. The system team structure had emerged naturally over about 20 years, and essentially it acted to ensure that the IS organization provided effective services to its customers. The term 'system team structure' is used here to include the overall structure of system teams, and also the relationship of each

system team with its corresponding business support team. The system teams played a crucial role in the informal IS governance framework. The term 'informal IS governance' is used here in recognition of the fact that the system team structure was not documented or acknowledged by the IT or IS executives as being an integral, effective part of the formal IS governance framework.

Over the 20 years or so during which the system team structure and related processes had evolved, a shared understanding between business and IS had developed, that business support teams would exist, that each one would represent the needs of users of a system, and that each one would generally be matched to a system team. A business support team looked after either one system, or a number of related systems within a given business functional area. A business support team was generally located within a particular line of business, and was subject to its executive arrangements. Any one system could be used by staff in one or many lines of business. A business support team therefore could represent the needs of users of a system within its own line of business, or across many lines of business. The corresponding system team supported that system technically, including undertaking development, enhancements and maintenance. A system team was located in the IS organization, and was therefore subject to its formal IS governance arrangements.

A system team and its corresponding business support team were therefore subject to different formal governance structures. However, between a system team and a business support team, most of the important day-to-day decisions about system development and support were made, and in effect the system was largely informally 'governed' by these means in an ongoing, everyday sense. In almost all cases a business support team interacted directly with its system team regarding error correction, and minor enhancements and changes to a system, generally without need for further approval. In many cases a business support team even interacted directly with its system team regarding major enhancements to a system. In such cases both the business support team and the system team generally needed higher level approval within their respective formal governance structures – but with the groundwork having already been laid, this was often forthcoming, and sometimes only a formality.

The 'system team' structure represented the sum of the informal arrangements described above, and formed the core of the implicit IS governance. After the initial development of a system – which usually involved decisions at higher levels – control over the future of the system was exercised largely within the system team structure. The system team structure represented the major intersection of IS service providers and business customers, and was the locus of most of

the important ongoing decisions about systems. The cumulative effect of many small changes to a system over several years could substantially alter the system as a whole. Decisions about such changes were largely within the province of the implicit IS governance. In TPE as in many organizations, goals were often achieved by people not restricting themselves to working within the confines of the hierarchical organizational structure. Thus members of a system team often achieved many of their work outcomes through informal, direct relationships and alliances with members of a business support team. In some cases at least the IS executives were not fully aware of these relationships, nor appreciated their value.

As seen, effective IS governance embraces and integrates both IS and business. IS governance entails the assignment of decision rights especially at the intersection of business and IS, and the accountability framework needed for effective IS processes and use (e.g. Broadbent 2002, 2005; Korac-Kakabadse and Kakabadse 2001; Marshall et al. 2005; Weill et al. 2003). The role of IS service providers is normally included in the IS governance framework. The role of customers in influencing IS decisions can also be a significant part of the governance. Andriole (2004: 15) comments that there is a great need for inclusive governance models which closely integrate business and technology decision-making. Patel (2002) notes that IT governance is more than the simple application of IT to business activity, but rather a complex fusion of IT with business activity, business partners, suppliers and customers.

As seen in TPE, many IS staff in system teams had built up long-standing relationships of trust and knowledge sharing, often within communities of practice. Effective collaboration and knowledge sharing is facilitated by relationships of trust (e.g. Koskinen 2003). Trust builds up over time, and long shared experience enhances both trust and knowledge transfer (e.g. Lindskold 1978; Nonaka and Takeuchi 1995). Effective relationships of trust also extended to business support areas, although these were often somewhat hampered by distance and therefore not quite as close.

The ‘system team’ governance framework was a form of ‘federated’ model (e.g. Weill 2004: 6), in which coordinated decision making involves both a centre and outlying units. This is along the lines of the federal governmental system of some nations, in which certain decisions are made at federal level and others are the responsibility of states. In TPE, certain major IS decisions – such as for new development – were usually made at executive level by the joint business-IS planning group, while ongoing day-to-day IS decisions were made at the system team level. In effect a ‘system’ was the primary unit in the federation, rather than any formal organizational unit such as a line of business. As such, a ‘system’ as a unit spanned the

business support team and the system team, and therefore also spanned lines of business. 'Systems' as entities were in fact the principal players in the governance structure. The IS governance could justifiably be described as a federated, system-based governance structure.

The system team structure in effect formed a knowledge ecosystem, that is, a complex set of interactions among people, process, technology and content (e.g. Davenport and Prusak 1997; Standards Australia 2005b). Because of their entrenched and long-standing nature, the system team structure and the implicit IS governance could legitimately be seen as integral components of the organizational structure and culture, insofar as they related to IS. The values, norms and behaviours represented by the system team structure were typical of cultural values and behaviours, as seen. They were accepted as part of the 'natural order of things' by most IS staff, and were passed on to newcomers in a manner typical of fundamental cultural beliefs and practices. Newcomers adopted and adapted to the elements of the IS culture, and in their turn became bearers of the culture.

5.4.3 IS Governance After the Organizational Changes

After the organizational changes, the IS organization was restructured to separate projects from maintenance. The formal IS governance processes were still mainly hierarchical, and were similar in broad outline and function to the earlier formal governance framework. However the implicit IS governance processes were undermined and diminished (discussed further below).

In the new formal IS governance framework, decisions still tended to be made at successive levels in the organizational structure, with each decision typically affecting mainly the level at which it was made. The CISO still led the IS organization, which consisted of eight branches each led by an IS executive. The IS executives still formed an 'IS executive committee', which met regularly to discuss significant issues and make decisions. One IS executive led a large maintenance branch which initially consisted of seven maintenance teams. The remaining seven IS executives each led a branch containing project teams. Project teams with aspects in common were grouped into a project branch, led by an IS executive. For example, one project branch contained four project teams which all worked on major enhancements to systems used by one line of business. A project branch typically had two to four project teams, each led by an IS mid-level manager.

For both projects and maintenance, the IS executive of a branch still met regularly with the branch's mid-level team managers as a branch management committee, to discuss significant

issues related to the branch, and make some formal decisions affecting the branch. However many formal decisions affecting a branch were made by its IS executive, either unilaterally or in conjunction with the IS executive committee.

For both projects and maintenance, a mid-level team manager still met frequently with the sub-team managers of the team, in the form of a team management committee. This committee discussed significant matters relating to the team, and made decisions involving the team. In turn, each sub-team manager met regularly with the members of their sub-team, often weekly. In most cases a mid-level manager also held periodic meetings with all team members, typically every one to three months. Such meetings were generally focused more on sharing information than on making decisions.

To a considerable extent the separation of projects and maintenance in TPE was driven by a perceived need of executives for improved visibility into the respective costs of these areas. In this regard, some executives often invoked a rather simplistic mantra taken from the quality assurance field: 'You can't manage what you can't measure' (e.g. Juran and Godfrey 1999). In strict terms this was partly true – under the former structure the cost of a system team could be measured through the cost of its human resources, which was by far the largest component. However this cost included all of development, major and minor enhancements, maintenance and other support of a system. The breakup of these components could be estimated, but because of their generally high level of integration within a system team, such estimates were often imprecise. Prior to the organizational changes, TPE did not have an effective means of recording time spent on tasks by individual employees. There was a system in place, but its use was largely optional, and it also allowed any employee to enter a new task descriptor at any time. As a result there was wholesale repetition of many descriptors in slightly different and overlapping forms – along the lines of 'dogs', 'canines', 'hounds', 'terriers' and so on. It was almost impossible to draw out sensible higher-level information from the system. However the problem tended to lie more in lack of executive attention to the proper use of the system by staff, than in any inherent deficiency of the system.

Weill (2004) proposes that "top-performing enterprises proactively.. measure and manage the amount spent and the value received from IT." After the organizational changes, an effective measurement regime was put in place which monitored and reported on the time and cost of the components of IS service delivery, to a higher level of accuracy than previously possible. For example, the number of errors corrected and changes made to a system per month, and the resources, time and cost spent on them were available. The resources, time and cost of work per

project were reported. The IS executives firmly believed that the new measurement regime had significantly improved the IS governance framework. However it may be argued that the ultimate measure of an IS organization is the quality of the services it provides to customers, as experienced and judged by the customers themselves. As Drucker (1954) observes, a product or service is of quality only if it is useful to the customer and gives the customer value. Many writers have advocated the inclusion of measures of customer satisfaction as an important part of a 'balanced scorecard' approach to the assessment of IT and IS service delivery (e.g. Martinsons et al. 1999; Van Grembergen and Timmerman 1998). Typically, customer satisfaction can be measured by well-designed surveys or similar procedures. In fact, in TPE formal customer surveys were not undertaken by the IS organization after the restructure.

There was other evidence that the quality of services provided by the IS organization declined after the restructure. Prior to the restructure, a professional survey carried out by the IT organization (broader than IS) revealed an acceptable level of satisfaction with services provided by IT. After the restructure, a different, less formal program of consultation with business was undertaken by the IT organization. The program revealed a range of negative views by customers of most services provided by IS (this is discussed further below). It was curious that no further professional surveys were performed by IT during the study, given that they were suggested by some staff, were recommended in TPE's own corporate 'best practice' guidelines, and were also commonly undertaken by other lines of business (compare Weill 2004). The situation possibly reflected some degree of acknowledgement by the IT executives – not publicly revealed – that the outcomes of the restructure of the IS organization were not as encouraging as expected.

After the restructure, a business-IS maintenance committee was set up to oversight the prioritization and approval of proposed support work, and decide on the allocation of work for maintenance teams. This committee included maintenance and business executives. The rationale for its establishment was to provide greater visibility into and control of expenditure on error correction, changes and minor enhancements. A maintenance team still interacted on a day-to-day basis with its corresponding business support team(s), but the decisions on what work was approved and undertaken were now largely made elsewhere.

After the restructure, decisions on what IS development work and major enhancements would be undertaken by project teams continued to be made by the joint business-IS planning group. The project teams, set up after the restructure, interacted with their corresponding business support teams as necessary. However the work of a project team was usually directed by a

steering committee for all key decisions, such as what major areas of work would be included in the project, significant changes in scope or direction, and action to be taken in the event of project delays. Such a steering committee had representation from the relevant business support area and the project team. If the size and significance of a project warranted it, there was also representation at executive level. The rationale for the establishment of the steering committees was partly as a facet of sound project management (e.g. Kemerer 1997; Royce 1998), and partly to provide for the IS executives greater visibility into development and major enhancements, and hence better control of expenditure.

The decision to restructure the IS organization – including introducing rigorous project management and a split between projects and maintenance – fell within the ambit of the formal IS governance, to the extent that consideration of organizational structures necessary to effectively match IS to business strategies is part of governance (e.g. Andriole 2004; Davis 2004; Highsmith 2004). As Andriole (2004: 22) puts it, "the governance agenda should be defined around your specific activities and interpreted through your culture and, ultimately, your organizational structure." In TPE however, while at the time of the organizational changes the IS governance agenda was indeed defined largely around a desired separation between specific activities – projects and maintenance – and this led to the decision to restructure, the agenda failed to properly understand and engage with the existing implicit IS governance and IS organizational culture. In practice, the governance agenda failed to adequately consider the pre-existing structure of system teams and their relationships with business support teams, why such structures had emerged as a key contributor to effective IS service delivery, and how they were related to IS culture and knowledge processes. As Andriole (2004) also comments, "Organizational structure, culture, and governance are all related"; "activities, policies, procedures, regulations, and organizational structures are influenced by corporate cultures"; and "companies should convert governance requirements into realistic matches among their requirements, structures and cultures" (Andriole 2004: 35-36).

It is sometimes acknowledged that relevant knowledge is a key factor in system development, and by implication should be considered as part of the IS governance agenda, along with knowledge processes (e.g. Sambamurthy and Zmud 1999; Walz et al. 1993). However it was clear that after the restructure in TPE, the IS governance agenda failed to adequately consider the pre-existing knowledge processes of system teams, and how they were related to IS organizational structure and culture. Although aspects of knowledge are sometimes briefly mentioned or implied in the IS/IT governance literature, in general the literature does not accord knowledge and knowledge processes the central role they warrant in an IS governance agenda.

The previous implicit IS governance framework had evolved naturally over more than 20 years, and reflected the values of the organizational culture and structure as regards IS. The IS organizational changes were in conflict with the precepts of the pre-existing implicit IS governance, which was an integral part of the IS culture and structure. The previous implicit IS governance had been a federated, system-based structure in which roles and processes were clear and well understood by most staff. The new structure introduced serious complications in how teams had to interact (discussed further below), but its major flaw was that it fragmented pre-existing knowledge processes and knowledge-based communities of practice. These pre-existing structures and processes had enabled effective IS services, and so it was not surprising that the effectiveness and quality of IS services declined after the restructure.

The TPE case study demonstrates that an IS governance agenda should include detailed consideration of organizational culture, structure and relevant knowledge structures and processes. The thesis focuses on information system development and support, and it was shown that an IS governance agenda should include the considerations noted above. It should also examine the pre-existing IS governance framework, including both its formal and implicit aspects, and consider whether, and how this framework may already support effective IS services. These steps are necessary in order to formulate an IS governance framework which will sustain or achieve improvements in the quality of IS service delivery, and not simply be counter-productive and reduce the effectiveness of IS services.

The next chapter focuses more fully on the organizational changes and their outcomes.

Chapter 6 CASE STUDY – PART 2

As noted earlier, Chapters 5 and 6 together describe and analyze in detail the extended case study around which the thesis is centred. Chapters 5 and 6 are approximately divided into 'before 'and 'after' the organizational changes to IS structures and processes that were initiated during the case study. Chapter 6 focuses on the organizational changes and their outcomes. A brief overall summary of the case study is provided at the end of this chapter, focusing on significant points and findings.

6.1 Organizational Changes

After the long era in which TPE had operated in basically the same fashion in relation to its information systems, the IT executives introduced a number of major organizational changes which they believed would achieve greater efficiency and effectiveness in the delivery of IS services for TPE, and align IS more fully with business. For some time the executives had been concerned about the high cost of IT, which they believed was largely due to ongoing high maintenance costs, and this in itself was seen as a problem. It was also a drawback from their perspective that the maintenance of a system was typically integrated into a team along with development work, plus major and minor enhancements. This meant that it was fairly difficult to accurately identify the cost of maintenance – although it could be estimated – and therefore problematic to control and reduce it.

Moreover from the executives' point of view it was also a drawback that each system team focused on just one or a few related systems. Even when there was a low demand for corrections or changes to a system, the team's resources were generally kept in place in anticipation of future demand – and as an additional benefit, a pool of knowledge of the system was retained. If a system did prove to be very stable over an extended period, its team might be wound down. However this rarely happened, and more often business requested a continual stream of changes to most systems. In general as Glass (2003) puts it:

> "Enhancement is responsible for roughly 60 per cent of software maintenance costs.. Maintenance is a solution, not a problem.. Far too many people see software maintenance as a problem, something to be diminished and perhaps even 'obliterated'.. The only way that software maintenance could be a problem would be if nearly all of it were about fixing errors.. Maintenance, instead, is software's unique solution to the organizational problem 'we built this thing, but now we wish we had built something a little different'." (Glass 2003: 117-119)

The portrayal of the organizational issue 'we built this thing, but now we wish we had built something a little different' is only partially correct. It tends to downplay the fact that maintenance is often necessitated by continual changes in the organizational environment, especially in emergent situations. As such, users do not so much regret any earlier deficiencies in specifying business requirements, but rather they want the systems continually updated to reflect changing requirements. However it is true that maintenance is the solution to a need, and not necessarily a problem in itself (Glass 2003). Similarly Swanson and Dans (2000) conclude that large systems are perhaps not so much maintenance 'burdens' as assets expected to provide returns over a longer period, given the provision of necessary maintenance. In TPE, due to business and legislative imperatives, and environmental shifts, users often had no choice but to request frequent changes to systems. It was the malleability of software which made such changes possible.

In general Murphy (2003: 3) points out that organizations often make the mistake of concentrating on 'upfront' analysis of IT initiatives, rather than examining them on a 'whole of life' basis in their full business context. Such an approach should consider the use of an IT system by business and the benefits to business over the whole of the system's expected life, and also take into account changes needed to the system over its life to meet changing business needs, especially in emergent organizations. Murphy (2003) proposes such a solution:

> "Therefore, a new approach is required. Given that IT is now an essential component of business operations, to be successful, an approach must incorporate the business dimension in a structured way, it must take *all* of the key determinants into the appraisal process, and it must be capable of adapting to rapid changes in business and technology.. In summary, this is a 'whole of life' approach to benefits realisation, which is superior to the traditional, narrow return on investment (ROI) approach because it combines a more comprehensive and appropriate range of investment management perspectives that provide the required level of shared management insight for effective decision making." (Murphy 2003: 4, 9)

Strassman (1997: 281) also proposes that systems should be viewed in whole-of-life terms, in order to properly understand the full costs and benefits to the organization. Agosta (1997) discusses this in a review of Strassman (1997):

> "If well-designed.. software is virtually immortal, can be continually improved as bugs are corrected, is cheap to reproduce, and does not wear out in being used. The residual value of software – what it is worth to an organization at the end of the estimated payback period used to justify its being built in the first place – is not generally recognized in justifying undertaking software projects. It needs to be. Its recognition would.. work against the build-and-junk approach.. so greatly promoted by the vendors and trade press benefiting from the churn in infrastructure." (Agosta 1997: 625)

In TPE, the IT executives were also concerned about a lack of rigour in project management, and limited adherence to sound project management and system development standards and

methodologies. Such methodologies were available within TPE. They had been instituted some years earlier in the context of a major IT project, but the level of adherence to standards had slipped over subsequent years. This had been exacerbated by major legislative changes which required tight deadlines for the implementation of some large changes and new systems. In this climate it was rationalized that there was no time for full observance of methodologies, and the level of attention to standards had diminished even further. Subsequently there had been sporadic attempts to both revive and update the system development methodologies, but these had made little headway.

The IT executives therefore introduced certain interrelated organizational changes which appeared at the time to be soundly based, and which were intended to improve the efficiency and quality of delivery of IS services to customers, and to align IS more fully with business. These initiatives included:

- the (re)introduction of more rigorous structures and processes for project management;
- system development and major enhancements to be undertaken by project teams using proper standards and methodologies;
- the structural separation of system development and ongoing maintenance (see Figure 5 below); and
- a goal of having an 'adaptable and portable' IS workforce enabling free movement of staff among project and maintenance teams, based on resourcing needs.

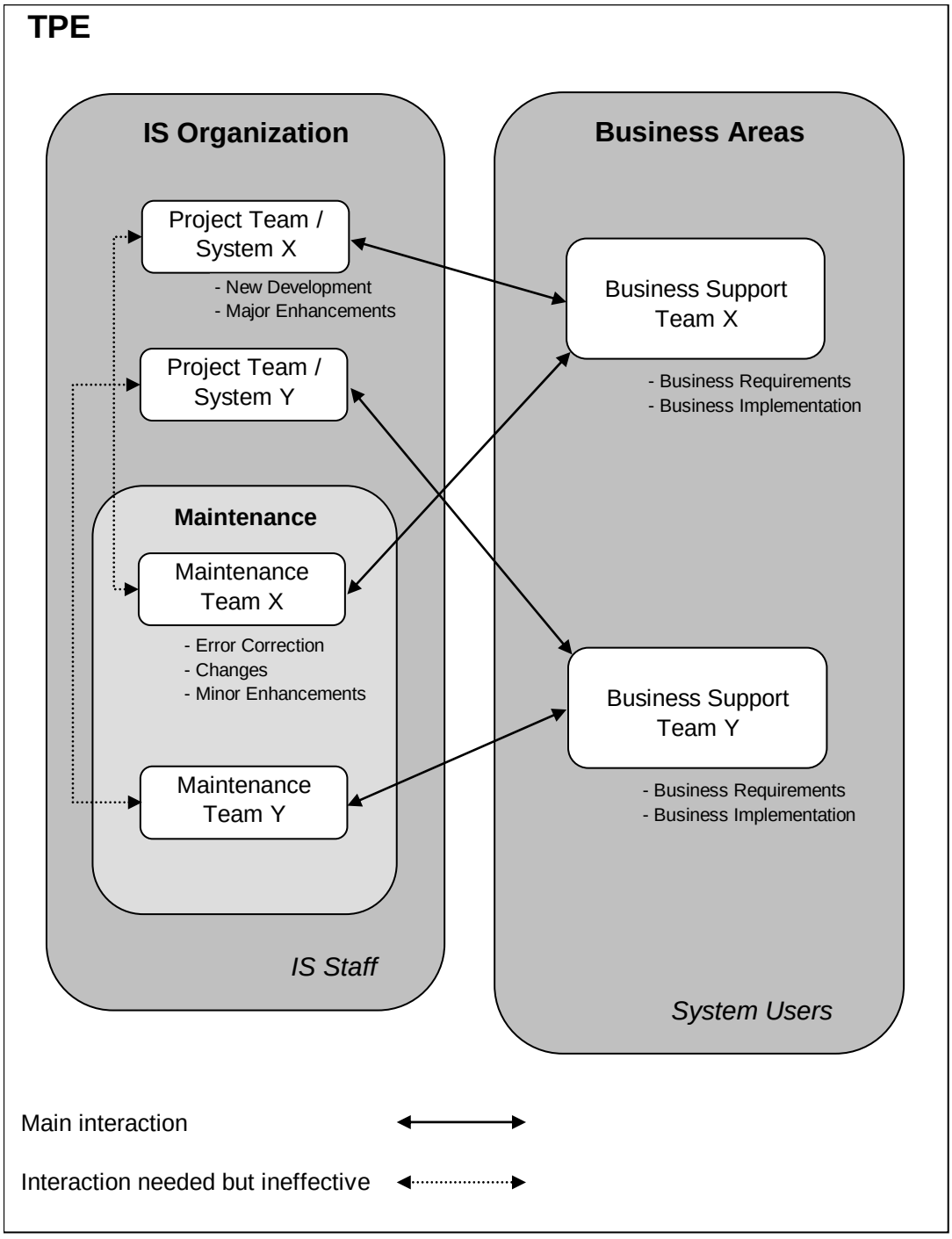

Figure 5. System Organization after Restructure (Simplified)

Figure 5 is an idealized diagram of the new structure, showing the separation of projects and maintenance, and typical links among related project, maintenance and business support teams. Figure 5 shows that interaction was in fact necessary between a project team which undertook development on a given system and the maintenance team which supported that system,

however the restructure rendered such interaction ineffective if not impossible to achieve (discussed further below).

The reforms aimed to institute a 'pure project' structure within the IS organization (e.g. Marchewka 2003: 81-82) with largely self-contained teams each dedicated to a project. Each project team would follow a rigorous methodology, and produce specified deliverable(s) within a defined timeframe. The project team would then be disbanded, and its resources allocated to another project or to maintenance. It was concluded that as maintenance was ongoing, it had to be structurally separated from development projects. The exact cost of maintenance would then also be made visible, and it could be controlled and minimized. Maintenance staff would also be portable, and could be reassigned within the maintenance branch or to project teams. All IS staff would thereby be 'adaptable and portable', and subject to reassignment between roles as required. The portability of staff was also intended to facilitate the professional development of staff, by providing opportunities to undertake new types of work. In effect many employees would move from specialist to generalist roles.

There was support from theory for some of the organizational change initiatives, for example, the adoption of good project management principles had long been widely espoused (e.g. Kemerer 1997; Royce 1998), and adaptable workers had been advocated by some writers (e.g. Davenport and Prusak 2000: 65; Dove 2001; Highsmith 2002; Marchewka 2003: 284-286). It all seemed to make good sense. The organizational changes were also endorsed by external management consultants who were engaged by the IT executives to advise them. Along similar lines, a widely-known IT consulting firm offered strategic management advice to CIOs as follows:

> ".. four of the top 10 strategic CIO management priorities focus on..
> • Applying metrics to the IS organization and IT services
> • Improving the quality of IS service delivery
> • Building a flexible technology infrastructure
> • Consolidating the IS organization and operations
>
> "This presentation provides guidance.. on achieving these CIO goals through thinking of and running their business as a business for the business (customers). This approach increases the credibility of IT to the business toward achieving a true partnership and value creation.. In addition, by following the path toward business orientation and transformation, IT will achieve that elusive and always-wanted goal of business alignment." (Haight 2006)

These general propositions corresponded to some of the statements made in TPE as rationale for the organizational changes (discussed above). The statement by Haight was published in 2006,

but it is likely that management consultancies had espoused similar views for some time. Although it could not be confirmed directly, it is probable that the external management consultants to TPE proffered similar advice, prior to the organizational changes.

As seen, before the restructure, the overall 'system team' structure including the corresponding business support teams essentially comprised part of a primarily functional, or function-based organizational structure (e.g. Marchewka 2003: 77-79). That is, a structure in which responsibility for the delivery of IS outcomes for business functions, including development, maintenance and support, was shared between business functional areas and corresponding system teams. After the restructure, the organization moved more to a form of 'functional matrix' organizational structure for IS work (e.g. Marchewka 2003: 83). That is, a structure in which there was still a functional focus, but responsibility for delivery of IS project outcomes was now shared between business functional areas and project teams, and separately, responsibility for delivery of IS maintenance and support outcomes was shared between business functional areas and maintenance teams.

As noted, the origin of these measures lay largely in the observed high cost of IT in TPE (in particular the perceived high cost of maintenance), combined with TPE's existing experience in sound project management. Limited attention was given by the executives to proper organizational change management and its requirements (e.g. Bridges 1995; Preece 1995; Senior and Fleming 2006). For example, Bolman and Deal (2003: 86-92) advocate that to be successful, an organizational restructure should include careful study of the existing structure and processes, clear definition of the new arrangements, and full communication with all affected people. Similarly, Young (2006) comments:

> "..structure is more about process design, roles, relationships and accountabilities. Thus, IT managers should approach the challenge of reorganization more in the context of work design.. Anyone making recommendations on this dimension should have a very good handle on these dynamics within the context of the specific organizational units that would be affected. To the extent such decisions will have a significant effect on the existing culture or staff, decision makers should also have a very strong background in organizational change management" (Young 2006).

In TPE the changes were essentially imposed in a 'top down' manner. There was limited analysis of the existing situation, although the executives did engage several IS mid-level managers to assist with the change process. Beyond these people, there were no 'change champions' or 'change agents' appointed to advocate and promote the changes. The executives did not hold discussions with the IS mid-level managers as a group, yet it was mainly the mid-level managers who collectively were expected to implement the changes and make the new

structure work. The mid-level managers would be required to devise new processes and procedures to support the changes, and put them into effect. There was also little attempt to involve general IS or business staff in the design of the changes, or to achieve a strong sense of ownership or 'buy in' of staff. In regard to communication of the changes, several information sessions for staff were held, but little else. Some key staff were not invited to the meetings, including some managers who were to manage teams within the new structure. There was also no single document which described all the changes, or provided justification for them, and the available documentation was mostly fragmentary. The most comprehensive document was one which outlined the anticipated structure and procedures of the proposed single maintenance branch, but it included little justification for the changes.

Some time after the organizational changes, a report to the IT executive committee on key issues and challenges made similar points. This report was based on the most prevalent concerns of IT mid-level managers, as recorded by the external facilitator of a series of seminars which covered nearly all 130 such managers. The report included the comments:

> "We don't have a clear and consistent communication of vision that is clearly shared across the organization.. Senior people are not seen as being up-front.. lack of transparency in decision making.. people feel isolated from the decisions that are being made – not enough of the decisions being made are being shared with the people who have to implement them." (Report to IT Executive Committee)

Bertsch and Markert (2002) observe in general that IT organization redesigns are:

> "major undertakings that stir up a lot of new issues with which to contend, such as:
> - Modification of processes
> - Re-identification of job roles
> - Development of communication plans
> - Implementation of transition plans
> - Employee discontent." (Bertsch and Markert 2002: 1-2)

There is no standard best-in-class structure for IT organizations, since each organization has unique features of its IT and business. An important consideration is to identify what currently works well, and work *with* it, not against it (Bertsch and Markert 2002: 2). Similarly, the findings of Agarwal and Sambamurthy (2002: 15) suggest that there is no single 'best' IT organizational structure, as IT needs to respond to the unique environments in which it exists. Bertsch and Markert (2002: 3) note that critical roles are often ignored in IT organization redesign, and this can have adverse results. This was borne out in TPE by the disregard of the key role of the system specialists. The executives also failed to properly understand the knowledge processes which centred on system specialists and communities of practice, and failed to define processes to replace those discarded, or specify how the new arrangements

would work (this is discussed further below). Bertsch and Markert (2002: 2) note that "if you don't have the correct processes defined, validated and adhered to, the most well designed organization structure won't have any impact on the changes you are attempting to instill."

In TPE, in addition to not acknowledging knowledge processes, there was little official recognition of the value of knowledge *per se* as related to a specific system. For example, an attempt was made soon after the organizational changes to record the skills of IS staff in a database which was developed in-house, to help facilitate the planned portability of IS staff. Significantly, the available options in the database did not allow knowledge of any system to be entered as a 'skill'. The available options were restricted to generic skills such as analysis, design and testing, and technical areas such as particular languages and platforms. Some staff protested about this, but to no avail, and it remained as such throughout the study.

The IT executives also tended to ignore reasonable objections that were raised regarding the organizational changes. For example, some mid-level managers and staff attempted to explain their understanding of the importance of the roles of the system specialists, and how the concept of an adaptable and portable IS workforce could undermine these roles. Some made written or verbal submissions to this effect. For example, one team manager said:

> 'They [the IT executives] don't seem to understand that we depend on people who have years of experience working on a system. You can't just throw new people in at the deep end and expect them to really understand what they're supposed to do, or properly understand the work that business needs to get done on a system.'

However such objections were generally treated as opposition to the changes. Similarly, a report to the IT executive committee on key issues, based on the most common concerns of IT mid-level managers (as recorded by an external facilitator) included the comment, "Some issues are presented to [IT executives] as a problem to be resolved, yet feedback we get is, 'don't be a change resister'." Once the notion took hold that a portable IS workforce with generalist roles was necessary as a key enabler of the other changes, no alternative view was considered. In time, many managers and staff simply accepted that the changes were inevitable, and ceased voicing their concerns, at least publicly.

It was mainly the IS mid-level managers who collectively were asked to implement the organizational changes and make the new structure work, yet there was clear evidence that many such managers were not in favour of the changes. It may be asked why in fact they persevered in attempting to make them work. In part this was due to the strong IS cultural ethic of hard work and providing a high level of support for customers. The organizational changes

had reduced the quality of service delivery for customers. If an excessive amount of time and effort was also spent by managers in opposing the restructure, it would likely have detracted from their systems work and further diminished the level of customer service.

Another factor that could not be discounted was coercive power. Each mid-level manager reported to an IS executive. In keeping with the hierarchical organizational structure of TPE, the IS executives had considerable influence over their direct reports. An IS executive could determine a mid-level manager's level of remuneration, and could also decide whether the manager received a bonus. The backing of the IS executive was also needed to support any promotional aspirations a manager may have. It was acceptable for a manager to express limited initial objections to the restructure, but any sustained campaign against it may have had adverse consequences for the manager. In their turn, the IS mid-level managers generally required similar support from their team members. If a team collectively opposed the restructure, its attitude could be taken by the executives as reflecting that of the team manager. A team manager did not have the same control over the remuneration of team members, but did have some influence over their career paths.

There was support from theory for some of the change initiatives, for example, good project management principles had long been widely supported (e.g. Cotterell and Hughes 1995; Kemerer 1997; Royce 1998). The concept of an adaptable IS workforce had been advocated by some (e.g. Dove 2001; Highsmith 2002). The structural separation of system development and maintenance was a corollary of the other initiatives. However in general terms the IT executives in effect followed the promoters of the earlier, now often-discredited approach of business process reengineering (or BPR, e.g. Hammer 1990), although in TPE the changes were not described as such. BPR advocates the creation of new, more efficient processes and structures, in so doing making a clean break from past practices, which in general are seen as historical accretions of little real value. For example, Hammer and Champy (1993) consider that it is irrelevant to business reengineering how people and companies did things previously. BPR encourages a lack of recognition of the value of past practices, and also of expert knowledge gained through long experience (Snowden 2002). As a result, by the late 1990s "a degree of disillusionment [with BPR] was creeping in, organisations were starting to recognise that they might have achieved efficiencies at the cost of effectiveness" (Snowden 2002: 101). In the TPE changes, the value of experience was largely unrecognized and ignored by the executives, and ultimately neither efficiency nor effectiveness gains were achieved, as discussed below.

A dedicated maintenance branch was accordingly set up, and initially comprised seven large teams, each of which was to undertake maintenance on an often diverse range of information systems. The maintenance branch consisted initially of about 150 staff, which if this could be sustained, would probably have represented a reduction in maintenance costs (even though these costs were previously not accurately known). Within two years the maintenance branch had grown by 70 per cent to about 240, which more accurately reflected the true cost of maintenance at the time. The cost was likely to have been even higher than it would have been if certain mistakes had not been made. At the time of formation of the maintenance branch, there was an assumption made by the IT executives that system development for the future was more important and more demanding than maintenance, and required greater investment of resources and expertise. For example, a discussion paper by an IT executive prepared prior to the changes included:

> 'We need to.. focus our resources and effort on building systems of the future.. build capability to take us into the future.. with more efficient and effective use of resources.. to invest in the future not the past.' (TPE IT organization, Discussion Paper)

As a result the project teams tended to be allocated more of the most experienced and skilled staff, while maintenance teams generally received less experienced people. The project teams were spread across seven branches, each directed by an IS executive, while the largest branch, maintenance, had just one executive. The ratio of executives was not in proportion to the relative sizes of project and maintenance areas. In the third year of the case study the IS organization consisted of 689 staff, including management and administrative support. There were 467 staff in projects with seven executives, and 197 staff in maintenance with one executive. That is, there were three times more executives per staff member in projects than in maintenance. Moreover, the number of mid-level managers per staff member was also significantly higher in projects than in maintenance. In TPE as in many hierarchical organizations, the status of an organizational unit was often gauged in general terms by the number and level of its senior staff. In TPE, executives had considerably more power and influence than mid-level managers. Their higher status and prestige was acknowledged tangibly by significantly higher remuneration and extensive perquisites of office.

Even more significantly, there were seven project executives and one maintenance executive on the IS executive committee. Therefore at executive level, projects had approximately seven times more voice and influence than maintenance. The IS executive committee was dominated by a 'project' perspective. Glass (2003: 120) also acknowledges the widespread bias in favour of development, and notes that contrary to a common view, maintenance is often more difficult and demanding than development (as seen). As a possible origin of this attitude, it has been

suggested that, "High IT project failure rates have resulted in a generation of IT organizations focusing on project execution improvement" (Harris 2006a). That is, the emphasis in many organizations on software development and rigorous project management stems from the long series of high-profile IT project failures in recent decades (e.g. Standish Group 1995). There was reason to suspect that a similar rationale applied in TPE. TPE itself had not had many substantial IS development failures. However at least two IS executives had fairly recently moved from organizations which had experienced major IT project failures shortly before. Moreover, the IT executives were generally aware of broader issues in IT.

Prior to the restructure in TPE, development and maintenance seemed to have about equal influence at executive level. The IS executives were not divided into 'development' and 'maintenance' roles. Each IS executive typically had responsibility for both the development and maintenance of systems within their portfolio. But probably more accurately, any difference in attitude to development and maintenance could not easily be translated into action, because these functions were closely integrated within system teams. The restructure acted to make manifest the differing attitudes to development and maintenance at executive level, to the detriment of maintenance. In many cases, the maintenance teams had also lost direct and easy access to many staff with long experience, as many of these had been placed in project teams in different areas and management structures, and were largely inaccessible due to their changed work commitments and (often) new locations.

All critical production systems, and a considerable number of other systems were allocated to the maintenance branch for ongoing support. Around 80 systems were included. The original intention had been to divide the systems among teams in a logical manner according to type of business function. However the approach was successful for only some teams. The maintenance branch initially had seven large teams, each of which supported an often diverse range of systems. In at least several cases the allocation of systems to teams was made more for motives of equalizing the workload across mid-level managers, than for any other reason.

As an example, a typical maintenance team was initially set up with about 30 staff to support nine key systems which were in three distinct business categories representing different business support areas. Only a few of the systems were related. There were also several different basic technologies (languages or technical platforms) used in the systems, mainly reflecting their various years of creation and the technologies favoured by TPE at those times. In keeping with the executives' principle of an adaptable and portable IS workforce, it was intended that most team members should be able to support any system, and would move to

meet various needs as they arose. In this way resource needs were expected to be minimized. Accordingly the team had no internal structure which matched either the business functions supported or the system technologies. Some team members saw the team as consisting of disjointed and unrelated components – for example, one said:

> 'This team is just a "camel", it's got bits and pieces from all over the place. It's actually more like some sort of weird animal from science fiction, with bits and pieces from all kinds of different animals.'

Another member of this team said:

> 'It's simply not possible to move people around to work on just any system in this team. You've got to have people with experience in each system, working on it. You might be able to have one person build up experience in say two systems and move between them, but that's about it. These aren't toy systems, they're big and complicated and they've been changed and added to for years. Some people don't seem to understand this. They're usually the ones who've never actually worked on any of these systems before.'

In this maintenance team, for six of the nine systems there were staff members (generally only one) with significant experience and knowledge of that system. The remainder of the staff were much less experienced. The team's initial structure did not prove workable, mainly because most of the systems required high levels of focused expertise to support them effectively. The team struggled in this state for about ten months, and IS service delivery, overall effectiveness and team morale were poor. At this point the team manager restructured the team into three sub-teams which better matched the natural business categories, and focused the work of each sub-team on to its respective system(s). In most cases each sub-team then had just one corresponding business support team to deal with. The overall team structure was still far from being ideal, but within several months effectiveness and morale had improved to some extent. The division by business function was more effective than any potential division according to basic technology or platform. However the team still floundered because access to the full range of system specialists remained limited, as many such people were now located elsewhere and were largely inaccessible. Partly as a result it was found that there were too few staff in this maintenance team to properly deal with all demands, and within a year the team had grown to over 40 (up by 35 per cent). This more accurately reflected the level of resources needed to support the nine systems, although the structure and processes were still not optimal.

Another typical maintenance team was initially set up with about 20 staff to support 14 systems which fell into four distinct business categories. Only some of the systems were related. There were several different technologies used in the systems. This team was fortunate to have received from the restructure some staff with a reasonable level of experience for most of its systems. From the outset the team manager had divided this team into sub-teams based on

business categories, each of which communicated independently with its respective business support area. This was essentially in defiance of the policy of an adaptable and portable IS workforce. In this case also, one large maintenance sub-team happened to remain co-located with its corresponding project team. The respective teams were divided only by an aisle. While this situation lasted – for about two years – the maintenance sub-team was able to have considerable covert interaction with the project team, to the benefit of both. This occurred with the clandestine support of the managers of both teams. Again, this was basically in defiance of the executives' intentions. This reflected passive but informed opposition to the organizational changes, but on a fairly small scale. The project team was disbanded on completion of its work, and its staff dispersed to other projects. From this point the maintenance sub-team gradually declined in knowledge and effectiveness. A few staff complained that they were becoming 'de-skilled', with their work being focused on routine maintenance, with a lack of interesting development work and reduced access to experienced staff with deep knowledge of the relevant systems. Three employees left this maintenance team for such stated reasons, including one who had to leave TPE to find other work.

6.1.1 Effects of Organizational Changes

After the organizational restructure, the project teams which were set up worked on both new developments (which were fairly rare) and major enhancements to existing systems. Each project team generally focused on one system or a small set of related systems – just as the earlier system teams had done, but with maintenance now excluded. Few project teams undertook purely new development, and most teams did only major enhancements to systems which had been implemented years earlier. The major difference between the work of 'project' and 'maintenance' teams lay in the size of the discrete tasks undertaken within the two areas. As such the work of a project team was typically closely related to that of corresponding maintenance team(s). It would have been of greater benefit to TPE if the 'project' and 'maintenance' teams had been able to collaborate more fully, instead of having to compete for expert resources. However this was against the intent of the organizational changes. As time passed, project teams often gradually lost the system specialists they once had, in some cases to the maintenance branch. They also then struggled because access to specialists was limited, since such people were now often dispersed and relatively inaccessible.

Figure 5 above represents an idealized version of the new structure. The reality was more complicated (see Figure 6 below), resulting from a combination of several factors, as discussed below.

a. Firstly, each *business support team* now had to interact with several IS teams. It had to deal with at least one maintenance team and one project team, and often more than these. Some related systems sharing a common business support team had been placed into different maintenance teams, reflecting in some cases a haphazard approach to the restructure. Also, in some cases different projects were set up to undertake tasks which included work on the business function represented by one business support team.

b. Secondly, each *maintenance team* had to interact with several teams. Each maintenance team had to support multiple systems, which often had different corresponding business support areas and different corresponding project teams. Each business support team was likely to have its own unique methods of interacting with its corresponding maintenance area. Even when a maintenance team was structured into logical business function-based sub-teams, the maintenance team still also had to operate as an entity, so complicating its management process, and leading to much time and effort being expended purely on administration and coordination activities.

c. Thirdly, each *project team* had to interact with several teams. Typically a project had to interact with only one business support team. However a project team might need to deal with more than one maintenance team, because a product under development could impact on various existing systems supported by different maintenance teams. A project team might also need to deal with several other project teams, if its work cut across several systems.

d. Each project team was expected to form and re-form in response to business needs and so have a finite life. If this intention had been fully realized, it would have resulted in shorter-lived relationships among many teams, and even less opportunity to develop effective working relationships.

e. Finally, the entire IS workforce was intended to be adaptable and portable. If this had been fully realized, it would have led to more frequent disruptions of relationships among both teams and people.

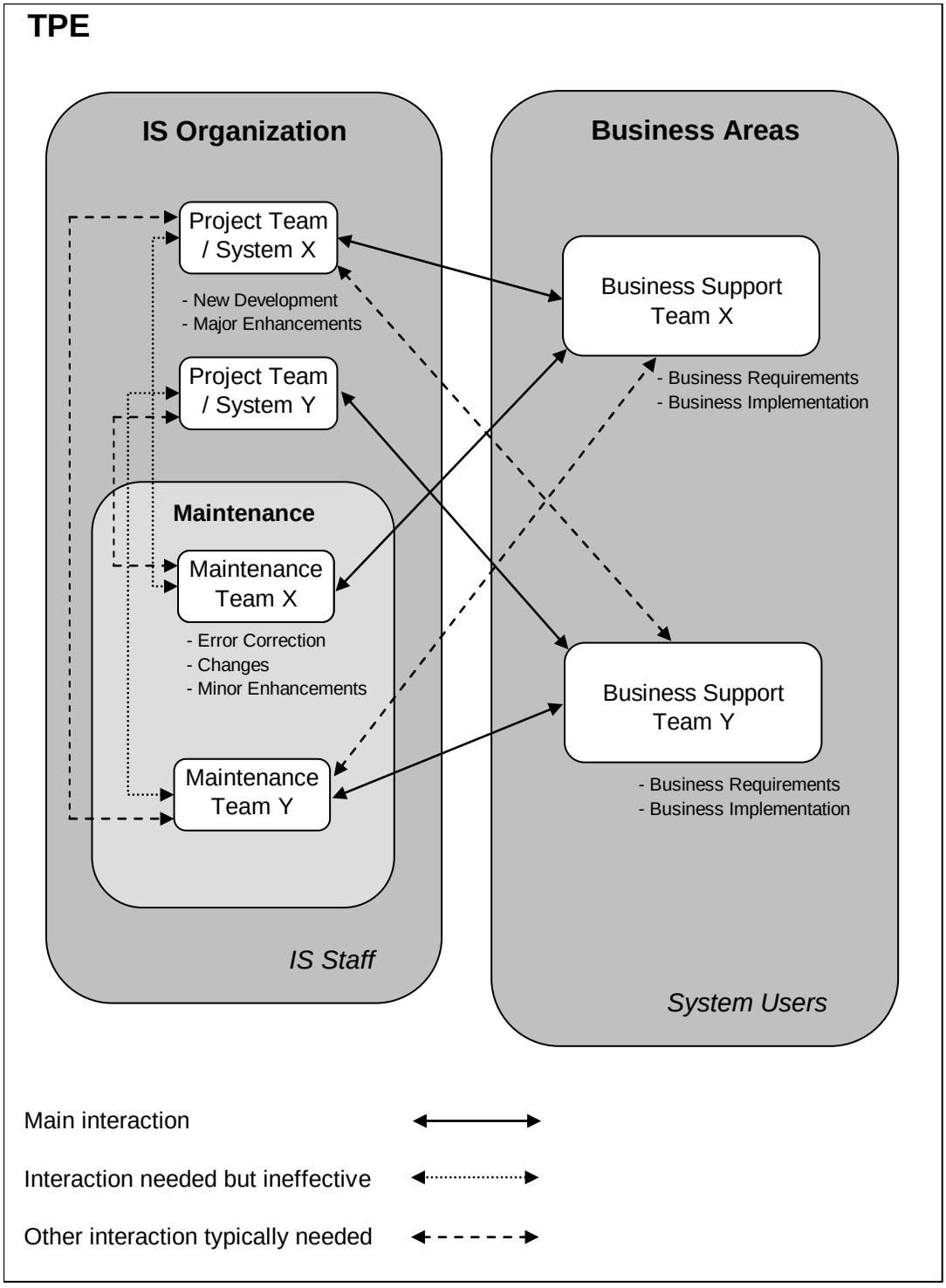

Figure 6. System Organization after Restructure (More Realistic)

All of the above factors meant that there were now multiple and more complicated links among teams and people than previously, and this acted to undermine the former situation of long-standing relationships of trust and effectiveness among teams and within communities of

practice. The previously quite direct state of alignment between IS and business had led to effective long-term relationships developing between a system team and its corresponding business support team. These direct alignments and relationships were substantially altered and undermined by the organizational changes. Resulting problems related to the interfaces required among project, maintenance and business teams after the restructure are discussed in more detail further below.

As noted earlier, prior to the restructure changes to several systems sometimes required interaction among the relevant system teams. Such changes were typically undertaken by each team, coordinated if necessary by change control processes which operated at a higher level than the system teams. Generally, the respective system teams had the resources and knowledge needed for the work. After the restructure, a project team was sometimes required to undertake major enhancements to several systems. However often the project team found that its experience and expertise lay mainly in just one system, typically one it had been set up to work on. For example, a project team was created to focus on enhancements to 'system j'. Its work also required enhancements to 'system k', but no project team had been set up to focus on 'system k'. There was a 'system k' maintenance team, but its work and level of resources were restricted to error correction and minor changes to 'system k'. The 'system j' project manager commented:

> 'We have to do quite complicated work on [system k], but none of us have ever worked on it before. Our experience is mainly with [system j]. There's no one really who can help us. The [system k maintenance team] doesn't know a lot about [system k], and there's only a few of them anyway, mainly just to keep it running. They don't know how to do major changes to it. There used to be a full [system k team] that looked after everything for [system k], but they reckon that isn't needed any more.'

Signs emerged within 18 months of the restructure that many project teams seemed reluctant to disband after their defined tasks were completed, in accordance with standard 'pure' project methodology (e.g. Marchewka 2003: 81-82). In some cases it was clear that project managers and their supervisors were not willing to give up project staff, in anticipation of further work being needed on a system, while knowing that they already had experienced staff and knowledge within the team. The difficulty of capturing a project team's knowledge and transferring it to a future new team was recognized (compare Disterer 2002), and this contributed to the reluctance to disband project teams. Moreover, in many cases the business area's interests were best served by keeping a project team in place, just as the earlier system team had been retained largely intact. There was often tension between the need of executives (both IT and business) to provide resources for a new project initiative, and the desire of both business area and project team to keep experienced IS staff in place for expected future work

(compare Marchewka 2003: 82, 284-286; Meredith and Mantel 2000). The vision of the IT executives for a structure in which project teams would dynamically form and re-form in response to changing needs was little realized in practice.

The IT executives' philosophy of a portable IS workforce was reflected in the maintenance branch by a policy designed to encourage the exchange of staff among different system areas. This 'exchange policy' had initially aimed for the turnover of all staff in each team within a year. Accordingly, about a year after the restructure, each maintenance team manager was asked to provide a 'transfer date' for each team member. In response, one maintenance team manager commented in writing:

> 'I think it would be a good idea to make the average stay of staff in [maintenance] reasonably long.. The main issue is learning about the systems, many of which are large and complex, but often not well documented. The issue doesn't relate so much to knowledge of the basic tools and technologies etc. If someone is in [maintenance] for only a year or so, they may have just reached the point of knowing enough to be useful, only to move on.. [IS] seems to want staff to stay only relatively briefly in [maintenance], in a way that doesn't seem to apply to any other area in [TPE]. Even in projects the project manager can reasonably expect that many staff will stay until implementation. There's always natural attrition, but rarely "attrition by policy". The exchange policy could create particular difficulties for [maintenance] managers.. in that they can't really put in place longer-term programs of mentoring for staff, as regards knowledge of systems. They also can't facilitate longer-term team building. There doesn't seem to be much in the way of documented justification for the policy. It wasn't mentioned in the [announcement of the launch of the maintenance branch].'

Another maintenance team manager added:

> 'There is currently a strong dependence on key people knowing what must be done and when. While this sort of information should be adequately documented, it often isn't. Consequently I think we are taking a very big risk implementing an exchange policy which deliberately increases staff turnover in such a critical area as [maintenance].. Mind you, it is [IS] policy to transfer people into and out of [maintenance].. Fighting it mightn't be an acceptable position to take. Perhaps we should try to identify the risks posed by the policy with a view to identifying ways of dealing with the risk.'

The maintenance branch exchange policy proved in practice to be unachievable, and any specific transfer targets were withdrawn. However the general policy remained in force. It was difficult to understand the initial level of support by the IS executives for the exchange policy. It was perhaps based on a pervasive dislike by many of maintenance, possibly because it was seen as not important, or lacking in challenge, or not technically demanding enough. As seen, these views cannot be substantiated, and maintenance is a critical, demanding and challenging task. As Glass (2003) comments,

> 'It is common, in the software world, to believe that software maintenance is something of an unworthy activity, in some ways beneath the talents of the software developer.. Maintenance is, in fact, quite complicated work.. it is possible to claim that maintenance is a more difficult task than development.. it is probably the most important life cycle phase of software.. In a survey.. researchers found that the "biggest problem of software maintenance" was "high [staff] turnover".' (Glass 2003: 115-117)

After about two years there had been a certain amount of staff movement within the IS organization for various reasons such as promotion to new jobs, but there had been relatively few movements resulting directly from the 'portability' policy, which had essentially failed. The outcome was largely due to a marked reluctance of mid-level managers (both project and maintenance) to give up experienced staff, in a situation in which significant experience was now dispersed more widely and thinly than it had been before, and had thereby become a scarce resource subject to competition. There was also a reluctance on the part of mid-level managers to accept staff of doubtful capability or experience from another team, and a sometimes well-founded suspicion that some managers were trying to dispense with poor performers. The effective failure of the portability policy reflected a passive but informed resistance by staff and mid-level managers to the organizational changes. In the maintenance branch, some competent employees succeeded in gaining promotion to other areas, but most of the less capable or experienced staff remained in their teams. One maintenance team manager commented:

> 'We've lost some good staff on promotion to projects. We can't stop those ones going. The project managers are always willing to take good people, but they don't often offer any of theirs to us. More often they try to offload ones who aren't too good. It's a bit like panning for gold. The project managers keep the gold nuggets in their dish, and we get the sand and gravel.'

It was significant that the policy objective of a 'portable workforce' was applied only to the IS organization. It was not applied to the rest of the IT organization, and nor as far as could be observed, to any other part of TPE. In fact it was contrary to the history of practice within TPE, to the extent anyone consulted could recall. It was widely criticized by both IS and IT staff, and regarded as being against a long-standing tradition of human resource management practice in TPE. In fact it was contrary to the organizational culture of TPE, and therefore it was not surprising that it was opposed and effectively undermined. Some staff even considered the policy to be in contravention of TPE's mandatory HRM procedures. However no compelling case could be made to support this, since the situation was not clearly addressed in TPE's HRM procedures, and the policy had been supported by the IT organization's HRM area. One employee commented:

> 'It's never been done like this as long as I've known. You've always been allowed to apply for a job you wanted, they'd hold interviews, and if you got the job, you owned it. They're trying to push people around into different jobs that can really be poles apart. They say they're basically all the same, but they're not. There's big differences between

> the work in one job and the next. Just to say that it's ok because it's all in [IS] isn't right. I reckon that if someone put in a formal protest about this to [TPE's corporate HRM area], it wouldn't stand up.'

Prior to the restructure, a staff member in a system team typically had available a variety of work related to the system(s) of that team, including contributing to development, major enhancement and maintenance. This allowed reasonable opportunities for professional career development for staff. Even a novice in a system team could often be allowed to contribute to development tasks, mainly because such work was done on a fairly long time scale and with a number of participants. The work of a novice could in effect be 'submerged', allowing them space to learn and develop professionally. After the restructure, and with the failure to achieve a significant level of portability of IS staff, there was now less opportunity for varied work for maintenance staff than there had been before. Now there was usually only maintenance, including error correction and minor changes, although many of these tasks were complex. There were now fewer and narrower opportunities for career development, and many of the less experienced staff complained that they were not given a chance to undertake any sizable development tasks which could 'stretch' them. In addition, inexperienced staff often could not be given the more complex maintenance tasks, because of their high priority and the pressure to complete them quickly. The outcome of most maintenance work was very visible, and the work usually had to be done by the more experienced staff. Some less experienced staff felt that they had become 'de-skilled' over time. This was one of the reasons why the portability policy had been initiated in the first place, however in practice it had proven ineffective, as discussed. The ramifications from either 'knowledge' or career development perspectives had been little considered by the executives. One maintenance employee commented:

> 'Mostly I get only routine production data updates to do for business. They happen nearly every week. I've got quite good at doing it, after two years. But I don't get much of a look in with the more complicated and interesting work. I've been sidelined into this backwater and I'm not really learning anything new. Projects are the keys to heaven around here now, but we don't get any real project work.'

Some years after the restructure, in a few cases a maintenance team was allocated some smaller projects to undertake, by agreement among the IS executives. This occurred partly as a result of complaints from maintenance staff about their becoming 'de-skilled'. Another contributing factor was complaints from some project teams that they had too few staff and too much difficult and demanding work, and allegations by them that maintenance had too little such work and too many staff. However such initiatives affected only a few maintenance teams, and in a limited way. Also for similar reasons, in some maintenance teams a few staff were seconded to a project team for a few months, by agreement between the respective team leaders. This was done for the maintenance staff to assist with the project's work and learn about its

product, which would in time be passed to the maintenance team to support. However this initiative benefited only around five per cent of maintenance staff at any time. For some, it had a positive outcome in terms of professional development, but it affected a minority of people. In general, these initiatives could be seen as small-scale attempts by some staff mainly at the 'grass roots' level to reinstate some aspects of the former system teams, and as such, limited expressions of opposition to the organizational changes.

A relatively small amount of policy-based portability of IS staff had occurred. There had also been a larger amount of staff reallocation imposed earlier, at the outset of the organizational changes. Together, these actions highlighted the problems involved in placing people with limited experience into a team in which they were required to have expertise in a complex system, often new to them. The view of some executives and others with limited practical IS experience was that the necessary knowledge could be transferred from an expert to a novice as a quantity, rather like pouring water into a bucket. A 'knowledge transfer' policy was therefore instituted, but it was found to be largely ineffective. Many beginners in a particular system were unable to 'come up to speed', even after many months. For example, in one particular maintenance sub-team all members had entered as novices in the system supported, and the team lacked an in-house specialist. An IS executive commented regarding this team:

> 'They've been working on [system w] for two years now, but they still can't handle any hard problems. They've had two years' to learn about just one system but they haven't put their minds to it. On top of that they keep on getting [A – a specialist who used to work on system w two years earlier] to come and help them out. Whenever there's an error, or a change that isn't straightforward, they're on the phone to [A] wanting him to do their work for them. When are they going to learn to stand on their own feet?'

In fact most novices in the IS organization had to embark on a prolonged learning curve, which was often exacerbated by limited access to experienced mentors for guidance. This acted against the goal that many such people had of becoming more effective in their work, and possibly eventually becoming a system specialist. The outcome was that the overall level of effectiveness and efficiency of system support was reduced.

As noted Styhre (2003) observes that many writers have a functional view of knowledge, which is treated as a tangible resource that can be managed and transferred at will to benefit an organization (compare Tsoukas 1996). This tendency to conceive of knowledge as an entity is prevalent because many are concerned with its codification, to facilitate transfer. Such a view prevailed among TPE's IT executives. Also as noted, in the technical-rational model problems are seen as being solved objectively through the application of logical analysis (Lester 1995). The dominant approach to date in professions such as IT has been technical-rational (e.g. Bines

1992). This was the case for many IT and IS staff in TPE, including the IT executives, and so they could visualize a ready transfer of knowledge from expert to novice. As seen, objectivist knowledge transfer methods may be appropriate for some entry-level learning by people with little prior understanding, while constructivist approaches typically have value for higher-level learning by people with relevant experience. Nevertheless, relying on objectivist methods for entry-level learning has distinct limitations, as demonstrated by the case study.

In contrast to the technical-rational approach, Styhre (2003) argues for a processual perspective on knowledge. Knowledge is manifested and brought into action through interactive processes. Knowledge underlies social practices, is embedded and entangled in social interactions, and is therefore distributed and dispersed. Knowledge is fluid, dynamic and emergent through interactions, is continually updated and refined, and is not fixed and stable. Orlikowski (2002: 252) sees knowledge as "an ongoing social accomplishment, constituted and reconstituted in everyday practice." As such knowledge is often not amenable to easy transfer as an entity or quantity. In TPE, the case study revealed that the knowledge embodied in a complex information system is fluid, emergent and distributed across people and processes of interaction within social networks. Knowledge sharing for a system occurred to the extent that it was necessary to provide effective support for the system. But to go beyond this, and to achieve easy transfer of the complex knowledge of a system to a novice was quite a different matter, even when a specialist was available to advise the novice.

6.1.2 Interfaces Among Projects, Maintenance and Business

The organizational changes imposed a separation between maintenance and projects. A new division of labour was introduced between each maintenance team and the corresponding new project team(s). The project teams were now responsible for developing new systems and undertaking substantial enhancements to existing systems, before implementing their products and passing them to maintenance for ongoing support. However there were frequent disputes between maintenance and project teams. Many of these were related to the fact that it became fairly common for project teams to make decisions for the sake of expediency which allowed a product to be delivered faster, but which had downstream effects of causing ongoing maintenance problems, or excessive commitment of time for support. In many cases a project team would prevail upon business to agree to an option which gave faster delivery. This was usually supported by the IS organization in general, which insisted on projects doing their best to meet deadlines under the reintroduced rigorous project management standards.

In general, as Murphy (2003) points out there is often too much emphasis in organizations on achieving efficiency in undertaking IT projects, at the expense of realizing business outcomes:

> "One of the biggest impediments to achieving [business] benefits is the absence of clear accountability for achieving them. Too often 'accountability' is viewed in terms of 'getting the project in on time and within budget'.. this does not guarantee business benefits." (Murphy 2003: 12-13)

In TPE, a common situation was for a project team to deliberately fail to invest the time required to build a module which was actually needed as part of a system, for the sake of expediency. For example, often a module was not developed which would allow users to update certain types of data. Rather, maintenance was obliged to do this by emergency changes to the relevant production data, whenever required. Not only did such work require unnecessary time and effort, but it often also conflicted with IT security policies regarding emergency changes to live data. Such changes were permitted only in genuinely urgent cases, to restore production after a failure. Maintenance staff and their managers were often put in an invidious position by being obliged to justify routine data changes as 'emergencies', when in fact they should have been catered for by the system. One maintenance staff member said:

> 'We often have to fix up hundred of rows of production data in [system z] every month now. When the project team was working on it, we sat in the peer review and told them they should build a module to do it. It wouldn't have taken them too long, but they wouldn't listen. Now we often get targeted personally by [IT security] when we have to change the data. It's somehow become our fault. The project team won't have anything more to do with it. As far as business is concerned, they only care about getting their data fixed. They don't mind how it's done. They don't care if we get in trouble with [IT security]. [IT security] only go after the person who changes the data. They don't even bother looking into why it needs to be done, or what the history was.'

As another example, a project team chose to develop a product by 'hard coding' certain parameters into its programs. Basically this was done to enable the product to be developed more quickly and with less effort, and thereby to have greater chance of meeting a deadline agreed with business. The maintenance team argued that instead, greater flexibility could be achieved by building reference tables to allow selection by users of the parameters required at any given time. An e-mail debate held between the maintenance and project teams included the following remarks:

> Project: 'At the external review [of system v], an issue was raised which was outside the agreed scope.. changing the design so that it is table driven presents a great deal more build work and an increased amount of function testing. This change could impact on when we are able to deliver..'
>
> Maintenance: 'From the [maintenance] point of view we disagree strongly with [parameters] being hard coded. As the eventual custodian of this functionality and given our experience in hard coded items in other programs that should/can be variable we will

> end up with a tremendous work load in future.. [System v] has been set up as a [parameter] table driven product to make changes easier for variable information.. [parameter tables] have proven very flexible in their ease of change.. Hard coding could take months to change..' [this referred mainly to the protracted testing and release processes required for most code changes]
>
> Project: 'It's up to the project team about the way we undertake the HOW bit. The structure and intent of the code meets the business outcomes and achieves the best results in the timeframe.. unless our business partners direct us otherwise – and accept the likely delay in delivery of the product – we must continue to build in order to meet our timeframes.'
>
> Maintenance: 'My concern is not for the project as much as for the end product. I am willing to work with the project as partners but will not subjugate our views on important issues. We are asked to provide feedback on specs [specifications] and because of our role we will look at the spec differently than business – or it seems the project – as we have longer term impacts to take into consideration. Now is the time to change the build not in 6 months or a year if we feel that it is being designed incorrectly. The HOW bit is not just the project team's decision, that is how [IS] has got into trouble [previously], the project team should offer alternative HOW bits if there are any and a recommended HOW bit for discussion and the best HOW bit chosen by all stakeholders, ie you [project team], business owners and [maintenance] custodians. If our views to the project are not important why do we spend so much time reviewing the specs? If our views are incorrect we will listen to the alternatives, however the only reason that I have been given for this decision is [that] it's quicker. I agree that business have to be the final arbiters but they have a right to hear other views. Many may not understand the difference between hard coding and [parameter] tables and the impacts on changes that each offer or impose.'

The outcome was that the project team's view prevailed, supported by the business area (this is discussed further below).

As a further example, a large system team had commenced developing a particular system ('system t') about a year before the restructure. It was then divided into a project team which varied over the years from about 20 to 30 members, and a small maintenance team of three to four members. The project team undertook most of the work on the system, including all significant development, enhancements, changes and error correction. The maintenance team mainly did just routine changes to certain tables. The project team failed to document their work properly, failed to adequately involve the maintenance team in their work, and failed to effectively transfer knowledge of the system to maintenance. Generally this resulted from deadline pressures on the project team, combined with a single-minded focus to 'get the job done.' In particular, the project team failed to document or explain some complex non-standard procedures they had adopted in developing the system, and which had been embedded in it. The maintenance team was not 'pushy' in demanding that they be kept informed. In fact the

maintenance team developed a state of dependence on the project team. The maintenance team came to feel that significant changes and errors were not their role to handle, and that this had been decreed by the IS organization. They came to have less and less interest in them, and their level of knowledge of the system declined further over time.

After several years this project team was gradually wound down in the face of reducing demand for changes from business, and pressure to use the team's resources elsewhere, and the project team was finally disbanded. Some six months after the project was disbanded, the maintenance team was floundering in their attempts to understand the non-standard procedures and to support business requests for changes. By then many former project members had left TPE. Only two former project experts were left in TPE, and these were in another project working to stringent deadlines, and were virtually inaccessible. The work of the maintenance team suffered accordingly, and consequently the level of support for business. Another project had also implemented a product which created many errors in 'system t', by changing the environment in which it operated. The 'system t' maintenance team manager said:

> 'The project team always did all the complicated work on [system t]. We were only ever asked to do the [table] changes. Suddenly the project team is dissolved and we're expected to take on all the sorts of work they used to do. With about a tenth of the people. We weren't ever asked to do this before, and we don't even have a good understanding of it. Now they're saying that we should have learned it all before, but that's all very good in hindsight. No-one told us that at the time. We were supposed to know about it by osmosis or something. They say the number of changes has gone down. That may be so, but it's not true for the number of errors, or how difficult they are. It's all about understanding [system t] and what can go wrong with it, and how to fix it.'

Another problem related to the fact that after the restructure, a guideline was established by the IS executive committee that if a change request required a person-month or less it would generally be done by maintenance, otherwise it should be directed to a project team. In the first year after the restructure, a project team would sometimes collude with business to under-estimate the resources needed for a task, with the aim of directing it to maintenance. Even if maintenance later disagreed with the estimate, by then the task had often become their responsibility. For their part, maintenance and business teams also sometimes employed deceptive practices. About a year after the restructure, the procedure for business to request a system change or error correction included formal assessment by the maintenance team of the work that would be involved, and an estimate of the resources and time it would take. If a change request was either well under or well over a person-month, there was usually no ambiguity. However requests of around a person-month were sometimes creatively over-estimated by maintenance, if it was considered they should be done by projects. For example, a project manager said:

> 'We often find we have to do work that [maintenance] really should be doing. They say that it's over a month's work and so it eventually comes to us. Sometimes we find that it's less than a month, and so you've got to wonder. This happens too often to be just a fluke. You might say it's only a few days here and there, so why worry? But with all the times this has happened, it adds up to a lot more. It's not the way we ought to be doing business.'

As a variation on this tactic, sometimes a business support team, often in collusion with a project team, would break up a larger change request into smaller parts, each of which was likely to be under a person-month, with the aim of having them done by maintenance. These forms of manipulation of the change request guidelines often led to conflict among projects, maintenance and business, to the detriment of focus on genuine system issues, productive collaboration and knowledge building about the system.

6.1.2.1 Warranty Processes

It was recognized soon after the organizational changes were instituted that a formal procedure was needed to help manage the interface between projects and maintenance. Accordingly, two mid-level IS managers suggested having a 'warranty' procedure aimed at reaching formal agreement among the affected parties. This procedure was introduced by the IS executives. It essentially entailed processes of negotiation and agreement aimed at enabling a smooth handover of products from projects to maintenance, and ensuring that any initial errors or problems were properly resolved by the project team for an agreed 'warranty period' after development of a new product, typically about two months. The warranty period recognized the fact that not all problems necessarily showed up in testing, and some conditions could not realistically be tested until they arose in production.

A warranty agreement base template was accordingly set up, which was intended to be filled in and modified if necessary by the relevant parties involved in a product release. It provided space for formal sign-off by the relevant managers, both at the time of initial agreement of the warranty, and at the end of the warranty period. The template continued to evolve over the course of the case study, mainly through the addition of extra points not originally considered.

It was later recognized that the business support teams were also stakeholders in the warranty process, and should be included in any negotiations and agreements. In the initial year after the organizational changes, the warranty process focussed mostly on maintenance and projects, but thereafter the business support teams became more significant, eventually often playing key roles. In this context, the interests of a business support team often shifted uneasily between the

interests of a project team and those of maintenance. This was partly because a business support team often initiated the business requirements which led to a project being set up, and so had an interest in ensuring that the requirements were converted into a useful system product to be implemented as quickly as possible. A business support team also had an interest in ensuring that the new product was as accurate, complete and reliable as possible, and that it did not become an error-prone liability after release (as some systems did, for example, as referred to in section 5.2). This conflict of interest on the part of business support teams was never able to be resolved.

There were many problems with the warranty process, most of which reflected underlying problems with the organizational changes and their effects, and in particular tension between a maintenance team and the corresponding project team(s). To a large extent this stemmed from the different perspectives of maintenance and project teams and their differing approaches to knowledge about a system and what aspects were seen as being most important, brought about by the organizational changes. As an example, as seen project teams typically valued speed of delivery of a product and adherence to schedule, whereas maintenance teams typically valued quality, robustness and reliability of a product more highly.

The warranty process was set up to reflect the fact that many of TPE's systems processed high volumes of transactions in short periods of time. As such, generally a reasonable proportion of a system's functionality could be run in production (or 'exercised') within a warranty period of some weeks. However there was a fundamental drawback to this in that many systems also had key functionality that was run irregularly, or at long intervals, for example monthly, quarterly or even annually. The intention was that a warranty period would be extended by negotiation until most functionality had been tested in production. However often a project team would not agree to this in order to free up resources to focus on other work, and prevailed upon the business support team to agree to this. This made the value of such warranties moot. On top of this, the initial 'standard' warranty period of two months was subject to pressure from project teams to reduce it over the course of the study, and it finished up at only a month. Issues of this type had not normally arisen under the system team structure, because typically a system team endured and was available to correct any problems that arose, even if they took many months to come to light. One maintenance team member commented:

> 'We have to take on the new work done on [system y] now, but we won't know if it works properly until next year, when they do the big [business function c] run. By that time the project will be working on their next thing, or they might've all gone and we'll never see them again. You wouldn't buy a fridge in winter if it only had a warranty of two months, because you wouldn't know how good it really was 'til next summer.'

In the early years after the organizational changes, several maintenance team managers took the view that while some kind of informal warranty agreement may be needed under the new arrangements, there was no need for any real formality, since everyone was willing to cooperate for the corporate good of TPE. In general this attitude stemmed from personal experience by these managers of the earlier era of system teams, when in fact most work on a system was done within one team, usually without any need for formal documented agreements. For example, one maintenance team manager said:

> 'All we need is a "gentlemen's agreement" on this. We're all in the same boat, and we all pull together. It's not as if we're on different sides. We've never needed a written agreement to get any work done on our systems before. That kind of thing is only needed when you have someone outside do work for you under contract.'

Such attitudes sometimes had unfortunate consequences. For example, in one case a project team released a large and complex system into production in late December. The maintenance team which received it was one whose manager did not support formal agreements. As a result there had been no written warranty agreement, and there was no formal warranty period. The maintenance team also believed the assurances of the project manager that the system had been fully reviewed and tested, and that there would be no serious problems. However the system had major errors. The maintenance team had little detailed knowledge of the system. They had not been closely involved in its development, and the project team had done little to pass on its knowledge of the system. To make matters worse, the project manager had permitted all project staff to go on leave just after the system was finished. For most people this coincided with the Christmas holiday period. Most project staff were unavailable to assist with the problems, and many could not be contacted. A good many had travelled overseas, including several system specialists. The maintenance team manager said:

> 'It was a disaster. Basically they threw a bag of rubbish over the back fence on Christmas Eve, and left us to sort it out. It was full of errors, and many of them were really hard to fix. We didn't know much about it. We couldn't get hold of most of their good people. A lot of them had gone overseas. We could get some of them on their mobiles, and that helped a bit. But they couldn't come in and work with us. It was a bad time.'

Severe problems of this type continued to occur sporadically over the course of the study, even when formal warranty agreements were in place. In such cases there was often simply an unabashed expectation by the project that maintenance would take on the outstanding errors and solve them, often on the stated grounds that this was their proper role. Similar but less severe problems occurred more often during the study. Typically there was not much that maintenance could do about it, in cases where the project and business teams engineered an agreement that the errors should be resolved by maintenance.

The warranty process allowed – officially at least – for a transfer of resources from a project to a maintenance team after the handover of a completed product, if it was agreed by the respective managers that the size or complexity of the product justified additional resources for its proper support. This was to occur under the umbrella of the 'portability' policy. However in practice few such resource transfers occurred. In one case observed, a project team transferred its least experienced employee to maintenance. In most cases, project managers asserted that they could not release any staff. Even when they could, the employee concerned usually preferred to move to another project, rather than to maintenance, and the project manager supported this. One maintenance team manager commented in an e-mail:

> 'There have been issues of resources from projects not materializing in [maintenance], even though promised under warranty.. I think that warranty resources should be agreed by name as early as possible with the project team, and once agreed should be unarguable, and.. in effect be stamped, "Reserved for [maintenance]".'

It was recognized later on at the instigation of some maintenance managers that the warranty process should also aim to help ensure more effective transfer of knowledge of a new product from the project team to maintenance, prior to maintenance taking on full support of the product. This was therefore written into the warranty template, but it could only really try to ensure that some basic aspects were covered, such as attendance by maintenance staff at peer reviews of deliverables produced by the project team, and handover of available system documentation to maintenance. There were still problems with the warranty process.

Even several years after the restructure, participation by maintenance staff in peer reviews run by project teams could not be guaranteed. In one case a maintenance team had tried repeatedly but unsuccessfully to be included in peer reviews by a project. Subsequently the affected system experienced a major production failure which had widespread repercussions. In relation to this, the affected maintenance team manager commented:

> 'I think a basic problem was that the [maintenance team] did not seem to be a stakeholder in the warranty or peer review process. [Team member B] says that she tried several times to get the project team to include the [maintenance team]. However the onus lay with the project team. My view is that the process that will avoid this problem in future is [maintenance] teams "getting in the face" of project teams to make them consider [maintenance] issues, and getting involved in warranty and review processes.'

As a result, the maintenance branch executive issued a request in writing to project executives which attempted to ensure representation by maintenance staff in peer reviews run by projects. It included:

> 'There have been instances where there has been insufficient information provided to [maintenance] about a project.. The biggest concern is that [maintenance] was not fully

> involved in the [project's] peer reviews.. Can you ensure that in future the relevant [maintenance] team is involved in the review process.'

However this had little success in ensuring adequate ongoing participation by maintenance staff in reviews run by projects. It was also clear that a request issued by the maintenance branch executive was not necessarily seen as important by project executives. This reflected the fact that maintenance had relatively little influence at executive level. As seen, there was one maintenance executive on the IS executive committee compared to seven project executives. The pervasive bias at executive level in favour of projects over maintenance was also reflected at lower levels of the IS organization.

Another contentious area was related to the fact that while a current production system was supported by maintenance, a project team was often simultaneously working on major enhancements to the same system to produce a new version. The project team was officially required to correct any errors in the new product that arose during the warranty period. If such errors could not be corrected during warranty, the stated position was that the period would be extended until the errors were fixed. However this condition was a source of many disputes. Error correction often entailed investment of substantial time and resources. A project team would therefore often attempt to shift work to maintenance during the warranty period. The project manager would sometimes assert that an error was caused by a part of the new product which had come from the older version, and was therefore the responsibility of maintenance to correct. In many cases the location and cause of an error remained uncertain until further investigation could be done. In such cases the project manager often succeeded in passing the error to maintenance to investigate. Many such errors were related to both old and new parts of a system, or their interactions. Even if further analysis revealed that the error was caused by a new part of the system, often by this time it had effectively became maintenance's responsibility. One maintenance team member said:

> 'The project team is always trying to duck shove part of their work to us. It's a bit rich when they've got more people than us, and they've got more experience in [system u]. They sometimes tell us that an error is in the old part of the system, and that we own it. This is a grey area, but we often seem to get the short straw.'

A further problem occurred in that during the warranty period, not only could definite errors arise, but also situations may be identified which could potentially be errors, and which should therefore be investigated. But projects and maintenance typically had differing perspectives on this. A project team often did not want such situations investigated, because they may turn out to be definite errors which they would have to rectify. The warranty period might need to be extended to allow for this. A business support team often acted as an arbiter in such disputes.

In such cases the business support team tended to favour allowing the project team to proceed with other work, even if it was best placed to investigate a potential error. For example, in relation to one such dispute, a maintenance team member wrote:

> 'Another possible issue has been identified regarding [system s]. This issue was only raised yesterday and we are arranging a meeting to discuss.. I do not support sign off of this warranty and I believe that sign off of the warranty had to be agreed by all parties, not at the discretion of the project team.'

As a result, the business support team held and chaired a meeting to resolve the dispute, but did not meaningfully involve maintenance. The minutes of the meeting included:

> 'Concerns were outlined relating to the possibility that [system s] may not have accounted for these processes properly. [Maintenance] were of the opinion that they would be unable to sign off warranty without these issues being further investigated and resolved.. [The project team] outlined that due to current project demands, specifically they would not be in a position to further support the system beyond resolving the current known errors. It was explained by the chair that the warranty process outlined an obligation upon the project team to resolve errors where known errors exist. [Maintenance] were not aware of any further [definite] errors in connection with [system s]. In this case, as no further [definite] errors had been identified, a recommendation to sign-off the warranty conditional upon the resolution of the two outstanding known errors could be made.'

In reply, a member of the maintenance team commented in part:

> 'The proposed compromise also tends to undermine in general terms the value of a warranty agreement, which is a shared understanding among all the parties, including Business, project and [maintenance]. A warranty agreement should not be "watered down" to suit some of the parties.. The warranty agreement includes.. "Completion of any other outstanding work not finalised at implementation".. The kind of compromise proposed may have ongoing ramifications for the effectiveness of working relationships among [maintenance], projects and [business]. [Maintenance] works very hard to help make effective what is basically a fragmented process. Apart from the issue of consultation with people who are directly involved, what would be the point of a [maintenance] or [business] team signing on to future warranty agreements when there's no real assurance they won't be disregarded later?'

Another problem was related to the fact that urgent changes to the current system could be requested by business at any time, and were the responsibility of maintenance. Changes often required substantial time and resources. However changes may also affect the new version, and officially it was the responsibility of the project to ensure that such changes were reflected in the new product. Arguments could erupt over whether a change affected the old or new parts of a system, or both. If the changes did affect the new part, a project team may still argue that they were the responsibility of maintenance, to be done after the product was handed over. If the warranty period remained at its minimum time, this could cause friction but maintenance often just accepted the changes. However if the warranty period was long extended because of complex errors in the product resulting from project work, conflict could ensue over which team

should make the changes, and when. The business support team was also a stakeholder in such issues. As noted, officially a project team was required to correct priority errors in the new product during the warranty period. Also as noted, there was often little clear distinction in practice between errors and changes. In some cases, a maintenance team and/or business would portray a change as an error, in an attempt to ensure the work was undertaken by the project team. This was another source of disputes among teams.

Yet another problem was related to the fact that the warranty process allowed project teams to deliver a system into production with unresolved errors that were not rated at the highest level of priority. The project team could then legitimately get on with their other work. Lower priority errors may be corrected later by maintenance as time permitted, or they might not be corrected at all. In some cases a project team would deliver a system with errors, and arrange with business to deem them a lower priority. After the system went into production and became the responsibility of maintenance, the errors would be reclassified as high priority, ensuring that maintenance then had to correct them as soon as possible. A maintenance team member said:

> 'The project team has been known to put out a product with errors, that they've cooked up with business to call level 2. As soon as it's released, they get business to say they're really level 1. That way they get part of their work locked into [maintenance], and they get themselves off the hook.'

The warranty process had not been well planned, or even thought through in any detail prior to its fairly abrupt implementation. It was largely left up to individual teams to do their best to handle problems and conflicts as they arose. This approach resulted in problems being dealt with separately and often inconsistently across different teams. It also resulted in the expenditure of much time and energy by many people – with much of this being additional effort that had not been needed under the 'system team' structure. There was also little attempt at overall coordination of the methods used to resolve conflicts and issues. The only real attempt was instigated about a year after the IS restructure, by the combined efforts of staff in a large line of business after they perceived that the restructure was causing serious problems in providing effective services for business. This resulted mainly in a prolonged attempt over several years to improve the warranty process, as noted. But as seen, this had only limited success. A business support manager said:

> 'We all spend a lot of our time trying to patch up disagreements between teams, and trying to work out the best way to resolve them. A lot of this is reinventing the wheel. The same things happen over and over, and often no-one does too much about it. '

The separation between projects and maintenance also led to many problems in knowing what system documentation was most accurate or current. Typically, electronic documentation had

been kept by a system team in 'private' repositories accessible only by that team, or on personal drives. Within a system team this situation was usually well understood and manageable, even though many documents were not up to date (as noted). When the system teams were disbanded and restructured, the system documentation was often left in a fragmented and chaotic state, with few clear roles and responsibilities for proper management. No procedures or guidelines were issued to assist in managing the transition, nor were they apparently contemplated. It was left up to individual teams to make the best of the situation, and many did not succeed. In some cases, the set of documentation for a system was fragmented across several current and former teams, including system, project and maintenance teams. In some cases, system documents which had been kept by individuals on personal drives were lost when they left TPE. In one case this was not realized for years, and the documents were never recovered. In this case there was no documentation left for a system, including no source code. All that remained was the binary object code that defined the system's programs. The system could not be modified or have any errors corrected, since such skills were not available in TPE. In this case, fortunately few changes were required.

There was wide variation in the documentation available for different systems. Some three years after the restructure, an audit review asked for the current documentation of several systems. In the case of at least one system, a widespread search eventually turned up only one document that was years old, was in an earlier, incompatible word processor version, and which had the function 'track changes' still active. No-one knew whether the many suggested changes should be accepted or not, and so the document was given to audit in this state. The resulting furore was likened by a staff member to 'executives running round like headless chooks.' This audit had a beneficial outcome in that a project was set up by the IS organization to implement proper system documentation management procedures. In one maintenance team, this project required review and assessment of over 2000 documents across eight systems with a variety of subjects, formats and dates of origin, to identify which were most current and accurate. The project was still running at the end of the study.

The examples given above illustrate a situation which was often commented on by IS staff, namely that the organizational restructure was divisive. To a considerable extent it had introduced adversarial, 'arms length' relationships between teams instead of collaborative relationships, to the detriment of effective knowledge sharing, updating and generation of new knowledge. For example, one maintenance team manager said:

> 'They've set manager against manager. We all used to work together and cooperate fairly well, and that was good for [TPE]. We all seemed to know what was going on better then. But now we're forced to compete. Now it's all about palming off work to someone

> else, and trying to get resources from them, and basically trying to get ahead at the expense of others. We don't see things the same way any more. We have to watch our backs all the time now.'

Similarly, a report to the IT executive committee on key issues and challenges, based on the most prevalent concerns of nearly all 130 IT mid-level managers (as recorded by an external facilitator) included the comments, "The [IT executives] we report to create division in our ranks.. Some people feel that their values and integrity are being compromised. For some the people who are compromising them are being supported by their [IT executives]". The restructure had undermined and weakened key principles and values of the IS organizational culture and the implicit IS governance, including effective collaboration, cooperation and knowledge sharing.

The situation following the organizational changes differed from the earlier 'system team' structure. A system team had combined the functions of system development, enhancement and maintenance. Even when there was a defined maintenance section in the team (as was sometimes the case), generally most team members worked closely together, discussed issues, and shared and generated system knowledge. During the study no major problems of the type described above were observed in system teams. It is acknowledged that the 'system team' structure was studied directly for only about a year. However in discussion with IS staff, it became clear that it was not that disagreements never arose – they did – but typically they were resolved through discussion within a system team, utilizing the pooled knowledge of the team. Former system team members said that issues about design decisions which could cause ongoing problems for maintenance were usually resolved internally, often in favour of quality rather than speed of delivery. A quality product may have taken longer to build, and business may have objected, but the influence and weight of the system team – combining development and maintenance – would often prevail. A decision to compromise on quality may have benefited one part of a system team but adversely affected another part. One IS staff member said:

> 'Things seemed to work better then. We worked together much better. There didn't seem to be as much of a "them and us" situation. We had some flare-ups but people used to be more reasonable, and we'd settle things sensibly. The business people included. Usually if we said something should be built a certain way, they'd accept the reasons for it. The way we said to do it was usually better in the long run, and that meant the same for business as for us.'

It was also significant that a system team had one single team leader – if necessary, any internal conflicts could usually be resolved at that level, within the team. A system team and its team leader generally 'spoke as one voice', and represented to business the view of the IS

organization on a particular system, and the work that was needed on it. After the restructure, each system was typically represented by a project team and a maintenance team, with separate team leaders who were located in different parts of the new IS organizational hierarchy. In most cases, each team leader reported to a different IS executive, who in turn reported to the chief IS officer (CISO). That is, if a serious conflict between a project team and maintenance had to be escalated for resolution, the closest apex common to both areas was at the level of the CISO. It was not feasible to escalate every conflict to the CISO or the IS executive committee, not least because the responsibilities at this level were normally above the details typically associated with project and maintenance work.

Also at the level of the CISO, the attitudes of the IT executives to the organizational changes became more relevant. As noted, these generally favoured project work over maintenance. As such, in some cases internal conflicts were not resolved on the basis of their detailed merits, but rather according to the executives' preconceptions. For example, one conflict concerned a project team which deliberately chose not to build a module to allow users to update certain types of production data, for the sake of expediency (as discussed above). Because of this, maintenance was obliged to update the data regularly via emergency changes, in contravention of IT security policies. This conflict was escalated to the IS executive committee, which decided against requiring the project team to build the appropriate module.

Prior to the restructure also, compromises between quality and speed of delivery sometimes had to be made by some system teams in the face of deadlines such as legislative imperatives for new systems to operate by a certain date. In particular, this occurred for certain system teams prior to the case study, as seen earlier. To some extent this set a precedent for later project team behaviour, in which quality was often compromised in favour of speed of delivery.

The examples given in the sections above are only a sample of many instances of conflict observed at the interfaces among projects, maintenance and business which emerged after the organizational changes. The warranty process was introduced to help try to resolve such conflicts. However generally it failed to do so effectively, and it was successful in only some relatively superficial areas of tension, such as handover of available system documentation from projects to maintenance.

The organizational changes had fairly abruptly introduced an altered division of labour between development and maintenance work – areas which had previously been integrated as part of the natural evolution of the system team structure within the organizational culture. As Durkheim

(1947) suggests, a division of labour in society works best when it is in accord with the precepts and assumptions of the group about the nature and character of work, that is, in harmony with the group's culture.

In his first major work, *The Division of Labour in Society*, Durkheim (1947) attempts to determine the basis of solidarity in social groups. While this book may now seem incomplete when judged against modern sociological approaches, it is a major part of Durkheim's approach. It is relevant to the situation observed in TPE. Normally, labour is divided according to the distribution of aptitude within a social group. The division of labour produces social solidarity when it arises spontaneously. Durkheim (1947: 376) comments, "We may say that the division of labour produces solidarity only if it is spontaneous and in proportion as it is spontaneous." Organized social groups cannot sustain solidarity unless their constituent parts are solidly linked. A spontaneous division of labour entails productive collaboration and interaction in the conscious achievement of wider goals. Durkheim (1947: 372) writes, "The division of labour presumes that the worker, far from being hemmed in by his task, does not lose sight of his collaborators, that he acts upon them, and reacts to them. He is, then, not a machine who repeats his movements without knowing their meaning, but he knows that they tend, in some way, towards an end that he conceives more or less distinctly."

To be most effective, a division of labour cannot take a preconceived form. It is a sharing of functions, but not according to a preconceived plan. As Durkheim (1947: 276) states, "The division of labour, then, must come about of itself and progressively." However as Durkheim (1947) notes, a *forced* division of labour can occur where such a division is not allowed to develop spontaneously. Ritzer (1992: 98) observes that this may be due to inequalities in the structure of work or inadequate organization, with the wrong people in particular positions, or incoherent organizational structures. Any interference with the operation of a division of labour that results in position(s) being filled by those who are not most apt for the position(s) is a forced division of labour (Ritzer 1992: 98). In TPE, an altered division of labour was enforced by the organizational changes. It placed people in positions for which they were not most experienced or apt. The restructure in fact created an inadequate organization.

In terms of knowledge processes, by separating projects and maintenance the restructure had acted to fragment knowledge of systems, and ultimately reduced the effective level of knowledge of systems. In many cases, the reshuffling of staff at the outset of the changes meant that fewer and less experienced staff were assigned to maintenance. Often the sum total of knowledge of a given system across projects and maintenance was effectively less than it had

been under the 'system team' structure. Even more seriously, the ability to share and extend the knowledge of systems was disrupted by the fragmentation. Also significantly reduced was the ability of staff who worked on a system to meet readily to discuss the system, share tacit knowledge, resolve issues and generate new knowledge about the system by social interactive processes. As noted earlier, the collective knowledge of a group can transcend that of individuals, and enable achievements not possible at the individual level. The ultimate outcome was that the level of IS support for systems was significantly reduced, and hence the level of support for the customers and business of TPE.

6.1.3 Outcomes of Organizational Changes

The reactions of staff to the organizational changes were revealing. The initiatives had been introduced accompanied by several presentations to staff by IT executives. The changes had initially seemed plausible to many people, and they were supported by the executives. However some staff expressed their doubts that the changes would be workable. Some commented that most of the key executives who had instigated the changes had little direct experience in the technical support of complex information systems, and they had not consulted experienced staff very widely. They also had not consulted business areas in a meaningful way, even though the changes would inevitably have considerable impact on business, and business would be required to help make the changes effective. For example, one IS employee said:

> 'They've bitten off more than they can chew with this. I don't think they really had much of an idea what they were doing. At their level it's basically all theory, they've got their heads in the clouds. They never really asked any of us what we thought. We only work here. And when we tried to tell them what we thought, the answer was, "get back in your box, what would you know?" They never really asked our business people either. They're the ones who drive our work, after all. You'd think they'd want to have some say in how they get their IT work done.'

Some IS staff were uneasy about statements which seemed to advocate that adaptable and portable staff were 'good', while less adaptable staff were 'not good'. There was an implied suggestion that the latter people were not valued by the executives. A typical comment was:

> 'They're saying that we're supposed to be able to go and work on just about anything, no matter if we've never worked on it before, or even if we know nothing about it. They reckon that the new breed of [analyst or programmer] will have to be multi-skilled and portable, and be able to work on any system they're sent to. They'll probably have to be so multi-skilled and portable they won't know where they stand. No-one will give credit to someone with experience in a system any more. Like me, I've been working on [system y] for 8 years now. They say that if we stay bogged down in a system then in future we'll just be seen as fossils, and we won't have much of a future here. That could be me. I think I should be out looking for another job.'

About a year after the changes were made an informal survey of about 80 IS staff indicated that about half thought the changes were unsuccessful. This survey was undertaken by a union workplace representative. It was indicative rather than rigorous, but nevertheless had a reasonable level of credibility. The fact that the changes had been even partially effective, and apparently accepted by some, was largely because most staff were conscientious and diligent, had a strong ethic of providing quality customer service, and worked hard to try to make the best of the situation. For example, one employee said:

> 'From where I stand, about half the staff don't agree with the changes outright. The other half have only really gone along with them for their own reasons, including they know they can't stop them, and they have to get on with the job as best they can. We're here to look after the systems, and the systems look after the business. They [the staff] also know that it's not a good idea to rock the boat around here, it won't do your career any good in the long run. Even when you're right, you can get remembered for a long time as a troublemaker.'

Some staff also questioned a stated rationale for the changes, namely that they would enable better IS services for customers and align IS more fully with business. The earlier structure of system teams had reflected quite strong alignment between IS and business, in that in most cases a system team had worked directly with its corresponding business support team, and both areas had shared a common focus on a particular business function and the system(s) which supported it. The revised structure had lost much of this direct alignment between IS and business.

In most cases the split between projects and maintenance also resulted in the respective teams becoming physically separated, often in different buildings. This dramatically reduced the scope for easy and direct interaction. A typical comment by a maintenance manager was:

> 'We used to have our resident [system z] expert on tap to help us out with any problems that came up, whenever we needed it. He was really good, he knew about everything that had ever been done on [system z]. He worked on it for donkey's years. But now he's over on the other side of town doing something completely different. We can't get to him unless we take a taxi, and he can't get to us easily. We can still ring him, and sometimes we do, but they've always got him flat strap working on his new job. They're behind schedule on that now, and I can't blame him for not being able to give us much time any more. Normally they won't allow him to spend much time helping us anyway.'

As noted, people usually gain knowledge from face-to-face communication with their neighbours, rather than seeking more remote sources. Miranda and Saunders (2003) found that face-to-face meeting favours effective information sharing and interactive generation of meaning, compared to the exchange of e-mail messages or printed material. In TPE interaction by telephone and e-mail remained possible, even when face-to-face communication was difficult. However for technical IS work e-mail had limitations. Maintenance staff for example

rarely resorted to e-mail in discussing a complex problem, apart from occasional use for specific questions. Effective collaboration on complex system issues typically entailed a small number of people sitting together to discuss them, often around a screen. TPE had not implemented any technologies to enable good virtual electronic collaboration (e.g. Ackerman 1996). Some video- and web-based conferencing tools were trialled, but were not particularly effective or useful. On one occasion a large IS team was required to move to other accommodation, and no visitors' chairs were provided at the new location – this caused a near riot. In any event some IT executives had strongly demanded that teams cease collaborating. In many cases this was reasonably effective, but in a few cases the respective team managers encouraged continued covert interaction, made possible by the fact that some teams remained in fairly close proximity. In some cases the team managers thereby incurred censure and recriminations from some executives, sometimes to the extent of perceived intimidation. In one case an executive sought to move a maintenance team to a location 10km distant, partly to reduce collaboration with people in a corresponding project team.

A significant number of employees in fact left the IS organization or TPE, partly as a result of the various factors outlined above. At least three mid-level managers who had been 'drafted' unwillingly into maintenance as team leaders soon left the IS organization, citing dissatisfaction with the changes. Two left within a few months, and one of these left TPE. Such decisions were not taken lightly, after long careers in IS in TPE. As noted, there had been a high retention rate of IS staff for many years. The staff turnover rate was around five per cent per annum at the outset of the study. By the end of the study the rate had risen to about nine per cent. While various factors might have contributed to this, it was probable that it had been significantly influenced by the organizational changes.

A further illustration of resistance to the changes was that in at least two geographically remote areas of IS, the split between projects and maintenance was never fully made. The formal reporting lines were changed, but 'on the ground' the synergy was retained of having close working relationships among staff with all kinds of experience in a system. This reflected an informed opposition to the changes. This was based essentially on awareness of the threatened disruption to underlying assumptions about the place of expert knowledge and the need for effective knowledge processes, including creating, sharing and sustaining tacit IS knowledge through social interaction and collaboration. This was an integral part of the IS culture of TPE, and the threat to it was therefore resisted.

As seen earlier, there was a widespread bias in favour of project-based development, despite the fact that maintenance is often more difficult and demanding than development. Nevertheless there were occasional signs of recognition of the importance of system maintenance and support in general. For example, late in the study a discussion paper produced by a multi-branch IT working party included the comment, "Focus on large or important projects can undermine our day to day operations." The comment reflected a view in the IS organization that maintenance and support were critical, even if they were not seen at executive level as being very important.

Perhaps more significantly, several years after the changes it was observed that there were moves in some parts of the IS organization to re-integrate development and maintenance. That is, in several areas there were moves to essentially re-create a single system team to undertake development, major enhancement and maintenance of a system. By the end of the case study, none of these initiatives had been fully implemented, and so this aspect was not able to be studied in detail. However it reinforced the fact that the organizational changes had acted to undermine effective structures and knowledge processes that had evolved naturally, and which were part of the IS culture.

An indication of how effective the organizational changes had been was given by measures of the perceptions of business areas of the quality of services provided by IT (which included IS services). About two years before the changes a survey of business customers (done by the IT organization with assistance from a professional survey firm) had indicated that the level of satisfaction with IT services was about 60 per cent (that is, the proportion of survey respondents who said they were 'satisfied' or 'very satisfied'). This suggested that the quality of IT services in TPE was seen as just adequate, in keeping with the situation in many organizations (e.g. Kling 1996). This survey had previously been conducted annually for some years, but it was not undertaken again in the same form. In contrast, about three years after the changes were made a less formal program of consultation with business elicited a range of negative comments from TPE's business managers which indicated widespread dissatisfaction with the IT organization's services, such as:

- IT has not developed appropriate communication processes to enable effective relationships [with business];
- we don't understand each other;
- communication is ad hoc;
- communication is reactive;
- IT is like a blank jigsaw;
- project management in some areas is not done well;
- we don't understand why approved projects get rejected by IT;

- there is no record of all the projects in IT;
- projects change their scope after approval, but are not subject to re-approval;
- there are multiple reporting systems for project status;
- it is difficult to know the true status and health of a project;
- there is no early warning system for projects 'on the edge';
- there is very little information supporting the effectiveness of expenditure on support [including maintenance]; and
- we can't tell how resources are being used.

This program did not report quantitative results. The comment 'IT is like a blank jigsaw' reflected a perception that the IT organization, including the IS organization, was seen as both amorphous and fragmented, with its components not clearly identifiable. It reflected a prevailing confusion among business areas about the new IS structure, and the multiplicity of new teams, including project and maintenance.

The comments from business covered three general areas – communication between IT and business, project work and maintenance work – and were critical of all three. These areas were closely related to three of the basic planks which were stated to underpin the organizational changes, namely to align IS more closely with business, to improve project management methods, and to structurally separate projects from maintenance. It was clear that business did not see improvements in these areas. While the comments were not direct evidence that the organizational changes had been responsible for the poor perception of IT services, it could reasonably be inferred that they had contributed materially to it.

Despite the fairly widespread view within IS that the organizational changes had not been effective, there was general denial of this at the executive level. For example, a conference of all IS managers was held two years after the outset of the organizational changes. The IS executives answered written questions received anonymously from the floor. One question asked, 'What do you plan to do about the problems caused by the split between development and maintenance?' The executive who answered the question vehemently denied that there were any problems, apart from some initial 'teething' difficulties in getting the structure and processes working properly. This executive then spent some time elaborating on the achievements and successes of IS since the organizational changes were initiated. There had of course been some significant achievements, for example, the revitalized project management methodology had enabled some projects to become efficient and deliver quality products. Also, the maintenance teams had corrected many system errors and implemented many changes. It was possible to cite a quite impressive list of the sheer number of errors corrected, changes

made and system products delivered. This seemed to impress other executives, but many staff remained unconvinced. One commented, 'The numbers might look good, but you need to look below the surface to know what's really going on.' As seen, the positive outcomes were realized largely because most IS staff were conscientious, had a strong ethic of quality customer service, and worked hard to make the best of a less than optimal situation. The achievements were not the result of the organizational changes, but rather were accomplished in spite of them.

Statements about the achievements of IS also made their way into official reports produced by the IS organization. As a result, a general view was formed at the executive level of the IT organization, which included the IS organization, that the organizational changes had been successful. Partly as a result of this, several of the executives who had strongly advocated and sponsored the changes, and at least three IS mid-level managers who played a material part in implementing them, later received career promotions and in some cases moved on to other areas. It was somewhat ironic that decisions made by a few in a relatively short time – almost in an *ad hoc* manner – would have large negative impacts for at least several years. In this context, Pfeffer (1992), in reference to power and influence in organizations, comments that decisions made in relative haste are usually not quite right, and in such cases "we almost invariably spend more time living with the consequences of our decisions than we do in making them" (Pfeffer 1992: 19).

After the IS organizational restructure, project teams were set up to undertake development and major enhancement of systems. As seen an explicit related goal was to minimize maintenance of systems. Truex et al. (1999) propose that if an emergent organization adopts an 'emergent systems' viewpoint, a number of goals of the IS development process become redundant. One such redundant goal is the undertaking of large-scale analysis and design activities in order to try to minimize maintenance. Emergent systems thinking assumes that business requirements are continually changing anyway, and that ongoing maintenance is therefore both necessary and beneficial. Truex et al. (1999) summarize this as:

> "..there is a need to radically rethink the way in which IS are developed. Rather than viewing information systems development (ISD) as a series of projects each having a clear beginning and end, [organizational] emergence calls for a continuous redevelopment perspective.. Emergent IS thinking accepts that every system must evolve continuously, and that all systems must be adapted regularly to their changing environments.. [this] implies the creation of an ISD environment that is optimized for high maintenance rather than low maintenance" (Truex et al. 1999: 118).

In TPE, the progression of IS changes was in the reverse order to that considered by Truex et al. (1999). That is, previously TPE had in fact effectively taken an 'emergent systems' viewpoint,

and its systems were regularly updated to match their changing environments. The system team structure was the vehicle for achieving this – integrating development and maintenance – and providing for all the maintenance that was necessary. As a result, many systems were long-lived, appreciated by their business users, and not regarded as outdated or approaching obsolescence. After the IS restructure, the project teams were favoured, and there was an explicit goal of reducing maintenance.

In more detail, Truex et al. (1999) comment that:

> "Continuous redevelopment. Under emergent assumptions, this goal supplants the current ISD project mentality under which all systems terminate at their obsolescence point. The goal of ISD is to preserve all existing IS applications by continuously enhancing and modifying these to match organizational requirements. The goal of ISD is to prevent system obsolescence and thereby eliminate system termination (and the implied new ISD project).. Continuous redevelopment implies that information systems are continuously enhanced and modified such that they are never totally outdated and irreparable. There are two interesting implications of continuous redevelopment. The first implication arises from the viewpoint of life-cycle termination as an anomaly. When an IS becomes too expensive to maintain and must be replaced, there is an implied failure on the part of ISD management. ISD management failed to keep the IS maintained in a state that permitted its further redevelopment. In other words, the IS was allowed to decay beyond its economic rescue point.. Another important element is the elimination of the 'project' as the primary means of organizing IT activities. An emergent IT organization replaces projects with 'streams' of redevelopment activity that are continuous as long as the particular IT system requirement is present. A new project represents the failure of the IT organization to properly adapt the systems in its charge.. The IT organization that supports emergent organizations must value system adaptation.. most of the organization's important development activities are merged with its maintenance activities.. We propose an alternative view that assumes systems should be under constant development, can never be fully specified and, like the organizations for which they are built, are subject to constant adjustment and adaptation." (Truex et al. 1999: 121-123).

In TPE, the project teams were each intended to undertake a specified development or major enhancement task, and then be disbanded. This did not entirely eventuate as planned. As noted, Truex et al. (1999) advocate the elimination of the 'project' as a primary means of organizing IT activities. Instead, continuous 'streams' of development activities merged with maintenance are advocated, as long as each particular system need persists. In TPE, the trajectory of change was reversed, with adverse effects. Formerly, continuous streams of merged development and maintenance activity had prevailed successfully. This was replaced by a focus on project work, combined with an aim of minimizing maintenance, with dysfunctional results. The 'emergent systems' model is thereby confirmed in the context of the TPE case study.

6.2 Summary of Case Study

This section gives a brief outline of the case study, with a focus on significant points and findings. For purposes of clarity it summarises material presented earlier.

Detailed case study research was undertaken in a large emergent transaction processing enterprise: 'TPE'. In an 'emergent' organization, features such as structures, processes and rules are continually emergent (e.g. Mintzberg 1979). The study applied qualitative research techniques including the interpretive methods of ethnography and participant observation. TPE had a diverse range of business functions, with many being managed by one or more largely discrete lines of business. Many business functions had not materially changed, at least in broad outline, for much of TPE's history. The associated business operations had evolved in their details over the years, largely as a result of continual, mostly small, emergent changes in both the internal and external environments of TPE. TPE had around 400 significant information systems, at least 50 of which were critical systems which supported key business functions. TPE depended almost totally on these systems to function effectively and achieve its objectives.

All TPE's systems were subject to ongoing processes of error correction, minor and major changes and enhancements, and rarely, complete redevelopment. There were frequent business changes needed, shifts in the environment of TPE, and also legislative or policy changes which were less common but usually more substantial. Business requirements, business processes and their system counterpart typically co-evolved as an integrated unit. In general a state of symbiosis existed between a set of requirements and its corresponding information system.

The initial aims of the research were to understand the structures and processes required for optimum system development and support in emergent organizations. The case study sought to interpret the relationships within TPE among information systems, related structures and processes, IS governance and organizational culture. The study drew attention to the role of system maintenance within the IS support function, which can represent a large investment of skilled resources. It was also found that knowledge of complex information systems, especially tacit knowledge, played a key role in effective development and support processes.

It was widely accepted that TPE's information systems needed continual, mostly minor adaptation to match the emergent organizational corrections. Truex et al. (1999) propose that:

> "Rather than viewing information systems development (ISD) as a series of projects each having a clear beginning and end, [organizational] emergence calls for a continuous

> redevelopment perspective.. [this] implies the creation of an ISD environment that is optimized for high maintenance rather than low maintenance" (Truex et al. 1999: 118).

In TPE, up until the time of the organizational restructure, low maintenance systems were not necessarily a primary goal of system designers. On the contrary, it was understood that maintenance and enhancement of systems were ongoing, and would be provided at the level – often substantial – necessary to support emergent business needs. In fact there was a 'continuous redevelopment perspective' optimized for the level of maintenance needed on each system. This was achieved largely via the 'system team' structure, which entailed system teams which were well matched to the integrated development and maintenance needs of systems.

To effectively fulfil its required role, each system team established a close relationship with a *business support team* in the corresponding business area of the organization, and typically a strong partnership had developed over time (see Figure 3 in Chapter 5). In most cases a system team worked closely with its business support team, and they shared a common focus on a business function and the system(s) that supported it. Both system teams and business support teams had remained fairly stable for many years. In such ways the 'system team' structure – including the business teams – had created strong alignment between IS and business.

TPE had long recognized and valued the experience gained and the situated knowledge held by its IS staff. Within a system team, there was typically someone available with long experience in any aspect of the system. Such knowledge could be applied as required in any part of the team, to guide, mentor or collaborate on either new development, problem resolution, changes or enhancements. The long-term commitments of IS staff had created effective relationships of trust and knowledge sharing. The structure of each system team took full advantage of the creative synergy of having all types of expertise about a system 'under the one roof'.

The most effective IS work unit was an informal, somewhat fluid group – a community of practice – usually within a system team. Such communities of practice were essentially components of the broader system team structure. The implicit understanding of how best to manage the development and support of complex systems had evolved naturally over many years. This understanding had been associated with the evolution of IS structures, processes and ways of thinking which optimized the ability to effectively manage systems, and to provide good support for business. The structures and processes were centred on the informal management of knowledge of complex systems – especially tacit knowledge. This entailed tightly-knit communities of practice, each focused on knowledge of a system. Such a community shared and discussed work; resolved problems via interactive processes; created,

maintained and enhanced knowledge of a system; and also identified and discussed potential improvements. TPE's IS communities of practice, and in general the related IS structures, processes and assumptions had evolved as an integral part of the IS culture to the extent that they influenced the associated values and behaviours of most staff working in IS.

The IS governance of TPE consisted of both formal and informal components. An effective informal or implicit IS governance framework had applied prior to the organizational changes, based on the system team structure. This framework had evolved naturally with the system teams over many years, and it closely reflected the values of the organizational culture and structure. Much collaborative decision-making occurred within the 'system team' structure. The 'system team' structure formed the core of the implicit IS governance. Because of their entrenched nature, the system team structure and the implicit IS governance could be seen as integral components of the organizational structure and culture, insofar as they related to IS.

During the TPE case study, the IT executives introduced changes to the structures and processes of the IS organization, which were intended to improve the efficiency of IS services and to align IS more fully with business. These initiatives included the introduction of rigorous processes for project management; a goal of having an adaptable and portable IS workforce; and the structural separation of system development from system maintenance. The decision to restructure the IS organization fell within the formal IS governance, because structures necessary to effectively match IS to business strategies are part of governance (e.g. Andriole 2004). But the IS changes were in conflict with precepts of the pre-existing implicit IS governance, which was an integral part of the IS culture and structure.

The earlier 'system team' structure had reflected strong alignment between IS and business, in that in most cases a system team had worked directly with its corresponding business support team, and both areas had shared a common focus on a business function and the system(s) which supported it. The revised structure lost much of this direct alignment, and introduced serious complications in how all teams had to interact.

In terms of knowledge processes, by imposing a separation between development projects and maintenance, the organizational changes unintentionally fragmented knowledge of systems, especially tacit knowledge, and undermined its effective use. A major flaw of the new IS structure was that it fragmented pre-existing knowledge processes and communities of practice. The ultimate outcome was that the level of IS support for systems was significantly reduced, and hence the level of support for business.

After the organizational changes many instances of conflict and dysfunction were observed at the interfaces among projects, maintenance and business. The organizational changes had quite abruptly introduced an altered division of labour between development and maintenance work – areas which had previously been integrated as part of the system team structure and culture.

Chapters 5 and 6 together described and analyzed the case study around which the thesis is centred. Chapter 5 drew for analytical purposes on the concept of IS governance (introduced in Chapter 3), as well as relevant knowledge principles, processes and concepts (introduced in Chapter 4). Chapter 6 focused more on the organizational changes and their outcomes. The following chapter reviews the research methods, draws inferences from the case study, summarizes the main findings and the contribution of the thesis, discusses its conclusions and provides some recommendations for IS organizations that rely on complex information systems.

Chapter 7 CONCLUSION

This chapter provides an overall conclusion of the thesis. It reviews the research methods, research aims and questions, and significant points established during the research. It draws inferences from the analysis and findings of the case study. It includes significant points introduced earlier, which are of central importance to the thesis, and are reiterated to facilitate coherence of the summation and conclusion. The chapter provides some practical recommendations for organizations – especially emergent organizations – which rely on complex information systems to support their business. It also suggests some areas for further research on related organizational issues.

7.1 Review of Research Methods

The TPE study primarily addressed several key research questions (as discussed in Chapter 2, and below). In general, these questions sought to better understand the relationships within TPE among information systems, related structures and processes, IS governance, knowledge of information systems, and organizational culture.

The research was focused on a detailed, extended case study which adopted an interpretive approach using qualitative research techniques. Anthropological methods have value in investigating social and cultural contexts. Accordingly, detailed investigation was undertaken utilizing two of the principal interpretive methods of social-cultural anthropology: ethnography and participant observation. These techniques allowed the researcher to become immersed in the situation studied, and so enabled the acquisition of comprehensive material and in-depth understanding within the context. The researcher worked in TPE during the study, and was thereby well-placed to observe and properly understand the setting at first hand.

Case study research is a common qualitative method used in IS research (e.g. Benbasat et al. 2002; Cavaye 1996). A case study is an empirical inquiry that aims to understand a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident. A case study is especially appropriate when ‘how’ or ‘why’ questions are posed, and when the investigator has little control over events occurring within the context of study (e.g. Hamel et al. 1993; Yin 2002). These conditions applied to the research, and so a case study approach was appropriate. In particular, the phenomena under investigation – the structures, processes and IS governance needed for the

development and support of complex information systems in emergent settings – were not separate from the context, and in fact were integrated into it.

The case study situation was complex and wide-ranging, and it required prolonged, intensive research to properly understand and analyze. In order to address the research questions, it was necessary to observe and study the relevant organizational structures, processes and cultural aspects in detail. It was therefore appropriate to focus mainly on a single extended case study. Nevertheless as part of the research project, some other smaller studies were utilized in a limited way for purposes of comparison (discussed below).

An ethnographic approach can provide deep understanding of a complex organization and its context (e.g. Myers 1999). Ethnographic research is well suited to gaining rich insights into the social, cultural and organizational aspects of complex information systems. The ethnographic approach, combined with an extended case study, was ideally suited to investigating the topic.

The research adopted an interpretive perspective (Berger and Luckmann 1990; Geertz 1973, 1983), that is, it aimed to interpret phenomena through the meanings understood by those closely involved with them. Case study research is often interpretive (e.g. Walsham 1993). Interpretive researchers work on the assumption that access to reality (either given or socially constructed) is through social constructions such as language, shared meanings and interpretations, symbols, rituals and other patterned behaviours. The interpretive approach is therefore well-matched to participant observation, which also aims to understand a culture or organization from within (e.g. Morey and Luthans 1984).

Ethnographic methods aim to interpret a culture by means of ‘thick description’ of the complex fabric of everyday structures, processes and discourse. The approach taken to the interpretation of the TPE situation can be summarized as follows:

> “ethnography.. is an elaborate venture in.. "thick description".. What the ethnographer is in fact faced with.. is a multiplicity of complex conceptual structures, many of them superimposed upon or knotted into one another, which are at once strange, irregular, and inexplicit, and which he must contrive somehow first to grasp and then to render.. there are three characteristics of ethnographic description: it is interpretive; what it is interpretive of is the flow of social discourse; and the interpreting involved consists in trying to rescue the "said" of such discourse from its perishing occasions and fix it in perusable terms.” (Geertz 1973: 6-10, 19-22)

The use of participant observation and anthropological methods in studies of organizational behaviour has been recommended by various writers (e.g. Schwartzman 1986). Participant observation requires an observer to also be a participant immersed in the setting, and to study it

in detail from the point of view of its own members. That is, the approach tends to take an insiders' viewpoint, or 'emic' perspective. The researcher must be prepared to investigate and critically analyze the unquestioned, 'taken for granted', usually undocumented (and often unarticulated) assumptions, values and behaviour of the members of the culture.

The researcher undertook the TPE case study as a participant observer 'embedded' in the organization, so gaining access to rich empirical data not generally available. Participant observation requires detailed understanding of a culture or organization. In the study, various methods were used to achieve this, including close observation of actions and processes, open-ended discussions, examination of records and to some degree, surveys. Surveys were utilized to a small extent, as they often have limited ability to reveal deep-seated, largely unarticulated assumptions and beliefs, unless combined with in-depth discussion and observation.

The research used an iterative process adapted from Miles and Huberman (1994) for data collection, analysis, literature review, drawing inferences and conclusions, and progressive write-up. The process was iterative – there was no linear sequence from literature review, data collection, analysis, and on to conclusions and write-up. Feedback from the various stages was used to inform and guide 'previous' stages, and to adjust them as necessary. The literature review thereby evolved with the case study. Wherever possible, evidence from multiple empirical sources was used to help validate particular lines of inquiry, patterns and findings.

In qualitative research, what counts most is the quality of an insight (e.g. Van Maanen 1979). In some cases it was necessary to critically assess such insights. For example, a key aspect of the case study was to assess whether the outcomes of the organizational changes were beneficial or not. This was assessed largely as a qualitative judgment, by drawing on facts, observations, opinions, inferences and conclusions from both case study and literature.

The main goal of a qualitative study is to produce a coherent description of a situation based on detailed study (Ward-Schofield 1993). A qualitative researcher should aim to demonstrate the validity of the analysis within its context by providing detailed 'thick description' (Geertz 1973). The TPE case study adopted this perspective. The primary aim of the research was to give a detailed and coherent description of the particular organizational situation, analyze that situation and provide a credible and supportable interpretation of it. Specific inferences and conclusions were also drawn from the material analyzed, in relation to the context (as discussed in Chapters 5 and 6, and below).

It has been suggested that a qualitative study may have implications for other similar situations, and thereby be capable of some level of generalization. However generalizability depends not just on detailed description of a phenomenon, but on demonstrating its underlying social patterns (Wainwright 1997). The TPE research aimed to shed light on the more general structures, processes and relationships that underpinned the situation. The research therefore has some applicability to similar situations in other settings. The thesis considers some limited comparisons with other similar organizations, but it is emphasized that any inferences drawn from such correlations cannot be extended too far (discussed below). Some general inferences are also drawn, mainly in the form of recommendations for 'good practice' and suggestions for further organizational study (discussed below).

This section summarized the research methods adopted. In general, the field of organizational IS research needs to be informed by detailed studies of what really goes on inside organizations in terms of information systems. The qualitative methods adopted for the TPE case study demonstrate a practical way of achieving this objective. The following sections review the research aims and questions, as well as significant findings and inferences drawn from the analysis and interpretation of the study.

7.2 Review of Research Aims and Findings

The initial aims of the research were to understand the structures, processes and IS governance which can result in optimum system development and support in emergent organizations. The research drew attention to the critical role of system maintenance within the IS support function, which can require a large investment in knowledge resources. The research focused on an extended case study conducted in a large emergent organization: 'TPE'. It was found that knowledge of complex information systems, especially tacit knowledge, also played a key role in effective development and support processes.

Early in the case study, substantial changes were introduced to TPE's organizational IS structures and processes, which were intended to improve the efficiency and quality of delivery of IS services, and to align IS more fully with business. The changes addressed the structures and processes that were the focus of the case study, and so it was appropriate to examine them as an integral part of the study. The organizational changes also served to highlight the ways in which the earlier structures and processes had effectively supported TPE's information systems. The interrelated changes included the introduction of rigorous standards and processes for

project management; a goal of having an adaptable and portable IS workforce; and the structural separation of system development from system maintenance.

The changes were generally supported by literature, for example two of the key concepts were sound project management and a portable, adaptable IS workforce. In TPE these ideas were applied in relative isolation from other factors such as social-cultural and knowledge aspects. The changes implied the question, what is the outcome when such concepts are applied to an emergent organization which relies on complex information systems to support its business goals? The changes initially appeared to be soundly based and yet were largely unsuccessful. The research therefore addressed key questions which aimed to better understand the relationships among information systems, associated structures and processes, IS governance, knowledge of information systems, and organizational culture (see section 2.1). The case study addressed and answered these questions in Chapters 5 and 6, and in summary in the sections below. These are not given in the form of answers to each question in turn. Rather, since it was found that information systems, knowledge of systems and IS governance were integrated with organizational structure and culture, the answers to the questions are also inter-related. Chapters 5 and 6, and the sections below reflect this integration.

The 'emergent systems' model assumes that the organizational environment continually evolves, that information systems must be regularly updated to match their ever-changing business requirements, and that ongoing maintenance is therefore both necessary and beneficial. As Truex et al. (1999) comment:

> "Emergent IS thinking accepts that every system must evolve continuously, and that all systems must be adapted regularly to their changing environments.. [this] implies the creation of an ISD [IS development] environment that is optimized for high maintenance rather than low maintenance.. Continuous redevelopment implies that information systems are continuously enhanced and modified such that they are never totally outdated and irreparable.. An emergent IT organization replaces projects with 'streams' of redevelopment activity that are continuous as long as the particular IT system requirement is present.. The IT organization that supports emergent organizations must value system adaptation.. most of the organization's important development activities are merged with its maintenance activities." (Truex et al. 1999: 118-122)

Prior to the organizational changes, TPE had in effect adopted 'emergent IS thinking', and its systems were regularly updated to match their changing requirements. The 'system team' structure – which integrated IS and business – was the primary means of achieving this. This structure combined development and maintenance in continuous 'streams of activity' involving both IS and business in close and productive partnerships. As a result, many systems were long-lived and continually adapted to their environments. After the restructure, the project

teams were favoured, and there was an explicit goal of reducing maintenance. The IS changes served to highlight the value and efficacy of the former structure and processes, which had enabled high quality IS services and effective support for the business of the organization. Therefore the case study provides support for the 'emergent systems' model.

The case study examined a 'brown field' organizational situation, in which most of the 'terrain' had long been 'built on' with computer-based systems. Academic research focusing on 'brown field' situations is still relatively new, and this thesis makes a significant contribution to knowledge in this important area. The research topic relates to the issue of aligning information systems with organizational business needs in 'brown field' situations. Andriole (2004) argues in general for 'inclusive' alignment models which closely integrate business and technology decision-making within a governance framework. The case study describes an effective, implicit IS governance arrangement and related processes in a large emergent organization, which allowed close integration of IS and business in the development and support of complex systems in a 'brown field' environment.

Although it is clearly desirable to integrate IS and business as closely as possible within a governance structure, there are practical limits to the degree of integration in many organizations. In many cases, some structural separation of IS and business remains necessary for reasons related to organizational realities. It is often the case that IS and business organizational units report to separate senior executives, with an apex only at the level of the CEO. Also, there are often different required qualifications and natural career paths for IS and business employees. This can make it difficult to completely merge the respective areas, or allow easy transfer of employees between them. However effective alignment between IS and business can still be achieved by arrangements such as the 'system team' structure observed in TPE. This enabled close interaction and effective decision-making for most day-to-day issues involving information systems. Such decisions were in fact the most significant ones over time, given that most systems were long-lived. The support of systems, and their adaptation to the continually changing business environment were generally more significant ongoing needs than the original development of the systems.

The following sections provide further concluding remarks regarding key aspects of the analysis and findings of the case study and of the thesis as a whole.

7.3 Emergent Organizations

7.3.1 Organizational Emergence in General

The scope of this thesis does not include a major focus on IS strategy, strategic management or strategic planning (see section 1.3.1 for what is included and excluded in the thesis). However the concept of organizational emergence is of central importance to the thesis. The concepts of organizational emergence, emergent strategy and strategic planning are related, and are discussed briefly below.

Mintzberg (e.g. Mintzberg 1978, 1994; Mintzberg et al. 1995) discusses different approaches to strategic planning. This thesis follows the terminology of Knights and Morgan (1991) in identifying the main approaches as 'rational' and 'processual'. The *rational* approach usually entails a top-down, management-led, analytical approach (e.g. Ansoff 1990). The *processual* approach acknowledges that a realized strategy may be either deliberate or emergent, that is, it may be either deliberately planned, or it may emerge from a complex background of everyday activities and decisions via a bottom-up process (e.g. Mintzberg 1994). In the processual model organizations are seen as subject to cultural, social and political forces that influence strategy. The literature demonstrates that when an organisation adopts a rational approach to strategic planning, it often has only limited success. In contrast it has been shown that the processual approach is more likely to be effective, although it may be combined to a greater or lesser extent with elements of a rational approach.

Organizational emergence has received attention in recent years (e.g. Bansler et al. 2000; Chandler and Van de Vijver 2000; Hatch 1997; Purao et al. 2003; Purao and Truex 2004; Quinn et al. 1991; Truex et al. 1999). Like Mintzberg (1978), Hatch (1997: 110-119) draws a distinction between the rational model of strategy formulation and the emergent model of strategy generation which reflects events taking place throughout the organization. Hatch (1997: 113) notes that in the view of Quinn et al. (1991), strategy can emerge within the general outline of a rational strategic plan, but more significantly it can evolve from a foundation of continual activities and changes which occur across the organization.

The *rational* approach proposes that an organization can follow a systematic strategic planning method, and by so doing is able to develop strategies which provide the direction needed to manage in an uncertain environment (e.g. Ackoff 1970; Ansoff 1990). This often includes steps such as assessing the strengths and weaknesses of the internal environment, identifying external

opportunities and threats, pinpointing the forces acting on the organization, identifying a desirable future state, and developing the strategies needed to reach this state. In this model the formulation of strategies is then followed by their implementation, as a separate stage.

Various criticisms have been made of the rational model (Mintzberg 1994; Mintzberg et al. 1995; Mintzberg and Waters 1985). For example, detached, objective assessment of the strengths and weaknesses of the environment is rarely achievable (Mintzberg 1994: 276-279). The analytical approach has also been criticized, in that the process is often mistakenly reduced to a complex series of elementary steps, which are then expected to operate to better align the organization with its environment – but often they do not (Mintzberg 1994: 191, 298-303).

The rational model separates strategy formulation from implementation, with responsibilities lying in different parts of the organization. Such a separation can lead to miscommunication and misunderstanding, resulting in failed implementation of strategy (Hatch 1997: 116). There is not much evidence that anything like the rational model operates successfully in any real organizations, although it can serve to focus attention on the normative value of rational planning (Hatch 1997: 116).

The processual model is preferred to the rational approach (Mintzberg 1978, 1994; Mintzberg et al. 1995). Mintzberg (1994: 286-287) contends that the dichotomy between the formulation of strategy and its implementation – as promoted by the rational school – is inappropriate, and that a better model is continuous strategy formation. This more effective process draws on all kinds of information inputs, including both quantitative data and qualitative information, including information about emerging changes. The qualitative information is often accessible only to strategists who are in close touch with the operations of the organization, rather than detached from them. The processual model has been shown to be more likely to be successful than the rational approach, although it may be combined with aspects of a rational approach.

The processual model sees realized strategies as being either deliberate or emergent (Mintzberg and Waters 1985), that is, they may be either deliberately planned via a formal process, or they may effectively emerge from the organizational background. Mintzberg (1994: 25-26) notes that in practice few actual strategies are either purely deliberate or purely emergent. The first suggests that an organization cannot learn from its own experiences, and the latter suggests a lack of control. In the processual model, organizations are seen as subject to cultural, social and political forces as well as to rational planning. In such an environment an organisation may attempt rational strategic planning – but the outcome is often unsuccessful, and more often it is

the emergent strategies which are followed. Organisations sometimes pursue 'umbrella' strategies, with the broad outlines being deliberate while the details are allowed to emerge within them. Such an organization can in effect 'learn' (Mintzberg 1994: 209-210), and significant changes can be achieved, in contrast to the rational approach.

For modern organizations, emergent processes of strategy generation are more relevant and of greater value. Quinn et al. (1991: 103) studied nine major companies and found that organizational emergence was very common. The case study of this thesis found that the organization of focus was emergent (TPE). The researcher also observed 15 other enterprises for various intervals of time – all these organizations were also emergent.

Buchanan and Badham (1999) imply that in an earlier period, organizations were more stable and ordered, and less subject to continual emergent change:

> "The relatively stable, ordered, bounded, predictable, rule-based hierarchical organization today seems an anachronism. The so-called 'postmodern' organization is characterized by fluidity, uncertainty, ambiguity and discontinuity." (Buchanan and Badham 1999: 1)

Examples of organizations which in the past remained relatively stable and predictable for long periods include some religious organizations, often supported by a long-standing set of beliefs or canons (Stark and Bainbridge 1996). However in recent times many once-stable religious organizations have experienced increased levels of change and uncertainty. Many religious organizations, along with other organizations, have not been insulated from the dynamic environment of the modern world, and have adapted accordingly.

Gibson et al. (2000) suggest that the pressures for change increased in the 1970s:

> "Years ago when change was slow.. stability was the rule rather than the exception, an organizational approach that emphasized top-down hierarchy, rules and regulations, and authority in the hands of executives dominated.. In the 1970s everything in the environment such as government regulations, information technology, global competitors, union strength and influence, and customer demands and needs changed, and pressures for change in how organizations operate dramatically increased." (Gibson et al. 2000: 3)

March (1988) notes that contemporary organizations are typically characterized by continual emergent changes in their environments, which they generally adapt to:

> "Organizations are continually changing, routinely, easily, and responsively, but change within them cannot ordinarily be arbitrarily controlled.. Most changes in organizations reflect simple responses to demographic, economic, social and political forces.. organizations are remarkably adaptive, enduring institutions, responding to volatile environments routinely and easily, though not always optimally.. Most change in organizations results.. from relatively stable, routine processes that relate organizations to their environments." (March 1988: 167-169)

McShane and Glinow (2000: 468) similarly comment that "successful organizations monitor their environments and take appropriate steps to maintain a compatible fit with the new external conditions. This adaptability requires continual change. It is an ongoing process because environmental change does not end."

There is ample evidence that modern organizations are typically subject to frequent emergent changes, and that this is not necessarily a new phenomenon. Over forty years ago, Litterer (1965) observed that:

> "Organizations can be properly considered to be a continual process of change: changing internal work methods to improve the accomplishments of objectives; changing objectives; and adjusting to depleting resources, shifting competitive patterns, and fluctuations in the environment. These and many other types of change are always taking place in organizations." (Litterer 1965: 671)

At about the same time, Tausky (1970) commented that "since the perfect adaptation of organizational structure to external conditions or internal operations is rarely if ever achieved, and since these factors are also changeful, the potential for experiencing organizational change is ever present" (Tausky 1970: 97). Regardless of exactly when the situation was different, the evidence suggests that for a long time many organizations have been subject to frequent if not continual emergent changes in their environments, and many have adapted effectively to the changes.

7.3.2 Organizational Emergence and Information Systems

The case study found that TPE was an emergent organization in that features of its internal and external environments such as policies, rules, regulations and so on had long been continually emergent. In this context, 'emergence' implies not stemming from any deliberate strategy or initiative. The organization continually adjusted to such changes, although they were often small. Accordingly, TPE's business functions and information systems were also continually adapted as necessary to conform to their changing environments.

TPE was a 'brown field' site, as opposed to a 'green field' site. In a 'green field' situation, systems are implemented to support business functions which previously had no IT support. In a 'brown field' site, typically the terrain has long been 'built on' with computer-based systems, and any new systems or enhancements must work within the constraints of existing systems (e.g. Clear 2005). Most of TPE's key business functions had been in a 'brown field' state since the 1980s, with a few dating from the 1970s.

Within the scope of the TPE case study, prior to the organizational changes, the processual model of continuous strategy formation was in effect successfully applied to IS within the organization. That is, there were emergent, ongoing processes of strategy generation in relation to key business functions and the development and support of their associated complex information systems. Strategy formulation and implementation were effectively combined in TPE, as opposed to the rational model in which strategy formulation and implementation are kept separate.

The case study focused on TPE's key business functions which were supported by critical information systems. In this respect, the emergent changes were dealt with locally for each business function rather than on an organization-wide basis. Emergent changes which affected a business function were handled by long-standing, often informal structures and processes which enabled effective translation of the changes into the associated system(s). The relevant TPE structures and processes included in particular the informal IS governance arrangements (especially the 'system team' structure, which covered both system teams and business support teams) and IS knowledge processes (especially regarding IS communities of practice). These are discussed in detail in the TPE case study (Chapters 5 and 6).

As noted above, the processual approach is more likely to be effective, although it may be combined to a greater or lesser extent with some elements of a rational approach. The processual approach acknowledges that a realized strategy may be either deliberate or emergent, that is, it may be either deliberately planned, or it may emerge from a complex background of everyday changes and activities, via a bottom-up process. Organisations also sometimes pursue 'umbrella' strategies, with only the broad outlines being deliberate while the details are allowed to emerge. Within the scope of the TPE case study, the processual model clearly dominated, although it may also be seen as situated under a broad senior management 'umbrella' which allowed the details to emerge at lower levels. However as shown in the case study, at the senior management level in TPE there was considerable lack of appreciation of the informal IS governance and knowledge processes which applied, or of their importance in enabling the effective development and support of complex information systems.

Purao and Truex (2004: 175-176) propose that much research in software engineering focuses on models and methods for creating IT systems in organizations. They suggest that much of this research has traditionally assumed that business requirements are relatively stable or evolve only slowly. Purao and Truex (2004: 176-177) suggest that to cope with emergent business environments, improved system development methods are needed, such as agile methodologies

or extreme programming. This proposal is along the lines suggested by Purao, Truex and Cao (2003) and Truex et al. (1999). Purao and Truex (2004: 177, 182, 186) imply that emergence in organizations is now relatively common, and that the requirements for many systems are therefore also likely to be continually emergent and changeable.

The proposal of Purao and Truex (2004) is also generally in accord with calls to integrate insights from 'hard' (software engineering) and 'soft' (social scientific) system development perspectives (Probert and Rogers 1999; Purao and Truex 2004: 176-178). The software engineering perspective aims mainly to translate requirements accurately into information systems. The social scientific perspective aims to explain the underlying logic of social organizations in contact with systems (Purao and Truex 2004: 178). By themselves, neither perspective deals adequately with the difficult problems of developing and implementing complex information systems in emergent organizations (Purao and Truex 2004: 179).

An integration of the two perspectives is suggested, whereby an information system is seen as part of the organizational fabric, and organizational assumptions are woven into the system (Purao and Truex 2004: 179). Emergent systems development is such an approach, incorporating a continuous redevelopment process (e.g. Bansler et al. 2000; Patel 1999; Purao and Truex 2004: 179; Truex et al. 1999). Organizational emergence entails considering the interwoven and mutually interdependent nature of an information system and the organization (Purao and Truex 2004: 180). Both the system and the organization are malleable and in a constant state of flux (Purao et al. 2003; Purao and Truex 2004: 180; Truex et al. 1999). Purao and Truex (2004: 182, 186) contrast their proposed approach with more traditional methods that aim primarily to accurately reflect requirements in systems, and which ask for example, "how can we model the world to better facilitate the development of information systems?" (Wand and Weber 2002: 363). The alternative, emergent systems development "require[s] us to go beyond this perspective, treating the organization itself as emergent.. Organizations themselves are ephemeral and emergent. Processes and the interaction of human and machine actors are never really fixed" (Purao and Truex 2004: 182). A basic assumption of this approach is the symbiotic relationship between a system and its organizational context – a relationship better described as emergence (Purao and Truex 2004: 186). The approach sees contemporary organizations as emergent and continually changing, along with their information systems.

In a similar manner, Liu et al. (2002) see a need to co-design information systems and organizational processes, and suggest that "an organic integration of IT into both processes will allow both systems to evolve naturally" (Liu et al. 2002: 254). Purao and Truex (2004)

advocate that "emergence must continue past deployment of the information system, and that the process of designing should continue to encompass what is traditionally referred to as the maintenance stage" (Purao and Truex 2004: 186). Such co-design and co-evolution is an ongoing process, which may result in a series of temporary equilibria between a system and the organization, alternating with phases of change (Purao and Truex 2004: 180, 186).

The case study of this thesis demonstrates that in TPE, emergence continued beyond the deployment of a system and into the maintenance and support phases, in which system errors, minor changes and enhancements continued to be analyzed, designed and implemented collaboratively between IS and business. Also, the organization and many of its embedded systems moved through repeated cycles of emergent change and relative stability, reflecting the mutually interdependent nature of the organization and its systems.

The emergent systems development approach has been characterized as a fundamental shift from 'traditional' system development practices to a continuous redevelopment process (e.g. Purao and Truex 2004: 179; Truex et al. 1999). The TPE case study demonstrates that in an organization in which business requirements are continually emergent, effective structures and processes for handling emergent system development and support can evolve naturally over the years, without the need for imposing new or improved system development methods such as advocated by Purao and Truex (2004: 176-177). An optimal outcome was achieved in TPE via long-standing organizational structures and processes centred on implicit IS governance mechanisms and knowledge processes, as discussed in detail in the case study of this thesis.

In a somewhat similar manner, Purao et al. (2002) observed that some system developers in practice adopted behaviours that loosely mirrored the idea of the organization and the system as being interdependent, treated them both as malleable, and engaged with both in the course of system development (see also Purao and Truex 2004: 183). This suggests that in some cases developers can constructively engage with the problem of integrating information systems and organizational factors, without necessarily following specific development methodologies aimed at achieving this. This observation is in keeping with the findings of the TPE case study.

Truex et al. (1999) suggest that in the past, IT designers in general strove to create stable information systems with primary goals that included low maintenance. Truex et al. (1999) propose that an emergent organization should adopt an 'emergent systems' viewpoint, which assumes that business requirements are continually changing. Such a viewpoint also means that

a number of traditional goals of the IS development process become redundant, including the minimization of maintenance. Truex et al. (1999) summarize this as:

> "Emergent IS thinking accepts that every system must evolve continuously, and that all systems must be adapted regularly to their changing environments. A new ISD [IS development] project arises only from the utter failure of an existing computer-based IS. Under stable systems assumptions, the high value placed on new ISD over maintenance paradoxically implied a high value on the ultimate failure of every IS." (Truex et al. 1999: 120)

Prior to the organizational restructure, TPE had in effect successfully adopted an 'emergent systems' viewpoint, and its systems were regularly updated to match their changing environments. The system team structure was the main vehicle for achieving this – integrating development and maintenance – and providing for all the maintenance that was necessary. As a result, many systems were long-lasting, appreciated by their business users, and not regarded as outdated. Up until the time of the IS organizational restructure, low maintenance systems were not necessarily a primary goal of system designers. On the contrary, it was intended that maintenance and enhancement of systems would be ongoing, and would be provided at the level – often substantial – which was necessary to support emergent business needs. In fact in TPE there was a 'continuous redevelopment' perspective optimized for the level of maintenance and support needed for each system. The system team structure was well matched to the integrated development and maintenance needs of systems.

After the IS organizational restructure in TPE, project teams were set up to undertake development and major enhancement of systems, with a separate maintenance branch. After the restructure, the project teams were openly favoured, and there was an explicit goal of aiming to minimize maintenance of systems. There was a plethora of related adverse outcomes of these organizational changes, as described in Chapter 6. In effect, the IS organization of TPE regressed to the dysfunctional situation which Truex et al. (1999) cautioned against. Within the context of the TPE case study, the emergent systems proposal of Truex et al. (1999) is confirmed by the research of this thesis.

In summary, the emergent systems approach has been seen as a fundamental shift from 'traditional' system development practices to a continuous redevelopment process. Emergence continues past system implementation to encompass maintenance. The approach sees contemporary organizations as emergent, along with their systems. A fundamental assumption of the approach is the mutually interdependent relationship between an information system and its organizational context (Purao et al. 2003; Purao and Truex 2004; Truex et al. 1999). The TPE case study demonstrates that in a large organization in which requirements were

continually emergent, effective structures and processes for handling emergent system development and support had evolved naturally.

7.4 Knowledge Processes

Davenport and Prusak (2000) note that knowledge in organizations ranges from the complex, accumulated expertise – tacit knowledge – that resides in individuals and is partly or largely inexpressible, to more explicit content. The aspects of the thesis related to knowledge of systems and associated knowledge processes were set within the general framework of the 'dynamic theory of organizational knowledge creation' (e.g. Nonaka 1994; Nonaka et al. 2000). This theory maintains that organizational knowledge is transferred, updated and created through continual social interaction. The theory proposes that effective knowledge is often closely linked with action and practice, rather than knowledge simply connoting elements or facts. The theory takes a social processual perspective on knowledge, that is, organizational knowledge is constituted through social processes (e.g. Orlikowski 2002). Knowledge, particularly tacit knowledge, is fluid and emergent through interactions, and continually updated. Knowledge underlies social practices, is embedded and emergent within social processes, and so distributed.

As Cavaleri (2002) notes, knowledge is held within and between people, and is dynamic and emergent. Substantial amounts of knowledge originate naturally in informal interactions within the social-cultural milieu of an organization. Stacy (2001) argues that knowledge is not a 'thing', but an active process of relating. It is also proposed that knowledge should be managed as a flow: "Properly understood knowledge is paradoxically both a *thing* and a *flow*" (Snowden 2002: 101-102). It was found in the TPE case study that knowledge was essentially all of 'process', 'action', 'thing' and 'flow'.

There is often tension between the benefit of capturing the rich tacit knowledge that has the greatest potential value to an organization, and the difficulty of representing that knowledge effectively. Tacit, complex knowledge, developed and internalized by a knower over a long period of time, is almost impossible to reproduce in a document or database. Such knowledge incorporates so much accrued and embedded learning that its rules may be impossible to separate from how an individual acts.

Davenport and Prusak (2000) observe that expert tacit knowledge developed through long experience can enable those with knowledge to assess a situation quickly without necessarily even being able to explain their reasoning. Knowledge allows its possessors to deal with

complex situations quickly. Davenport and Prusak (2000) note that providing ready access to people with tacit knowledge can be more efficient than trying to capture, codify and transmit that knowledge to others. In TPE as seen, prior to the organizational changes, ready access to system specialists and their expert tacit knowledge had previously been possible. High priority problems in critical information systems required urgent resolution. Expert practitioners could often make rapid intuitive analytical leaps which could help resolve complex problems quickly. However the level of access to the specialists was undermined by the changes.

7.4.1 Communities of Practice

A number of writers have discussed 'communities of practice', that is, groups of people with common work interests who meet frequently to share expertise and solve problems (e.g. Wenger 1998). The term 'community of practice' is used in this thesis to refer to a co-located community which focuses on one or a few related systems, and interacts intensively on a regular basis. In a community of practice, ongoing dialogue maintains and enhances the informal knowledge held by its members, and can often generate new knowledge. A necessary condition for knowledge creation is 'redundancy' – shared information that allows individuals to 'invade' one another's boundaries and offer advice and new perspectives (Nonaka and Takeuchi 1995). An important element of an effective community of practice is shared trust among members. Trust facilitates effective knowledge transfer by creating openness and co-operative partnerships (Wathne et al. 1996). Communities of practice can thereby enable organizational processes to work effectively. For example, expert knowledge developed through long experience can enable its possessors to deal with complex problems quickly and accurately.

TPE had about 50 critical information systems which supported key business functions. Many of these systems were large and complex. The systems supported a high level of complex transaction processing for customers. The average age of the systems was around 12 years. Most systems were used on a daily basis, and TPE depended almost totally on its systems to function effectively and achieve its business objectives. All TPE's systems were subject to ongoing processes of error correction, minor and major changes and enhancements, and rarely, complete redevelopment. Business requirements, business processes and their system counterpart typically co-evolved as an integrated unit. In general a state of symbiosis existed between a set of requirements and their corresponding information system.

The understanding of how best to develop and maintain complex information systems had evolved naturally in TPE over many years. This had been associated with the evolution of

organizational IS structures and processes which had optimized the ability to effectively support complex systems, and so provided good support for business. The structures and processes were centred on communities of practice mainly within system teams, with each team focused on the informal management of the largely tacit knowledge needed to support a complex system, or a set of related systems. In these communities, co-workers discussed their work regularly, maintained and enhanced their knowledge of a system, and identified improvements. The communities of practice tended to be informal groups generally not acknowledged by executives. As noted in Chapter 2, the informal components of an organization can have a powerful influence on behaviour and action within the organization (see Figure 1 in Chapter 2).

TPE's IS support framework had evolved naturally over the years, and it reflected the values of the IS organizational culture. The IS culture implied that members of this culture saw the way in which their systems were developed and supported as constituting part of widely accepted structures and processes. The implicit ground rules of the IS framework were deep-seated and long-established, as cultural values often are. Cultural values are fundamental, and are typically seen by members as part of the natural state of affairs. The process by which the IS framework came to be widely adopted within TPE, in the absence of any formal management strategy, was related to the informal learning of values within the IS culture.

Constructivist theory in learning was found relevant to better understanding the TPE situation. Constructivist principles are based on the concept that learning is an active process through which learners can 'construct' new, context-based understandings based on their existing knowledge plus their individual capacities and experience, acting in conjunction with social and cultural factors. Constructivist learning typically entails 'learning by doing', involving collaborative work among people, and/or active 'on the job' mentoring. Constructivist principles require active participation by people in the creation of new understandings (e.g. Honebein et al. 1993; Jonassen 1991). This usually requires 'problem-based learning' approaches, with learners solving problems which are complex and realistic, by undertaking authentic tasks (e.g. Boud and Feletti 1997). Within a community of practice, as seen knowledge of relevant information systems was typically shared, enhanced and updated via collaborative work, 'learning by doing', problem-based learning and 'on the job' mentoring.

The concept of communities of practice has much in common with that of knowledge ecosystems. For example, Standards Australia (2005b) proposes that an organization, or a significant organizational component, may be seen as a knowledge ecosystem that consists of a

complex set of interactions among people, process, technology and content. Such a knowledge-based organization considers people and their knowledge as a primary asset.

In TPE, the IS structures and processes enabled effective informal management of the knowledge of complex systems, acquired through long experience. The structures, processes, social groupings and assumptions had become an integral part of the culture of the IS organization to the extent that they influenced the associated behaviours, beliefs and values of most IS staff. However the key contribution of communities of practice to the efficient running of TPE was little recognized at executive level. Their contribution, and the underlying role of knowledge of complex systems, were disrupted by the organizational changes. The members of a community of practice were then typically fragmented across several areas, often physically separated and with different work roles. The integrity of the former community and its immediacy of interaction were largely lost. The organizational changes acted to reduce the potential for sustaining and generating knowledge about information systems.

7.5 Information Systems Governance

The *IT governance* of an organization comprises the set of rules or guidelines that determine the division of IT roles and responsibilities, and how decisions on IT are made. It requires knowing what decisions have to be made at the intersection of IT and business, specifying who has input to the decisions, and who makes them. IT governance is also seen as a mechanism for matching business requirements with technology planning, and IT governance is a critical success factor for enterprises (e.g. Weill and Ross 2004).

The *IS governance* of an organization is a significant subset of the IT governance framework, and comprises the framework for governance of information systems. IS/IT governance has traditionally been seen as a controlled, executive-level framework for decision-making. However effective IT governance should focus on relationships and processes, with collaborative relationships among all key stakeholders, both business and IT. To be successful, enterprises should integrate their IS/IT governance with their strategies and culture (e.g. Korac-Kakabadse and Kakabadse 2001).

The IS governance of TPE consisted of both formal and informal components. It was shown that in practice there was an effective informal or implicit IS governance framework which applied prior to the organizational changes. This framework had evolved naturally with the system team structure over many years, and it closely reflected the values of the organizational

culture and structure. The IS cultural framework was deep-seated and long-established, and the implicit IS governance had long been widely accepted within TPE. Cultural values are fundamental, and are typically seen as being part of the natural order.

The formal IT governance which applied in TPE, and its subset of IS governance, essentially entailed a hierarchical structure of executive positions supported by formal groups, committees and processes. Decisions on what IS development work would be approved and undertaken were made by a joint business-IS planning group. This group consulted TPE's lines of business to ascertain their needs for systems development. Within many of TPE's lines of business there were business support teams which represented the needs of users of certain information systems, who were frequently spread across many lines of business. A business support team typically interacted with one or more IS teams, and made decisions at the operational level.

In addition to the formal, executive-led IS governance framework, in practice there was also an influential, informal level of IS governance. Prior to the organizational changes, there were about 45 key system teams – about equal to the number of critical systems. In almost all cases a business support team interacted directly with its corresponding system team regarding error correction, and minor enhancements and changes to a system, generally without need for further approval. In many cases a business support team also interacted directly with its system team regarding new development or major enhancements to a system, although generally these required higher-level endorsement. Much collaborative decision-making occurred within the 'system team' structure. The system team structure included the relationship each system team with a business support team. The system team structure played a crucial role in the implicit IS governance framework, especially as regards day-to-day decisions about system development and support. Collectively these were the most important decisions which affected the evolving systems. The IT executives had not consciously shifted decision-making closer to the 'front lines', but this situation had emerged over time as an integral part of the system team structure and the informal IS governance. In effect, each system was largely 'governed' in an ongoing manner by these informal arrangements.

The 'system team' structure is taken to represent the sum of the informal arrangements described above, and this formed the core of the implicit IS governance. As seen, effective IS governance embraces and integrates IS and business. IS governance entails the assignment of decision rights especially at the intersection of business and IS, and the accountability framework needed for effective IS processes and use (e.g. Weill et al. 2003). In TPE, the 'system team' structure represented the major intersection of business and IS service providers,

and for all practical purposes was the locus of the most important ongoing decisions about systems. The 'system team' governance framework was a form of 'federated' model (e.g. Weill 2004). In TPE, in effect a 'system' was the primary unit in the federation, rather than any formal organizational unit such as a line of business. As such, a 'system' as an entity spanned both the business support team and the system team. 'Systems' as entities were in fact the principal players in the governance structure. The implicit IS governance could justifiably be described as a federated, system-based governance structure.

The system team structure in effect also formed a knowledge ecosystem, that is, a complex set of interactions among people, process and technology (e.g. Standards Australia 2005b). Because of their entrenched nature, the system team structure and the implicit IS governance were integral components of the organizational structure and culture. The values and behaviours represented by the system team structure were a part of the organizational culture. However as seen, the organizational changes acted to disrupt the system team structure and the implicit IS governance framework, so challenging key aspects of the organizational culture.

Sambamurthy and Zmud (1999) comment that "regardless of whether the focus is research or practice, IT governance issues invariably take the form of very messy and ephemeral phenomena. We are convinced that efforts to understand and direct these phenomena cannot follow a 'business as usual' stance. We hope that our application of holistic theoretical and methodological postures will encourage other researchers – and practitioners – to likewise innovate in their explorations of effective IT governance arrangements" (Sambamurthy and Zmud 1999: 283). The case study of this thesis demonstrates that complex, 'messy', ephemeral phenomena were indeed part of the IS processes and structures of the organization studied, and an integral part of the IS governance framework. Such phenomena are an essential focus of a qualitative, interpretive study (e.g. Geertz 1973, 1983), as discussed in Chapter 2. The thesis follows the suggestion of Sambamurthy and Zmud (1999) in advocating that the researcher be innovative or think laterally in the exploration of IS governance arrangements in an organization, and considering how they can be made more effective.

In general this thesis indicates that for an organization to meet its business objectives, it must consider all essential aspects in its governance strategy. These often include processes and social-cultural factors as significant components, and all should be considered in an integrated manner. This applies as much to IS governance as it does to corporate governance (e.g. Kingsford et al. 2003). For organizations which develop and maintain information systems, the IS governance needs to include consideration of how best to ensure effective systems planning,

development, maintenance and support. IS governance should also include consideration of aspects such as IS organizational culture, structure, human resources and processes, including knowledge processes. It is not acceptable to relegate some aspects to be decided later, possibly in isolation, such as IS organizational structure, knowledge processes or HRM arrangements. If all aspects are not considered together at the level of IS governance, the organization risks compromising its ability to achieve its business goals, and hence its competitive position.

Effective IS governance is closely linked to the achievement of greater competitive advantage by an organization, as seen. IS governance is the organizational capacity to control the formulation and implementation of IS strategy, and a guide to proper direction for the purpose of achieving competitive advantage. It is strongly in the interests of any organization to pay close attention to the quality and efficacy of its IS governance. The thesis focuses on information systems development and support. Information systems planning is an integral part of any IS governance arrangement, but it is not a focus of this thesis. It was shown that an IS governance agenda should include the considerations given above, and should also examine the pre-existing IS governance framework, including both its formal and implicit aspects. The last point applies especially to implicit aspects of IS governance in emergent organizations. These steps are necessary in order to formulate an IS governance framework which will sustain or improve the level of IS service delivery. Therefore a general recommendation can be made:

Recommendation 1

> *IS governance should include consideration of how best to ensure effective information systems planning, development, maintenance and support. It should include detailed consideration of organizational culture, structure and human resources, and also knowledge structures and processes. It should examine any pre-existing IS governance framework, including both formal and implicit aspects, and consider whether such a framework already effectively supports IS processes. The last point applies especially to implicit aspects in emergent organizations.*

7.6 Organizational Change Management

Many organizational restructures and process re-designs have had limited success because they "were either ignorant of, or actively cut across, knowledge flows and content within an organization and its stakeholders" (Standards Australia 2005b: 60). In TPE as noted, the IT executives had in effect followed the advocates of business process reengineering (e.g. Hammer 1990), in regard to the latter's advice to make a clean break from past practices. However BPR actively discourages recognition of the value of expert knowledge gained through long experience (Snowden 2002). The outcomes of BPR projects have often been poor (e.g. Bolman and Deal 2003). It has also been observed in general that:

> "For many, reengineering was carried out with missionary enthusiasm as managers and consultants rode roughshod across pre-existing 'primitive' cultures with the intent of enrichment and enlightenment that too frequently degenerated into rape and pillage" (Snowden 2002: 101).

In TPE, the organizational changes had sought to impose far-reaching transformations on IS structures and processes that had evolved naturally over many years, and also attempted to alter ingrained ways of thinking. Essentially the changes challenged or disrupted the deep-seated cultural assumptions and values of many IS staff, and attempted to alter their long-established behaviours. The reforms to structures and processes had effectively enforced change in some areas, such as the structural separation of maintenance from development and major enhancements. However in other areas many IS staff had resisted the changes either actively or passively, with justification. One such example was that many mid-level managers and staff had resisted as far as possible implementing the 'adaptable and portable IS workforce' principle, knowing that this would further undermine effective support for systems and business.

This resistance was based on strongly held cultural assumptions, and also based on direct evidence in TPE that the effective support of complex systems required ready access to specialist knowledge. Part of the IS culture was a strong sense of obligation to provide quality services and support for business. The resistance of many managers and staff to the organizational changes was rational and soundly based, in that they perceived the changes as compromising their ability to provide good customer service. The organizational changes were not in harmony with the informal IS knowledge processes of TPE, nor the underlying culture of the IS organization, nor the implicit IS governance. Hence they were resisted at the 'grass roots' level of IS practitioners, to the extent they could do so. However it was not possible to fully overturn or reverse the changes, which therefore continued to undermine the effectiveness of the IS knowledge processes, and hence the effectiveness of IS support for business.

It was rather difficult to understand the strong level of support of the executives for the 'adaptable and portable IS workforce' principle, which if implemented in full would probably have led to an outcome of staff with specialist knowledge in information systems being gradually replaced by adaptable generalists, who could (in theory) face just about any challenge on any system. The evidence provided by TPE over 20 years had strongly suggested that specialist system knowledge was necessary and valuable. This case study illustrates the importance of including a 'knowledge processing' perspective when considering the likely impacts of any significant organizational changes.

7.6.1 Knowledge Processes and Change Management

McElroy (2002) draws a distinction between knowledge processing and knowledge management, which is a management discipline which seeks to improve knowledge processing. Such a distinction can be useful, however TPE's IT executives did not seek to understand the nature of the knowledge processing performed within the domain of the study. As seen, it is possible for effective implicit knowledge management to exist in an organization, without any specific formal KM program. This underscores the need to understand the informal KM and existing knowledge ecosystems within an organization first, and how they operate, before any formal KM initiative is adopted, or indeed before any other strategy which might inadvertently disrupt the implicit knowledge processes, or the ecosystems and culture in which they are embedded. This applies especially to implicit knowledge processes and informal knowledge management in emergent organizations. If the informal knowledge processes are working well, it can be wise not to disturb them. In TPE, the IT executives' intervention led to the unintended disruption of crucial knowledge processes.

About four years after the organizational changes were initiated, IS managers in some areas had attempted to re-integrate development and maintenance. By the end of the case study, these initiatives had not been fully implemented, and so this aspect was not able to be studied in detail. However it reinforced the fact that the organizational changes had acted to undermine structures, processes and assumptions that had evolved naturally in TPE, and which had become associated with key elements of the IS culture. When aspects of a culture are challenged or disrupted, the members of that culture often resist, and attempt to reinstate the 'natural' order (e.g. Pheysey 1993).

The sections above have demonstrated the importance of taking a 'knowledge processing' perspective in the context of organizational restructures or process re-design. Therefore a general recommendation can be made:

Recommendation 2

> *When planning any significant organizational strategy, it is important to investigate and understand how existing knowledge processes and informal knowledge management operate within the organization first, before any strategy is adopted which might inadvertently disrupt the implicit knowledge processes, or the culture in which they are embedded. This applies especially to implicit aspects in emergent organizations.*

7.7 Further Inferences and Summation

The case study found that information systems, knowledge of systems and IS governance were closely integrated with organizational structure and culture, and that the answers to the key research questions posed were also closely inter-related.

The case study indicates that the need to provide ongoing support and maintenance for complex systems in an emergent organization may not be compatible with a 'pure' project management structure. A corollary is that it may be unwise and inefficient to segregate the development and maintenance of complex information systems into different functional areas in an emergent organization. The study utilized an understanding of governance and knowledge principles to draw these inferences. The earlier structure in TPE of multi-purpose system teams, each of which undertook all development and maintenance on a system, was better adapted to the needs of TPE, and better supported organizational goals. This does not suggest that such arrangements would necessarily apply effectively in all organizations.

As noted in Chapter 2, it has been argued that it is possible for a qualitative study to have implications for other similar situations, and thereby to be capable of some degree of generalization (e.g. Wainwright 1997). The TPE case study focused primarily on in-depth study, 'thick description', detailed analysis and interpretation of a certain organizational situation, and also aimed to shed light on the more general structures, processes and governance frameworks that underpinned that situation. The research findings therefore have some degree of applicability to similar situations in other settings.

The case study was primarily of one organization, and there are limits as to how widely its findings can be generalized. The researcher also observed the general nature of IS organizations in 15 other emergent enterprises, but did not study most of them in much detail. These organizations all developed and supported their own information systems. The organizations were observed for various intervals of time over about 15 years. The period of observation was in many cases relatively brief, with some being only a few weeks. They were either observed by the researcher in the course of employment in an organization, or were advised to the researcher by trusted sources including one of the researcher's academic supervisors. In most cases, it could not be determined how effective or long-lasting the observed structures were. The majority of organizations (11 out of 15, or about 70 per cent) were observed to have a general IS structure which integrated development and support for each supported system, such

as a 'system team' or similar structure. This at least suggests that such an organizational arrangement is often effective, at least in emergent organizations.

One of the organizations observed placed advertisements for jobs which included the following expectations of applicants. This organization integrated the development and support of key critical systems. The advertisements made it clear that the organization valued knowledge of such systems, including both technical and business aspects:

> "You are required to have sound knowledge of the applications that support the business.. to consolidate the development and sustainment of the.. principal enterprise systems.. Sound knowledge is required of.. relevant systems and business areas.."

The researcher worked in another emergent organization ('B') and was able to observe its IS structure for two years in the 1970s, and again for three years in the 1990s. In the 1970s organization B had a 'system team' structure for all its systems, which were mostly mainframe-based. By the 1990s it had moved to separate development and maintenance branches for its mainframe systems, but had a 'system team' structure for its mid-range systems. The mid-range systems were newer than the mainframe systems. It was found that when a mid-range system team was set up, typically it initially worked on developing the first production release of a system. It then moved on to simultaneously maintaining the first release and undertaking major enhancements to the system. This scenario was quite similar to that observed in TPE prior to the restructure. Also somewhat similarly to the situation in TPE, the chief IS officer of organization B complained of the high cost of maintenance of mainframe systems. This had been a key driving factor in changing from the earlier mainframe 'system team' structure, that is, to make maintenance more visible and so potentially reduce its cost. The resource cost probably had been reduced, but it was observed that some maintenance staff experienced excessive workloads and work-related stress. At least one such person was observed to require being moved to lighter duties.

It should be noted that most of the observations of other organizations were relatively brief, and such observations may not reveal layers of complexity beneath the surface. Attempts to draw meaningful conclusions from superficial comparative observations are risky. For example, in another one of the organizations which could be observed in somewhat greater detail, it was noted that although this organization had a separation of projects and maintenance, it also regularly moved staff between project and maintenance areas. How this organization dealt with knowledge of systems could not be determined, and no further details were available.

Organizational structures and/or processes for undertaking IS development and maintenance have been discussed by a number of writers (e.g. Bennett and Rajlich 2000; Swanson and Beath 1990). It is unsurprising that various forms of structure may be observed in different organizations. In the case of TPE, it might be hypothesized that an organization which relies fairly heavily on the deeply entrenched knowledge – especially tacit knowledge – of system specialists each with a long tenure in working on a particular system may be susceptible to problems. Such hypothetical problems might include over-reliance on specialists, inability of such staff to move freely, difficulty in replacing such staff if they do move, the slow process for a newcomer to develop knowledge in a particular system, and the vulnerability of critical systems to loss of key staff. For some organizations, any of these aspects may have valid negative connotations. However TPE had evolved and shaped these factors to have mainly positive connotations, over the more than twenty years in which the 'system team' structure prevailed. The structure did in fact depend on a high retention rate of experienced IS staff, and the related IS culture and implicit IS governance had helped to achieve this. The IS culture valued long experience and the gradual building of expertise in a given system, or a small set of related systems. Experienced IS staff in turn felt that their work inhered in an atmosphere of mutual trust, confidence and inter-dependence, and that their contributions were recognized, valued and rewarded. TPE benefited from the structure and culture which these arrangements represented, and so the hypothesis posed above would not be supported.

As Gray and Larson (2000) advocate, the best organizational structure balances the needs of projects with that of the organization. In general the TPE case study indicates that organizations which rely on complex information systems and have their own software development and/or maintenance functions should examine their systems knowledge and how it operates, and consider what processes and structures work best to sustain it. Agarwal and Sambamurthy (2002) suggest that there is no single 'best' IT organizational structure, since IT needs to respond to the unique environments in which it exists. Similarly, Bertsch and Markert (2002) observe that there is no standard best-in-class structure for IT organizations, since each organization has unique features of its IT and business. An important consideration is to identify what currently works well, and work *with* it, not against it. IT organization redesigns are major undertakings that need to be managed as such. Critical roles are often ignored in IT organization redesign, and this can have adverse results. This was borne out in TPE by the disregard of the key role of the system specialists. The executives also failed to properly understand the existing knowledge processes centred on the system specialists, and failed to define new processes.

The TPE case study does not necessarily imply that any organization which develops and maintains software should merge these two functions. Even in TPE, if the functions had been separated from the early years of IT, it may be speculated that effective processes and structures might have emerged over time. However it was considered that four years was a sufficiently long period of time over which to evaluate the success of the organizational changes. By way of comparison, Young (2006) notes that technology organizations typically need two to three years to complete a major transformation of their structures and processes (Young 2006, quoted in Woodhead 2006). In TPE it was concluded that as the changes had not achieved widespread acceptance or effectiveness after four years, there were good grounds to deem them largely unsuccessful for most practical purposes. Consequently there was justification to investigate the reasons for their failure.

From its origins as the administrative 'personnel' function, human resource management (HRM) has more recently come to be seen as an important organization-wide, distributed function which is a key source of competitive advantage for a firm (e.g. Blount et al. 2005; Boxall and Purcell 2003; Sheehan et al. 2006). Put more precisely, the employees of the firm are the source of competitive advantage, if shaped and guided well by effective HRM. The single most important corporate resource of many organizations is now often seen as employees, together with their knowledge and competencies (e.g. Michaels et al. 2001; Sheehan et al. 2006). The HRM function is taken to mean the process of ensuring the effective planning and management of the human resources of an organization, including consideration of the structures, processes, knowledge and capabilities needed across the organization, now and in the future (e.g. Sheehan et al. 2006). An effective HRM function should include influencing these aspects to support the achievement of the organization's objectives.

Young (2006) also comments:

> "[Human] resource management is one of the IS organization's most complex issues.. Unfortunately, the IS organization is generally focused only on obtaining bodies and putting bodies to work against whatever demand occurs. It is purely reactive, which creates an emphasis on training, development and recruitment. These disciplines are essential but not enough. Without the ability to analyze demand patterns to enhance future predictions, translate business and technology plans into demand schedules and match skills against requirements, resource assignment will always be 'sketchy'. Likewise, it is impossible to build an optimized organization or structure." (Young 2006)

The HRM function includes as an essential component human resource development (HRD), that is, professional learning and training. A pivotal aspect of the HRD function is creating and sustaining environments conducive to learning; to acquiring, sharing and disseminating knowledge; to nurturing communities of practice and social networks; and to recognizing and

supporting the nexus among learning, knowing and doing within specific work contexts (Standards Australia 2005b: 42). In regard to communities of practice, Roberts (2006a: 635) notes that, "Given that knowledge is transferred through social interaction within communities, then businesses need to pay particular attention to their recruitment and training policies to ensure that they maintain an appropriately skilled workforce to maximize the benefits of communities of practice."

Therefore a recommendation can be made:

Recommendation 3

> *The HRM function should consider the structures, processes, knowledge and capabilities needed across the organization, and ensure that they support the achievement of organizational objectives. This includes shaping effective structures and processes for the development and maintenance of information systems – both present and future. The HRM function includes creating and sustaining environments to support learning; acquiring and sharing knowledge; nurturing communities of practice; and supporting the nexus among learning, knowing and doing in work contexts.*

Systems and system knowledge often confer competitive advantages for an organization, and warrant careful consideration by executives and managers. The case study indicates that organizations which rely on complex information systems should carefully consider their systems knowledge and how it operates. They should consider in detail what is needed to most effectively sustain the generation, sharing and use of system knowledge, and what solutions fit best within the organizational culture. This includes informed consideration of organizational structures, processes, interactions and HRM arrangements. It is advisable to perform these steps before embarking on significant organizational changes.

Also as noted above, the provision of effective ongoing support and maintenance for complex information systems may not necessarily best be achieved via a 'pure' project management structure, especially in emergent organizations. It may be more effective to integrate the development and maintenance of complex systems into a common organizational arrangement. Alternatively, it may be appropriate to allow for the natural evolution of effective informal structures and processes which may entail integrated development and maintenance.

In recognition of the points made above, the following general recommendations can be made:

Recommendation 4

> *Organizations which rely on complex information systems and undertake software development and/or maintenance should examine their systems knowledge and how it operates. They should consider what is needed to effectively sustain the generation,*

> *sharing and use of system knowledge, and what arrangements fit best within the organizational culture. This includes informed consideration of organizational structures, processes and HRM arrangements. Critical roles should be identified and considered. It is important to identify what currently works well, and work with it, not against it.*

Recommendation 5

> *The need to provide ongoing support and maintenance for complex information systems may not be compatible with a 'pure' project management structure, especially in emergent organizations. It may be more effective to integrate the development and maintenance of complex systems into a common organizational arrangement.*

In general terms, Bittinger (2006) advocates that in order to provide value into the future, IT organizations should strongly focus on ensuring that they have effective processes, relationships and services. These arguments are particularly apt in the context of the findings and recommendations of this thesis:

> "..in the future, the IT organization's most critical assets and capabilities will be processes, relationships and services, because these will increase the end-to-end value the organization can contribute.. Focusing on end-to-end value – as represented through processes, relationships and services – has a profound impact on the roles and the balance of competencies and skills in the IT organization.. They mandate competencies that enable people to work collaboratively, to persuade, to influence and to negotiate..
>
> "[managers] must put in place measures and build behaviors that result in collaboration and cooperation among all the resources required to deliver a service – again driving action at the interfaces in the enterprise.. when we talk about 'services' in this context, we are primarily referring to the services the IT organization delivers to its business stakeholders.. The success of the IT organization increasingly relies on its ability to build effective relationship and communication channels." (Bittinger 2006)

It can be concluded that in order to succeed and add value in an uncertain future, IS organizations should focus strongly on ensuring that they have effective structures, processes, relationships and services. To achieve this, they should examine how their structures and processes fit best within their organizational culture. They must consider what arrangements are needed to sustain the generation, sharing and use of system knowledge. This should include informed consideration of organizational structures, processes, IS governance and human resource management arrangements.

The sections above reviewed the research methods, aims and questions, and significant points arising from the research. Inferences drawn from the findings of the case study were considered. Practical recommendations were offered for organizations – especially emergent ones – which rely on complex information systems. The following sections briefly outline the contribution of the thesis, and suggest some areas for further research on organizational issues.

7.7.1 Contribution of This Research

This thesis makes significant contributions to knowledge and better understanding in the following key areas. The areas of contribution are discussed briefly further below.

- Qualitative research approach
- Structures, processes and governance of complex information systems in emergent organizations
- Role of knowledge of complex information systems, especially in emergent organizations
- Systems in 'brown field' organizations
- Aligning systems with organizational needs
- Recommendations for 'good practice' regarding complex information systems, especially in emergent organizations

Qualitative research approach

The field of organizational IS research needs to be informed by detailed studies of what really goes on inside organizations regarding their information systems. The qualitative techniques adopted for the extended case study were well suited to gaining good understanding of complex information systems in an organizational setting. The research used interpretive methods including ethnography and participant observation. Ethnography can provide deep understanding of a complex organization. As a participant observer, the researcher had good access to rich empirical data. Ethnographic research is thus well suited to gaining rich insights into the organizational and cultural aspects of complex information systems.

Structures, processes and governance of complex information systems in emergent organizations

The thesis explores the structures, processes and IS governance arrangements which can enable effective development and support of complex systems in an emergent organization. A key issue is providing effective support for critical systems. Maintenance often entails a large investment in resources, and warrants attention. These are relevant issues for organizations which rely on critical systems to support their business operations. The thesis makes a significant contribution by extending the level of knowledge in these areas. Key findings include the critical role of informal or implicit IS governance structures and related processes.

The organization studied was emergent in that its environmental aspects were continually changing. The organization continually adapted to these changes, and its systems were also

continually adjusted. An 'emergent systems' approach has been proposed – seen as a fundamental shift from 'traditional' system development practices to a continuous redevelopment process which integrates development and support in an ongoing sense (e.g. Truex et al. 1999). The case study examined a large emergent organization, and demonstrates that effective structures and processes for an emergent systems approach had evolved naturally – thereby supporting the emergent systems approach.

Role of knowledge of complex information systems, especially in emergent organizations

The thesis also addresses the key role of knowledge processes and knowledge of complex systems, emphasizing the crucial role of tacit knowledge. Detailed qualitative studies are comparatively rare of the way in which systems knowledge can help enable effective systems development and support, and the thesis contributes to better understanding in this area. It was found that tacit knowledge of complex systems played a key role in effective development and support in an emergent organization. The sharing of such knowledge and the generation of new knowledge was achieved by constructivist learning involving collaborative work and 'learning by doing'. The thesis examines these social interactive dimensions of situated learning. Systems and system knowledge often confer competitive advantages, and warrant consideration. The thesis suggests that organizations which rely on complex systems should examine their systems knowledge, and consider the structures and processes that will best sustain it.

Systems in 'brown field' organizations

The organization studied was a 'brown field' site, which had long been 'built on' with computer systems, and new or altered systems had to work within the constraints of existing systems and accrued data. Research focusing on 'brown field' situations is relatively new, and the thesis makes a significant contribution to knowledge in this important area. The research topic relates to the issue of aligning systems with organizational needs in 'brown field' situations. The case study describes effective, implicit IS governance arrangements and related knowledge processes in a large emergent organization, which allowed close integration of IS and business in the development and support of complex systems in a 'brown field' environment.

Aligning systems with organizational needs

The research topic relates to the long-standing issue of aligning information systems with organizational business needs. The problem of business-technology alignment has in general not been 'solved', even after decades of research and practice. The thesis makes a contribution to better understanding of the issue of aligning complex information systems with business needs in an emergent organization.

Recommendations for 'good practice' regarding complex information systems, especially in emergent organizations

Some general inferences are drawn from the research in the form of recommendations for 'good practice'. These include recommendations relating to arrangements for IS governance, knowledge processes, systems knowledge, human resource management and change management in organizations that rely on complex systems, especially emergent organizations. Some suggestions are also made for further organizational research (see below).

7.7.2 Suggestions for Further Research

It is suggested that further applied academic research on organizational IS issues related to this thesis would significantly advance general understanding in the field of IS. IS research needs to be informed by studies of what actually happens in organizations. This applies particularly to research in emergent organizations which rely on complex information systems to support their business. Especially relevant in the current environment are 'brown field' situations, in which an organization has long depended on legacy systems, and any new systems or enhancements must work within the constraints of existing systems. Relevant research would focus on areas such as system development, system support (including maintenance), IS governance (formal and informal), knowledge of information systems, related organizational structures, processes and culture, IS-business alignment and HRM arrangements. IS-business alignment refers to the ongoing issue of effectively aligning systems with business needs.

Organizational research of this type is often well-suited to the use of qualitative, interpretive techniques, such as those adopted for the TPE case study. The interpretive anthropological methods of ethnography and participant observation have value in investigating both social and organizational settings. Such approaches can provide deep understanding of a complex situation, and are well suited to gaining rich insights into related social and cultural issues. Such techniques also allow a researcher to become immersed in the context studied, and can enable access to detailed empirical data which may not be generally available. Researchers with good access to suitable organizational settings are well placed to undertake further studies of this type.

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GLOSSARY OF TERMS

Descriptions of terms as they are used in this thesis are given below. Brief definitions of key terms used in the thesis are given near the front of the thesis.

application	computer-based part of an information system; consists of program(s)
batch system	computer-based information system which updates relevant production data within it from a batch of transactions in sequence, some time after they enter the organization; this may occur nightly, weekly, monthly etc
brown field	organizational situation in which typically computer-based systems have long existed, and any new systems or enhancements must work within the constraints of existing systems and accumulated production data; see also *green field*
business	that part of an organization which is directly responsible for fulfilling the purpose of the organization; the basic reason for existence of the organization; may refer to a specific area of an organization in regard to a certain business function
business function	area of responsibility of an organization related to fulfilling one or more of its aims; e.g. customer records, accounting, ordering etc
business needs	broad requirements for one or more related information system(s), expressed in business terms
business process	a process used by a business area to support the fulfilment of an aim of the organization; may include the use of information system(s)
business requirements	specific requirements for an information system, expressed in business terms which can be translated into system specifications; generally documented
business rules	specific rules relating to business process(es) which are incorporated in an information system; often included in business requirements and/or system specifications
business staff	staff of a business area of an organization
change management	management of significant change(s) in an organization, such as to organizational structure or processes; methodology used to manage such change(s)
community of knowers	group or network of people brought together by common interests, who usually talk, share expertise and solve problems together; when such a group shares sufficient knowledge to communicate and collaborate effectively, their ongoing conversation often generates new knowledge

community of practice	community of 'knowers' who share both their work and interpersonal discussion of it, and so acquire, maintain and enhance their informal knowledge about the work, and also identify and discuss potential improvements; can enable organizational processes to be effective; used specifically in this thesis to refer to a co-located IS community which focuses on one or a few related systems, and interacts intensively on a regular basis
complex information system	information system used by an organization which is regarded as complex by IS staff, users and/or managers; system which is difficult and time-consuming to develop extensive knowledge of; there is no precise division between 'complex' and 'simple' systems
complex system	system which is regarded as complex by persons involved with it, such as developers or users; system which is difficult and time-consuming to develop extensive knowledge of; a relative statement, there is no precise division between 'complex' and 'simple' systems
critical system	information system which an organization relies on totally, and which must remain available to users and work properly; also called business-critical system, mission-critical system or key system
culture	system of shared ideas, concepts, rules and meanings that underlie and are expressed in the way people live in a group in society; cultural values, beliefs, assumptions and norms are usually deep-seated and long-established
customer	a customer of IS internal to the organization; a consumer of services provided by the IS organization; may sometimes refer to a customer of IS external to an organization
data	element recorded in business terms at the lowest level; stored in an information system to help fulfil the aims of the organization
database	structured repository for storing production data; allows orderly retrieval of data and information; also called data holding
database management system	standard support software for designing, developing and using a database; usually a commercial software product
deliverable	discrete document or item produced as part of the development of a system or system product; output of a stage in the system development process; often an output of a stage in a project
e-business	electronic business; business undertaken with the support of internet (web) technologies
emergent organization	organization in which features of its internal and external environments such as structure, policies, regulations, decision processes etc are emergent and dynamic; emergence implies not stemming from any deliberate strategy or initiative; the emergence may be gradual and continuous
emergent system	system in an emergent organization; assumes that business requirements are continually changing, and that the system is continually adapted to its environment, and so continually evolves
ethnography	approach drawn from social-cultural anthropology, generally used to study the culture, structure and/or processes of a group or organization

explicit knowledge	knowledge which can usually be readily articulated and documented; relatively easy to transfer to other people
federated governance	governance model in which coordinated decision making involves both a centre and outlying units; similar to the federal governmental system of some nations, in which certain decisions are made at federal level and others are the responsibility of states
formal organization	visible aspects of an organization such as goals, strategy, plans, resources and formal structure; see also *informal organization*
governance	system by which an organization is directed and controlled; framework, or set of rules or guidelines that determine the distribution of roles, responsibilities, decision-making, accountability, resources and processes in an organization; governance guidelines may be explicit or implicit
green field	organizational situation in which computer-based systems are implemented to support business processes which previously had no computer support; see also *brown field*
guidelines	pragmatic, sound advice regarding best practice for a specific process, procedure or methodology (usually documented); often includes good examples; may involve business, IS or both; guidelines are generally not mandatory; also 'guide'
hardware	physical infrastructure related to a computer system
heritage system	computer-based information system which typically has long existed in an organization, and which the organization relies upon to support critical business function(s); also called *legacy system*
HRM	human resource management
human resource management	management of human resources; also HRM; organizational unit responsible for this
human resources	persons employed by an organization; may include ongoing ('permanent'), temporary and contract employees
ICT	information and communication technology
informal organization	implicit or 'hidden' aspects of an organization such as culture, values, beliefs, attitudes, behavioural norms, power, politics and informal structure; informal aspects typically have strong influence on actions and decisions; see also *formal organization*
information	element recorded in business terms at the next level above data; stored in or generated by an information system to help fulfil the aims of the organization
information system	system used to support certain business requirements related to information, typically entailing information acquisition, processing, storage, transfer and/or display; typically a human-technological system which includes significant computer-based component(s)

information technology	broad area of application and/or study of technology used to support information acquisition, generation, processing, storage, transfer and display, often within groups or organizations; includes human and technological aspects; includes related processes and knowledge; includes IS as a sub-set; also called information and communication technology
information and communication technology	information technology
interpretive research	research approach typically associated with the social sciences and ethnography, which generally attempts to understand and interpret phenomena through the meanings assigned to them by people closely involved with those phenomena
intuition	tacit knowledge derived from mental models based on long experience, dependent on context, and not based on linear cause-consequence thinking; such mental models are often founded on deep understanding, and are so internalized and thought about so often from so many perspectives that typically they cannot easily be explained in simple cause-effect language; generally not able to be clearly articulated or documented
IS	information systems; may refer to the development, support, use and/or study of information systems; may refer to the IS organization
IS culture	organizational culture of the IS organization
IS employees	employees of the IS organization; refers mainly to employees who perform technical work related to development, maintenance or support of information systems, and their managers
IS governance	governance framework relating to information systems in an organization; subset of IT governance
IS/IT governance	IT governance with an emphasis on its significant IS component
IS organization	that part of an organization which develops and maintains information systems, in particular their software aspects, and supports the technical operation of systems; also IS group
IS services	services provided by the IS organization related to development, maintenance or support of information systems; generally provided to customers internal to the organization; some services may be provided to external customers
IS staff	employees of the IS organization; refers mainly to employees who perform technical work related to development, maintenance or support of information systems, and their managers
IT	information technology
IT governance	governance framework relating to IT in an organization
IT organization	that part of an organization which supports information technology; also IT group
IT security	security of IT systems and information; policies, standards and procedures related to this; organizational unit responsible for this

key system	information system which an organization relies on totally, and which must remain available to users and work properly; also called critical system, business-critical system or mission-critical system
knowledge	fluid mix of framed experience, values, contextual information and expert insight that provides a framework for evaluating and incorporating new experiences and information; knowledge may be either, or simultaneously, a 'thing', a 'process', an 'action' and/or a 'flow'; substantial amounts of knowledge originate naturally in interactive social processes; often embedded in organizational routines, processes and norms
knowledge ecosystem	complex set of interactions among people, process, technology and content within an organization, or a significant organizational component; the components of a knowledge ecosystem may include its objectives, strategic intent, organizational context, culture, specific enablers (activities, tools, techniques), networks and communities
knowledge management (KM)	management discipline that seeks to improve the quality of knowledge processing within an organization
knowledge process	social process involving the production, diffusion and/or use of knowledge; evolves naturally within an organization, without necessarily any explicit imposition of a knowledge management framework
knowledge processing	social process found in all organizations, covering the production, diffusion and use of knowledge; act of performing knowledge process(es)
legacy system	computer-based information system which typically has long existed in an organization, and which the organization relies upon to support critical business function(s); also called *heritage system*
methodology	formal documented method or standard procedure for undertaking a certain set of actions and achieving a certain outcome; often refers to system development or project management; often mandatory if applied by an organization
mission-critical system	information system which an organization relies on totally, and which must remain available to users and work properly; also called critical system, business-critical system or key system
on-line system	computer-based information system which updates relevant production data shortly after a user enters a transaction
operating system	standard support software to drive a computer; almost always a commercial software product
organization	set of roles, responsibilities, accountabilities, people and other resources set up to fulfil a common purpose, which may comprise a number of aims; an organization has a structure, of varying types
organizational culture	system of shared ideas, concepts, rules and meanings that underlie and are expressed in the way people live and work in an organization; cultural values, beliefs, assumptions and norms are usually deep-seated and often long-established

organizational structure	arrangement of groups, networks, roles, responsibilities and people in an organization; may refer to either formal configuration, or significant informal arrangements
participant observation	approach in which the observer is also a participant immersed in the relevant culture or organization, and studies it in detail from the point of view of its own members
peer review	review of a system deliverable produced by a team, undertaken by peers from the same team and other team(s); part of quality assurance process
platform	(usually) technical platform: technological infrastructure underlying a system – this may refer to a type of computer, operating system, database management system or programming language (e.g. 'mainframe platform'); sometimes refers to a computer-based system or application over which another system or application is placed (e.g. 'SAP platform')
policy	general rules of good practice for a particular process or area (usually documented); may involve business, IS or both; generally mandatory if applied by an organization
procedure	specific rules of good practice for a particular process (usually documented); may involve business, IS or both; may be mandatory
process	means of achieving a certain output or result; generally refers to a regular or recurring need; often includes a set of actions; not necessarily rigidly specified; may or may not be documented; may apply to business and/or IS
production data	data stored in a computer-based information system and used by business staff to help perform business processes; also 'live' data
program	module of software code designed and written to achieve a certain aim, which may be business or technical
programming language	standard support software used to write a program; almost always a commercial software product
project	logical array of activities intended to achieve a certain objective which may include the delivery of a product; has a defined start and finish, is not ongoing; may refer to a project team
project management	process or procedure used to manage a project; sometimes documented as a methodology
project team	team set up to undertake a project
quality assurance	procedure or methodology used to ensure the quality of a given product or process; typically based on statistical techniques or sampling, rather than checking and confirming everything; organizational unit responsible for this; also QA
resources	manageable assets of an organization, including financial, human, physical and other resources; may include tangible and intangible elements; may include knowledge resources
social-cultural factor	factor related to social and/or cultural aspects of a group
software	non-physical components of a computer system; usually comprises coded application programs, support utilities and tools

stakeholder	any individual or group that can affect, or is affected by, decisions regarding the area of interest
standard	specific documented rules of best practice for a particular process or procedure; may involve business, IS or both; generally mandatory if applied by an organization
system	bounded entity set up to support certain requirements; includes defined input(s), processes and output(s); interacts with its environment via input(s) and output(s); may include human and/or technological component(s)
system change	requested change to a system; requires update of system specifications to keep them current; a change is generally requested by business, but may be requested by IS
system design	process or deliverable related to the design of a system; generally from a business / user perspective; may be documented
system development	process or procedure used to develop a system; generally includes analysis, design, build (construction), testing and implementation of the system; sometimes documented as a methodology
system documentation	set of documents relating to an information system from an IS perspective; may include business requirements, design documentation, system specifications and system test plans; see also *user documentation*
system enhancement	enhancement to a system requested by business – generally larger and/or more complex than a system change; requires update of system specifications to keep them current
system error	error in the operation of a system; mismatch between operation of system and current specifications; does not require update of system specifications; an error may be identified by either business or IS
system knowledge	knowledge about an information system, often including both technical and business-related knowledge
system life cycle	life of a system including sequential stages of development (including analysis, design, build, testing and implementation), operation (including maintenance and support), and retirement; the 'operation' stage may be protracted
system maintenance	includes corrections of errors, changes and enhancements to a system
system product	significant part of a system, typically implemented into production at a given time as a system release
system release	implementation into production of a system or a significant part of a system; may include a set of accumulated changes or enhancements
system specifications	document(s) specifying how a system fulfils its business requirements through technological means
system support	includes system maintenance, and other technical assistance with the operation or effectiveness of a system as required
system testing	procedure for ensuring that an information system operates correctly, accurately and efficiently; often includes separate testing of different system components

system test plans	documented plans for performing system testing
tacit knowledge	includes practical 'know how' of a function which for most people lacks explicit, detailed awareness of how it is achieved (such as riding a bicycle); may be partly or largely inexpressible; often difficult to transfer to other people; also called implicit knowledge
tacit$_1$ knowledge	tacit knowledge which could potentially be codified (articulated and/or documented) and made explicit, but often is not
tacit$_2$ knowledge	tacit knowledge which is rarely able to be fully codified (articulated and/or documented), and so can rarely be made explicit
technical platform	technological infrastructure underlying a system; may refer to a type of computer, operating system, database management system or programming language
transaction	procedure undertaken by a user or a system to enter, update or extract data from a system at an elementary level, e.g. entering a customer's details, updating an order etc
transaction processing	refers to handling a number of transactions, usually in sequence; generally implies a large volume of transactions in a given period
user	person who uses a computer-based information system as all or part of their work, in support of a business aim of an organization
user documentation	set of documents relating to an information system from a business/user perspective; may include business requirements, user instructions and/or training manual; see also *system documentation*
work around	alternative business procedure to enable users to avoid or bypass a known system problem or error; sometimes documented

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