Incongruence and Enactment in Information Systems: A Sensemaking Analysis

by

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Declaration

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Date: 2013/09/30 ....

Abstract

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In the six decades since organisations first adopted computer machinery to support their operations this form of technology has undergone rapid evolution. This evolution is characterised by both the advancement of the machines themselves and the expansion of their application in the organisational domain through the development of increasingly advanced software. A particularly influential development for large enterprises has been the introduction of computerised *Enterprise Resource Planning Systems (ERPs)* and the popularisation of proprietary ERP packages.

By integrating the feature sets of an increasingly wide range of business software applications ERPs enable organisations to satisfy a large part of their information processing requirements by adopting a single software artefact. This approach offers numerous benefits to adopters as it ensures the integration of information processing activities across organisational functions. However, the realisation of these benefits depends upon the organisation's ability to achieve congruence between its own structures and those embedded in proprietary ERP packages. This includes, on one level, the management of the processes of adaptation through which organisational actors become accustomed to a new technology and, on another level, the configuration and alignment of the artefact with the organisation's operating procedures.

Despite the popularity of ERP adoption the achievement of congruence in information systems is an illusive ideal for many organisations. Accordingly, many *Information Systems (IS)* scholars have researched the organisational, technical and social factors which obstruct congruence and the interventions proposed to counter these. A key finding following from these investigations is that, notwithstanding the implementation of countering interventions, organisations often need to continue operations while experiencing some degree of *incongruence* or *misfit* in their information systems. The research performed in this study advances knowledge about this phenomenon by investigating the implications of incongruence for the behaviour of users of proprietary ERPs in organisations.

Weickean *Sensemaking Theory* is adopted as conceptual framework to enable the investigation of instances of incongruence as events experienced by users in the context of their work environments. The theory dictates that users, rather than passively adopting the impositions of software artefacts, *enact* information systems in unpredictable ways based on subjective and shared processes of sensemaking. An empirical investigation is performed and takes the form of a single, cross-sectional case study in which a variety of data collection techniques are utilised. The data sources are analysed and triangulated to trace the relationship between *experiences of incongruence* and patterns of information systems enactment among the user community.

The findings of the study reveal that experiences of incongruence cultivate knowledge sharing among a user community, a process which aligns their beliefs about the nature, role and use of a technology in an organisation. Furthermore, experiences of incongruence encourage users to augment designed technologies through the development informal information processing activities and alternative workflows. These forms of behaviour, while resolving users' experiences incongruence, lead to variance between the *designed* technology and the *enacted* technology creating various risks for the integrity of the organisation's business processes.

Uittreksel

Inkongruensie en Enactment in Inligtingstelsels: ‘n Sensemaking Analise

(“Incongruence and Enactment in Information Systems: A Sensemaking Analysis”)

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In die ses dekades sedert organisasies rekenaar masjinerie begin toepas het om hul bedrywighede te ondersteun, het hierdie vorm van tegnologie dramatiese ontwikkeling ondergaan. Hierdie ontwikkeling word gekenmerk deur beide die bevordering van die masjiene self, asook die uitbreiding van hul toepassings in die organisatoriese domein deur die ontwikkeling van meer gevorderde sagteware. ’n Besonder invloedryke ontwikkeling vir groot ondernemings was die bekendstelling van gerekenariseerde *Enterprise Resource Planning Systems (ERPs)* en die popularisering van kommersiële ERP pakkette.

Deur die integrasie van ’n toenemend wye verskeidenheid funksionaliteit stel ERPs organisasies in staat om ’n groot deel van hul inligting verwerking vereistes deur die aanneming van ’n enkele sagteware produk te dek - ’n benadering wat talle voordele bied aangesien dit die integrasie van inligting verwerking tussen organisatoriese funksies verseker. Die verwesenliking van hierdie voordele is egter afhanklik van die organisasie se vermoë om kongruensie tussen sy eie strukture en die van ERP pakkette te bewerkstelling. Dit sluit die bestuur van prosesse waartydens organisatoriese akteurs aanpas by ’n

nuwe tegnologie in, asook die konfigurasie van die pakket om belyning met die organisasie se operasionele prosedures te verseker.

Ten spyte van die gewildheid van ERPs is die bereiking van kongruensie in inligtingstelsels 'n ontwykende ideaal vir baie organisasies. Gevolglik word die organisatoriese, tegniese en sosiale faktore wat kongruensie belemmer gereeld deur *Information Systems (IS)* akademici ondersoek. 'n Prominenete bevinding wat uit hierdie navorsing voortspruit is dat organisasies dikwels hul werk moet voortsit ten spyte van *inkongruensie* in hul inligtingstelsels. In hierdie studie word die bovermelde fenomeen verder ondersoek deur die implikasies van inkongruensie vir die gedrag van gebruikers van kommersiële ERP pakkette te ondersoek.

Weick se *Sensemaking* teorie word toegepas as konseptuele raamwerk om gevalle van inkongruensie as gebeure wat deur gebruikers ervaar word te ondersoek. Die teorie bepaal dat die gebruikers nie bloot rekenaarstelsels aanvaar nie, maar dit op onvoorspelbare maniere *enact* op grond van subjektiewe en gedeelde prosesse van singewing. 'n Gevallestudie word uitgevoer waarin 'n verskeidenheid data-insamelingstegnieke gebruik word. Die databronne word ontleed en kruisvalidasie word gedoen om die verhouding tussen *ervarings van inkongruensie* en patrone van gedrag binne inligtingstelsels te beskryf.

Die bevindinge van die studie dui daarop dat ervarings van inkongruensie die deel van kennis binne 'n gebruikersgemeenskap tot gevolg het. Hierdie proses belyn gebruikers se verwysingsraamwerke oor die aard, rol en gebruik van 'n tegnologie in 'n organisasie. Verder word bevind dat gebruikers, agv ervarings van inkongruensie, 'n tegnologie uitbrei dmv die ontwikkeling van informele inligting verwerkingstegnieke en alternatiewe werksprosesse. Hierdie gedrag stel gebruikers in staat om inkongruensie te oorkom, maar lei tot variansie tussen die ontwerpte tegnologie en die toepassing daarvan binne die organisasie. Dit hou verskeie risiko's vir die integriteit van die organisasie se besigheidsprosesse in.

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Lastly, I would like to thank my supervisor, Prof. Johann Kinghorn, for his guidance.

Dedications

This dissertation is dedicated to my father who taught me many things, the most valuable being to ask many questions.

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Chapter 1

Introduction

1.1 Background

The research reported in this dissertation concerns, like a great number of contemporary studies, a dimension of the astounding impact that the development of computer technology has had on human life over the past seven decades. Our appreciation of this impact is often numbed by the ubiquity of computers in all areas of our lives and we tend to loose sight of the massive strides that have been made since Howard Aiken designed the *Mark 1* in 1941.[1] Indeed, it has been hardly more than 30 years since Bill Gates first verbalised his vision of “a computer on every desk and in every home”.[2]

It is the notion of *computers on desks* and their implications for organisational operation which provide the context for this study. While scholars and practitioners were quick to recognise the potential benefits of computer technology for organisations in the 1960’s, the realisation of these benefits posed numerous challenges.[3] What emerged from these challenges was the knowledge that the theories which enable the development of computer technology is of little value to those charged with the duty of applying it in organisational contexts. It is this realisation which, upon further elaboration, became the catalyst for the development of *the academic field of Information Systems (IS)* in the 1960’s.[4]

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[1] Zwiers (2011, p. 8)
[2] Beaumont (2008)
[3] Fitzgerald and Adam (2000)
[4] Avgerou *et al.* (1999)

In the past five decades IS scholars have produced an extensive and intricate body of literature characterised by contributions from a diverse community. Particularly challenging for its contributors is the need to align theory development with the perpetual and rapid advances which characterise modern *Information Technology (IT)*. There is broad recognition, accordingly, that the basic science of IS is still in its infancy, with some going as far as questioning the legitimacy of IS as academic pursuit.[5]

The immaturity of the science of IS is also reflected in practice. In their 2001 report *The Standish Group* states that only 28% of American companies consider their IS projects to be succesful, despite spending four times more on IS projects in 2000 than they did annually in the 1990's.[6] A similar scenario is observable in Europe where the cost of IS project failure amounted to 142 billion Euros accross the European Union in 2004 alone.[7]

These statistics paint a rather bleak picture of the progress which has been made in IS and, not surprisingly, spawn discourse about the measurement of success in information system projects. Notable in this regard is the success model proposed, and later updated, by DeLone and McLean[8] and the body of literature it has spawned. A prominent line of reasoning emerging from this literature adopts the perspective that success in an information system depends, primarily, upon *the degree of congruence* or *fit* between its elements. This includes, on one level, research which investigates congruence between tasks, technologies and individuals[9] and, on another level, the *alignment* between IT artefacts and organisations.[10] Underlying this line of research is the premise that information system designers should, to achieve success, aim to obtain and maintain congruence.

A major challenge for IS practitioners is that congruence is obstructed by a range of factors which disrupt the stability of organisational structures. These factors includes regulatory or competitive forces in the organisation's environment, as well as internal factors like employee turnover, policy amendments and changes to operating procedures. Combined, these forces are responsible

[5] Checkland and Holwell (1998); King and Lyytinen (2004); Fitzgerald and Adam (2000); Culnan (1987); Avison *et al.* (2001, 2008); Avgerou *et al.* (1999)

[6] The Standish Group (2001); Xia and Lee (2005)

[7] McManus and Wood-Harper (2007)

[8] DeLone and McLean (1992, 2003)

[9] Joshi and Rai (2000); Goodhue and Thompson (1995); Avital and Te'eni (2009)

[10] Strong and Volkoff (2010); Soh and Sia (2004); Sia and Soh (2007); Kanellis *et al.* (1999)

for changing and emerging information system requirements and, as a result, the disruption of congruence in information systems. A further contributing factor is the advancement of IT artefacts and the impact it has on stakeholders' perceptions about the appropriateness of a technology. The utilisation of archaic technology may, for example, create perceptions of incongruence among users based upon the assumption that the features of newer technologies would enhance performance.

A substantial part of IS theory concerns the strategies organisations adopt to promote congruence. Most prominent, one may argue, has been the emphasis on *development methodology* as a means to ensure that IS projects are driven by and aligned with organisational requirements. However, a common phenomenon in post-industrial organisations (and a primary obstacle to maintaining congruence) is the inability of notoriously rigid software artefacts to cope with the changing and emerging information requirements of organisations. This is particularly relevant to organisations, or departments, operating in turbulent environments where future information requirements are often unknowable at the time of software development or procurement. Consequently, the notion of continuous cycles of *agile development*, as propagated in the controversial *Agile Manifesto*,[11] has been an important topic in IS over the past decade.

Ironically, a second trend, which has emerged alongside agile development, is to control IT expenditure by evading large development projects through the procurement of commercially available software packages. Such packages have been particularly successful in domains where large numbers of organisations share a common set of information system requirements (e.g., *Enterprise Resource Planning Systems or ERPs*). The dramatic increase of ERP adoption over the last decade has been a particularly influential driver of theory development in IS.[12]

The decision to adopt an integrated software package, like an ERP, has significant implications for the achievement and maintenance of congruence in information systems. These implications are centered around the principle that a large portion of an organisation's information system requirements can be satisfied by the *out-of-the-box* features offered by the procured software

[11] Beck *et al.* (2001)
[12] Strong and Volkoff (2010, p. 731)

package. ERP procurement, accordingly, has the potential to shorten the duration of IS projects substantially. It is broadly accepted that adopting organisations can satisfy around 80% of their requirements with standard, non-customised ERP packages.[13] Two primary strategies are generally adopted to enable satisfaction of the remaining 20% of requirments: the first involves the customisation of the package; while the second involves the adaptation of organisational structures to improve package-organisation alignment.[14] These strategies should, in theory, enable organisations to achieve congruence prior to implementation and counter the range of factors which disrupt congruence post implementation.

A more realistic appreciation of information systems practice, as reflected in the bulk of IS literature, is that *perfect fit* is an illusive ideal often strived for but rarely achieved. Efforts by IT/IS departments to develop and maintain information systems, introduce new artefacts and train users are countered by the emergence of new requirements, the introduction of more advanced artefacts and the persistent challenges of organisational changes. It is in the context of this labyrinth of push and pull factors that contemporary organisations operate, often inhibited, obstructed, challenged and frustrated by the effects of incongruence on business processes.[15]

Numerous research problems are identifiable when considering incongruence in information systems. Most prominent, one may argue, are questions concerning the relationship between aspects of development projects (e.g., methodologies, techniques, tools etc.) and the achievement of congruence.[16] Studies which address these problems are generally performed from the perspective of *developers* and often operate upon implicit assumptions about users as *passive consumers* of IT artefacts.[17] More recently, however, IS researchers have begun to appreciate the unpredictability of user behaviour around IT artefacts through the adoption of qualitative research techniques. A key argument, which is broadly supported in this line of research, is that there exists a degree of slippage between the use of IT artefacts as envisioned by their

[13] Strong and Volkoff (2010, p. 731)

[14] Avison and Fitzgerald (2006); Soh and Sia (2004)

[15] Joshi and Rai (2000)

[16] IS has, over the past four decades, produced a considerable collection of literature relating to the execution IS development projects. An extensive, though not exhaustive, summary of this body of literature is provided by Avison and Fitzgerald (2006).

[17] Bansler and Havn (2006)

designers/developers and the *actual* usage practices adopted in work environments.[18] Recognition of this perspective signals a paradigm shift away from *technological determinism* towards the understanding that IT artefacts are *enacted* by their user communities. Interestingly, and perhaps also surprisingly, only a small collection of IS studies have investigated the relationship between incongruence and enactment in information systems.

1.2 Research Problem

Prior research on incongruence in information systems have investigated the antecedents of the phenomenon,[19] its impact on the performance of individuals and/or organisations,[20] and, more recently, the categorisation of particular *instances* of incongruence.[21] This body of literature suggests, firstly, that a wide range of factors, both organisational and technological, impact the achievement and maintenance of congruence. Secondly, it provides evidence that incongruence obstructs effective and efficient performance by users and, thirdly, that users are directly and indirectly affected by different *types* of incongruence when performing their work. There is, consequently, strong and broadly accepted evidence that incongruence impacts the operation of an information system by affecting the behaviour of user communities.

In the body of literature which concerns user behaviour scholars have identified a variety of practices adopted by users to cope with or overcome incongruence. These include, for example, the development of personal information management systems and the adoption of end-user computing practices by non-IT/IS staff members.[22] More recently, a small collection of scholars have investigated the development of information system work-around practices in ERP utilising organisations.[23] From these studies emerge the knowledge that user communities do not passively accept the impositions of software artefacts

[18] Askenäs and Westelius (2003); Beaudry and Pinsonneault (2005); Orlikowski and Gash (1994); Henfridsson (2000); Bansler and Havn (2006)

[19] E.g., Kanellis *et al.* (1999); Kanellis and Paul (2005); Soh and Sia (2004); Sia and Soh (2007)

[20] E.g., Goodhue and Thompson (1995); Barki *et al.* (2007); Avital and Te'eni (2009)

[21] Strong and Volkoff (2010); Soh and Sia (2004); Sia and Soh (2007)

[22] Kanellis and Paul (2005); Boardman and Sasse (2004); Ducheneaut and Bellotti (2001); Lansdale (1988); Teevan *et al.* (2006); Barreau and Nardi (1995); Bergman *et al.* (2004)

[23] Azad and King (2008); Hayes (2000); Ignatiadis and Nandhakumar (2009); Pollock (2005)

or act in accordance with the rules of formally designed information systems, but *enact* these systems in innovative and unpredictable ways.

While the interconnectedness of these two bodies of literature is implicitly accepted by IS scholars working in each, there exists a lack of research which explicitly addresses the relationship between incongruence and enactment. As a result these two themes have developed in relative isolation from one another. Studies of incongruence tend to be performed from the perspective of developers with the aim of advancing their ability to achieve project success. Importantly, this is often done under implicit assumptions of technological determinism. Behavioural studies, on the other hand, generally avoid detailed analyses of the technical and organisational complexities which shape users' contexts. These complexities are handled as independent environmental factors when the user is the primary unit of analysis. There is, as a result, a lack of understanding in IS about the causal relationships between incongruence and the behavioural patterns of users in information systems.

This study aims to address this problem by proposing a theoretical framework which describes the mechanisms by which incongruence impacts the enactment of information technologies and systems in organisations which utilise ERPs.

1.2.1 Research Question

Based on the research problem outlined above the primary research question for this study is formulated as follows:

> What are the implications of *experiences of incongruence* among user communities for the *enactment of information systems* in organisations utilising proprietary Enterprise Resources Planning Systems?

1.3 Research Design

The study consists two main phases - a *theoretical analysis* and an *empirical analysis*. The purpose and structure of each phase are presented in the sections which follow.

1.3.1 Theoretical Analysis

The theoretical analysis is based upon the review of five sets of literature. Each set of literature was compiled and categorised in a five-step process:

1. Publications were located through the use of a variety of web-based research databases. The researcher targeted articles published in the leading IS journals based on the journal rankings provided by the *Association for Information Systems (AIS)*.[24] Where appropriate emphasis was placed on articles published more recently (i.e., over the last five to 10 years). The majority of these journals were accessed using the *Business Source Premier* database available through *EBSOHost*. The researcher utilised *Mendeley Desktop (version 1.8)* to manage digital publications.

2. After compiling each literature set the researcher systematically reviewed and summarised the publications.

3. Publications were categorised based on their relevance to the research problem and questions.

4. A second search was done to augment the literature set if the original set proved to be inadequate. In various instances this included locating and reviewing articles referenced in the original set.

5. Publications located through the second search were reviewed and categorised.

The purpose of the literature review was to obtain a broad and deep understanding of the various dimensions of the research problem. This enabled the contextualisation of the study within the academic field of IS, the identification of prominent IS scholars with similar interests and, finally, to utilisation of their findings in the execution of the empirical analysis. The reviewed literature covered five primary categories:

- *IS as academic field.* The content of this study aligns with the academic field which is generally referred to as *Information Systems* or *IS*. The nature of the phenomena under scrutiny in IS requires it to be a

[24] Association for Information Systems (2011)

multi-disciplinary field and it attracts, as a result, interest from scholars outside the traditional *Computer Science* or *Informatics* schools. A symptom following from this *broadness* is that the spectrum of research covered in IS is thematically diverse and the field is perceived by many as *adhocratic*, or even chaotic.[25] To ensure that this study was accurately contextualised within the historical and academic development of IS, the first set of literature included publications which address the emergence, development and current state of IS. As a developing discipline IS is subject to ongoing debates about its academic purpose and legitimacy. The review of these publications, which include numerous co-citation analyses, enabled the contextualisation of this study by describing its relevance to these debates and its ability to advance knowledge in IS.

- *First principles in IS.* An important consequence of IS's multi-disciplinary development is that the field is characterised by conceptual confusion.[26] This confusion results from a lack of broadly accepted first principles in IS which cultivates the importation of concepts and their definitions from reference disciplines.[27] There is, accordingly, ongoing debate about the meanings of some the field's fundamental concepts - most notably *information*.[28] To ensure that the findings of this study are not tainted by conceptual ambiguity the second set of literature included conceptual analyses which were used to inform the selection or development of working definitions for first principles at the outset of the investigation.

- *Incongruence in information systems.* The third set of literature relates more directly to the research problem and concerns the first of the two key constructs in the primary research question: *incongruence*. The studies that were reviewed address various aspects of incongruence including its antecedents, symptoms and impacts on organisational performance. From these studies an in-depth understanding of the organisational and technological dynamics which influence congruence in information systems was gained. In a particularly important subset of these studies incongruence is framed, not as a state of the relationship between ele-

[25] Fitzgerald and Adam (2000); King and Lyytinen (2004)
[26] Checkland and Holwell (1998)
[27] Fitzgerald and Adam (2000)
[28] Capurro and Hjø rland (2005)

ments of the information system, but as events that are experienced by users. This perspective enables the identification and categorisation of *instances of incongruence* and provides a basis for the investigation of its impact on user behaviour.

- *Enactment of information systems.* The fourth set of reviewed literature included studies which address the behavioural patterns of user communities in information systems. A prominent theme emerging from this review was the growing tendency among IS scholars to utilise theories about the social construction and *enactment* of technologies as a means to counter technological determinism as the dominant perspective in IS.[29] The purpose of this review was two-fold. Firstly, it enabled understanding of the manner in which technological and organisational factors impact user behaviour and, secondly, it led to the identification of *Sensemaking Theory* as a conceptual framework suitable for the analysis of the relationship between incongruence and enactment.

- *Sensemaking Theory.* After making the decision to adopt sensemaking theory as a conceptual framework, seminal publications which outline it were reviewed. While the notion of sensemaking has been used by numerous scholars from a variety of disciplines, the most complete description of it is contained in the work Karl Weick. A collection of Weick's publications were reviewed with emphasis falling on his influential book, *Sensemaking in Organisations.*[30] The adoption of sensemaking theory enabled the development of working definitions for notions which concern the cognitive and behavioural aspects of user communities in information system and provided a framework which informed the collection and analysis of empirical data.

1.3.2 Empirical Analysis

The empirical analysis took the form of a single, cross-sectional, interpretive case study performed at a large public sector organisation. A mixed method approach was adopted to obtain multiple data sources and both statistical and

[29] E.g., Faisal *et al.* (2009); Bansler and Havn (2006); Henfridsson (2000); Orlikowski and Gash (1994); Griffith (1999)

[30] Weick (1995)

qualitative analysis techniques were utilised to interpret the collected data. Finally, the various data sources were triangulated to corroborate findings.

At the outset of Chapter 5 a detailed description of the protocols, instruments and techniques utilised in the empirical analysis are presented. These were, of course, influenced by the reviewed literature.

1.4 Motivation for the Study

Motivation for the execution of this study is rooted in two themes. The first is the strong evidence that there remains a large degree of unanswered research questions relating to the ability of organisations to design, develop and implement successful information systems. In this sense the study is part of the continuous effort to solidify the basic science of IS. For this reason the study departs from the perspective that *incongruence*, as a dominant symptom of an unsuccessful information system, is an important source of knowledge about how systems and the processes of systems development, adoption and maintenance can be improved.

The second theme which motivates the execution of this study concerns the normative applications of its findings. If one accepts the assumption that information systems incongruence is a common phenomenon in contemporary organisations, then one must also accept that organisations, in some way or other, are able to cope with, absorb, or overcome its implications. This may suggest a great variety of things, one of which is that organisational actors, in the context of their ongoing projects, behave in a manner that enables task completion despite incongruence. More specifically, that they *enact* organisational structures that are robust, flexible and dynamic. Understanding the intricacies of such behaviour may uncover valuable insights for the future of information systems design.

1.5 Chapter Layout

The dissertation consists of three parts. The first part concerns the theoretical analysis and consists of three chapters. In Chapter 2 the emergence and evolution of IS are discussed, followed by a conceptual analysis of its first principles. In Chapter 3 the notion of incongruence in information systems is addressed based on differentiation between IT artefacts and information systems. The final chapter in the first section provides a detailed description of Weickian Sensemaking Theory, followed by reviews of IS studies in which its concepts have been applied.

The second part of the dissertation describes the planning and execution of the empirical analysis. The part also consists of three chapters. The first (Chapter 5) outlines the research design employed adopted for the empirical analysis and the factors contributing to it. It also provides an overview of the legislative and regulatory environment of the organisation under investigation. Chapter 6 describes the execution of the various data collection activities and the design of instruments utilised in each. The analysis of the case data and the findings made are presented in Chapter 7.

The third and final part includes two chapters. Chapter 8 provides a detailed summary of the findings made in the study by, firstly, providing answers for each of the research questions and, secondly, utilising these findings in the development of a novel conceptual model for the enactment of information systems as influenced by incongruence. In the final chapter of the dissertation (Chapter 9) the researcher discusses the limitations of the study and makes recommendations for IS research and practice based on its findings.

Part I

Theoretical Analysis

Chapter 2

First Principles in IS

A notable obstacle for research in inter-disciplinary domains such as IS is the development and adoption of a shared conceptual framework by contributors from diverse reference disciplines. With such a framework as basis a heterogeneous scholarly community can engage in unambiguous discourse utilising theories developed in their home fields. In IS the establishment of a strong *theoretical core* for the field has been a contentious topic[1] accentuated by broad recognition that there exists confusion, even anxiety,[2] among its members about the field's academic legitimacy.

In the context of these challenges the purpose of this chapter is two-fold. It provides, firstly, an overview of the emergence and evolution of the field with the aim of clarifying its role in relation to its most prominent reference disciplines. Secondly, it provides a conceptual analysis of key first principles in the field and establishes working definitions for these. Combined, these sections serve to contextualise this study and form a theoretical basis to enable accurate interpretation of its findings.

[1] Fitzgerald and Adam (2000); King and Lyytinen (2004); Checkland and Holwell (1998)
[2] King and Lyytinen (2004)

2.1 The Emergence and Evolution of the IS Field

In this section an overview of the emergence and evolution of the academic field of *Information Systems (IS)*[3] is presented. The purpose of the section is, firstly, to contextualise the study in terms of progress that has been made in the field since its inception in the 1960's. Despite its relative youth the field has produced a large and diverse volume of literature, evidence of its wide influence and multi-disciplinary nature. This study, with its emphasis on the human dimension of information systems, builds upon an extensive line of research about socio-technical work environments performed from various perspectives. The second aim of this section is to contextualise the decisions made in terms of research paradigm, design and methodology by recognizing the broad trends that have shaped the field's development. Various authors have criticized the field for its lack of cumulative research tradition and reference indiscipline,[4] factors that hinder progress in theory development and raise questions about the field's identity and legitimacy.[5]

The section commences with a chronological overview of the key events in the field's development since the late 1950's, followed by brief discussions of important themes that have emerged in the field's evolution over the past 45 years.

2.1.1 Important Events

Information systems as an academic discipline has diversified considerably since its emergence in the 1960's.[6] Although formal studies that may be classified as information systems research was done as early as 1957 by Enid Mumford and colleagues[7], the term *information system* was only coined by Langefors in 1965,[8] the same year that *Management Information Systems*

[3]The acronym, IS, is used in to refer to the academic field of Information Systems. The same acronym is often used interchangeably to also denote information systems themselves. In this dissertation, however, it will be used specifically to denote the field and not the phenomenon.

[4]Fitzgerald and Adam (2000); Cheon (1993); Avgerou *et al.* (1999)

[5]King and Lyytinen (2004)

[6]Avgerou *et al.* (1999, p. 136)

[7]Davenport (2008, p. 521)

[8]King and Lyytinen (2004, p. 543)

(MIS) became a popular term.[9] The first academic programmes in IS also appeared in the 1960's[10] along with the first textbooks articulating the central concerns of this new field.[11] At the time it was essentially the field of applied computing, also referred to as data processing,[12] emerging as a result of the problems associated with the application of computers in business contexts.[13] Although much of the early work in the field was essentially performed by computer scientists, being the natural early custodians of the technical artefacts, Fitzgerald and Adam note that there was a certain reluctance among them to engage the business-related problems like the implementation and management of information systems.[14] Checkland and Holwell also make the point that information system problems and computer system problems attract a different type of individual by stating that "many of those taken up with the delights of a fast-moving technology are notoriously uninterested in the application of computer systems and their richly ambiguous organizational consequences".[15] The notion that the implementation and management of computer technology in organisational environments required a move away from the engineering emphasis with which computer science problems were typically approached, was an early indicator that the discipline would not develop sufficiently as a sub-field of computer science.

The emerging discipline soon drew interest from scholars in various fields other than computer science. Management scientists were particularly interested in the economics of information systems and their potential to influence both the bottom and top lines of businesses. Although an explicit line of *Social Informatics* thinking was already articulated in the early 1970's at the University of California,[16] information systems publications throughout the 1970's were mainly authored by scholars from computer or management science backgrounds and human factors received little attention.[17] Nonetheless, the field's multi-disciplinary nature became increasingly apparent as an array of non-technical research problems emerged in the wake of the rapid computerisation

[9] Culnan (1986, p. 157)
[10] Avgerou *et al.* (1999, p. 136)
[11] Fitzgerald and Adam (2000)
[12] Avison *et al.* (2001, p. 3)
[13] Fitzgerald and Adam (2000)
[14] Fitzgerald and Adam (2000)
[15] Checkland and Holwell (1998, p. 10)
[16] Davenport (2008, p. 520)
[17] Culnan (1986, p. 157)

of organisational environments throughout the 1970's. The first publication of the *MIS Quarterly* in 1977 and the first *International Conference on Information Systems (ICIS)* held in 1980[18] were evident of the field's rapid growth in North America where technical and managerial issues were prominent topics. In Europe, however, the publication of Mumford's "uncompromisingly humanistic"[19] ETHICS methodology in 1979, based on various earlier research projects in social informatics, highlighted the social dimension of information systems and its important role in achieving system success. In the same period user involvement in systems development projects also emerged as an important research theme in MIS journals in North America.[20]

During the early 1980's emphasis fell on the intricate challenges posed by the development, continuous maintenance and adaptation of information systems. Culnan, through a co-citation analysis of the MIS field, reports that managerial issues became increasingly important while technical issues started to receive less interest from researchers.[21] In the same period the alignment of information system and organisation emerged as a key issue.[22] Although still predominant at the time, researchers slowly began to move away from non-empirical methods in an attempt to solidify theories through field studies.[23] Theory formulation was, however, complicated by the field's inherit openness and the diversity of its contributors and their backgrounds, resulting in a lack of IS-specific first principles for researchers to build on.[24] Systems development and management remained the key research topics throughout this period[25] resulting in a large collection of development methodologies being published.

By the late 1980's research about the social dimension of information systems was gaining momentum and, consequently, the *Information Systems Research (ISR)* journal was founded in 1987.[26] ISR, while broad, "appeals to the social sciences, and probably tends to discourage submissions of a more purely technical nature."[27] Two other influential journals followed the ISR.

[18] Avgerou *et al.* (1999, p. 136)
[19] Davenport (2008, p. 521)
[20] Culnan (1986, p. 169)
[21] Culnan (1987)
[22] Culnan (1987, p. 348)
[23] Alavi and Carlson (1992, p. 50)
[24] Fitzgerald and Adam (2000, p. 4)
[25] Alavi and Carlson (1992, p. 50)
[26] Burton Swanson and Ramiller (1993, p. 299)
[27] Burton Swanson and Ramiller (1993, p. 323)

The *Information Systems Journal (ISJ)* founded in the UK in 1991[28] and the first publication of *Accounting, Management and Information Technology (AMIT)*[29] in the same year[30] provided researchers with alternative outlets open to pluralistic research methods. AMIT had the "explicit aim of soliciting and encouraging the contributions of interpretive researchers".[31] These developments were indicative of the growing rift between computer science and information systems scholars at the time. Avison *et al.* (2001) convey the situation particularly well:

> The perspective was different to that of computer science at the time, and we took the view that we, in IS, stood with our backs to the machine and looked outward towards the world at large, whereas computer science stood in much the same place but looked in.[32]

In the view of the founders of the ISJ the continued domination of technical issues in IS research was problematic as it neglected to recognize the role of human factors in the operation of an information system. Their argument was, essentially, that "technology is rarely either the limiting factor in information systems design or is it frequently the cause of IS failure".[33] They emphasized that other factors, such as poor strategy, poor communications, poor control, poor training and user resistance, play a crucial role in a system's operation and should be researched more extensively.[34] The focus on IT application and its related issues rather than IT artefacts themselves remains the key factor which alienates the field from computer science.[35] In 1993 MISQ, having so far almost exclusively published studies adopting a positivist paradigm, recognized this view by publicly announcing its acceptance of alternative research approaches.[36,37]

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[28] Avison *et al.* (2001, p. 3)
[29] The journal's name changed to *Information and Organization* after 2001.
[30] Walsham (1995, p. 383)
[31] Walsham (1995, p. 383)
[32] Avison *et al.* (2001, p. 3)
[33] Avison *et al.* (2001, p. 5)
[34] Avison *et al.* (2001, p. 5)
[35] King and Lyytinen (2004, p. 543)
[36] Chen and Hirschheim (2004, p. 199)
[37] Despite this announcement there has never been a year in which the journal has published more than five interpretive studies. Occasionally (e.g. 1991, 1992 and 1995), no interpretive research appears in the journal.(Chen and Hirschheim, 2004, p. 214)

Chen and Hirschheim, in their analysis of eight top information systems research outlets[38] between 1991 and 2000, report that empirical research studies exceeded non-empirical studies in 1993. Although still popular, analytical, conceptual and descriptive types of research was in a decline as editors were increasingly looking for studies which could substantiate arguments with data. Of the empirical studies 60% were quantitative, 30% qualitative and 10% employed mixed methods. The authors comment that, despite "years of advocacy of paradigmatic pluralism," their data reveals that the field has not managed to make significant progress in terms of interpretive research, with only 19% of studies being classified as such.[39] While the common belief at the time was that European researchers, unlike their North American peers, adopted the interpretive paradigm more readily in their studies, Chen and Hirscheim's analysis revealed that the actual difference was marginal. While 91% of the MISQ studies analysed adopted positivism, 88% of EJIS studies followed suit during the 10-year period.[40] In the ISJ, being particularly open to interpretive research, 60% of the articles reported studies which adopted positivism.

The formation of the *Association for Information Systems (AIS)* in 1994 as the leading international organization for information systems teaching and research,[41] although predominantly North American at the time,[42] provided information system scholars with an international identity and home. It's membership, at the time of writing, spanned 90 countries.[43] Although questions around the field's maturity were still raised in some circles, it was argued that the discipline had obtained coherence and wide-spread influence in schools and universities by the turn of the century.[44]

Interestingly, the emphasis on IS development issues, which has been a key topic in the field since its inception, and particularly since the 1980's, lost its prominence over the past 15 years.[45] Avison *et al.* speculate that a number of factors may have triggered this shift of focus. It may be that the inabil-

[38]These were: MISQ; ISR; Journal of Management Information Systems (JMIS); ICIS; Accounting, Management, and Information Technology (AMIT); ISJ; Journal of Information Technology (JIT); and European Journal of Information Systems (EJIS).

[39]Chen and Hirschheim (2004, p. 210)

[40]Chen and Hirschheim (2004, p. 217)

[41]Avison *et al.* (2008, p. 6)

[42]Avgerou *et al.* (1999, p. 136)

[43]Association for Information Systems (2011)

[44]Avison *et al.* (2001, p. 15)

[45]Avison *et al.* (2008, p. 16)

ity of methodologies to produce consistent success in development projects has hindered belief in methodological development or that the emergence and rapid adoption of off-the-shelf *Enterprise Resource Planning (ERP)* or similar systems have minimized the number of traditional in-house SDLC-type development projects undertaken in practice. There is evidence that ERP adoption is on the rise[46] and with it numerous new research topics emerge - aspects such as ERP selection procedures and client-vendor relationships are amongst those. There is also clear evidence that IS is being recognized as a field in its own right in research institutions with the ISJ reporting that the largest number of contributors to the journal between 1991 and 2008 were located in departments of IS (or similar title; 43.4%), followed by Business/Management departments (34.9%), and then by CS departments (11.1%).[47]

Considering the novelty of computers in the 1960's, it is not surprising that computer scientists, as original custodians of the technology, were also the first scholars studying its application in organisational contexts when the field emerged. Equally unsurprising are the reductionist predisposition and positivist perspective, the predominant research traditions in the natural sciences, with which they approached the subsequent business-related problems. The "incontrovertible"[48] ties between CS and IS, amongst other factors, have and continues to ensure that positivism remains the preferred research paradigm in IS.

The field's development, however, suggests that IS problems also require epistemological approaches which recognize the non-technical nature of IS problems. Particularly noticeable developments in this regard are the calls for paradigmatic pluralism in IS research and the growth in popularity of journals heeding this call. A number of important themes have developed as a result of this. Firstly, the recognition of social issues in IS have opened the field to researchers from disciplines other than CS or Management Sciences, bringing new backgrounds and perspectives to IS studies. Although this openness is seen by many as a positive aspect of IS, it has also had certain negative impacts on the field. Secondly, it has spawned the emergence of interpretivism as research paradigm in IS. These themes are discussed next.

[46] King and Lyytinen (2004, p. 549)
[47] Avison *et al.* (2008, p. 8)
[48] King and Lyytinen (2004, p. 543)

2.1.2 Identity, Maturity and Legitimacy

Despite the field's intellectual progress since the 1960's, questions about its identity, maturity and legitimacy have been raised throughout its short history. Checkland and Holwell, in a rather graphical comparison, liken the field to the "confused tangle of intertwined strands which characterize a briar patch".[49] This section is by no means an effort to untangle the multi-dimensional strands of IS, but presents a short overview of the conceptual confusion which characterizes the field and the reasons for its existence.[50]

Dearden, in 1972, referred to MIS as a mirage[51] and questioned the fundamental ideas behind the field. Kling, in 1980, described IS as an arena yearning to be a discipline,[52] while Keen, in the same year, argued that MIS lacked a theoretical base because no consensual definition of information existed.[53] In 1985 Mumford and her colleagues described the field as a doubtful science characterized by poor intellectual and methodical rooting.[54] In 1997 the question of whether IS is a distinctive discipline was again raised[55] and Avgerou *et al.* described it as ill-defined and facing problems in terms of recognition and legitimacy. This line of thinking was reiterated through Carr's influential 2003 article, *IT Doesn't Matter*,[56] in which he argued that the strategic importance of IT has diminished.

A popular discourse, relating to these arguments, is that of the divergence, as opposed to convergence, which has characterized theoretical development in the field. Fitzgerald and Adam describe this convergence by defining a series of phases in the field's evolution.[57] It starts with the attraction of a new field (IS) to more established disciplines (Computer, Management and Organisational Sciences). Because of the new field's youth it lacks a widely accepted conceptual foundation for researchers to build upon and first principles from other disciplines are imported to fill this void.[58] The result of which is that many of the debates opened up in publications are never resolved as

[49]Checkland and Holwell (1998, p. 61)
[50]Checkland and Holwell (1998)
[51]Referenced in King and Lyytinen (2004, p. 540)
[52]Referenced in King and Lyytinen (2004, p. 540)
[53]Referenced in Culnan (1986, p. 169)
[54]King and Lyytinen (2004, p. 540)
[55]King and Lyytinen (2004, p. 540)
[56]Carr (2003)
[57]Fitzgerald and Adam (2000)
[58]Capurro and Hjø rland (2005, p. 343)

researchers tend to offer new perspectives on these debates rather than close them through hypothesis testing.[59] This problem is exasperated by the fact that IS is concerned with people and organizations as well as technology, the research approach is rarely purely scientific and that experiments cannot be repeated unless they concern technology alone.[60]

In the next phase of the field's evolution it undergoes explosive expansion due to its openness. Fitzgerald and Adam point out that this openness is reflected, for instance, by the large number of non-IS researchers that publish at IS conferences. The influence of researchers from various disciplines and the field's reliance upon the foundational concepts they apply, lead to the development of a broad intellectual scope. Rather than developing as an independent field, it runs the risk of becoming a "weakly federated community where its members relate more strongly to other fields than to IS".[61]

Although the argument that multi-disciplinarity leads to confusion of views and incoherence in the field certainly carries weight, it has also been argued that multi-disciplinarity is a key strength of the field and should be embraced.[62] A reason for this is that it cultivates diversity in terms of the topics researched in the field, one of the aspects by which a field's maturity should be measured.[63] It also ensures that the field does not become introspective, "talking mainly about itself to itself".[64] The opposing argument, however, is that the field develops into a "mile-wide, inch-deep"[65] phenomenon due to the vast breadth of the potentially-relevant area but the lack of depth of research produced.[66] Critics of the field have pointed out that, as a result, IS studies often seem to be grounded in a "theoretical void".[67]

A further result of the field's multi-disciplinary expansion is that it obstructs the formation of a cumulative research tradition.[68] Not only do researchers fail to build upon frameworks or theories developed in earlier work

[59] Cheon (1993, p. 107)
[60] Avison *et al.* (2001, p. 13)
[61] King and Lyytinen (2004, p. 545)
[62] Fitzgerald and Adam (2000); Avison *et al.* (2001)
[63] Cheon (1993, p. 108)
[64] Fitzgerald and Adam (2000)
[65] Fitzgerald and Adam (2000)
[66] There have been efforts to narrow down the field's focus in an attempt to overcome this problem. King and Lyytinen (2004) report that certain actors have, for instance, encouraged a focus on "the IT artefact" as a means of defining boundaries for the field.
[67] Checkland and Holwell (1998, p. 69)
[68] Fitzgerald and Adam (2000); King and Lyytinen (2004); Avgerou *et al.* (1999)

(i.e. reference indiscipline), but studies investigating the same topic often fail to corroborate each other's findings.[69] The evolution of IS in this manner has meant that the "basic science of IS"[70] has not been secured and that issues such as what to teach, how to research and how to influence practice remain the topics of ongoing debates.[71]

Avison *et al.* choose to take a more optimistic view of the situation, describing the field as "exciting and pluralistic" as opposed to lacking focus.[72] They argue that despite the plethora of theories developed, good ideas will remain and bad ones will disappear. King and Lyytinen are also less morbid about the field's status and attributes its continued existence and growth to its intellectual strength.[73] They take a critical stance to the notion that the field lacks academic legitimacy due to its failure to develop a strong theoretical centre. Their argument being, essentially, that academic legitimacy is a "consequence of the social salience of the topics studied, the presence of strong results, and the ability to maintain disciplinary plasticity rather than the strength of the theoretical centre".[74]

A final point to consider in this regard is that the ties between IT and IS minimise the duration of relevance of theories. The introduction of new IT artefacts to socio-organisational contexts will continue to have unpredictable consequences which will not only spawn new theory, but may deprecate or even invalidate existing theory. This reduces the certainty with which researchers can approach problems.[75] The onus is on researchers to be aware of the multi-disciplinary perspectives taken by peers and to take care in specifying the contexts in which research was conducted before comparing results or refuting claims.

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[69] Fitzgerald and Adam (2000)
[70] Fitzgerald and Adam (2000)
[71] Avison *et al.* (2001, p. 4)
[72] Avison *et al.* (2008, p. 5)
[73] King and Lyytinen (2004)
[74] King and Lyytinen (2004, p.546)
[75] Mumford (2003)

2.1.3 Research Paradigms in IS

A *research paradigm* refers to the underlying epistemological perspective which guides the research.[76] In IS two research paradigms, positivism and interpretivism, are predominantly adopted by scholars. In this section each of these paradigms will be defined and discussed briefly, followed by some statistics on its adoption within the field based on publication analyses. The research performed in this study is concerned with the social enactment of reality by actors and is guided, therefore, by the interpretive epistemological perspective. The aim of this section is to provide background on the emergence of interpretivism in IS research and discuss views on its relationship with positivism.

Positivism is concerned with the hypothetic-deductive testability of theories and positivists believe that scientific knowledge should allow verification or falsification and seek generalizable results.[77] This epistemological stance implies that a causal relationship is usually presented and a tight coupling among explanation, prediction and control is expected.[78] Ontologically, positivists believe that reality exists objectively and independently from human experiences.[79] This belief enables the application of research methodologies which objectively collects and measures research evidence.[80]

Since the field's emergence positivism has been the dominant research paradigm in IS. An analysis by Orlikowski and Baroudi, based on articles between 1985 and 1989 found that it was adopted in 96.8% of the studies analysed.[81] Accordingly, Chen and Hirschheim report that, for the period between 1991 and 2001, 81% of IS articles analysed in their study adopted the positivist paradigm.[82] Although the dominance of positivism could be explained by the field's roots in and close ties to disciplines where it thrives,[83] it has also been suggested that positivist research is typically less time consuming than interpretive methods and that, as a result, authors are likely to choose the former in response to our publish or perish age.[84] In 1962 Khun's

[76] Orlikowski and Baroudi use the phrase *research epistemology* as opposed to research paradigm which is used by other authors. (Orlikowski and Baroudi, 1991, p. 4)
[77] Chen and Hirschheim (2004, p. 201)
[78] Orlikowski and Baroudi (1991, p. 10)
[79] Chen and Hirschheim (2004, p. 201)
[80] Chen and Hirschheim (2004, p. 201)
[81] Orlikowski and Baroudi (1991)
[82] Chen and Hirschheim (2004)
[83] Mumford (2003)
[84] Chen and Hirschheim (2004, p.225)

influentional book, titled *The Structure of Scientific Revolutions*, challenged the notion of positivism as the only epistemological perspective in scientific research arguing that paradigms are not permanent and that what is considered as truth depends upon the specific time in history of that consideration.[85]

Adopters of the interpretive paradigm, unlike their positivist counterparts, assume that scientific knowledge should be obtained not through hypothetic-deductive reasoning but "through the understanding of human and social interaction by which the subjective meaning of the reality is constructed".[86] Interpretivists believe that people create and associate their own subjective and intersubjective meanings as they interact with the world around them[87] and build, therefore, upon the primary presumption of social constructionism.[88] Epistemologically, interpretivists do not attempt to make generalizations from the research setting to a population but, rather, aim "to understand the deeper structure of a phenomenon, which it is believed can then be used to inform other settings."[89]

Despite calls for paradigmatic pluralism in IS, interpretivism has not been widely adopted by its scholars. Although European research outlets have published more interpretive research, Chen and Hirschheim present clear evidence that positivism also remains the dominant paradigm there.[90] Interestingly, in their analysis of the ISJ between 1991 and 2007, Avison *et al.* report that 70.9% of the articles published in this period reported studies adopting the interpretive paradigm. They also report that, since the journal's inception, it has consistently maintained at least a 65% to 35% interpretivism to positivism ratio.[91] Chen and Hirschheim, however, in their analysis of the ISJ between 1991 and 2000 report that interpretivism was only adopted in 40% of the articles analysed.[92] Although the argument could be made that the researchers used different criteria in their analyses, Avison *et al.* state that they adopted the calssification criteria employed by Chen and Hirschheim. The failure of the two studies two corroborate each other's results indicates that the adop-

[85]Mumford (2003, p. 199)
[86]Chen and Hirschheim (2004, p. 201)
[87]Orlikowski and Baroudi (1991, p. 5)
[88]Orlikowski and Baroudi (1991, p. 13)
[89]Orlikowski and Baroudi (1991, p. 5)
[90]Chen and Hirschheim (2004)
[91]Avison *et al.* (2008, p. 11)
[92]Chen and Hirschheim (2004, p. 218)

tion of a research paradigm is not always stated explicitly and depends on the interpretation of the reader, as Avison *et al.* admit.[93]

To understand the interplay between positivism and interpretivism in research it is useful to note the distinction between the weak and strong constructionist views as discussed by Orlikowski and Baroudi.[94] These variances of the interpretive tradition has implications for the relationship between the two research paradigms. In the weak constructionist view the researcher interprets action and events by investigating the existing meaning systems shared by actors.[95] Following this perspective interpretivism is understood to support positivism "by generating hypotheses for further investigation, and by filling in the knowledge gaps that positivist research cannot attend to, such as the contextual exigencies, the meaning systems, and the interaction of various components of a system".[96] The strong constructionist view, however, is that the researcher is enacting the reality he/she is studying by imposing his/her interpretive schemes on the social reality under scrutiny.[97] The researcher, therefore, plays a certain role in creating reality through the constructs used to view the world. The implications of strong constructionism is that it is impossible for a researcher to independently assess the nature of phenomena without relying on his/her predispositions.[98] Because the researcher's assumptions and values are "embroiled"[99] in the phenomenon he/she chooses to focus on certain aspects of reality and, as a consequence, to neglect others. Interpretivism, in the view of strong constructionism, should not be adopted to complement positivist investigations, but to replace them.

Walsham, through the work of Lee,[100] proclaims a different perspective on the relationship between positivism and interpretivism. By adopting what he refers to as the "integrationist position",[101] he argues that positivist and interpretive approaches are not opposed and irreconcilable. The position suggests that three levels of understanding should be distinguished. Firstly, the subjective understanding of the human participants in any social situation. Secondly,

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[93] Avison *et al.* (2008, p. 11)
[94] Orlikowski and Baroudi (1991)
[95] Orlikowski and Baroudi (1991, p. 15)
[96] Orlikowski and Baroudi (1991, p. 15)
[97] Orlikowski and Baroudi (1991, p. 15)
[98] Orlikowski and Baroudi (1991, p. 16)
[99] Orlikowski and Baroudi (1991, p. 16)
[100] Lee (1989)
[101] Walsham (1995, p. 381)

the interpretive understanding of the researcher arising from the researcher's in-depth contact with the participants, and, thirdly, the positivist understanding arising from formal testing in an objective way by the researcher.[102] These levels of knowledge can be used to compliment each-other and present a holistic understanding of phenomena. For example:

> "... an interpretive organizational researcher who needs to choose among competing interpretive understandings might narrow down the possibilities with the help of the empirical and logical rigours of positivism. Based on each of the interpretive understandings, the interpretive organisational researcher could develop alternative positivist understandings and then rule out the ones whose consequent predictions are disconfirmed through controlled empirical testing".[103]

Walsham emphasizes the importance of research paradigm selection in IS studies.[104] The field's concern with research problems that contain elements which are technical, social and organisational in nature necessitates that researchers adopt more than one epistemological perspective. The dominance of positivism in IS research, however, indicates that the field's theoretical development has been guided by "a single set of philosophical assumptions regarding the underlying nature of phenomena being investigated, the appropriate research methods to be used, and the nature of valid evidence".[105] Furthermore, existing IS literature indicates that researchers often fail to acknowledge the impact of their chosen epistemological stance on their findings, nor do they acknowledge the existence of alternative positions and approaches.[106]

The emergence of interpretivism in IS and the popularity of pro-interpretivism research outlets have, however, encouraged paradigmatic pluralism in the field. The argument driving plurality being, essentially, that if the field's researchers explore problems from various epistemological perspectives the theory produced would be more realistic and reflect the diverse set of factors at play in the development, management and operation socio-technical systems. Fur-

[102] Walsham (1995, p. 381)
[103] Lee (1989) referenced by Walsham (1995, p. 381)
[104] Walsham (1995, p. 376)
[105] Orlikowski and Baroudi (1991, p. 2)
[106] Checkland and Holwell (1998, p. 61)

thermore, it acknowledges the widely accepted argument that the introduction of IT to a working environment will have profound effects on both individuals and organisations, effects which go beyond those measured through quantitative investigations.[107]

2.2 First Principles in IS

In this section the focus shifts from the development of the academic field of IS to a conceptual analysis of the field's first principles. The section aims to ensure conceptual clarity in the remainder of this dissertation through the development of working definitions for first principles in IS. Furthermore, through the use of these definitions an analysis of various information system conceptualisations is performed culminating in the selection of a socio-technical, activity-oriented conceptualisation for the phenomenon.

Ensuring conceptual clarity is, as argued in section 2.1.2, a crucial, yet often neglected aspect of IS research. A plethora of classical and contemporary literature which may be deemed relevant to this section and, as Checkland and Holwell have done, one could write a book on the topic.[108] For this reason the section will build primarily upon seminal publications and the work of oft-cited authors.

Knowledge and its communication are at the heart of human society.[109] The transfer of ideas between people is so ingrained in everyday life that the mechanics thereof is rarely considered outside the context of academic discourse (and rather rarely here too). Following this line of thinking it is argued that information systems, as systems of communication, have been in existence before any form of technology, be it paint on rock or bits on discs, was used to convert ideas into sets of symbols or signs. Thus, before attention can be paid to the tools which facilitate the communication of ideas, the notion of communication itself should be considered as it relates to the core of what information systems are.

Because this section of the dissertation is concerned, essentially, with definitions, it is important to recognise that there are certain implicit principles which relate to their accuracy and *usefulness*. The most important one being

[107] Checkland and Holwell (1998), Zuboff (1988)
[108] Checkland and Holwell (1998)
[109] Capurro and Hjø rland (2005, p. 343)

that a definition's preciseness should be considered relative to the theoretical framework in which it is used.[110] As Capurro and Hjø rland explain:

> "Statements, and the concepts figuring in them, will be as precise and informative as the theory in whose language they are formed is precise and informative. For instance, I think it will be agreed that the Newtonian concept of mass has a more precise meaning than the concept of democracy."[111]

It follows from this principle that definitions should not be considered as being wrong or right but rather as being more or less fruitful, constructed to serve a specific duty in an optimal way.[112] It is therefore of critical importance that, when interpreting the work of others, the application of a term (its implicit definition) should be considered as opposed to the definition offered at the outset (its explicit definition).[113] In IS literature, in particular, the two are often at odds as the communication of definitions is usually done in a rather ceremonial manner at the outset of a study without real consideration of the conceptual implications of the definition selection.

A second principle which should be acknowledged is that, in the construction of a lexical definition, a concept is defined through the use of other concepts and their individual meanings.[114] "If the meanings of these latter concepts are themselves established by definition, it is clear that an infinite regress will result, unless the meanings of some concepts are known by other means".[115] When defining *information systems* a fair bit of regression is certainly required - not only for "the highly controversial concept"[116] *information*, but also for the notion of *systems*. It is emphasised that the aim here is not the construction of general definitions of these terms to be accepted across academic domains, if that is at all possible.[117] The aim is, rather, to review prominent definitions of relevant terms in IS and related fields and offer definitions capable of serving

[110] Capurro and Hjø rland (2005); Zins (2007)
[111] Capurro and Hjø rland (2005, p. 346)
[112] Capurro and Hjø rland (2005, p. 344)
[113] Capurro and Hjø rland (2005, p. 344)
[114] Capurro and Hjø rland (2005, p. 346)
[115] Capurro and Hjø rland (2005, p. 346)
[116] Capurro and Hjø rland (2005, p. 343)
[117] It has been argued, for instance, the the term 'information' is "most useful when left without any formal definition.(Capurro and Hjø rland, 2005, p. 347)

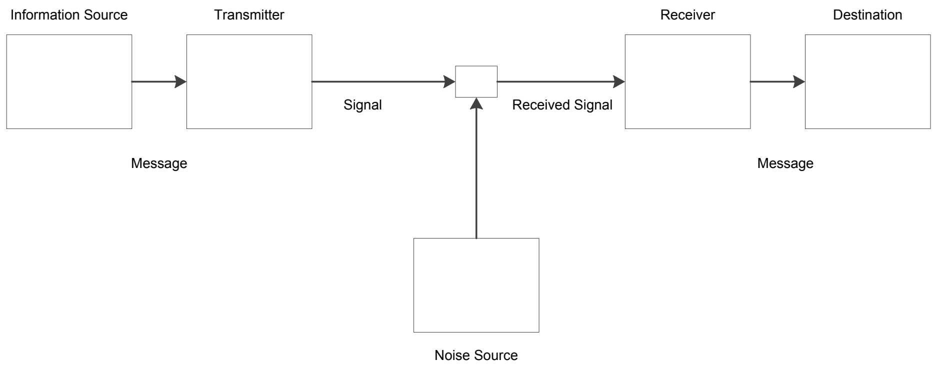

Figure 2.1: Shannon's schematic diagram of a general communication system.

a specific duty in an optimal way - i.e., enabling unambiguous argumentation throughout this dissertation.

The section commences with an overview of Shannon and Weaver's communication and information theory. It is followed by a discussion of various perspectives of, specifically, the concepts data and information. The discussion is concluded with the selection of working definitions for information and data. In the second part of the section attention is paid, firstly, to general systems theory and its applicability to IS. This is followed by critical reviews of information system conceptualisations which appear in literature with a discussion on the relevance and applicability of aspects of each.

2.2.1 Data and Information

2.2.1.1 Information in the work of Shannon and Weaver

Shannon expresses the fundamental problem of communication to be that of reproducing at one point either exactly or approximately a message selected at another point.[118] He approached this problem from an engineering perspective in the context of the Bell Telephone Laboratories, focussing primarily on the "quantitative limits of mediated communication".[119] His schematic diagram of a general communication system (see figure 2.1) has become synonymous with information and communication theory.

The basic principle of the model is that an *information source* "produces a message or sequence of messages to be communicated to the receiving ter-

[118]Shannon (1948, p. 379)
[119]Krippendorff (2009, p. 614)

minal".[120] The message is converted to a suitable signal by a *transmitter* and transmitted over a *channel* to a *receiver* which "ordinarily performs the inverse operation of that done by the transmitter, reconstructing the message from the signal".[121] The result of which is received by the *destination*.

Three important aspects of Shannon's theory are worth emphasizing here. Firstly, the theory is not concerned with the meaning contained in messages sent and received by the source and destination. Shannon points out that the "semantic aspects of communication are irrelevant to the engineering problem"[122] and concerns himself with the latter.

Secondly, the theory has been particularly useful due to its being particularly general. As Weaver states:

> "This is a theory so general that one does not need to say what kinds of symbols are being considered whether written letters or words, or musical notes, or spoken words, or symphonic music, or pictures. The theory is deep enough so that the relationships it reveals indiscriminately apply to all these and to other forms of communication. This means, of course, that the theory is sufficiently imaginatively motivated so that it is dealing with the real inner core of the communication problem with those basic relationships which hold in general, no matter what special form the actual case may take".[123]

And, thirdly, based on his theory, Shannon develops a rather "queer"[124] definition for the term *information*. He defines information as a measure of the freedom of choice of the information source in the selection of possible messages to transmit. Information, in the context of Shannon's communication theory, thus "relates not so much to what you *do* say, as to what you *could* say".[125]

Weaver, in his interpretation of Shannon's work, concedes that the semantic aspects of the communication problem are irrelevant to the engineering aspects of the problem but makes the important argument that "this does not

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[120] Shannon (1948, p. 380)
[121] Shannon (1948, p. 380)
[122] Shannon (1948, p. 379)
[123] Weaver (1949, p. 14)
[124] Weaver (1949, p. 5)
[125] Weaver (1949, p. 5)

mean that the engineering aspects are necessarily irrelevant to the semantic aspects".[126] He extends this argument by defining three levels of problems in communication.

- Level A problems are *technical problems* and are "concerned with the accuracy of transference from sender to receiver of sets of symbols, a continuously varying signal, or a continuously varying two-dimensional pattern etc."[127] Shannon's theory of communication is relevant to problems at this level.

- Level B problems are *semantic problems* concerned with the "identity, or satisfactorily close approximation, in the interpretation of meaning by the receiver, as compared with the intended meaning of the sender".[128]

- Level C problems are *effectiveness problems* concerned with the "success with which the meaning conveyed to the receiver leads to the desired conduct on his part."[129]

Weaver makes the observation that although problems at level A seems, *prima facie*, to be superficial in terms of content compared to those at levels B and C, the engineering aspects of communication do, in fact, play a central role in level B and C communication problems. This is so because "levels B and C can make use only of those signal accuracies which turn out to be possible when analysed at Level A. Thus any limitations discovered in the theory at Level A necessarily apply to levels B and C".[130] This argument does not, nor tries to, offer insight into the process of meaning attribution by human sources and destinations, but emphasizes that we cannot separate problems of meaning attribution from problems concerning the transfer of signals to which meanings are attributed.

Although the work of Shannon and Weaver has influenced IS research, their definition of information correlates poorly with conceptualisations of the term found in the bulk of IS literature. It is also at odds with the way the term is commonly used in speech, making the adoption of their definition in

[126] Weaver (1949, p. 5)
[127] Weaver (1949, p. 2)
[128] Weaver (1949, p. 2)
[129] Weaver (1949, p. 2)
[130] Weaver (1949, p. 3)

research problematic. Checkland and Holwell, for example, argue the notion that Shannon's work is concerned with *information theory* is the result of "grotesquely misnaming the subject area".[131] The mistake, they argue, was "to refer to what is clearly, in plain language, *'signal transmission theory'* as 'information theory'!"[132] It should be emphasized, however, that Shannon's definition "retains the basic aspect of the modern concept of information in the sense of knowledge communication, namely selection".[133] Selection is not only an action taken by the source when constructing the message, but also by the destination which interprets the message by making a selection "between the semantic and pragmatic possibilities of the message".[134] In a system of communication, therefore, destinations, like sources, play active roles in the construction of messages and the creation of 'information'.

2.2.1.2 The Information Hierarchy

Despite the broad recognition of Shannon and Weaver's contributions, the more predominant definitional model in the fields of information science, information systems and knowledge management is the D-I-K(-W)[135] model, also referred to as the information or knowledge hierarchy.[136] The model's origin is contributed to the work of Ackoff[137] and it is often represented as a pyramid with data as its base and information, knowledge and wisdom as layers upon it. The structure of the model typically implies a sequential order among the concepts, i.e., processed data constitutes information and processed information constitutes knowledge. However, although it is commonly accepted that the three key concepts are interrelated, "the nature of the relations among them is debatable, as well as their meanings".[138] The "mainstream"[139] version of the D-I-K model, based on an analysis by Zins, is characterized by a "non-metaphysical, human-centered, cognitive-based, propositional approach"

[131] Checkland and Holwell (1998, p. 93)
[132] Checkland and Holwell (1998, p. 93)
[133] Capurro and Hjø rland (2005, p. 359)
[134] Capurro and Hjø rland (2005, p. 359)
[135] D-I-K stands for data, information and knowledge. In some variations of the model, e.g. Ackoff (1989), *wisdom* is also in included.
[136] Rowley (2007, p. 164)
[137] Ackoff (1989)
[138] Zins (2007, p. 479)
[139] Zins (2007, p. 488)

to the three concepts.[140] Although Zins recognizes that alternative approaches exist, the study revealed that D-I-K conceptualisations provided by 45 top information science scholars followed the mainstream approach. Following Zins, this discussion will not consider instances of data or information outside the domain of communication among humans, although it is accepted that the concepts may be relevant to, and defined differently in, for example, the physical and biological domains.[141,142]

The predominance of the D-I-K hierarchy in IS and its influence on the development of theory in the field necessitate that its basic premises are, if not accepted, acknowledged here. This, however, raises some conceptual problems which result from the ontological variations found in different versions of the hierarchy. These variations typically relate to two discourses. The first is concerned with the relation between D-I-K and human cognition and promotes the definition of the layers based on their existence relative to the subject. The second is concerned with the codification of D-I-K and the differentiation between D-I-K and representations thereof.

Checkland and Holwell, for example, provide a thoughtful variation of the D-I-K model with the addition of a fourth concept, *capta*, between data and information. Despite this addition the model maintains the general layered structure of its predecessors and differentiate between the layers based on the cognition-based processes of selection and meaning attribution.

The model accepts the premise that "there are a myriad of facts about the world", and that these facts "are in principle checkable; if disputed, evidence can be produced to support or refute them".[143] It is emphasised that facts do not imply universal acceptance, but that they may be disputed or only accepted by certain individuals or groups. The term *data* is used to describe this mass of facts. To distinguish between the mass of facts about the world and those facts which an individual or group has decided is relevant and wishes to collect, they have created a new term: *capta*. Capta, from the Latin *capere* ('to take'), thus refers to a subset of data. The authors state that "turning data into capta is a very familiar mental process, so familiar in fact that it has

[140] Zins (2007, p. 488)

[141] For an overview of information's relevance in these domains see Bawden (2007).

[142] The focus, in this section, falls primarily on the concepts data and information, although definitions of knowledge provided by various authors will be presented where applicable.

[143] Checkland and Holwell (1998, p. 88)

become completely transparent to us".[144] Once data have been selected and paid attention to it is related to other data and contextualized. The authors refer to this process as "meaning attribution"[145] and argue that it "converts" capta into *information*.[146] Finally, the process of meaning attribution can itself lead to "larger structures of related information" which the authors refer to as *knowledge*.[147] Knowledge "may be expected to have greater longevity than many items of information which are only ephemerally meaningful and relevant".[148]

The simplicity of the model makes it appealing for IS scholars, particularly as a tool to introduce the field to students. This simplicity, however, is gained through the acceptance of a number of implicit assumptions that only become clear once the model is analysed more thoroughly. Particularly ambiguous in the case of Checkland and Holwell's model are its assumptions about meaning. The sequential structure of the model suggests that data (facts) exist prior to the cognitive processes of selection and meaning attribution, i.e., facts exist *out there* and can be selected for attention by the human knower to create capta. Although the concept *fact* is not explicitly defined, the examples provided (e.g., the birthplace of a person) suggest that they represent observations about the real world. However, based on the model, these observations exist independent of (prior to) cognitive processes. More specifically, the model suggests that meaning exists prior to the process of meaning attribution by humans. This, however, is contradictory to their argument that the "act of creating information is a *human* act" which is performed in "a context which may well be shared by many people but may also be unique to an individual".[149] Conceptually, the model creates to an infinite loop where the difference between data and information disappears due to ambiguity around the concept of meaning: information is the product of attributing meaning to a subset (capta) of all the possible meanings which may be attributed to the real world (data). Bawden, accordingly, argues that "the model is far from rigorous; in particular, it is unclear exactly how it is determined when the transition is

[144] Checkland and Holwell (1998, p. 89)
[145] Checkland and Holwell (1998, p. 90)
[146] Checkland and Holwell (1998, p. 90)
[147] Checkland and Holwell (1998, p. 90)
[148] Checkland and Holwell (1998, p. 90)
[149] Checkland and Holwell (1998, p. 92)

	Subjective Domain	Universal Domain
Data	Stimuli which we perceive through our senses or their meaning, i.e. the empirical perception.	Sets of signs that represent empirical stimuli or perceptions.
Information	Empirical knowledge, i.e. knowledge obtained from the meaning of sensory stimuli.	A set of signs which represents empirical knowledge.
Knowledge	A thought in the individual's mind, which is characterized by the individual's justifiable belief that it is true.	A set of signs that represent the meaning (or the content) of thoughts that the individual justifiably believes are true.

Table 2.1: D-I-K in the subjective and universal domains.

made between the various states".[150]

A second, more fundamental, problematic aspect of the model is that it neglects to address the role of codification in D-I-K conceptualisation. In the model it is implied that facts can be processed electronically (which suggests that they can be coded), but no explicit distinction is made between coded and *uncoded* facts, between representations of observations and observations themselves. Failure to acknowledge that these two phenomena are indeed different opposes the most basic ideas about communication as presented in the work of Shannon and Weaver.

Zins comes to a similar conclusion. Like Checkland and Holwell he accepts that the D-I-K layers should be differentiated based on human cognitive processes but argues, also, for the distinction between two possible "modes of existence"[151] of D-I-K based on semiosis: the subjective domain (SD) and the universal domain (UD).[152] This enables him to develop a D-I-K model for each domain which addresses both the role of cognition and codification. The model, consequently, defines six concepts and is presented in table 2.1.

In the subjective domain the model involves the perception of stimuli through the senses from which the perceiver gains empirical knowledge through meaning attribution. The model differentiates between data as *empirical perception* and information as *empirical knowledge*. Because both empirical perception and empirical knowledge are essentially created by the perceiver, both will be unique to the individual.

Zins argues that empirical perceptions and empirical knowledge can be

[150] Bawden (2007, p. 317)
[151] Zins (2007, p. 486)
[152] Zins (2007, p. 487)

represented by sets of signs ("engraved signs, painted forms, printed words, digital signals, light beams, sound waves, and the like"[153]) to form data and information in the universal domain. It is emphasized in the description of the model that sets of signs do not equate to meaning. Although we cannot perceive with our senses meaning itself, we relate, through communication, to the sets of signs which forms representations thereof.[154] It maintains, therefore, Shannon and Weaver's communication principles.

By not distinguishing between the subjective and universal domains, the conceptualisations of data and capta offered by Checkland and Holwell equate an empirical perception to a set of signs which represent it. It is important to highlight why this distinction is crucial. Firstly, and most importantly, perception is produced by an individual perceiver and influenced by the unique knowledge, values, experiences, needs, motivation etc., of that person at the time of perceiving stimuli. The coded representation of the perception is void of these factors. Secondly, the process occurs in a specific context which enriches the perception formed and which, like the perceivers state of mind, is lost when the perception is converted to signs. Finally, the construction of a coded representation of an empirical perception is dictated by the range of available of signs which can be used and influenced by the selection of these signs made during construction, which is essentially what we learn from Weaver.

2.2.1.3 Information as Patterns of Organisation

The afore mentioned versions of the D-I-K hierarchy share a cognition-based perspective of information. The perspective implies that, coded or uncoded, the existence of information is a product of human cognitive processes. There are, however, also alternative conceptualisations in which information is seen as a property of the physical world.[155] Bates, for example, argues that information should be considered as the "pattern of organisation of matter and energy".[156]

> "Information is the pattern of organisation of the matter of rocks, of the earth, of plants, of animal bodies, or of brain matter. In-

[153] Zins (2007, p. 487)
[154] Zins (2007, p. 487)
[155] Bates (2006); Stonier (1990)
[156] Bates (2006, p. 1033)

> formation is also the pattern of organization of the energy of my speech as it moves the air, or of the earth as it moves in an earthquake. Indeed, the only thing in the universe that does not contain information is total entropy; that alone is pattern-free".[157]

Unlike Zins's definition of information in the universal domain, Bates's definition of information is not exclusively a part (e.g. thought) or product (e.g. human made sign) of human cognition.[158] Once produced by humans, sets of signs can, of course, be considered as a subset of this classification but Bates's definition points to the informativeness of all phenomena, not only of signs, prior to human perception. Information is not constructed but exists *out there* and humans can, through perception and background knowledge, become informed.

Hjø rland is critical of Bates's view arguing that following the proposed definition it could be concluded that everything is information and that such an all embracive concept serves no purpose,[159] much like Checkland and Holwell's concept of data as *the myriad of facts about the world*. It is postulated, rather, that for a phenomenon to be informative it should be considered in relation to questions it is able to answer, e.g., a tree stump can answer questions relating to its age.[160] A thing's "informativeness is thus a *relation* between the question and the thing. No thing is inherently informative".[161] This emphasises that "background knowledge is *always* important to establish the informativeness of any object (including documents and texts)".[162]

There are two aspects of the view of information as patterns of matter and energy which should be highlighted here. Firstly, it makes the concept of data redundant. Where other D-I-K models distinguish between data and information based on cognitive processes (e.g., meaning attribution, selection or perception), the idea of information as matter and energy makes such a distinction impossible. Secondly, it emphasises that the relationship between knowledge and information is far more complex than suggested by D-I-K models. The idea of data being converted into information and ultimately into knowledge

[157] Bates (2006, p. 1033)
[158] Zins (2007, p. 488)
[159] Hjø rland (2007, p. 1451)
[160] Hjø rland (2007, p. 1451)
[161] Hjø rland (2007, p. 1451)
[162] Hjø rland (2007, p. 1451)

is invalidated when the informativeness of matter and energy is considered. The informativeness view suggests, rather, that knowledge converts patterns of matter and energy into information by relating it to questions, i.e. information is a product of knowledge and not vice versa.

2.2.1.4 Conclusions

The preceding review of popular approaches to defining first principles for IS is indicative of the conceptual intricacy of the field. To label any of these approaches as either wrong or right would be to disregard that each contributes in a unique way to our understanding of what information, data and knowledge are. Thus stated, further conceptual ambiguity would certainly follow if an unambiguous working definition for information is not specified at this point. From the analysis three primary options emerge:

- *Information as understanding.* The advantage of defining information as understanding is that it maintains the richness of subjective processes like selection, perception and meaning attribution. It has the weakness, however, of correlating poorly with the general usage of information to denote sets of signs. For example, information as understanding cannot be transferred, processed or related to by someone other than the subject.

- *Information as cognition-based signs.* Cognition-based signs, unlike understanding, associate more readily to with the general usage of information as perceivable *stuff*. This, however, has the drawback of limiting the term to only denote sign, voiding it of the cognitive processes that make sign meaningful.

- *Information as patterns of matter and energy.* By defining information as a property of the physical world it is recognised that all things are potentially informative (including cognition-based signs). It has the added advantage of highlighting the role of knowledge as enabler of the informing process. The all-embracive nature of such a definition, however, makes its unambiguous usage particularly difficult.

It is at this point important to reiterate the principle outlined at the start of this section: that a definition should perform a specific duty in an optimal way. This requires that attention be directed to the context of the proposed research and the duty which *information* is expected to perform therein. What is certain in this regard is that IS research in contemporary organisations, as context, is incontrovertibly tied to IT. It is not surprising then that the terms data and information are often used interchangeably to denote some aggregation of codified sign. In general language data is typically employed when this aggregation is digital and used in automated processes (e.g. data transfer, data recovery, data warehouse etc.). Information, on the other hand, tends to be used when such signs are presented in some human-perceptible format (e.g. information is contained in documents, information is edited by a person, information is shared by a group of people). The terms are, of course, also used interchangeably.

Boland is particularly critical of the adoption of *information as sign* by IS scholars and postulates, rather, a *data as sign* and *information as meaning* ontology.

> "We all know that information is the meaning or inward-forming of a person that results from an engagement with data. Yet, we consistently avoid the problem of meaning in our information systems research and practice, assuming information to be structured data instead of meaning".[163,164]

The research conducted in this study addresses Boland's argument by taking particular interest in the processes by which actors in organisations construct meaning, or, rather, make sense. Instead of avoiding the problem of meaning the research specifically addresses it. Contrary to Boland, however, it is argued here that the term information has, through its adoption in both academia and practice, become an insufficient instrument to denote meaning. Whether this implies that its adopted usage is not *accurate* remains open

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[163] Boland (1987, p. 363)

[164] One way of understanding the failure of scholars to conceptually separate sign from meaning is the presence of a broadly accepted underlying assumption that information, as sign, is *always* cognition-based. Consequently, the subjective processes by which signs are perceived, interpreted and created are tacitly implied whenever sign, or the term information, is used. Following this view, cognition-based signs do not exist unto themselves but are created by humans and represented for the purpose of human interpretation. This distinguishes them from other patterns of organisation which may be informative, but are not information. The problem with this assumption is that it reduces meaning attribution in the information system to an inconsequential process, the result of which is that meaning is effectively ignored in IS work and the role of human cognition in information systems operation conveniently sidestepped.

to conceptual debate, but this debate alone will have little influence on IS practice. Additionally, the argument proposed by Hjø rland that *information as matter and energy* is unusable due to its all-embraciveness is acknowledged. Although it is accepted that patterns of matter and energy other than cognition-based signs may be informative, usage of the same term to refer to both phenomena will certainly lead to ambiguity.

It is posited, therefore, that to be a meaningful and useful theoretical construct, information should be conceptualized as *sets of cognition-based signs which exist in the universal domain.* The term will be used in this manner in the remainder of the dissertation. Further, it is accepted that the term data is used interchangeably with information to distinguish between sets of signs based on their configuration or encoding. Based on the accepted definition of information, however, this distinction becomes one of little consequence. Finally, while it is clear from the discussion that knowledge is a central concept in this discourse, it demands a far more intensive analysis than is presented in the preceding overview. Its role in the operation of information systems is addressed in more detail later in this text.

2.3 Conceptualising Information Systems

The selection of a working definition for *information* provides certain boundaries for the conceptualisation of *information systems.* Within these boundaries, however, there remains a variety of possible conceptualisations which denote largely different phenomena. The aim of this section is to identify these variations and, based on the nature of the study, formulate a conceptualisation which serves the purpose of this study.

As a starting point the notion of *systems* is briefly analysed. In the majority of IS literature the relevance of general systems theory to IS is noted in “a ceremonial way, but there is as yet not much in the way of determined persistent effort to forge a link between systems thinking and the organised provision of information in organisations”.[165] To forge such a link in an accurate and sensible manner, some background on the development of systems thinking is presented, followed by a review of popular conceptualisations of

[165] Checkland and Holwell (1998, p. 60)

information systems in IS literature. The section concludes with the adoption of a working definition for information systems.

2.3.1 Systems and Systems Thinking

"A system is a complex whole the functioning of which depends on its parts and the interaction between those parts".[166] In the study of systems, a popular scientific method, reductionism, sees the parts of the system as paramount and seeks to "identify the parts, understand the parts and work up from an understanding of the parts to an understanding of the whole".[167] Systems thinking dictates, however, that certain properties of the whole cannot be explained through the study of its parts or, rather, that the whole is more than the sum of its parts. "The whole emerges from the interactions between the parts, which affect each other through complex networks of relationships" and "once it has emerged, it is the whole that seems to give meaning to the parts and their interactions".[168]

In philosophy early contributions to the ideas of systems thinking were made by Plato and Aristotle and were further developed by European philosophers in the 18th and 19th centuries, notably Kant and Hegel.[169]

Holism, as the alternative to reductionism, became particularly popular due to the inability of reductionism to enable the study of problems in complex systems.[170] Its development can be attributed to work done in various fields of study. Most prominently, it may be argued, in Biology where von Bertalanffy (1950) studied organisms as stable levels of organized complexity above molecules, organelles, cells, and organs. Through holism Von Bertalanffy could explain the emergence of autonomy as a property of the organism, one which does not exist at lower levels of the systems hierarchy.

Von Bertalanffy realised the applicability of his ideas to other domains and explored the possibility of outlining a general systems theory[171] in which he made the now famous distinction between closed and open systems.[172] A

[166]Jackson (2003, p. 3)
[167]Jackson (2003, p. 3)
[168]Jackson (2003, p. 3)
[169]Jackson (2003, p. 4)
[170]Jackson (2003, p. 4)
[171]von Bertalanffy (1950, 1968, 1972)
[172]von Bertalanffy (1950)

closed system does not interact with its environment but will "attain a time-independent state of equilibrium where the composition remains constant".[173] Unlike a closed system, an open system lacks a clear boundary separating it from its environment. Open systems are characterized by inflows and outflows of materials which lead to changes in the component materials of the system.[174] "An open system has to interact with its environment to maintain itself in existence" and ensure its steady state (homeostasis).[175]

Von Bertalanffy's theories have been challenged, more recently, by Maturana and Varela[176] who emphasised the "closed system of interactions that occurs in living entities" and the ability of such autopoietic systems to respond to disturbances in their environments.[177]

In the field of Control Engineering Wiener[178] introduced the notion of cybernetics as "the science of control and communication in the animal and the machine".[179] Wiener was concerned with the general laws of control processes in all systems. Amongst his most notable contributions to systems thinking is the concept of *negative feedback* - the notion that a system can maintain its goal-directed behaviour through the transmission of information about goal divergence.[180]

Developments in systems thinking prompted organisation and management scholars to develop "systems models of organisation emphasizing the importance of subsystems to overall organisational effectiveness and the significance of the organisation-environment fit".[181] Importantly this inspired the notion that, unlike mechanical or biological systems, organisations as social systems are *purposeful* systems. As system parts human actors generate multiple purposes in addition to those purposes prescribed to organisations by managers. This perspective emphasises that in the management of social systems the "resistance, or otherwise, of *Weltanscauungen* or appreciative systems to change becomes critical".[182] Accordingly, the concept of system boundary becomes

[173] von Bertalanffy (1950, p. 156)
[174] von Bertalanffy (1950, p. 155)
[175] Jackson (2003, p. 6)
[176] Maturana and Varela (1980)
[177] Jackson (2003, p. 7)
[178] Wiener (1948)
[179] Jackson (2003, p. 7)
[180] Jackson (2003)
[181] Jackson (2003, p. 9)
[182] Jackson (2003, p. 10)

problematic as it depends on the world view of the observer.

More recently systems thinking has been "welcomed in physics and chemistry as offering new forms of explanation and new avenues of exploration".[183] Particularly notable in this regard have been the notions of complexity and chaos. Under the banner of complexity theory, scientists have started to explore the apparent disorder in complex systems, their underlying patterns and limits.[184] Kinghorn, in describing complexity, contrasts it to *complicatedness*. "A complicated worldview is based on the assumption of our ability to identify definitively - and then manage - all the constituent elements of any given phenomenon, including their interrelationships. There may be a vast number of such elements and they may be difficult to track and comprehend, but it is assumed that with the sound application of mechanical rationality, a problem-solving methodology and dedication, this can be achieved".[185] A complex worldview, contrarily, replaces mechanic rationality with the notion of reality as "fluid moments in continuously adapting organic processes" of which we can recognise the flows and patterns.[186]

2.3.2 Systems Thinking and Information Systems

"To many people a computerised information system is the very paradigm of what they mean by 'system', so it is perhaps particularly surprising that work on information systems has paid little heed to the general development of ideas of system".[187] A reason offered for this lack of heed, Checkland argues, is that the system concept is used "not only as the name of an abstract concept which the observer tries to map to reality, but also as a label for things in the world" (e.g., the legal system or the education system).[188]

The application of general systems theory concepts in information systems research is a contentious topic. Debate in this matter relates, in various ways, to confusion resulting from the lack of accepted IS first principles as discussed

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[183] Jackson (2003, p. 11)
[184] Jackson (2003, p. 11)
[185] Kinghorn (2005, p. 320)
[186] Kinghorn (2005, p. 320)
[187] Checkland (1988, p. 242)
[188] Checkland (1988) criticises the decision by the early non-reductionist biologists to use the term *system* to refer to the whole because the term was already used in general language. He argues that the use of a neologism, like *holon*, would have avoided some of the resulting confusion.

in previous sections, but also to conflict around what the central concerns of the IS field should be. Carvalho, accordingly, points out that the information system concept is used in literature to denote various, fundamentally different phenomena.[189] Although confusing, this is not, in a semantic sense, inaccurate - there are certainly more than one type of system in which the interaction between parts involves communication through cognition-based signs. The task of conceptualising information systems, then, presents not only an ontological problem, but also a typological one. To address the latter of these two, it is important to distinguish information systems as investigated in this study from other types of information systems. Two assumptions are emphasised in this regard:

- Firstly, this study adopts the assumption that the core concern in IS is the provision of relevant information within some social collective to enable members to act purposefully. Although possibly applicable to other contexts, the bulk of IS research is performed in and/or apply to organisations. Interest falls, therefore, on the *processes* and *activities* concerned with the creation, manipulation, storage, transfer and presentation of information which relates to the requirements of organisational members spawned from the work they are expected to perform. It should be noted that a host of information processing activities which do not relate to organisational work also occur in organisational contexts (e.g., casual conversation, social e-mails etc.). Such activities may themselves be *systemic*, but generally fall outside the scope of *information systems* as studied by IS scholars. It should be noted, however, that the line between work related and non-work related information processing is not always cut and dry. Casual conversation between members of an organisation may, for example, be intertwined with the communication of work-related understandings or observations. The relationship between such *undesigned* or *informal* information processing activities and designed information systems is a key theme in this study.

- Secondly, it is accepted that contemporary information systems typically, but not specifically, harness an array of *tools* to support information processing activities. Such tools include paper-based forms, files or

[189] Carvalho (1999)

documents which enable the assembly, storage and presentation of information. It also includes computer technology which, in addition to these functions, enable the manipulation of information through rule-based algorithms (automated processing). Following the work of Orlikowski[190] the term *artefact* is adopted to denote material configurations of hardware and software (where applicable) that enable information capturing, storage, presentation and manipulation. In doing so a distinction is sustained "- at least theoretically - between the material nature of technology and the human activities that design or use those artefacts".[191] In accordance with this distinction the term technology better denotes the *activity system* which is enabled by the adoption of an artefact.

Based on these two assumptions it is argued that information systems are, essentially, *socio-technical activity systems*. The oft-cited definition proposed by Buckingham *et al.*[192] supports this view:

> "A system which assembles, stores, processes and delivers information relevant to an organisation (or to society), in such a way that the information is accessible and useful to those who wish to use it, including managers, staff, clients and citizens. An information system is a human activity (social) system which may or may not involve the use of computer systems".

While Buckingham *et al.*'s definition resonates well with popular ideas about information systems, it fails to resolve the confusion created by the lack of consensus about first principles in the field. Ironically, this confusion tends to reflect Weaver's response to Shannon's communication model[193] as it is, on a fundamental level, concerned with the relationship between the engineering and semantic aspects of information systems.

The relationship between these aspects is partly addressed by Checkland and Holwell who, in their conceptual analysis of the field, identify two *schools of thought* in IS. They refer to the first as the hard, functionalist school which subscribes, in the words of West,[194] to the *conventional model* of organisations.

[190] Orlikowski (1992)
[191] Orlikowski (1992, p. 403)
[192] Buckingham *et al.* (1986)
[193] See section 2.2.1.1
[194] West (2005)

It views individuals and organisations as goal-seeking entities which continuously try to detect differences between present situations and goals. To reach their defined goals they aim to identify the tools or processes which will enable them to reduce those differences. Organisational problems are typically divided into sub-problems in a recursive fashion, until a level is reached where sub-problems can be solved individually.

The functionalist school concerns itself with the engineering aspects of communication systems and, as such, emphasises the activities and tools which facilitate communication processes. An example of a conceptualisation which aligns with this school comes from the work of Alter who defines *information systems as work systems.* “A work system is a system in which human participants and/or machines perform work (processes and activities) using information, technology, and other resources to produce specific products and/or services for specific internal or external customers.”[195] He continues to define an information system as “a work system whose processes and activities are devoted to processing information, that is, capturing, transmitting, storing, retrieving, manipulating, and displaying information”.[196]

While Alter recognises the role of artefacts in information systems as work systems, he emphasises the distinction between artefacts and information systems by stating that computer technology and/or software applications are not information systems because they do not, in isolation of work processes, “produce specific products and services for specific customers”.[197] “Rather, depending on the purpose of the analysis, they should be treated either as part of the technology within a specific information system or as part of the technical infrastructure shared among multiple information systems”.[198] This view, he argues, is contrary to that adopted by many IS/IT pundits:

> “The IS discipline is ostensibly about systems, but many of its fundamental ideas and viewpoints are about tools, not systems. For example, our basic vocabulary implies that IT vendors and IT groups provide tools and that an IT group’s ‘users’ use them. Similarly, typical concepts about IS success imply that a tool’s success is measured by whether it fits specifications, how well it is used, and what

[195] Alter (2008, p. 453)
[196] Alter (2008, p. 453)
[197] Alter (2008, p. 453)
[198] Alter (2008, p. 453)

> is its impact. Likewise, system development often refers to developing software tools that meet requirements and satisfy perceived needs of users, rather than developing or modifying a work system in an organisation".[199]

Although emphasising the distinction between information systems and artefacts, Alter does not "try to establish a separation between a technical system and social system as is discussed by many proponents of socio-technical approaches".[200,201] "Trying to separate the social system from the technical system is more difficult. For example, in many cases specific activities and business process steps can be viewed simultaneously as part of the social system and the technical system".[202] His motivation for avoiding this distinction is that it is unlikely that "most business people, IT professionals, and non-Ph.D. analysts would be willing or able to make that type of distinction".[203]

A further advantage of the work system approach, he argues, is that the it distinguishes between general IT-reliant work systems and information systems. Although information systems may "produce intermediate products and services that are meaningful and useful primarily in the context of a larger work system", the larger system would involve activities beyond information processing. IS studies are, for this reason, relevant in areas such as industrial engineering and operational research where the focus is not information processing *per se*, but production or service delivery systems. "This distinction is often ignored because IT-reliant work systems are sometimes treated as subject matter within the IS field, an inclusion that may have significant benefits for the IS field".[204]

Alter's conceptualisation is about the decomposition of organisational work to processes and activities and aligns well with the functionalist school. While his distinction between information systems and artefacts facilitates differentiation between manual and automated information processing activities, the differences between these are irrelevant to him. Like Shannon, Alter doesn't, nor aims to address the *semantic problems* of communication systems. While

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[199] Alter (2008, p. 453)
[200] Alter (2008, p. 453)
[201] E.g., Hirschheim and Klein (1994)
[202] Alter (2008, p. 453)
[203] Alter (2008, p. 453)
[204] Alter (2008, p. 451)

Alter's functional perspective is certainly relevant, failure to address the semantic dimension of information system operation cultivates the assumption that actors, like machines, consistently perform information processing activities in a rational, rule-based manner.

Functionalist ideas about organisation have been challenged by, amongst others, Geoffrey Vickers.[205] He argues that the goal-seeking model encourages the simplification of a complex situation by reducing multiple objectives to a single goal.[206] Goals are considered to be once-and-for-all states to be attained and their establishment and pursuit equates to organizational planning and control. Once these goals are attained, new goals need to be considered and set.[207] Vickers argues, however, that reaching a goal is not important, but that it becomes important only when considered in the wider context of related desires. Entities or objects, accordingly, only become important in the context of their relations.[208] It is not the attainment of a goal which satisfies the individual or organisation, but the relationship which have been achieved between objects and desires. A single goal, when viewed in this manner, is actually a complex web of relations. As Vickers explains, "the successful management of any human activity system, whether business organisation or one's personal life does not consist in prescribing one goal or even a series of goals; but in regulating a system over time in such a way as to optimise the realisation of many conflicting relations without wrecking the system in the process".[209]

West, in accordance with Vickers, argues that the functionalist approach treats an organisation as a single entity capable of unitary purposeful action. "In this model, organisational members are considered to understand and share the organisation's aims and objectives, and consequently, work within the organisation to attain these objectives".[210] In reality, however, an organisation contains a myriad of intentions of purposeful action which influence the array of objectives which may be pursued by organisational members. From this perspective the notion of organisational decision making as a consensus-seeking activity is unrealistic. Instead organisation involves the seeking of accommoda-

[205] Vickers (1970); Checkland (1988); Checkland and Holwell (1998); Checkland (2005); West (2005)
[206] West (2005, p. 267)
[207] West (2005, p. 267)
[208] West (2005)
[209] Vickers (1970, p.116)
[210] West (2005, p. 264)

tions between the conflicting interests on which members base their action.[211]

In contrast to the functionalist school the *interpretive school* views organisations as networks of communicative exchanges[212] in which IT is used to enable and simplify such exchanges.[213] Vickers, accordingly, views an organisation as ongoing debate of possible courses which may be followed and the relationships they will affect.[214] The role of managers changes from the prescription of goals to setting standards and managing relationships. The actions of individuals and organisations are based upon personal and collective sensemaking processes during which goals are continuously adapted and re-evaluated.[215] In Vickers' work this continuous learning process is referred to as an *appreciative system*.[216] Winograd and Flores, in agreement with the interpretive school, define organisations as networks of conversation, facilitated by the use of IT, in which commitments are generated.[217]

The interpretive school is sensitive to the semantic problems of communication through its recognition of the personal and shared appreciative systems which guide action in organisations. While many IS scholars subscribe to its premises, there remains a lack of clarity about the implications this sensitivity has for the design of information systems. Checkland and Holwell attempt to address this problem by integrating the functionalist and interpretive schools when developing their information system conceptualisation. They conceptualise organisations as collective or social units in which ongoing discourse between members leads to purpose definition and the declaration of processes to achieve them. Based on these processes organisational roles can be defined and the norms and values which determine good and bad organisational behaviour established. They claim that this view of organisation drops the pretence that a single collective conceptualisation of the organisation is shared by its members. It acknowledges the interests and agendas of individuals and sub-groups within the organisation, as well as the overall, public account of the organisation. Consequently, the organisation as a whole has to constantly "seek accommodations between conflicting interests upon which action can be

[211] West (2005, p. 265)
[212] Based on the work of Ciborra (1987)
[213] Checkland and Holwell (1998)
[214] Vickers (1970, p.118)
[215] Checkland and Holwell (1998)
[216] West (2005, p. 270)
[217] Winograd and Flores (1986)

based".[218] The model manages to capture "the tension between the rationality of collectively organizing to achieve goals and the ultimate recalcitrance of human beings as members of organizations".[219]

Based on this integrated model of organisation they conceptualise an information system as an "organised attempt at meaning-creation-from-data by an institution".[220] They augment this line of reasoning by stating that information systems have "social implications which are at least as important as technical implications".[221] This conceptualisation, they argue, implies a fundamental shift in IS research and development from the "idea of optimizing to the idea of learning the meanings by which people sharing a human situation seek to make sense of it".[222] The information system's purpose is essentially to contribute to someone's acquisition of knowledge which enables the execution of some action in some context.[223]

When considering this conceptualisation it should be remembered that Checkland and Holwell's definition of information denotes subjective understanding as opposed to signs. Accordingly, their emphasis falls on the meanings generated from sign-based communication as the enablers of purposeful action - *information system as meaning system*. This is significant because it recognizes that although individual and collective sensemaking processes in the organisation are influenced by signs and sign processing, they also depend on the appreciative systems adopted by its users. While the functional school adopts a complicated, yet rational world-view, Checkland and Holwell, in accordance with Vickers, are sensitive to the complex nature of organisations and information systems. This does not, however, imply the absence of order - activities (as system parts) are seen to be linked and interdependent creating recognisable flows and patterns.

The dominance of positivism in IS research suggests that the interpretive school has, thus far, failed to make a considerable impact on the development of the field. In particular, there seems to be a lack of research which successfully reconciles hard, mechanistic theories about artefacts and work systems with the non-linear processes of personal and shared sensemaking. A reason for

[218] Checkland and Holwell (1998, p. 84)
[219] Checkland and Holwell (1998, p. 79)
[220] Checkland (1988, p. 239)
[221] Checkland (1988, p. 239)
[222] Checkland (1988, p. 245)
[223] Carvalho (1999, p. 6)

this gap in IS research may be that the field lacks the conceptual grounding to address soft themes like organisational learning and sensemaking.

One approach which partly addresses this problem is the distinction between *formalised* and *unformalised* information systems. This distinction separates information processing activities that follow planned, pre-defined, repeating patterns from *ad-hoc* information processing activities that are dynamically and continuously created by actors to inform themselves. Avison and Fitzgerald, for example, use the phrase *formalised information systems* to distinguish information systems which "provide information on a regular basis and in a predefined manner" from other, "less formalized" information systems like "rumour, gossip, ideas and preferences".[224] Thus stated, the question which arises is what constitutes formalisation. Avison and Fitzgerald partly avoid this question by referring to less-formalised, as opposed to non-formalised, systems which suggests that there exists some degree of formalisation in both types.

Land,[225] however, is somewhat more specific in his description. He uses the terms *designed* and *undesigned* interchangeably with *formal* and *informal* to describe the distinction. Designed information systems, he argues, are formally specified, rule-based and purposeful. "Most designed information systems of interest are open systems, operating through the interaction of individuals or groups assisted by the use of a variety of tools and instruments".[226] The description correlates with Alter's work system approach.[227]

[224] Avison and Fitzgerald (2006, p. 3)

[225] In Finkelstein *et al.* (1988) and Farbey *et al.* (1995)

[226] Finkelstein *et al.* (1988, p. 6)

[227] The various approaches to the development, operation and maintenance of designed information systems are well-documented and dominate the content of entry-level IS textbooks. Although not a prerequisite, such information systems are often developed together with particular artefacts in which business rules and processes are typically embedded. In such cases formalisation is imposed by the artefact and its associated usage policies. This area of IS, in particular, shares a lot of theory with the field of software development because it dictates that software systems and activity systems should be developed in unison. It has the undesired effect, however, of implying that information systems development "refers to developing software tools that meet requirements and satisfy perceived needs of users, rather than developing or modifying a work system in an organization". (Alter, 2008, p. 453) This implies a shift of emphasis from designing processes and activities to designing artefacts. The risk is that system designers focus primarily on the system's technical success and loose sight of its actual purpose - to contribute to the acquisition of knowledge by system stakeholders. IS literature typically promotes the adoption of a development methodology for development projects. These range from the teleological, linear Systems Development Life Cycle (SDLC), developed in the 1960's by Rowan and Enthoven at the United Sates Department of Defence (Le Roux, 2007), to prototype and iteration-based approaches spawned by the Spiral Model (Boehm, 1988), to, more recently, those approaches subscribing to the

Undesigned information systems, on the other hand, are "informal, have no specification, may be unauthorised and operate through informal and undefined interactions between individuals and groups".[228] They are, however, also purposeful, although "the purposes are often covert".[229] Importantly, their operation is not guided by explicit, formalised rules but by "tacit rules of behaviour and through the action of norms".[230] Like designed information systems, undesigned information systems may also involve the use of IT artefacts.

Undesigned systems are, due to their dynamic, unplanned and covert nature, a topic less susceptible to scientific study. Nonetheless, various approaches have highlighted different aspects of these phenomena. One such approach has been to investigate the role that social networks, and their associated influences on the flow of information, play in the performance of organisations.[231] The main argument being that, although not easily managed or cultivated, these seemingly invisible webs are "central to performance and execution of strategy".[232] From an IT perspective, the notion of *end-user computing* (EUC) has highlighted the role of non-IT organisational actors in developing and using computerised tools to improve their work.[233] There have also been efforts to investigate the role of non-IT organisational actors in developing and maintaining large-scale artefacts, called *Tailorable Information Systems* (TIS).[234] In another approach, under the banner of *Personal Information Management* (PIM), scholars have studied the processes in which organisational actors use tools, such as e-mail and spreadsheets, to organise their personal work processes and cope with aspects like information overload.[235]

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loosely defined Agile school (Beck *et al.*, 2001). Despite the more than 1000 methodologies which have been published (Fitzgerald, 1996), the high percentage of failure experienced in formal information systems development projects remains a well documented and much-debated concern in IS. (Fitzgerald, 1996; Jiang *et al.*, 2001; Le Roux, 2007; Xia and Lee, 2005; Goulielmos, 2004)

[228] Finkelstein *et al.* (1988, p. 6)

[229] Finkelstein *et al.* (1988, p. 6)

[230] Finkelstein *et al.* (1988, p. 6)

[231] Kilduff and Tsai (2003); Cross *et al.* (2004); Bertolotti and Tagliaventi (2007); Le Roux and Le Roux (2010)

[232] Cross *et al.* (2004, p. vii)

[233] Doll and Torkzadeh (1988); Rockart and Flannery (1983); Nardi (1993)

[234] Stamoulis *et al.* (1996, 1998, 2001); Patel (1999*a*,*b*); Patel and Irani (1999); Le Roux (2008, 2007)

[235] Lansdale (1988); Whittaker and Sidner (1996); Barreau and Nardi (1995); Boardman and Sasse (2004); Ducheneaut and Bellotti (2001); Whittaker and Sidner (1996); Bergman *et al.* (2004); Teevan *et al.* (2006)

Land makes a number of important observations about the subtle differences and interplay between designed and undesigned systems. He argues that because designed information systems are based on the logic and rule sets prescribed by an analyst with bounded rationality, and discovered through interactions with stakeholders who may "operate with different conceptions and viewpoints", the problem of accurately knowing or describing an information system is constrained. Once implemented, such systems "have a tendency to decay (or evolve, according to the viewpoint)" into undesigned systems.[236] Undesigned systems, on the contrary, evolve with the changing requirements of their stakeholders and are, for this reason, relatively robust. Attempts to replace them with designed systems can lead to "difficulties, manifested by such behaviour as resistance to change".[237]

From a conceptual perspective, formalised activities form the core of information systems and are the focal point of concern in the IS field. That the information system concept should denote them is unquestionable. A less certain matter is whether it should denote *only* them and, consequently, exclude unformalised information processing activities. One way to approach this question is to consider the implications of such a decision. If it is accepted that the purpose of the information system is to ensure that, through its activities, stakeholders become sufficiently informed to perform their organisational work, acceptance of an exclusively formalised information systems concept dictates that this purpose can be achieved through formalised activity only. Or, stated differently, that the set of designed information processing activities can sufficiently satisfy the requirements of its stakeholders. Acceptance of this premise has various implications, two of which are important in this context:

- Firstly, it implies that no information processing would be required beyond formalised activities and, consequently, that business processes would follow, exactly, the flows envisioned and plotted by system designers. Accordingly, each entity would have acceptable values for the attributes associated with it. Any exceptions to these rules would need to be handled through alternative, but also formalised, activities. Stated differently, it implies that information system designers can foresee and satisfy every possible variation of the information processing requirements of an

[236] Finkelstein *et al.* (1988, p. 6)
[237] Finkelstein *et al.* (1988, p. 6)

organisation.

- Secondly, it implies that stakeholders throughout the information system would consistently perform activities as envisioned by system designers. This may be a less problematic implication in the context of low-level activities which are, essentially, mechanistic (e.g., data capturing). It becomes problematic, however, when the information processed during the activity supports multiple interpretations which potentially affects the outcome of the activity. The non-linearity of such activities limit the extent to which they can be formalised.

If the exclusively formalised view is rejected, it is acknowledged that organisational operation also depends upon unplanned, undesigned, random information processing activities. The question, then, is whether the information system boundary (and the concept itself) should include, not only formalised activities, but also unformalised activities. The argument may be made that due to their covert, random nature unformalised activities are not systemically related to formal activities which are designed to form a meaningful whole. Also, because they are not, directly at least, within the locus of control of IS/IT departments they fall outside the scope of systems development and implementation projects. This line of thinking, although recognising the existence and role of unformalised activities, views them as isolated, non systemic occurrences of information processing. An alternative view is to consider unformalised activities as critical parts of the processes by which stakeholders become informed and, consequently, as parts of the information system. This view would recognise their agency in organisational operation.

2.3.3 Conclusions

Based on the preceding conceptual analysis it is possible to identify four distinguishable systems which are associated with popular information system conceptualisations.

- *IT Artefacts.* Following the work Orlikowski[238] IT artefacts denote material configurations of hardware and software (where applicable) that enable information capturing, storage, presentation and manipulation.

[238]Orlikowski (1992)

While the term information system is often used to denote an artefact, most scholars agree that artefacts are tools utilised in information systems.

- *Work Systems.* Following the work of Alter work systems denote systems in which human participants and/or machines perform processes and activities that are "devoted to processing information, that is, capturing, transmitting, storing, retrieving, manipulating, and displaying information".[239] Work systems, like the definition proposed by Buckingham *et al.*, accurately describe the popular conceptualisation of information systems as adopted among members of the functionalist school.
- *Undesigned Information Systems.* Following the work of Land undesigned information systems denote systems of informal, random interactions between individuals and groups in an organisation.[240] While undesigned information systems are standard features of organisations, their activities and processes generally fall outside the scope of popular information system conceptualisations.
- *Appreciative Systems.* Following the work of Vickers appreciative systems denote the personal and collective sensemaking processes during which organisational goals are continuously adapted and re-evaluated. Shannon's theory dictates that appreciative systems can only operate through the transfer of sign and sign processing activities (rule-based and/or random) are therefore implied when the term is used.

It is important to recognise the relationships between the four conceptualisations. In both work systems and undesigned information systems the presence of artefacts within the system boundary, while not mandatory, is generally assumed. Work systems are typically associated with integrated applications like ERPs, undesigned systems involve the use of artefacts like e-mail which facilitate mediated communication. Appreciative systems, on the other hand, assume the presence of both work systems and undesigned systems within the system boundary. The information processing activities of such systems underlie organisational sensemaking processes.

Rather than representing four different systems, the conceptualisations, much like Weaver's levels of concern in communication, represent different,

[239] Alter (2008, p. 453)
[240] Finkelstein *et al.* (1988, p. 6)

interdependent levels of concern in the analysis and operation of information systems. In this study particular interest falls on the influence of appreciative systems on the operation of work systems and, as such, it represents an attempt to advance knowledge about the interdependency between these levels. Checkland and Holwell's integrationist approach, while lacking rigour, provides some guidance for the reconciliation of the two schools which is required when undertaking a study of this nature.

From a lexical perspective it is important to ensure resonance between the definitions of *information*[241] and *information system*. The acceptance of an *information as sign* view suggests that a functional perspective of information systems should be adopted and Buckingham's definition can be accepted. The same arguments which support a sign-based definition for information are then applicable. In particular, it enables conceptual separation of information processing and sensemaking. While such separation may aid conceptual distinction between the functional and appreciative dimensions of information systems, it has the undesired effect of suggesting that these dimensions *are* indeed separable.

Thus stated, the dominance of the functionalist school in IS has cultivated the popularisation of an *information systems as work systems* perspective. Hence, the adoption of an *information systems as appreciative systems* view in this study may detract from its value. Following this line of reasoning Buckingham's definition is accepted as working definition for information systems. Together with it, however, three key principles are emphasised:

1. Firstly, Buckingham's definition does not distinguish between designed and undesigned information processing and, as such, the definition is taken to be inclusive of both forms. This is significant because it implies that information systems are partly *undesigned, unplanned* and *self-regulating* systems.

2. Secondly, it is emphasised that any information system in which human actors perform activities are subject to the unpredictability (nonlinearity) that results from the limited rationality with which actors interpret and produce information. Following this principle it is argued that appreciative systems directly impact the operation of information systems.

[241] See section 2.2.1.4

3. Finally, by providing media for sign transfer among organisational actors information systems directly impact appreciative systems. Despite conceptual separation of information systems and appreciative systems the two phenomena are seen to be intertwined and interdependent.

2.4 Summary

In this chapter attention is paid, firstly, to the academic field of information systems or IS. The field's development is outlined and key events in its short history are discussed. Despite its rapid growth the field faces numerous challenges relating to ambiguity around what its core concerns should be as well as conceptual confusion resulting from the wide spectrum of disciplines which contribute to its science. A number of key discourses which relate to these themes are discussed. The final section in this part of the chapter provides an overview of the epistemological paradigms and research designs which are adopted and utilised by IS scholars. Literature suggests that IS scholars generally favour positivism in their research despite calls for interpretive research from popular outlets.

The first principles of IS are discussed in the latter sections of the chapter and working definitions for the concepts of *information* and *information system* are formulated. These concepts are contextualised in the differences which exist between functionalist and interpretive perspectives in IS and the assumptions upon which these schools of thought operate are briefly analysed. Following the analysis information is defined as *cognition-based signs which exist in the universal domain*, while information systems are defined as *designed and undesigned activities during which organisational actors process work-related information.*

The literature reviewed in this chapter suggest that much of the ambiguity which surrounds the information concept is relevant, in different ways, to information systems. In particular, there is a lack of consensus about the extent to which IS can or should address themes associated with cognition (e.g., learning, interpretation, meaning attribution, cognition, sensemaking etc.). The prevalence of positivism in IS research suggests that there are not many IS pundits with the conceptual grounding needed to address these themes through interpretive studies. A key challenge in this regard is the need for a conceptual framework which facilitates research of the interconnectedness between the functional, *engineering* aspects of information systems and the processes by which organisational actors form individual and shared understandings of reality.

Chapter 3

Incongruence in Information Systems

The conceptual analysis reported in Chapter 2 enabled differentiation between various levels of concern in the study of information systems. Emerging from this analysis is the understanding that the operation of information systems involves the systemic interaction between human actors and IT artefacts in the context of organisational work processes. It is against this backdrop that the notion of *incongruence in information systems* can be introduced.

Information system success models, like the broadly accepted models proposed by DeLone and McLean,[1] subscribe to the general premise that the performance of an individual user in an information system is influenced by the degree to which his/her requirements are satisfied by the artefact utilised. This premise has been elaborated upon in a particular line of IS research which emphasises the congruence, or *fit*, between users, artefacts and tasks as the key determinant of information system success.

While initial theories about congruence in information systems framed artefacts as *tools* utilised in particular application areas, the development of integrated enterprise artefacts has prompted scholars to extend this theory. Emerging from this research is the understanding that, in addition to user-level congruence, the successful adoption of integrated artefacts like ERPs also depends upon the achievement and maintenance of congruence between the organisation as a whole and the artefact.

[1] DeLone and McLean (1992, 2003)

In this chapter the notion of incongruence in information systems is analysed through the review of studies which address the construct on both the user and organisational levels. The chapter commences with a review of information system success models before outlining the basic principles of user-level congruence. This is followed by an overview of the advancement of artefacts from *tools* to *frameworks*. Finally, based on this overview, models which address congruence on the organisational level are reviewed.

3.1 User-Level Incongruence

To accurately conceptualise the notion of user-level incongruence in information systems two prominent models of information system success developed by DeLone and McLean are reviewed. The review of these models serves two purposes. Firstly, Goodhue and Thompson's initial publication of a theory for fit in information systems was developed in response to the original success model developed by DeLone and McLean.[2] Hence, the range of factors identified in this model provides the context in which initial theories of fit should be considered. Secondly, it serves to clarify the distinction between theories about information system success in general and theories which address congruence in particular. The review of these models is followed by an overview of Goodhue and Thompson's theory of task-technology fit which outlines the basic premises of user-level congruence.

3.1.1 Success and Failure in Information Systems

Most efforts to establish an authoritative figure on the percentage of failed information systems development projects present a rather bleak picture of IS practice.[3] Such efforts are often met with scepticism and tend to spawn discourse in the IS community, intensified by and centered around the equivocality of success variables and their independencies. By the early 1990's more than 180 conceptual and empirical studies have been published on this con-

[2] DeLone and McLean (1992)

[3] Although statistics vary in this regard it is generally accepted that more than 50% of information systems development projects are abandoned before completion or fail post implementation.Jiang *et al.* (2001); Maguire (2000); Kanellis and Paul (2005); McManus and Wood-Harper (2007)

troversial topic,[4] presenting a wide array of approaches for determining the successfulness of an information system.

3.1.1.1 The Original DeLone and McLean Model

Originally published in 1992, the DeLone and McLean Information System Success Model was the result of an attempt to draw together earlier findings and aggregate them in a descriptive model for use in future empirical work by the IS community.[5] The model adopts an artefact-centered approach to information systems[6] and builds upon Shannon and Weaver's levels of communication problems (see section 2.2.1.1) to distinguish between the various levels at which information system success should be considered. A particularly important feature of the model is the identification of causal relationships between the multiple measures which may influence success as the *dependent variable*. In the model these measures fall in six broad categories:

- *System Quality* measures aspects of the artefact and its automated information processing capability.
- *Information Quality* measures aspects of the information (accuracy, precision currency, format etc.) presented by the artefact to the user.
- *Information Use* measures the degree to which an artefact is utilised by actors to perform their work.
- *User Satisfaction* measures the degree to which the user's information requirements are satisfied after interacting with the artefact.
- *Individual Impact* measures the influence of the artefact on the user's behaviour in the performance of tasks.
- *Organisational Impact* measures the influence of an artefact on the organisation's performance (financially, strategically, productivity etc.).

The proposed categories are clearly overlapping, interrelated and not easily defined. Accordingly, the authors conclude that the multidimensional and

[4] DeLone and McLean (2003, p. 10)

[5] DeLone and McLean (1992)

[6] Unlike the activity-oriented approach proposed in chapter 2, DeLone and McLean conceptualise the information system around a particular computerised artefact. While the two approaches are clearly conflicting, the model itself remains applicable to both if one assumes the presence of a computerised artefact in an information system.

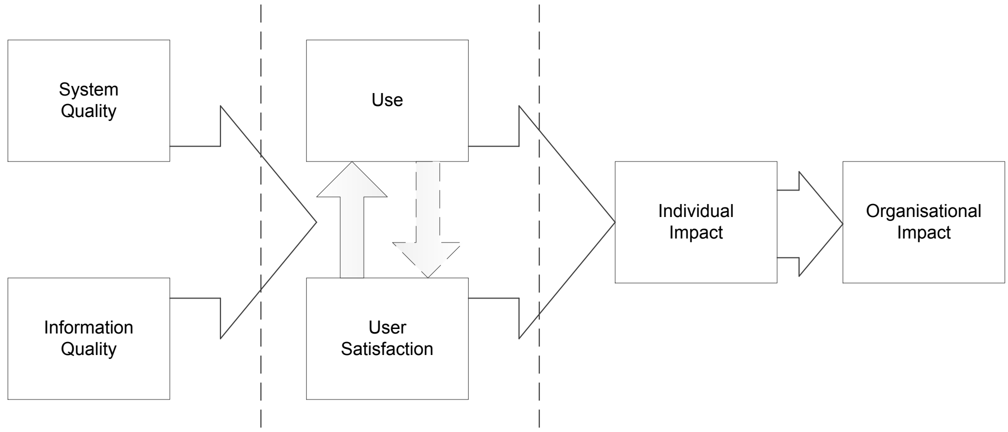

Figure 3.1: The Original DeLone and McLean Information System Success Model.

interdependent nature of information system success requires that great care be taken when variables are specified and measured.[7] Also, they argue, "no single measure is intrinsically better than another; so the choice of a success variable is often a function of the objective of the study".[8] Based on their categorisation, the authors offer the following proposition as the basis of their model:

> "SYSTEM QUALITY and INFORMATION QUALITY singularly and jointly affect both USE and USER SATISFACTION. Additionally, the amount of USE can affect the degree of USER SATISFACTION - positively or negatively - as well as the reverse being true. USE and USER SATISFACTION are direct antecedents of INDIVIDUAL IMPACT; and, lastly, this IMPACT on individual performance should eventually have some ORGANISATIONAL IMPACT".[9]

3.1.1.2 The Updated DeLone and McLean Model

In 2003 the authors published an updated version of the model[10] based on studies in which the original model was empirically tested by other researchers.

[7]DeLone and McLean (1992, p. 87)
[8]DeLone and McLean (1992, p. 80)
[9]DeLone and McLean (1992, p. 86-87)
[10]DeLone and McLean (2003)

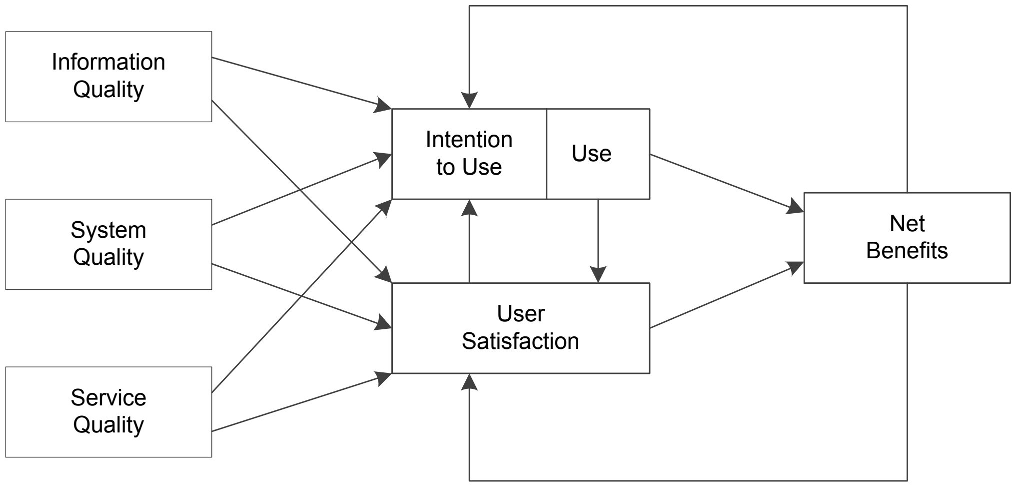

Figure 3.2: The Updated DeLone and McLean Information System Success Model.

Between 1992 and 2003 this was done in 16 studies of which only one could not validate its proposed links or associations.[11] Based on the results of these studies the authors update their model by adding *Service Quality* as a measurement category. Through this category the performance of IS/IT departments are recognised as a key factor in the achievement of system success. In the model service quality impacts both use and user satisfaction. The authors also reconsider the measurement of use by distinguishing between use and intention to use:

> "Given the difficulties in interpreting the multidimensional aspects of 'use' - mandatory versus voluntary, informed versus uninformed, effective versus ineffective, and so on - we suggest 'intention to use' may be a worthwhile alternative measure in some contexts. 'Intention to use' is an attitude, whereas 'use' is a behaviour. Substituting the former for the latter may resolve some of the process versus causal concerns".[12]

[11] DeLone and McLean (2003, p. 15)
[12] DeLone and McLean (2003, p. 23)

3.1.2 Task-Technology Fit

In one of the studies which evaluates the original DeLone and McLean model, it is suggested that a more appropriate measure of information system success is the degree to which artefacts *fit* the tasks in which, and actors by whom they are utilised.[13] This is, of course, implicitly measured in DeLone and McLean's model which applies *user satisfaction* as a surrogate variable to measure correspondence between the requirements of a task and the information or functionality offered by the artefact (i.e., users are satisfied when their task requirements are met by a technology). Goodhue and Thompson, however, argue that, in addition to characteristics of artefacts, success measurement needs to explicitly measure the influence of task characteristics on fit. This principle "was missing or only implicit" in DeLone and McLean's as well as other early models.[14]

To test their hypothesis the authors develop a model, referred to as the *Technology-to-Performance Chain (TPC)*,[15] with the aim of investigating linkage between individual task performance and the use of IT artefacts. Higher individual performance, in their view, implies "some mix of improved efficiency, improved effectiveness, and/or higher quality"[16] and depends upon good fit, or congruence, between artefacts and task requirements.

They base their study on two premises. The first follows from a line of research which "employs user attitudes and beliefs to predict the utilisation" of technology, with its general hypothesis being that increased utilisation leads to performance benefits.[17] Accordingly, their first premise states that to influence the actor's performance, IT artefacts must be "utilised" by the actor.[18] The authors point out, however, that the utilisation premise has two important limitations. These are, firstly, that the causal relationship between utilisation and performance is non-linear (i.e., increased utilisation of an artefact does not guarantee higher performance, particularly when the artefact is poorly designed or developed); and, secondly, that utilisation cannot be accurately measured if it is involuntary. The notion of voluntariness is important in this

[13]Goodhue and Thompson (1995)
[14]Goodhue and Thompson (1995, p. 213)
[15]Goodhue and Thompson (1995, p. 213)
[16]Goodhue and Thompson (1995, p. 218)
[17]Goodhue and Thompson (1995, p. 214)
[18]Goodhue and Thompson (1995, p. 214)

context and should not be deduced to an attribute of task design - mandatory use of technology is not only enforced through organisational rules embedded in task design but also when "social norms to use a system are very strong and overpower other considerations".[19] DeLone and McLean address this issue in their 2003 model by distinguishing between *use* and *intention to use*.

The second premise upon which the TPC model is based is that, to increase performance, an artefact must have good "fit" with the task it is utilised in. Good fit describes a scenario in which an artefact "provides features and support that fit the requirements of a task".[20] Embedded in the fit construct is aspects such as the appropriateness of the data representation techniques, the range of functionalities offered by an artefact, as well as the ability of the user to effectively utilise it.[21] Hence, *Task-technology Fit (TTF)* essentially denotes "the correspondence between task requirements, individual abilities, and the functionality of the technology".[22]

They use the TPC model to test three propositions empirically through questionnaires distributed to 600 users in two organisations. The propositions are:[23]

1. That user evaluations of TTF will be influenced by both task characteristics and artefact characteristics.
2. That user evaluations of TTF will influence the utilisation of an artefact by individuals.
3. That user evaluations of TTF will have additional explanatory power in predicting perceived performance impacts beyond that from utilisation alone.

Upon analysis of their data the authors report moderate support for the first proposition. In terms of task characteristics their findings suggest that individuals performing non-routine tasks find artefacts less influential on their performance. The non-routine nature of their jobs forces these individuals "to use information systems to address new problems, such as seeking out new data and combining it in unfamiliar ways".[24] Not surprisingly, such users

[19] Goodhue and Thompson (1995, p. 218)
[20] Goodhue and Thompson (1995, p. 214)
[21] Goodhue and Thompson (1995, p. 214)
[22] Goodhue and Thompson (1995, p. 218)
[23] Goodhue and Thompson (1995, p. 219)
[24] Goodhue and Thompson (1995, p. 226)

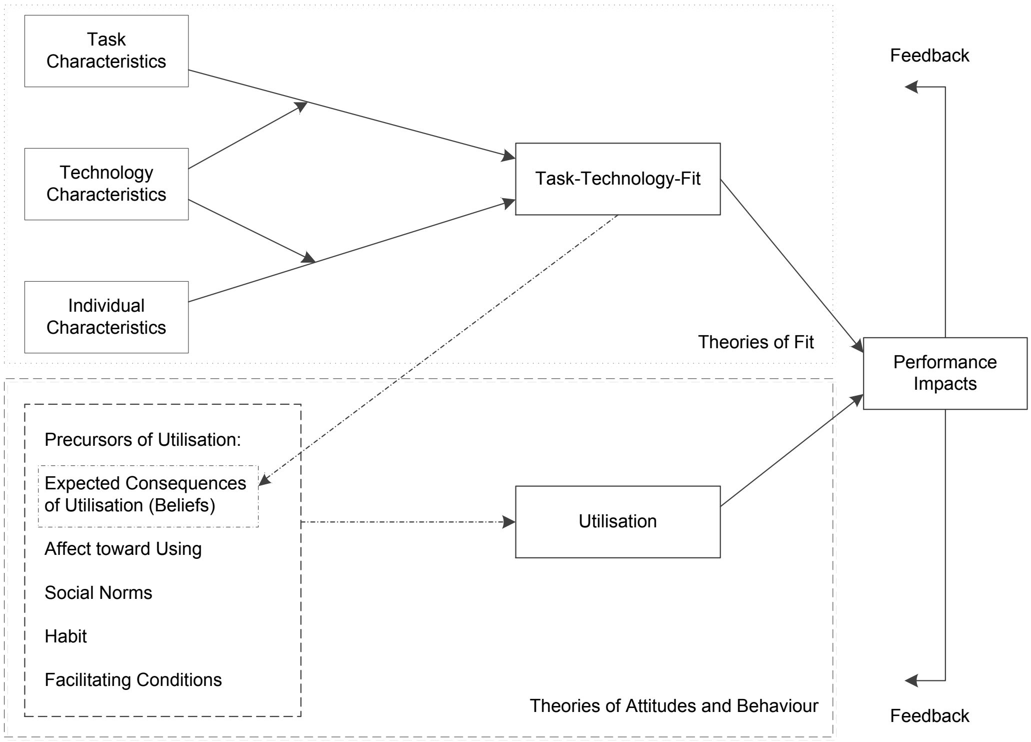

Figure 3.3: The Technology-to-Performance Chain.

experience frustration because they often require features or information which is not readily available. Interestingly, they find that such frustrations are not experienced by members of upper management because, it is argued, they are "shielded from the hands-on difficulties of bringing together data from multiple sources" and access it only after such difficulties have been dealt with. "It is lower and mid-level individuals who must pay with effort and frustration for data incompatibilities"[25] and, as a result, management may be unaware of poor TTF experienced at lower organisational levels. In terms of technology characteristics their findings suggest that *data locatability* and *systems reliability* are considered influential factors of TTF.

The authors report little support for their second proposition but make the rather surprising discovery that their data suggest strong links between high *utilisation* of an artefact and negative beliefs about its *reliability*. They argue that an explanation for this link is that high utilisation of the artefact leads to greater dependence upon its reliability and, hence, more critical appreciation

[25] Goodhue and Thompson (1995, p. 262)

of its reliability. It should be remembered here that utilisation does not, in this study, correspond to voluntary use of a system which implies that linkage between technology characteristics and utilisation should be considered in the context of task design.

Finally, their data showed strong support for the third proposition. This suggests that "performance impacts are a function of both task-technology fit and utilization" as opposed to utilisation alone which was suggested in earlier research.[26] It also implies, of course, that high utilisation does not always lead to high individual performance, if the artefact does not fit the task, individual performance will remain low.

3.1.3 User-Level Incongruence Defined

By considering the findings of Goodhue and Thompson in the context of DeLone and McLean's models, it is possible to formulate a general description user-level incongruence. In terms of the measurement categories proposed by DeLone and McLean *user satisfaction* is an indicator of the degree to which an individual user's requirements are satisfied during artefact interaction. Goodhue and Thompson elaborate upon the notion of user satisfaction by arguing that the degree to which user requirements are satisfied by an artefact depends upon characteristics of the task the user is performing. Hence, following the basic premises of their TTF construct,[27] user-level incongruence denotes *a scenario in which a particular user experiences a low degree of correspondence between a particular artefact and the task he/she is performing.* A number of principles follow from this definition:

- User-level incongruence may be experienced despite the achievement of a high degree of congruence between artefacts and tasks. While the design of information systems may serve to ensure artefact-task congruence, the successful operation of the information system remains dependent upon the characteristics of the individual users performing those tasks. The

[26] Goodhue and Thompson (1995, p. 228)

[27] While user-level incongruence and TTF share the same basic premises, there are two reasons why the basic TTF constructed is not adopted here. Firstly, the omission of reference to the individual user in the name *task-technology fit* is problematic as it seems to suggest that TTF can be measured irrespective of an individual user's characteristics. Secondly, the notion of user-level incongruence is defined to describe an *experienced scenario or situation* whereas TTF describes a degree of correspondence.

principle highlights the unpredictability of information system operation due to the differences between individual users, not only in terms of their knowledge and skills, but also in terms of their *worldviews*.[28]

- User-level incongruence may be experienced despite the achievement of a high degree of congruence between users and artefacts. Hence, user-artefact *congruence* may coincide with user-level *incongruence* when the artefact does not provide features which support requirements produced by particular tasks.

- By acknowledging that experiences of user-level incongruence are task-specific it is accepted that users may experience varying degrees of congruence/incongruence when performing different tasks. Following this line of reasoning one may argue that, in the models of DeLone and McLean, user satisfaction represents *the average degree of task-artefact congruence a user experiences when interacting with a particular artefact across his/her task portfolio.*

3.2 IT Artefacts and Incongruence

The notion of user-level incongruence is, of course, applicable to contexts other than information systems. In essence, any scenario where a person utilises a *tool* to perform a task can potentially produce an experience of user-level incongruence as defined in the preceding section. The generalisability of the construct is facilitated by the implicit assumption that IT artefacts can be equated to *tools*. While this view is tacitly supported by a large portion of IS publications, it is important to recognise that the advancement of IT artefacts over the past three decades invalidates certain aspects of the *tool* metaphor. This section provides a brief overview of the advancement of IT artefacts used in organisational information systems and the impacts of this process on IS theory, particularly theories which address congruence.

The search for a definitive conceptualisation for the *IT Artefact* has been an important theme in IS research since the early ontology-based views of Wand and Weber were introduced - a line of research which is continuously extended.[29] Although their approach has been widely adopted by IS scholars,

[28] This theme is elaborated upon in the empirical investigation.
[29] See Wand and Weber (1990, 1995); Weber (1997, 2003).

there remains persistent challenges "to bridge the gap between the abstract ontological" representations of artefacts and *real* IT artefacts.[30]

In their review of IS research Orlikowski and Iacono[31] consider 188 *Information Systems Research (ISR)* articles with the aim of forming an understanding of how IS scholars generally conceptualise IT artefacts, implicitly or explicitly, in their research. They extract from these studies five general classifications with various sub-classifications. These five general classifications are:

- The *tool* concept denotes the artefact as a stable black-box with particular information processing capacity used for labour substitution, productivity and information processing. Although tools are essentially mechanical, the introduction of a tool in a social context may have non-technical consequences. "Social roles may change, hierarchies may become more or less salient, business processes may be modified, and communication may require choices".[32]
- They use the term *proxy* to denote those conceptualisation which "focus on one or a few key elements that are understood to represent or stand for the essential aspect, property, or value of the information technology".[33] Included in this category are technology as perception (user perceptions of IT), technology as diffusion (penetration of a particular type of IT artefact) and technology as capital (the costs associated with the tools themselves).
- The *ensamble* view denotes those conceptualisations which focus on "the dynamic interactions between people and technology - whether during construction, implementation, or use in organizations, or during the deployment of technology in society at large".[34] This includes technology as development project (social process of designing, developing and implementing tools), technology as production network (network and nature of tool suppliers), technology as embedded system (evolving system embedded in a complex and dynamic context) and technology as structure (rules and regulations built into tool).

[30] Matook and Brown (2008, p. 2)
[31] Orlikowski and Iacono (2001)
[32] Orlikowski and Iacono (2001, p. 124)
[33] Orlikowski and Iacono (2001, p. 124)
[34] Orlikowski and Iacono (2001, p. 126)

- The *computational* view of technology describes the view of studies where the primary interest is "the capabilities of the technology to represent, manipulate, store, retrieve, and transmit information, thereby supporting, processing, modelling, or simulating aspects of the world."[35] This includes technology as algorithm or technology as model.
- Finally, the *nominal* view of technology is adopted in studies where interest falls on some IS related aspect but not IT itself. The presence of technology in the information system is implied but not addressed explicitly.

The authors conclude that the broad array of conceptualisations adopted reflect the refusal by IS scholars to engage with the artefact and develop deeper understandings thereof. "We believe that this lack of attention to the core subject matter of our field represents both a unique opportunity and an important challenge for us to engage more seriously and more explicitly with the material and cultural presence of the information technology artefacts that constitute the 'IT' in our IT research".[36] This argument is supported by Benbasat and Zmud[37] who argue that IS researchers tend to avoid deep investigations of the nature of IT artefacts by treating them as black-boxes or "as being synonymous with a more generic entity" such as innovation, investment, or Internet.[38] This they argue, drives the field further away from those artefact-related aspects upon which it should focus.

While the argument that IS researchers avoid deep investigations of artefacts is certainly valid, it should be acknowledged that the material nature of artefacts, and their agency in organisations, have changed significantly over the past five decades. In general, IT artefacts have advanced from basic tools designed for specific application areas to systems which are engrained in almost every aspect of organisational work.[39] It is unrealistic for IS scholars to subscribe to a single conceptualisation which accurately denotes all the different types of IT artefacts utilised in information systems.

[35] Orlikowski and Iacono (2001, p. 127)
[36] Orlikowski and Iacono (2001, p. 130)
[37] Benbasat and Zmud (2003)
[38] Benbasat and Zmud (2003, p. 193)
[39] A useful summary of the development of computer technology and its uptake in organisations can be found in Zwiers (2011).

The section which follows outlines a number of key principles relating to the *artefact* concept as it is used in this study. The formulation of these principles have the specific purpose of enabling differentiation between incongruence on the user and organisational levels.

3.2.1 Artefacts as Tools

Following the work of Griffith this study departs from the perspective that "features of technology are the building blocks or components of a technology".[40] Hence, while recognising the existence of physical and deep structures in artefacts, these are considered as sub-parts which, when integrated meaningfully, enable certain capacities or features. Griffith's perspective is suitable to this study for two particular reasons. Firstly, due to the study's interest in user experiences and behaviour it is important to adopt a view of artefacts which correlates with users' perceptions thereof. Griffith, accordingly, argues that a feature-based conceptualisation is an appropriate mechanism for the study of linkages between technologies and sensemaking processes. Secondly, it serves to enable differentiation between stand-alone artefacts designed for particular application areas and integrated systems like ERPs.

Based on Griffith's feature-based perspective Orlikowski and Iacono's *tool* concept describes stand-alone IT artefacts which provide features that satisfy requirements emerging from particular application areas. Because tools are developed for particular application areas, organisations with multiple business functions have to adopt, implement and maintain a variety of tools to satisfy their complete information requirements set. The integration of multiple *stand-alone* tools across organisational functions is associated with various technical challenges arising from the disparate standards and technologies underlying them. As a result, many organisations are forced to maintain isolated *silos* of information for each of their business functions.[41]

Not surprisingly, software vendors have realised the opportunity to integrate the features offered by widely utilised stand-alone tools to form large-scale, integrated artefacts like ERPs. Early versions of computerised ERP packages typically covered application areas such as production, inventory management and logistics, and were mainly developed to cater for manufactur-

[40] Griffith (1999, p. 473)
[41] Jacobs and Weston (2007, p. 357)

ing organisations.[42] More recently, however, they have been extended to cover the requirements of other organisational functions. Included in these functions are strategic planning, sales and distribution, marketing, financials, controls, quality management, supply management, materials management, plant maintenance, production planning, work-flow and human resource management.[43]

The potential advantages offered by such systems are obvious. "The business gains from a fully integrated system that enables visibility and integrity of data throughout the organisation".[44] On the downside, however, ERP adoption typically involves a long implementation span, huge investment and a variety of other direct and indirect costs.[45] It is important to acknowledge, however, that these artefacts are built upon a set of abstract, generic requirements which is likely to differ (to various degrees) from those of the adopting organisation. Typically, it is argued, an organisation will be able to satisfy 80% of its requirements with a commercial ERP package, while satisfying the other 20% would depend upon the resources available to customise the ERP.[46] As an alternative strategy to ERP customisation, many organisations attempt to minimise expenditure by opting to adapt business processes around software, a trend referred to as "vanilla ERP" adoption.[47]

The development of ERPs has had significant implications for IS research. Matook and Brown argue that "prior adoption research examined simple, individual-oriented, stand-alone systems as opposed to the more complex and sophisticated systems" currently utilised in many large organisations.[48] This, they argue, has implications for interpreting findings across studies and "highlights the importance of clearly and consistently conceptualizing the IT artefact in our research".[49]

Following this line of reasoning it is postulated that differentiation is required between *tool*-like artefacts and integrated artefacts like ERPs. To achieve this an alternative artefact concept for ERPs is required.

[42] Avison and Fitzgerald (2006, p. 183)
[43] Avison and Fitzgerald (2006, p. 183)
[44] Avison and Fitzgerald (2006, p. 184)
[45] Avison and Fitzgerald (2006, p. 185)
[46] Strong and Volkoff (2010, p. 731)
[47] Avison and Fitzgerald (2006, p. 185)
[48] Matook and Brown (2008, p. 2)
[49] Matook and Brown (2008, p. 2)

3.2.2 Artefacts as Frameworks

The development of an artefact concept which recognises the integrated nature of ERPs requires consideration of three important factors:

Firstly, by integrating information processing features utilised across organisational functions computerised ERPs combine multiple *tools* in an abstract formalised work system. Hence, many of the design decisions which an organisation needs to make during the development of an information system are made by the developers of commercial ERPs when they integrate previously stand-alone tools.

Secondly, as abstract formalised work systems ERPs complicate the distinction between artefact and information system. Because the design of the work system (e.g., processes, work-flows, roles etc.) is determined (to some extent) by the artefact, the flow of information between activities is hidden from ERP users. Rather than *processing information* ERP users follow the prompts of the *artefact as information system.* This is reflected in users' tendency to label an information system using the name of the artefact it utilises. An important implication of this aspect of ERPs is that it tends to advance the imposition of theories about artefacts on information systems, cultivating artefact-centered thinking in IS.[50]

Thirdly, formalisation is imposed by an ERP artefact through its control over activity and process structures. This opposes ideas about information systems as work systems in which tools are utilised and suggests, rather, that informations systems are *artefacts which direct human actors to perform mundane tasks such as data capturing.* Users, accordingly, are not free to choose an alternative *tool* when performing tasks, but are restricted to act in accordance with the impositions of the artefact.

Based on these arguments ERP artefacts are fundamentally different phenomena from *tools.* While tools provide certain information processing features, ERPs integrate multiple tools on the basis of an abstract work system model. The artefact concept used to denote ERPs must reflect this *structural* dimension.

This argument is well illustrated in the work of Strong and Volkoff.[51] They

[50] Alter (2008)
[51] Strong and Volkoff (2010)

investigate the emergent attributes of *Enterprise Systems (ESs)*[52] and argue that they are not "deliberately written in the code, but are the effective outcome of the integrated totality of the software".[53] Stated differently, the artefact "is more than the sum of its surface, deep, and physical structures".[54] They argue that the integration of tools to form ERPs leads to the emergence of "latent structures" which, "while they are an integral part of the ES, the specific IT artefact of interest to us, they are not designed and scripted in the same way as are the other structures but arise from them as second order structures".[55]

> "We must conceptualize the ES not only in terms of its deep and surface structures that are explicitly scripted and which may or may not be deficient (incomplete or inaccurate), but also in terms of latent structures that emerge from the combination of many scripts which taken together create the inherent ES characteristics that enable and constrain how roles are designed, how control can be exercised, and the overall culture of the organization".[56]

Following these arguments the term *framework* appears to be a more accurate concept than *tool* for denoting ERPs. By combining the term with Jacobs and Weston's general definition for enterprise resource planning, ERPs are conceptualised as *computerised frameworks "for organizing, defining, and standardizing the business processes necessary to effectively plan and control an organisation"*.[57]

3.3 Organisation-Level Incongruence

Based on the notion of ERPs as *frameworks* it becomes apparent that there is a need to conceptually separate congruence constructs based on different levels of analysis. Individual-level constructs, like TTF, apply to congruence between

[52] The authors use the term *Enterprise System (ES)* as opposed to ERP. While it is acknowledged that enterprise-level systems may address aspects other than resource planning, the ERP concept have been widely adopted in literature to denote these types of artefacts.
[53] Strong and Volkoff (2010, p. 731)
[54] Strong and Volkoff (2010, p. 751)
[55] Strong and Volkoff (2010, p. 750)
[56] Strong and Volkoff (2010, p. 752)
[57] Jacobs and Weston (2007, p. 357)

task, individual and artefact.[58] There have also been studies, however, which address the congruence between artefacts as *frameworks* and the organisations in which they are utilised.

3.3.1 Package-Organisational Misalignment

Notable research of organisation-level incongruence has been done by Sia and Soh[59] in the context of Singaporean organisations. "Package-organisational misalignment", they argue, is a key reason for project and even organisational failure.[60]

Soh and Sia define package-organisation misalignment as "differences between the structures embedded in the organisation (as reflected by its procedures, rules and norms) and those embedded in the package"[61] and make the important assertion that package adoption implies the imposition of package-embedded structures upon an organisation. They base this assertion on the view that "technology creators, such as the developers of packaged software, inscribe their vision or view of the world in the technology that they create".[62] This view is influenced by "the institutional properties of their particular setting and draws on the knowledge, resources and norms that are a part of their institutional context when developing the technology".[63] The natural consequence of this tendency is that ERP packages tend to reflect the "home market" of their creators. If adopted in non-local markets there is a likelihood of a large degree of separation in terms of world-views, knowledge and norms between developers and end-users.[64]

Soh and Sia consider structures embedded in organisations as existing in one of two categories: *imposed structures* and *adopted structures*.[65] Imposed structures result from external authoritative agents which impose industry rules and regulations upon the organisation. They may also be the result

[58] Goodhue and Thompson do generalise their data to make more abstract conclusions, but the construct is rooted in a stand-alone tool-view of the artefact which makes it more applicable to artefacts aimed at specific areas of application.

[59] Soh and Sia (2004); Sia and Soh (2007)

[60] Soh and Sia (2004, p. 375)

[61] Soh and Sia (2004, p. 376)

[62] Soh and Sia (2004, p. 377)

[63] Soh and Sia (2004, p. 377)

[64] Soh and Sia (2004, p. 378)

[65] Soh and Sia (2004, p. 378)

of structures imposed by normative authorities of a particular industry, e.g. industry best practice. Adopted structures are not imposed on organisations but result from the strategies organisations employ to differentiate themselves from competitors. They may, for example, result from particular leadership or management styles and reflect the identity of the organisation. Unlike imposed structures which are enforced by law or dictated by coercive industry authorities, organisations are free to adapt their adopted structures on their own accord.[66]

The authors also categorise the strategies with which organisations respond to package-organisation misalignment. One strategy is to perform package customisation which "can range from customizing the package code, to interfacing with custom developed modules or modules from other vendors".[67] Alternatively, an organisation may choose to adapt its own structures to promote alignment. Such adaptation may take the form of "a conscious redesigning of organisational processes and structures accompanied by substantial change management, to more piecemeal, evolutionary workarounds as individuals adapt to the package and their practices become part of the new organisational structures".[68]

The authors base their empirical investigation on instances of misalignment as extracted from an organisation's formal error reporting system. Three large hospitals adopting the same commercial ERP package were investigated. They categorise instances of misalignment as occasions where package embedded structures failed to align with either imposed organisational structures or adopted (voluntarily acquired) organisational structures. Finally, they tabulate responses to misalignments as either package modification or organisational adaptation. "Package modification was evidenced by contract annexes of agreed modification, engineering change request (consultants), and formal request for change (signed and approved)".[69] Evidence of organisational adaptation, on the other hand, included "the rejection/lack of follow-ups of requests for changes and the discussion of the related change and workaround efforts in the project minutes and interview transcripts".[70]

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[66] Soh and Sia (2004, p. 378)
[67] Soh and Sia (2004, p. 382)
[68] Soh and Sia (2004, p. 382)
[69] Soh and Sia (2004, p. 386)
[70] Soh and Sia (2004, p. 386)

Their findings suggest that roughly two thirds of misalignment instances result from voluntarily acquired organisational structures. "It is understandable that there would be more differences in voluntarily acquired structures since each hospital had been pursuing different strategies and had different histories".[71] These acquired structures meant that, although similar in most regards, each organisation was differentiated by the various ways in which its acquired structure influenced the flow and content of information during business processes. The relatively small portion of misalignment instances which resulted from imposed structures could be explained by the fact that "some country imposed structures had already been built into the finance and accounting modules which had been implemented by many other organisations in many industries within the country".[72]

In terms of organisational responses to misalignment the authors report that imposed structure misalignments, in 90% of the reported instances, led to package modification.[73] Responses to voluntarily aquired structure misalignments, on the contrary, were moslty resolved through organisational adaptation. Importantly, they note, such misalignment often led to users to develop their own "workarounds".[74] Such workarounds relied on the assistance of consultants who "taught the users how to use the query function to create simple reports for themselves".[75,76]

The authors conclude that misalignment between structures embedded in packages and structures embedded in organisations are not easily resolved. "Organisational members may understand their country and industry context well, while consultants are likely to understand the package structures. Such contextual knowledge is often hard to communicate, as its embedded nature gives it a 'taken-for-granted' quality".[77] They also point out that, due to organisational adaptation in response to misalignment, ERP adoption will limit

[71] Soh and Sia (2004, p. 386)
[72] Soh and Sia (2004, p. 386)
[73] Soh and Sia (2004, p. 387)
[74] Soh and Sia (2004, p. 390)
[75] Soh and Sia (2004, p. 390)
[76] Le Roux and Le Roux (2010) report similar findings with regards to the role of IT/IS staff in supporting users to resolve misalignment. They argue that IT/IS staff engaged in such activities knowing that it may be counter-productive to their efforts to ensure package adoption as intended by desingers. They were also aware, however, that misalignments had a negative impact on production which, at the time, was a bigger concern.
[77] Soh and Sia (2004, p. 394)

Type	Description
Imposed deep	Missing or inappropriate thing, property, state, or transformation arising from different assumptions about national or industry policy.
Imposed surface	Missing or inappropriate access, input, presentation, or output arising from different assumptions about national or industry policy.
Voluntary deep	Missing or inappropriate thing, property, state, or transformation arising from organisation-specific assumptions.
Voluntary surface	Missing or inappropriate access, input, presentation, or output arising from organisation-specific assumptions.

Table 3.1: Organisation-package misalignment typology developed by Sia and Soh.

an organisation's ability to strategically differentiate itself from competitors.[78] Finally, they emphasise the emerging importance of the vendor-adopter relationship which is compounded by the increasing intricacy and application-area coverage of commercial packages.

3.3.2 A Typology for Package-Organisation Misalignment

Sia and Soh[79] follow up their earlier research by integrating their findings on package-organisation misalignment with the information systems ontology proposed by Wand and Weber.[80] In doing so they extend their earlier findings which differentiates between imposed structure misalignment and voluntarily acquired structure misalignment. The updated typology has the added feature of differentiating between misalignments which relate to the deep structure (data and functionality) of the artefact and misalignments which relate to the surface structure (usability) of the artefact. This distinction enables the authors to identify four types of misalignment which are presented in table 3.3.2.

The authors test their typology by mapping 400 instances of misalignment on it and find that voluntary-surface misalignment is the most common type - accounting for 34-44% of all instances. This was followed by voluntary-deep misalignment (24-28%), imposed-deep misalignment (16-35%)

[78](Soh and Sia, 2004, p. 394)
[79]Sia and Soh (2007)
[80]Wand and Weber (1990); Weber (1997)

and imposed-surface misalignment (3-14%).[81] They contribute the high occurence of voluntary-surface misalignment to the individual and sub-organisational preferences in terms of data input or screen presentation. The findings support their view that "package software's inability to capture the implementing organisation's unique business rules, policies, and procedures in operational processes" inhibits strategic differentiation.[82] More importantly, package-embedded structures are "predicated on specific institutional and ontological assumptions" such as ideas about what constitutes best practices in a particualr area of application.[83]

3.3.3 Organisation-Level Incongruence Defined

The findings of Sia and Soh provide the basis for the definition of organisation-level incongruence. Unlike user-level incongruence, organisation-level incongruence does not concern individual users interacting with the artefact as tool, but describes the misalignment between the structures of an organisation and those embedded in artefacts as *frameworks*. Hence, following the basic premises of package-organisation misalignment as defined by Soh and Sia, organisation-level incongruence describes *the degree to which an information system is characterised by a lack of correspondence between the latent structures embedded in the adopted computerised ERP package and the information processing requirements of the organisation.* A number of principles follow from this definition.

- Organisation-level incongruence is likely to occur when organisations with non-standard or unique information processing requirements adopt commercial packages developed for a broad market.
- Organisation-level incongruence leads to particular, identifiable *instances of incongruence* which can be classified based on its technical (artefact) and organisational antecedents.
- Distinction between *work systems* and *artefacts as frameworks* is problematic due to the automated integration of tasks and flows in ERP packages. It is emphasised, however, that the adopted working definition for

[81] Sia and Soh (2007, p. 577)
[82] Sia and Soh (2007, p. 580)
[83] Sia and Soh (2007, p. 580)

information systems includes the unformalised, random information processing activities which occur outside the work system boundary. These activities have been shown to shield the organisation from the effects of organisation-level incongruence.[84]

3.3.4 Experiences of Organisation-Level Incongruence

Despite clear differences between the levels of incongruence defined in the preceding sections, Sia and Soh's investigations suggest that instances of organisation-level incongruence, like user-level incongruence is *experienced* by artefact users. Following this line of thinking Strong and Volkoff propose a typology through which they aim to integrate earlier findings about user-level incongruence with those of organisation-level incongruence. However, unlike Sia and Soh's approach which utilises formally reported instances of incongruence, they adopt critical realist approach. Ontologically, critical realism, like positivism, "assumes objects, entities and structures have an objective, independent existence", while "its epistemology, like that of interpretivism, asserts our knowledge of these items is socially and historically conditioned".[85] Following this perspective they describe instances of incongruence as:

> "The misfits that arise as various organisational and ES elements interact when individuals attempt to perform their jobs while using the technology. Furthermore, misfits can be experienced differently by different people, but in all cases will be observed as incidents of individuals feeling that the ES is impeding the proper execution of organisational operations".[86]

They recognise, like Goodhue1995 as well as Kanellis *et al.*,[87] that an instance of incongruence is essentially a situation experienced and perceived by organisational actors performing tasks. They integrate this view with the work of Sia and Soh by recognising that these experiences may be spawned by incongruence between latent structures embedded in ERP packages and structures acquired by or imposed on organisations. Thus, while experienced

[84] Le Roux and Le Roux (2010)
[85] Strong and Volkoff (2010, p. 733)
[86] Strong and Volkoff (2010, p. 733)
[87] Kanellis *et al.* (1999)

by users, instances of incongruence are events caused by "generative mechanisms" of entities which exist in the "domain of the real".[88] Their approach, consequently, is to explore these generative mechanisms as antecedents of experienced incongruence. The authors contrast their approach to that of Sia and Soh:

> "Sia and Soh's data for testing their prediction are the submitted requests for changes to the ES. These data provide a total set of documented misfits. As they note, such data has the advantage of permitting counts and percentages for their framework, but also the disadvantage of being biased due to only including formally requested changes. In comparison, our data collection methods, based on grounded theory techniques, provide for theoretical saturation, but do not identify every instance of misfits. As a result, counts and percentages are not valid for our data."[89]

The authors conduct an extensive three-year, qualitative case study employing grounded theory techniques and synthesise their findings in an integrated typology which extends those developed in prior congruence studies. Their typology is rooted in the view that any instance of incongruence is either a *deficiency* or an *imposition*. Deficiencies are "problems arising from ES features that are missing but needed" and lead to scenarios where users cannot take the action required to complete tasks.[90] Impositions are "problems arising from the inherent characteristics of an ES such as integration and standardisation" and are experienced when they require "ways of working that are contrary to organizational norms and practices or that negatively affect organisational performance".[91]

They extend this deficiency/imposition classification by arguing that impositions and deficiencies can be placed in six categories based on the generative mechanisms associated with the experienced instance of misfit. These are presented in table 3.3.4.

[88] Strong and Volkoff (2010)
[89] Strong and Volkoff (2010, p. 748-749)
[90] Strong and Volkoff (2010, p. 737)
[91] Strong and Volkoff (2010, p. 737)

Source	Description	Experienced as deficiency	Experienced as imposition
Functionality misfit	The reduction of process efficiency due to artefact adoption.	When artefact functionalities require work-arounds to complete tasks.	When integration or standardisation embedded in the artefact is incongruent with that required by interdependent business processes.
Data misfit	Data or data characteristics stored in or needed by the ES leads to data quality issues such as inaccuracy, inconsistent representations, inaccessibility, lack of timeliness, or inappropriateness for users' contexts.	When there are too few attributes or levels of data associated with certain entities or the software fails to support relationships between entities.	When integration and standardisation between different business units re- quires the alignment of entity definitions which leads to imposed generalisation of entities.
Usability misfit	Interactions with the artefact required for task execution are experienced as cumbersome or confusing.	When the artefact's user interfaces are poorly designed for data capture (e.g. forms and fields) or presentation (e.g. reports).	When integration of application areas in the artefact leads to large, complex data sets and more effort is required to locate relevant data.
Role misfit	Roles in the artefact are inconsistent with the skills available creating imbalances in the workload, bottlenecks, idle time and mismatches between responsibility and authority.	When it is not possible to set up roles with the desired locus of accountability within the ES.	When integration or standardisation embedded in the artefact impacts the roles and responsibilities defined in organisational structure by changing skills required in roles, workloads, authority required in roles etc.
Control misfit	The controls embedded in the artefact provide too much control, inhibiting productivity, or too little control, leading to the inability to assess or monitor performance appropriately.	When the artefact forces the application of standard rules to instances where a business process presents an exception to the rule.	When rules embedded in the artefact make diversions from typical business process flow impossible.
Organisational Culture misfit	The artefact requires ways of operating that contravene organizational norms, such norms, in turn, may be embedded in a broader (e.g. national) culture type.	Due its holistic nature, emerging from the totality of the technology and its context, misfits from this source are only experienced as impositions.	When actors are required to contravene organisational norms by acting in obedience to rules imposed by the artefact.

Table 3.2: Misfit typology developed by Strong and Volkoff.

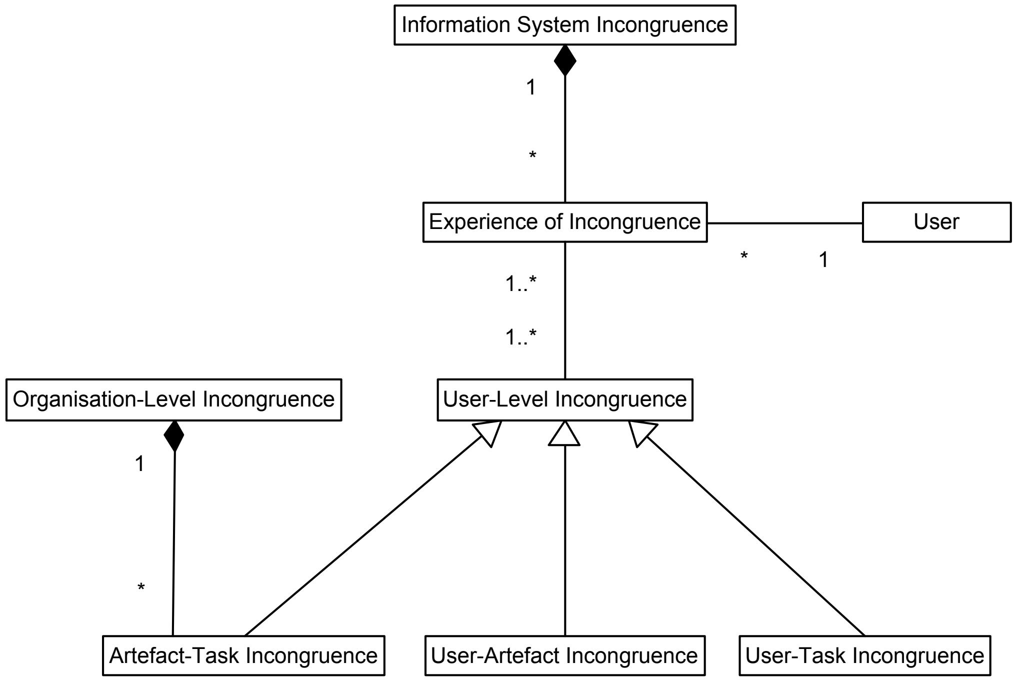

Figure 3.4: An Ontology of Information System Incongruence.

3.4 Conclusions

To integrate and conclude the findings of the studies reviewed in this chapter it is useful to illustrate the relationships between the various instances of incongruence through an ontology. The ontology is visually represented in figure 3.4 in the form of a UML (Unified Modelling Language) class diagram.

Following the ontology *Information System Incongruence* is a collection of all the *Experiences of Incongruence* by users of an ERP artefact in an organisation. Hence, the degree of incongruence in an information system corresponds with the frequency with which users experience incongruence. Each of these experiences can be associated with one or more instances of *User-Level Incongruence*. This implies that an experience of incongruence may result from multiple instances of incongruence. An instance of user-level incongruence may occur as one of three specialisations.

1. The first, *Artefact-Task Incongruence*, denotes an instance of misfit between the users' requirements during a particular task and the features of the artefact. Importantly, these instances reflect differences between

the structures of the artefact and the organisation. Following the work of Strong and Volkoff the collection of all instances of task-artefact incongruence represents *Organisation-Level Incongruence*.

2. The second and third types of user-level incongruence are not explicitly addressed in the reviewed literature. However, analysis of the basic premises of user-level incongruence, as outlined by Goodhue and Thompson, suggests that inadequate knowledge and skills of users may lead to experiences of incongruence even if the artefact does support the requirements of the task at hand. Hence, incongruence may be experienced in the absence of an artefact deficiency or imposition. *User-Artefact Incongruence*, consequently, denotes a situation where the user's lack of artefact knowledge leads to an experience of incongruence.

3. *User-Task Incongruence* denotes a situation where a user's lack of task knowledge leads to an experience of incongruence. Lack of task knowledge involves a user's failure to comprehend the task at hand in terms of its required method and/or its outcomes. This may lead to an experience of incongruence under the false perception that the artefact fails to support the task requirements.

3.5 Summary

Incongruence in information systems can be analysed on two levels. *User-level incongruence* describes a scenario in which a particular user experiences a low degree of correspondence between a particular artefact and the task he/she is performing. *Organisation-level incongruence*, on the other hand, describes the degree to which an information system is characterised by a lack of correspondence between the latent structures embedded in the adopted computerised ERP package and the information processing requirements of the organisation. Importantly, however, the literature reviewed in this chapter suggest that both levels of incongruence are experienced by users of artefacts in the context of their tasks.

The distinction between levels of incongruence is a product of the advancement of IT artefacts from stand-alone *tools* to integrated *frameworks*. This advancement is a particularly important development in IS as it suggests a shift in thinking about information systems as *work systems in which IT arte-*

facts are utilised to information systems as *computerised frameworks in which users perform certain roles*. Not only do these frameworks have a great degree of agency in the organisation, they also cultivate greater reliance on the knowledge and skills required to maintain them.

It is important to recognise the dynamics of the relationship between the two levels of incongruence. The existence of organisation-level incongruence is experienced as particular instances of misfit between the artefact and the requirements produced by tasks. Task-artefact misfit, however, is not the only form of user-level incongruence - a user's inability to utilise the artefact's features, i.e., user-artefact misfit, is a second form of user-level incongruence. Consequently, it is possible that a user might perceive a particular instance of incongruence as task-artefact misfit when, in actual fact, the experience results from his/her inability to utilise the artefact correctly.

There are two important things worth noting in conclusion. Firstly, it should be emphasised that, while Strong and Volkoff's typology focuses on artefact characteristics as the antecedents of incongruence, incongruence itself describes the nature of a *relationship* between elements of the information system. It is quite possible, consequently, that the same artefact characteristic may generate incongruence in one organisation but not in another due to differences in organisations' structures. Secondly, in the reviewed studies attention falls on the *generative mechanisms* of experiences of incongruence. While acknowledging and utilising their findings, this study adopts the view that these experiences are themselves *generative mechanisms*. It is implied, consequently, that a comprehensive understanding of the effects of incongruence can only be gained if the consequences of such experiences are considered.

Chapter 4

Enactment in Information Systems

In the preceding chapter it is established that incongruence in information systems is constituted of users' experiences when they engage with artefacts during tasks. While various authors have studied the antecedents of these experiences, there has been a lack of research which considers their implications for the operation of information systems. Studies of the antecedents of experiences may provide an appropriate starting point, but a more comprehensive understanding can only be gained through investigation of the cognitive dimensions of experiences as phenomena which are incontrovertibly tied to human subjects. Such investigation, however, signals a move away from the artefact-focussed theories which tend to dominate IS. It calls, instead, for theories which facilitate study of the processes by which human actors *create* experiences when they perceive the world around them.

In recent years a growing number IS scholars from the interpretive school have addressed research problems with cognitive dimensions. In a number of these studies researchers adopt *Sensemaking Theory* (or *Sensemaking*) as theoretical framework to guide their investigations.[1] Sensemaking has its roots in the early 20th century and emerged from work by numerous scholars with diverse interests on the interplay between social action and the cognitive processes which underlay it.[2] Usage of the sensemaking concept itself, however, can be traced to the early 1980's as a subject in the field of *Organisational*

[1] Askenäs and Westelius (2003); Bansler and Havn (2006); Beaudry and Pinsonneault (2005); Berente *et al.* (2011); Blackmon *et al.* (2003); Faisal *et al.* (2009); Griffith (1999); Henfridsson (2000)

[2] Weick (1995, p. 65-69)

Research (OR).[3] More recently various scholars have emerged as sensemaking pundits, applying its concepts and theories in an array of contexts.

After analysis of the theory and its use in IS it was concluded that sensemaking, as propagated Weick, is particularly well-suited to the research problem addressed in this study. Two primary reasons support this decision: Firstly, Weick's primary interest lies in sensemaking as a "phenomenon in organisational life"[4] which plays a "central role in the determination of human behaviour".[5] Secondly, the notions of *experience* and *enactment*, as well as the relationship between them are prominent aspects of sensemaking. This is reflected in Weick *et al.*'s statement that the process of sensemaking "involves turning circumstances into a situation that is comprehended explicitly in words and that serves as a springboard into action".[6]

Consequently, the purpose of this chapter is three-fold. It commences with a detailed overview of Weickian sensemaking theory to outline its fundamental premises. This is followed by the review of IS studies in which concepts of sensemaking theory have been applied to investigate the role of cognition in the operation of information systems. The review of these studies serves to establish links between sensemaking concepts and the dynamics of information system operation. The final section concerns user behaviour in information systems characterised by incongruence. At the end of the section the findings of these studies are considered from a sensemaking perspective to enable the formulation of propositions about the impact of incongruence on the operation of information systems.

4.1 Overview of Sensemaking Theory

Notable contributions to the development of sensemaking theory have come from the field of *Knowledge Management (KM)* and, in particular, the work of Snowden.[7] He defines sensemaking as "the way that humans choose between multiple possible explanations of sensory and other input as they seek to conform the phenomenological with the real in order to act in such away as to

[3]Klein *et al.* (2006*a*, p. 70)
[4]Dervin (1999, p. 729)
[5]Weick *et al.* (2005, p. 409)
[6]Weick *et al.* (2005, p. 409)
[7]Snowden (2005)

determine or respond to the world around them".[8] Also notable is the work of Dervin[9] who developed the *Sense-making* methodology - a widely applied communication-based research methodology which has been used in IS contexts.[10] Further applications of sensemaking theory has been done in the field of human-computer interaction as a means to investigate the role of machines, and mental models of machines, in the processes by which humans become informed.[11]

However, the most extensive and complete account of sensemaking, it may be argued, is contained in the writings of Karl Weick.[12] This section provides an overview of Weickian sensemaking based, primarily, on his seminal publication *Sensemaking in Organisations*.[13] While a large collection of sensemaking literature has been produced (by Weick and others), this book provides a detailed and complete overview of the theory.

4.1.1 Occasions for Sensemaking

4.1.1.1 Properties of Occasions for Sensemaking

Weick states that human actors perceive reality as a constant stream of experiences through ongoing processes of "automatic information processing".[14] During these processes "present moments of experience" (*cues*) are extracted from the environment through the senses and placed in "perceptual frameworks" (*frames*) to form a plausible understanding of reality.[15] Meaning, accordingly, is created when a person can construct a relation between a cue and a frame.[16] Over time and through exposure to a greater variety of experiences humans develop a repertoire of frames which enables them create meaning of a greater variety of cues.

When actors are confronted with novel events which disconfirm their expectations of reality, these processes of automatic information processing are

[8] Snowden (2005, p. 46)
[9] Dervin (1998, 1999); Naumer *et al.* (2008)
[10] Naumer *et al.* (2008); Foreman-Wernet (2003)
[11] Klein *et al.* (2006*a*,*b*)
[12] Weick (2005, 1993); Weick *et al.* (2005); Weick (1998, 1991, 1995); Weick and Quinn (1999); Weick and Roberts (1993)
[13] Weick (1995)
[14] Weick (1995, p. 14)
[15] Weick (1995, p.109-111)
[16] Weick (1995, p.109-111)

interrupted.[17] Such interruptions may be insignificant and bridged with little cognitive effort, but when the disparity between an actor's expectations and perceived reality reaches a "threshold of dissatisfaction" - experienced as a "*shock*" - the actor is prompted to "pay attention and initiate novel action" to form a plausible understanding of events.[18] Stated differently, shocks denote situations where an actor's inability to relate cues to frames lead to confusion and agitation[19] which, Weick argues, form the wellspring of occasions for sensemaking. Importantly, shocks are not, per definition, singular experiences but may be the result of various events which, in retrospect, are combined to have a significant impact.[20]

In organisational contexts actors in certain roles are more likely to be confronted with occasions for sensemaking. These roles can be identified through certain properties of the ongoing flow of experiences associated with them. Weick identifies three properties in this regard:

- *Information Load* is "a complex mixture of the quantity, ambiguity, and variety of information that people are forced to process".[21] People cope with overload by employing some strategy which enables them to reduce information to, what they believe to be, its essential parts. These strategies, accordingly, influences perceptions of reality. Importantly, "any device that reduces information load prestructures what people notice and effects the sense they can then make".[22]

- *Complexity* results from a great number of diverse elements which interact in a great variety of ways.[23] Within complex environments "unexpected sequences of events are commonplace" and minimize the effectiveness of routine formalisations. Complexity, Weick argues, requires the organisation to expect incomprehensible or unimaginable events by cultivating "a greater variety of beliefs" of what might happen.[24]

- *Turbulence*, defined as a combination of instability and randomness, has the effect of increasing an organisation's reliance upon intuition and

[17] Weick (1995, p. 5)
[18] Weick (1995, p. 84)
[19] Weick (1995, p. 14)
[20] Weick (1995, p. 84)
[21] Weick (1995, p. 87)
[22] Weick (1995, p. 87)
[23] Weick (1995, p. 87)
[24] Weick (1995, p. 87)

heuristics.[25] Weick argues that, in turbulent environments, people will apply those heuristics which they have, through past experience, become most familiar with.[26]

Weick's description of occasions for sensemaking resonates well with the critical realist conceptualisation of experiences of misfit as proposed by Strong and Volkoff.[27] Both are products of "properties of the environment, processes, structures of organisations, and dispositions of individuals".[28,29]

4.1.1.2 Ambiguity and Uncertainty

Having identified their general properties, Weick defines two broad categories of occasions for sensemaking - *ambiguity* and *uncertainty*.

Ambiguity describes occasions when stimuli perceived are unclear in meaning to the perceiver, or stimuli perceived make "multiple explanations possible".[30] The problem, in such occasions, is not a lack of stimuli, but the inability of the perceiver to choose between the various possible meanings which perceived stimuli may have. Experiences of ambiguity prompt "people to engage in sensemaking because they are confused by too many interpretations", rather than a lack of information.[31] Accordingly, to resolve experiences of ambiguity, "people need mechanisms that enable debate, clarification and enactment" which facilitate selection between possible meanings.[32]

Weick defines uncertainty as "an individual's perceived inability to predict something accurately".[33] He extends this definition by arguing that uncertainty describes the inability to accurately predict the possible outcomes of lines of actions which an individual can choose from. The ignorance of an in-

[25] Weick (1995, p. 88)
[26] Weick (1995, p. 88)
[27] Strong and Volkoff (2010)
[28] Weick (1995, p. 86)
[29] Weick points out that scholars of cognitive psychology may note the likeness between the construction of occasions for sensemaking and *problem definition*. A likeness rooted in the notion that a problem represents "disharmony between reality and one's preference" and is, thus, a conceptual entity or construct spawned from both subjective preference and the "objective state-of-the-world". He argues, however, that the term problem may be too narrow to adequately describe the variety of occasions for sensemaking - terms like issue, paradox or dilemma also describe the novel situations which may lead to sensemaking.
[30] Weick (1995, p. 92)
[31] Weick (1995, p. 95)
[32] Weick (1995, p. 95)
[33] Weick (1995, p. 95)

terpretation which facilitates extrapolation leads people to try to reduce such ignorance, thus creating an occasion for sensemaking.[34]

While admitting that the distinction between ambiguity and uncertainty is not always easily made, Weick argues that it is particularly important because they prompt different requirements and different types of action. The reduction of ambiguity (or confusion), for example, calls for rich media which supports lateral thinking by sensemakers. Rich media may, however, obstruct sensemaking during instances of ambiguity (or ignorance) where lean channels may be more appropriate.[35]

4.1.2 Properties of Sensemaking

Weick identifies seven properties of sensemaking processes which describe "what sensemaking is, how it works, and where it can fail".[36]

- *Sensemaking is grounded in identity construction.* There exists a strong relationship between one's self-concept and the process of sensemaking. Not only does the idea of self influence the sense made, the sense made in turn influences identity construction. Accordingly, "the establishment and maintenance of identity is a core preoccupation in sensemaking"[37] which enables various perspectives on the process. The disconfirmation of a positive self-concept, for example, often triggers sensemaking as an effort to reaffirm that self-concept. This is applicable at both an individual and organisational level of analysis as members act on their own behalf, as well as the behalf of their organisation - they are, simultaneously, individuals and members of the collective to which they belong.[38] "From the perspective of sensemaking, who we think we are (identity) as organizational actors shapes what we enact and how we interpret, which affects what outsiders think we are (image) and how they treat us, which stabilizes or destabilizes our identity".[39]

- *Sensemaking is retrospective.* Sensemaking is always a retrospective process because "people can know what they are doing only after they have

[34] Weick (1995, p. 99)
[35] Weick (1995, p. 99)
[36] Weick (1995, p. 18)
[37] Weick (1995, p. 20)
[38] Weick (1995, p. 24)
[39] Weick *et al.* (2005, p. 416)

done it".[40] There exists a time gap, however slim, which separates the existence of situations in the environment and their internal construction by the individual. Any experience, therefore, is in actual fact an experience of the past or, simply stated, a memory. Following this line of thinking, Weick argues that individuals are exposed to a constant "stream of experience"[41] and that individual experiences can only be identified when the individual steps outside this stream and directs attention to it.[42] Weick uses the term *meaning* to denote this attention. Importantly, meaning is influenced by the circumstances of the present moment and, consequently, the same experiences may lead to different meanings when considered at different points in time. A single experience may, therefore, have multiple, sometimes conflicting, meanings. Another important implication of this property is that it leads to tight causal coupling between events and their eventual outcome. By knowing their outcome when giving meaning to events in hindsight, sensemakers are in a position to label certain events as 'errors' or vice versa. This "hindsight bias" implies that events which are not coupled with the outcome are more easily forgotten.[43]

- *Sensemaking is enactive of sensible environments.* Through their actions sensemakers continuously "produce part of the environment that they face".[44] This perspective serves to dissuade the decoupling of actor and environment as two independent entities. Through their action actors influence events, objects and their relationships which, in turn, produce sensible stimuli. Weick highlights the ontological conflicts which emerge when those who adopt a purely subjectivist stance attempt to "operationalise their ideas within an empirical context".[45] This conflict, he argues, is embraced by the sensemaking approach as it is sensitive to the need of actors to cope with reality by bracketing, punctuating and labelling streams of experience. It also, however, recognises the role of subjective beliefs and expectations in influencing these processes.[46] Sensemaking students, therefore, do not deny the existence of concrete reality,

[40] Weick (1995, p. 24)
[41] Weick (1995, p. 25)
[42] Weick (1995, p. 25)
[43] Weick (1995, p. 28)
[44] Weick (1995, p. 30)
[45] Weick (1995, p. 34)
[46] Weick (1995, p. 35)

but emphasise the enactment of that reality and, particularly, the fact that "people act in such a way that their assumptions of realism become warranted".[47]

- *Sensemaking is social.* Weick emphasises the role of other persons (real or imagined) on individual sensemaking processes. His argument being, essentially, that thought processes of individuals cannot be separated from the social context in which sensemaking occurs, as that context influences both internal constructions and actions. Importantly, social influences on sensemaking do not arise solely from the physical presence but also from the "imagined" or "implied" presence of others (i.e. "symbolic interaction").[48] This does not imply, however, that the result of sensemaking will be shared meaning or social constructions. Organisational actors may perform their roles effectively in the absence of shared meaning, choosing, for example, to act out of duress. [49] The effect, however, when multiple cognitions are interconnected socially is that "a collective mind capable of varying degrees of intelligence emerges as a kind of capacity in an ongoing activity stream when activities among people are tied together as contributions that constitute and are subordinated to a joint system".[50]

- *Sensemaking is ongoing.* Weick argues that events or scenarios have no objectively definable starting or ending points, but are part of the constant stream of experience perceived by people. To cope with this constant flow sensemakers bracket parts of it to construct distinguishable moments and extract cues from these moments.[51] In this way people assign absolute categories to perceived reality and, simultaneously, ignore large parts of it in an effort to make sense of a "continuous and dynamic" world.[52] This process is crucial to organisational functioning as it enables members to "focus and crystallise meanings" and "reaffirm individual and organisational identities".[53] The flow of experience is often punctuated by "arousal triggers" which direct attention to certain cues and inter-

[47] Weick (1995, p. 36)
[48] Weick (1995, p. 40)
[49] Weick (1995, p. 43)
[50] Weick (2005, p. 59)
[51] Weick (1995, p. 43)
[52] Weick (1995, p. 44)
[53] Weick (1995, p. 45)

rupt ongoing projects.[54] Such triggers lead people to "construct some link between the present situation and relevant prior situations to make sense of the arousal".[55] Importantly, arousal triggers are associated with the spawning of emotion which, in turn, influences sensemaking. Interruptions which occur in organisational settings that are formally regulated (e.g., by policies or rules) are likely to generate more emotion than less-structured settings which are also "less interruptible".[56] Accordingly, those emotions are typically negative when interruptions are persistent and cannot be circumvented. Positive emotions, on the contrary, may result from the removal of interrupting stimulus or from "events that suddenly and unexpectedly accelerate completion of a plan or behavioural sequence".[57]

- *Sensemaking is focused on and by extracted cues.* The study of sensemaking processes requires close attention to "ways people notice, extract cues, and embellish that which they extract".[58] These cues form the focal points around which people "develop a larger sense of what may be occurring".[59] Consequently, "control over which cues will serve as a point of reference is an important source of power".[60] Weick uses the metaphor of a seed to describe how cues play a "form-producing" role in the sensemaking process, guiding actors to link the concrete to the abstract within a specific context. This context, importantly, influences both the extraction and embellishment of cues which highlights its influence in the sensemaking process. The influences of context is particularly visible when various sub-groups of an organisation make different sense of the same events, something which may lead to political conflicts.[61] This influence is then accentuated (and may enhance conflict) when those sub-groups enact their sense as if it equates to universal truth. Action, in turn, produces more cues which will lead to further (ongoing) sensemaking.[62]

[54] Weick (1995, p. 45)
[55] Weick (1995, p. 46)
[56] Weick (1995, p. 47)
[57] Weick (1995, p. 47)
[58] Weick (1995, p. 49)
[59] Weick (1995, p. 50)
[60] Weick (1995, p. 50)
[61] Weick (1995, p. 53)
[62] Weick (1995, p. 55)

- *Sensemaking is driven by plausibility rather than accuracy.* Sensemaking processes do not depend on consensual information or "accurate perceptions" to be meaningful, or lead to purposeful action.[63] On the contrary, incomplete information or "misperceptions" may be beneficial to goal attainment when it serves to prompt confident action.[64] Likewise, the focus in sensemaking is not the establishment of universal truth, it is rather the investigation of the processes by which actors construct the perceptions that which they believe to be true. A more appropriate approach, therefore, is to investigate the construction of beliefs which enable actors to complete projects, which Weick terms project-specific, pragmatic accuracy.[65] Rather than accuracy, a coherent, reasonable and plausible perception of reality which serves to explain scenarios and energise actors typically drives sensemaking.[66] "When a plausible story is retained, it tends to become more substantial because it is related to past experience, connected to significant identities, and used as a source of guidance for further action and interpretation".[67]

4.1.3 Levels of Analysis

Because occasions for sensemaking are subjectively constructed and sensemaking itself is influenced by subjective dispositions, sensemaking theory seems, *prima facie*, to be applicable to the individual level of analysis. Weick, however, takes particular interest in sensemaking within the organisational context and extends the framework to higher levels of analysis such as the intersubjective, generic subjective and extrasubjective. He considers organisations relative to their *openness*, with "rational systems" on one extreme and "open systems" on the other.[68] Rational systems represent highly structured organisations "oriented to the pursuit of relatively specific goals" while open systems "develop goals by negotiation" and change in form based on environmental requirements. Between these two extremes are "natural systems" which are informally structured and whose participants "share a common interest in the

[63] Weick (1995, p. 56)
[64] Weick (1995, p. 57)
[65] Weick (1995, p. 59)
[66] Weick (1995, p. 61)
[67] Weick *et al.* (2005, p. 414)
[68] Weick (1995, p. 70)

survival of the system".[69] He defines three levels of analysis above the subjective at which sensemaking in organisations can be investigated.

At the intersubjective level, the first level above individual sensemaking, focus falls on the process through which a group with identifiable selves make sense through interaction. While aspects of individual sensemaking processes remain relevant, attention shifts to the the level of social reality which emerges when the thoughts, feelings and intentions of two or more selves become merged and synthesised through communication.[70] In this process different individuals highlight and communicate the cues they have extracted from streams of experience and reveal the frames they used to form plausible understandings of events. While this level of analysis is not primarily concerned with the individual, individual properties remain applicable. Personality traits, beliefs, dispositions, intentions and values, for example, give form to intersubjective sensemaking.

At the generic subjective level, however, concrete selves are replaced with the roles, or abstract selves, which are created in social collectives such as organisations. While it is accepted that different individuals in similar roles will make different sense, this level is concerned with the abstraction of these individuals to *role players* and the investigation sensemaking as influenced by the properties of a particular role and its associated portfolio of tasks (i.e., how a manager/auditor/clerk makes sense). Of interest at this level of analysis is routinisation which formalises interaction between various roles and enables individuals to swop roles.

On the extrasubjective level focus shifts from generic subjectivity to "pure meanings" void of subjects.[71] What emerges at this level is a "symbolic reality" or "culture" conceptualised as an "abstract idealised framework derived from prior interaction".[72]

Weick argues that organisations emerge from and are maintained through continuous intersubjective and generic subjective sensemaking processes. During these processes meanings are shared, refined and eventually taken for granted, forming a basis for the actions which constitute organisational culture. He defines the organisation, based on this view, as an aggregation of "patterned

[69] Weick (1995, p. 70)
[70] Weick (1995, p. 71)
[71] Weick (1995, p. 72)
[72] Weick (1995, p. 72)

activity developed and maintained through continuous communication activity, during which participants evolve equivalent understandings around issues of common interest".[73]

4.1.4 The Substance of Sensemaking

The properties of sensemaking, as discussed in section 4.1.2, describe, primarily, the process of sensemaking. In this section focus falls on the things people "draw on" when they make sense - the substance of sensemaking.[74] Important in this regard is the role of language as enabler of sensemaking processes. "Sense is generated by words that are combined into sentences of conversation" and impose "discrete labels" on events.[75] Weick, like Weaver, recognises the "chronic slippage"[76] between words and experiences, a necessary consequence of humans' inability to perceive (as opposed to form) meaning. Hence, the richness of language and the range of available words influences the accuracy with which meanings can be shared.

To illustrate the role of language in sensemaking Weick identifies six *vocabularies* which, in organisational contexts, represent the content of sensemaking:

- *Ideology: Vocabularies of society.* "Ideologies combine beliefs about cause-effect relations, preferences for certain outcomes, and expectations of appropriate behaviours".[77] Through ideologies social situations are made "comprehensible and meaningful".[78]
- *Third-order controls: Vocabularies of organisation.* Third-order controls denote the deep assumptions and definitions which enables organisational operation[79] Weick describes the important role of these premises in decision making as suppositions made to facilitate efficiency, typically introduced at early stages of sensemaking processes.[80] Premises play a more important role at higher levels of organisation where information flow and decision-making activities are less routine, implying less reliance on fac-

[73] Weick (1995, p. 75)
[74] Weick (1995, p.109)
[75] Weick (1995, p.107)
[76] Weick (1995, p.107)
[77] Weick (1995, p. 111)
[78] Weick (1995, p. 112)
[79] Weick (1995, p. 113)
[80] Weick (1995, p. 115)

tual information. In such contexts larger ranges of stimuli are considered, implying emphasis on premises. It follows from this that sensemaking by top management typically occurs "under conditions of high ambiguity and high arousal"[81] as opposed to controlled work at lower levels of organisation. Weick, through this argument, questions the role of organisational top-management as sensemakers. The organisation, he argues, "makes sense, literally and figuratively, at the bottom".[82] Organisations in which strong control is enforced at lower levels inadvertently create complex managerial problems which are more often handled under the influence of self-interest than that of collective interest.[83]

- *Paradigms: Vocabularies of work.* Paradigms, although more readily associated with scientific inquiry, have been extended to organisational theory as "standard operating procedures, shared definitions of the environment, and the agreed-upon system of power and authority".[84] Weick adopts this conceptualisation and argues that the development of paradigms enable organisations to resolve conflict by reflecting consensus on matters of organisational strategy.[85] Paradigms should not be considered unambiguous, the point is made that a degree of ambiguity within a paradigm is required to create the perception of consensus among those who share it.[86]

- *Theories of action: Vocabularies of coping.* Theories of action refer to the knowledge people in organisations gain through responding to certain situations in certain ways. A theory of action entails, therefore, knowledge of what action, under what circumstances, should be used to achieve some desired outcome.[87] Importantly, a theory of action implies that reality will be influenced by the action-taker in accordance to his or her beliefs and is, in this sense, a self-fulfilling prophecy.[88] Since theories of action are abstractions there is slippage between theory and action in practice, such slippage encourages the evolution of theories over time.

[81] Weick (1995, p. 116)
[82] Weick (1995, p. 117)
[83] Weick (1995, p. 118)
[84] Weick (1995, p. 118)
[85] Weick (1995, p. 119)
[86] Weick (1995, p. 120)
[87] Weick (1995, p. 122)
[88] Weick (1995, p. 123)

- *Tradition: Vocabularies of predecessors.* Weick argues that "if organisations are social forms distinguished by their capability for coordinated action, and the distinguishing factor of those forms disappears the moment it occurs, then we must be concerned with what persists when actions keep vanishing".[89] He elaborates this point by arguing that actions themselves cannot be transmitted, once they have been taken the seize to exist. What can be transmitted, however, are symbolic representations of those actions, i.e. "images and beliefs that capture the patterns which guide action".[90] Tradition, defined as such symbolic encodings, "facilitate the reconstruction of practices and institutions made up of human action".[91]
- *Stories: Vocabularies of sequence and experience.* Through narration a discontinuity between that which was expected and that which occurred can be expressed. Such stories, particularly when vivid and interesting, "evoke a mixture of fear and curiosity" and are pretexts to update frames.[92] They enable people to "impose formal coherence" on the flow of events experienced.[93] Because stories are told in hindsight they are edited by the narrator to filter and sequentialise experience.[94] This abstracts the story from the experience and serves to focus attention on specific aspects of the experience and convey shared values and meanings.

4.1.5 The Drivers of Sensemaking

4.1.5.1 Belief

Beliefs, which are embedded in ideologies and paradigms, "influence what people notice and how events unfold" as they are used to not only filter cues, but also spawn action.[95] Belief-driven sensemaking typically takes one of two forms - *arguing* or *expecting*.

Arguing is conceptualised as ordered interaction to reduce the variety of beliefs shared by a group to those which are relevant to some event or situation.[96]

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[89] Weick (1995, p. 127)
[90] Weick (1995, p. 126)
[91] Weick (1995, p. 126)
[92] Weick (1995, p. 128)
[93] Weick (1995, p. 128)
[94] Weick (1995, p. 128)
[95] Weick (1995, p. 134)
[96] Weick (1995, p. 134)

It is based on the principle that any opinion is "potentially controversial" as it represents a subjective interpretation with which others may disagree.[97] Argumentation commences when a person "tries to establish some degree of intersubjective reliability" in his or her opinion.[98] When others criticise opinions or explanations offered, "people discover new explanations, which is why argument can produce adaptive sensemaking".[99] By exchanging arguments and counter-arguments people establish more dependable understandings of reality. This process may also be internalized as "people can question themselves and serve as both proposer and critic".[100] Meetings are contexts for arguing in organisations and play a particularly important role in organisational sensemaking since they "create the infrastructure that creates sense".[101]

Expecting relates to people's prophecies about future events and how these prophecies become self-fulfilling as they serve to validate events.[102] Expectations act as more severe filters of cues than arguments and raise a "host of issues concerning accuracy, error, and the limits of social construction".[103] Through experience people build models of expected reality and continuously place perceived cues into these models. Expecting, consequently, enables people to commit less attention to what they perceive as long as that which they perceive conforms to what they are expecting. It is only when these expectations are disconfirmed that real attention is paid to stimuli. In such cases, however, "both the expectation and the event can be adjusted"[104] to enable meaning construction. Through such changes people fulfil their own expectations (prophecies), the accuracy of which is both subjective and relative to their goals. These prophecies drive reality construction by filtering cues and directly influencing the target of a person's attention.[105]

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[97] Weick (1995, p. 137)
[98] Weick (1995, p. 138)
[99] Weick (1995, p. 139)
[100] Weick (1995, p. 140)
[101] Weick (1995, p. 141)
[102] Weick (1995, p. 134)
[103] Weick (1995, p. 145)
[104] Weick (1995, p. 147)
[105] Weick (1995, p. 148)

4.1.5.2 Action

Sensemaking processes can also be driven by action which, not only makes explicit the beliefs of a person *committing* to action, but also manipulates the environment in which, and of which, sense is made.

Committing is defined as the process that makes explicit behaviour irrevocable.[106] The relation between committing and beliefs is important as it is beliefs that "make sense of" actions taken when people build meaning around the actions they are committed to.[107] Sensemaking, therefore, can be investigated through inquiries about justifications for actions, particularly those actions for which agents accept responsibility (i.e., are committed to). Weick emphasises three variables that "increase responsibility for action": publicity, irrevocability and volition.[108] Accordingly, settings where there is "action, publicity, choice, high stakes, and low tolerance of mistakes" are likely to produce commitment.[109] Commitment, in turn, affects sensemaking as it "imposes a form of logic on the interpretation of action"[110] which focusses attention on the particular aspects of action which supports the beliefs by which it is justified.

Through actions people and organisations manipulate the environments they make sense of. This does not suggest that the environment itself has no influence on determining the sense made by people, but questions, rather, the significance, meaning and content of the environment. Objects in the environment, Weick argues, "are inconsequential until they are acted upon and then incorporated retrospectively into events, situations, and explanations".[111] Once acted upon the environment is manipulated as its existence is an enacted reality, as opposed an objective reality. Also enacted are the relationships between people and objects to define aspects like responsibility and compliance which form the platform for functional decomposition. Environments, therefore, are partly created and recreated through action and the environment faced is a result of action.

[106] Weick (1995, p. 156)
[107] Weick (1995, p. 156)
[108] Weick (1995, p. 157)
[109] Weick (1995, p. 158)
[110] Weick (1995, p. 159)
[111] Weick (1995, p. 164)

4.2 Sensemaking and Information Systems

The sensemaking perspective offers "a powerful means of articulating and tracing the influence of information systems in organisation"[112] by enabling the researcher to "explain and anticipate outcomes around technology".[113] In this section an overview is presented of a selection of studies in which concepts of sensemaking are applied in the context of information systems, a variety of which have been reported. The predominant portion of these studies focus on sensemaking as a consequence of *IT events* in organisations. An IT event, in this context, typically involves the introduction of a new information system and its associated artefact(s) in the organisation, prompting actors to adopt new ways of working.

Three broad themes are identifiable in this area of research. The first is the *social construction of technology* which concerns the process by which social groups develop shared understandings of technologies. The second is *adaptation* which concerns the process by which organisational actors align their work patterns with new technology over a period of time. The third is *structuration* which, in the IS context, describes how artefacts and human action jointly shape the work environment. In this section a brief overview of IS studies which address these themes is presented. Because the themes share a general interest in the cognitive aspects surrounding technology, the studies tend to partially address aspects of each theme. Nonetheless, they are separated here based on their primary focus.

4.2.1 The Social Construction of Technology

Jackson *et al.*[114] provide a useful review of the various theories that have been proposed to describe the process by which technologies become socially constructed in organisations. Constructionism, in contrast to determinism, rejects the notion that a technology's development over time can be predetermined through technical rationality. It is argued, rather, that the consequences and effects of technology use are non-linear and cannot be anticipated.[115] Constructionism dictates, accordingly, that "technical and social factors are intimately

[112] Orlikowski and Gash (1994, p. 201)
[113] Orlikowski and Gash (1994, p. 200)
[114] Jackson *et al.* (2002)
[115] Jackson *et al.* (2002, p. 237)

interconnected" and discourages attempts to isolate them in research. An important implication of this perspective is that technologies are seen to undergo continuous change through engagement by user communities. The social construction of a technology is, therefore, an important facet of structuration. A consequence of this view is that it encourages a process-orientated, as opposed to artefact orientated, view of technology. Work and work processes come to the foreground and "technological products come to be redefined as sets of processes".[116] Jackson *et al.* note the strong parallels between the social construction of technology perspective and sensemaking as proposed by Weick. Sensemaking, they argue, is particularly useful in studies of technology through its emphasis on the action-driven processes by which users of artefacts come to develop meaningful frames thereof.

Two studies are reviewed in this section. The first is Orlikowski and Gash's seminal publication on *fames of technology* which provides insight to the content and effects of social constructions of technology.[117] The second, by Askenäs and Westelius, considers the social construction of ERP's role playing actors in organisations.[118]

4.2.1.1 Frames of Technology

Orlikowski and Gash introduces the notion of "technological frames" in their oft-cited article on sensemaking of IT in organisations. Technological frames constitute the "subset of members' organisational frames that concern the assumptions, expectations, and knowledge they use to understand technology in organizations".[119] This includes "not only the nature and role of the technology itself but the specific conditions, applications, and consequences of that technology in particular contexts of use".[120] Using this concept the authors build "a theoretical framework to extend research into users' and designers' cognitions and values by proposing a systematic approach to examining the underlying assumptions, expectations, and knowledge that people have about technology".[121]

[116] Jackson *et al.* (2002, p. 238)
[117] Orlikowski and Gash (1994)
[118] Askenäs and Westelius (2003)
[119] Orlikowski and Gash (1994, p. 179)
[120] Orlikowski and Gash (1994, p. 179)
[121] Orlikowski and Gash (1994, p. 174)

In accordance with Weick the authors argue that frames serve as implicit guidelines that organise and shape actors' interpretations of events and organisational phenomena. Further, they subscribe to the notion that frames are held by the individual but become shared, to some degree, by members of social collectives through interaction - "individuals can be said to share a frame if some core cognitive elements (assumptions, knowledge, and expectations) are similar".[122]

Their primary interest is in the effects of discrepancies between frames of technology held by various organisational sub-groups. Shared frames held by different sub-groups tend to be incongruent because they are "shaped and constrained by various groups' purpose, context power, knowledge base, and the artefact itself".[123] Such frame incongruencies, they suggest, obstruct the effective adoption and utilisation of artefacts by organisations.

To investigate frames of technology the authors perform an extensive qualitative case study of a large (more that 10 000 employees) global consulting firm's adoption of Lotus Notes. Their findings suggest that three domains of technology frames are identifiable. While the domains are clearly overlapping and interdependent, distinction between them is made for analytical purposes. The domains are:[124]

1. *Nature of Technology* frames include "people's images of the technology and their understanding of its capabilities and functionality".
2. *Technology Strategy* frames refer to "people's views of why their organization acquired and implemented the technology" and includes their "understanding of the motivation or vision behind the adoption decision, and its likely value to the organization".
3. *Technology-in-Use* frames which refer to "people's understanding of how the technology will be used on a day-to-day basis, and the likely or actual conditions and consequences associated with such use".

The authors found that "cognitive incongruence" about the nature of technology was particularly apparent between the technical staff responsible for implementing Lotus Notes (a group referred to as "technologists") and the

[122] Orlikowski and Gash (1994, p. 179)
[123] Orlikowski and Gash (1994, p. 180)
[124] Orlikowski and Gash (1994, p. 183)

user community (referred to as "consultants"). While technologists understood the scope and possible applications of the artefact, consultants had very little knowledge of its potential. Their utilisation of the artefact, accordingly, was limited to individually-orientated functions mimicking their utilisation of simple e-mail tools which they were familiar with. Among the technologists, however, the artefact was utilised to support collective work. This incongruence was also reflected in interviews about the technology strategy of the firm in terms of its adoption of Lotus Notes. Technologists believed this strategy would involve a major shift in the communication culture of the firm which will impact various modes of operation while consultants believed it merely substituted older communication tools without affecting their operational procedures. Furthermore, technologists shared the broad assumption that consultants would discover and learn the features and capabilities of the artefact without assistance and utilise these as required. Consultants, however, expected training instruments and formal guidelines to facilitate more advanced utilisation.

Importantly, the authors report a consistent relationship between stakeholders' frames and their actions when utilising the artefact. In more general sensemaking terms it could be stated that stakeholders *enact* their prophecies about the artefact by utilising it in accordance with their understandings of its nature and purpose in the organisation. Frames held by an organisational sub-group, therefore, have certain explanatory power about that group's behaviour.

4.2.1.2 Socially Constructed Roles of ERP's

Askenäs and Westelius[125] use the social construction perspective to illustrate how various organisational actors construct ERPs in different ways. They argue that users will construct an ERP as an intentional role player in the organisation rather than a passive object. Their premise is that earlier studies neglected the artefact's agency by treating it as an object while in organisations people talk of artefacts "as if they were intentional beings".[126] The authors identify five stereotypical roles that ERPs play based on the perceptions of individuals and groups. Two primary factors influence these perceptions:

[125] Askenäs and Westelius (2003)
[126] Askenäs and Westelius (2003, p. 210)

> "We suggest that the way an information system is used is influenced by the perceived fit between the structure in the company and the IS functionality on the one hand, and the user's perception of how the system is trying to influence the user's work on the other hand".[127]

Using these two dimensions they create four quadrants each representing a type of role (see figure 4.2.1.2), adding one more role for ERPs that have been rejected by the user. The roles are described as:

1. *Bureaucrat:* The ERP maintains the organisational structure and ensures that the enactment of structure conforms to rules. Users tend to accept this imposed structure if it fits their task portfolio.
2. *Manipulator:* The ERP forces users to follow procedures that are experienced as unproductive or ineffective and aligns poorly with their requirements.
3. *Consultant:* The ERP does not command work processes, but advises users when required. Users are able to manipulate the artefact to meet the requirements of non-standard use cases.
4. *Administrative Assistant:* The ERP is used for simple data-related tasks but does not control or enforce the organisation's processes or structure.
5. *Dismissed:* A redundant ERP which has been dismissed by the user community.

The authors test their model in a qualitative case study of a Swedish firm running BAAN's Triton ERP and find that constructions of each of the five roles are present in the organisation. They report that users, in the early phases of adoption, construct the ERP as a manipulator which imposes unwanted processes upon them. Modifications to the artefact over a period of time improve its alignment with user requirements changing its constructed role to that of bureaucrat. In some departments the ERP's functionality could not be aligned with user requirements and users extracted data from the ERP to manipulate it using alternative software. In this context the ERP played the role of administrative assistant. There was also a group of users that learnt to manipulate the ERP's functionality and control its operation using the provided training material, for them it acted as a consultant over which

[127] Askenäs and Westelius (2003, p. 210)

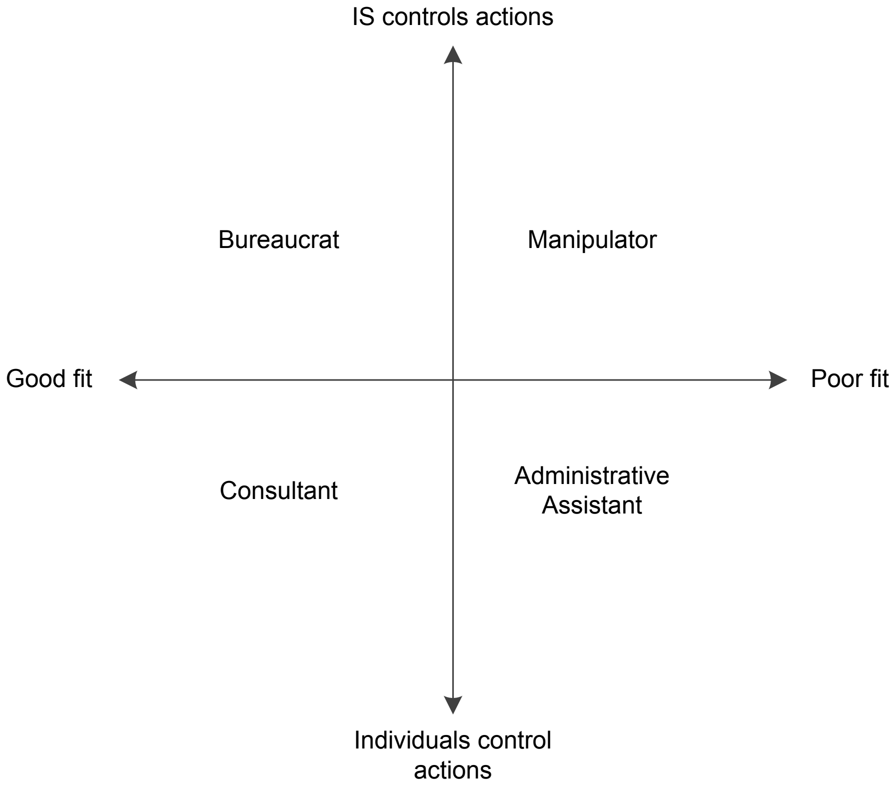

Figure 4.1: Socially constructed ERP roles.

they had certain control. Finally, the firm's sales staff dismissed the ERP due to experiencing usage thereof as cumbersome. Since they were seen as key role players in ensuring the firm's income they had enough bargaining power in the organisation to reject the artefact.

The authors emphasise the strong causal relationship between these constructions and the process of structuration. When the artefact is constructed as bureaucrat or manipulator it tends to have the upper hand in the structuration process and force users to act in accordance with its demands. However, when the ERP is constructed as administrative assistant or consultant it empowers the user by offering him/her a sense of control and freedom to manipulate organisational work patterns.

4.2.2 Adaptation

Adaptation describes the process by which users, over a period of time, align their work patterns with a new technology. The process is a necessary consequence of IT events but take variety forms due to a range of contextual and subjective factors. The studies reviewed in this section illustrate that underlying and driving adaptation are processes of sensemaking. Three studies are reviewed: the first investigates features of technology as triggers for sensemaking;[128] the second investigates the role of ambiguity as a source of innovation during adaptation;[129] and the third draws parallels between adaptation and *coping theory*.[130]

4.2.2.1 Artefactual Features as Triggers for Sensemaking

Griffith argues that the adaptation process is preceded by the extraction of particular cues about artefacts which serve as triggers for sensemaking.[131]. Because artefacts may be large and complex it is idealistic to suggest that users will, initially, form accurate understandings of entire artefacts. Rather, they will form initial conceptualisation of an artefact by latching onto cues that are easily extractable. These cues are specific features of the artefact upon which users construct their initial perceptions:

> "Any technology is actually a combination (constellation) of features: distinct parts, aspects, and qualities. Features that are noticed by users then can be socially constructed into an organisational system".[132]

To extend her argument she develops a model in which she classifies features of technology using two dimensions:

1. *Abstract - Concrete*: Features that are more readily perceivable by stakeholders are seen to be more concrete and can be more directly described. Abstract features, in contrast, are not easily verifiable and their descriptions are often indirect and general.
2. *Core - Tangential*: Core features of a technology are considered as those which define the overall nature of the technology while tangential features play a less prominent role and may be rarely utilised.

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[128] Griffith (1999)
[129] Henfridsson (2000)
[130] Beaudry and Pinsonneault (2005)
[131] Griffith (1999)
[132] Griffith (1999, 473)

Her findings suggest that new/adapted concrete features are more likely to trigger sensemaking and more likely to be experienced as discrepant by a user community. Further, new/adapted abstract features are more likely to trigger concious deliberation among stakeholders. Along the core-tangential dimension new/adapted core features are more likely to trigger sensemaking and be experienced as discrepant. In contrast, tangential features are more likely to trigger concious deliberation. She makes the argument that implementers of new technologies in organisations should be mindful of the role of various features in triggering user sensemaking and, as a result, determining the initial conditions of structuration. The adaptation process can of course be manipulated by technology designers when they emphasise, through design, those features of an artefact which they wish users to extract initially.

4.2.2.2 Ambiguity as a Source of Innovation

While Orlikowski and Gash suggest that the alignment of technological frames between organisational sub-groups will advance artefact adoption, Henfridsson argues that initial ambiguity around an artefact is a "necessary component in making the new technology sensible and meaningful for those involved".[133] Frame incongruencies, in his view, are "potential sources of innovation" which should be managed to facilitate adaptation.[134] Like Orlikowski and Gash he performs an interpretive case study employing qualitative techniques (interviews and observations) using the Swedish social services department as research site. He investigates their adoption of *First Class* - a client/server system that integrates e-mail with group conferencing and other communication features.

In the case study the artefact was introduced to users with little or no formal training creating ambiguity about its nature and role in the organisation. Henfridsson argues that this initial ambiguity and the sensemaking it spawned played two contrasting roles: it had the potential to drive innovative use of First Class, but it also threatened its further integration into existing work practices.[135] Over time, however, the First Class frames held by users became more meaningful and usage patterns solidified as they became shared among

[133] Henfridsson (2000, p. 88)
[134] Henfridsson (2000, p. 92)
[135] Henfridsson (2000, p. 96)

sub-groups. Interestingly, Henfridsson notes that "ways of using First Class largely corresponded to the procedures and ways of organizing things that preceded the system's introduction", intensifying the routines and procedures adopted prior to the artefact's introduction.[136]

> "It seemed that the sensemaking processes started out with Utopian visions of vertical integration and the social worker as active information consumer, but this process ended up by viewing First Class as a substitute technology for the internal paper mail system, the telephone and face-to-face interaction".[137]

He explains this observation by arguing that users' frames of their task portfolio dictated their sensemaking of the artefact, i.e., they made sense of First Class in relation to its potential to influence their ways of work. This was particularly noticeable with regards to administrative work: because users were generally frustrated with administrative workloads they "bracketed out certain information" about First Class which led them to construct it as a tool that speeds up administrative work.[138] This belief, much like those held by Orlikowski and Gash's consultants, was enacted when they used the artefact.

4.2.2.3 Adaptation as Coping

Beaudry and Pinsonneault, in an attempt to integrate the adaptation process with traditional, variance models of adoption, turn their attention to *coping theory*. Coping theory focusses on the adaptational acts performed by individuals in response to disruptive events in their environments. These acts can be classified as *cognitive efforts* by which individuals aim to alter their subjectively held understandings of events or *behavioural efforts* by which individuals aim to alter their surrounding circumstances.[139]

According to the authors coping is influenced by three factors:

1. *Internal Demands* which represents the individual's personal desires.
2. *External Demands* which represents requirements prescribed to the particular role an individual is expected to play in the organisation.

[136] Henfridsson (2000, p. 97)
[137] Henfridsson (2000, p. 98)
[138] Henfridsson (2000, p. 99)
[139] Beaudry and Pinsonneault (2005)

3. *Resources* available to the individual.

Furthermore, it involves two distinct phases:

1. *Appraisal* which consists of *primary appraisal* during which the individual evaluates the potential consequences of the event for him/her and *secondary appraisal* during which the individual evaluates the degree of control he/she has over the event.
2. *Coping Efforts* which involves the various actions taken by the individual to adapt either himself/herself or the situation.[140]

The authors apply coping theory to the process of adaptation by developing a *coping model for user adaptation (CMUA)* (see figure 4.2). In the model they define user adaptation as "the cognitive and behavioural efforts exerted by users to manage specific consequences associated with a significant IT event that occurs in their work environment".[141] The model suggests that, based on primary and secondary appraisal, individuals will classify IT events as opportunities or threats and determine the level of control they have over the situation. Consequently, they will undertake a coping strategy based on this appraisal. Four principal strategy types are identified:

1. *Benefits Maximising* is undertaken when an event is appraised as an opportunity and users have control over the situation. In such scenarios adaptation efforts will be oriented to take full advantage and maximise the benefits offered by the event.
2. *Benefits Satisficing* is undertaken when an event is appraised as an opportunity but users have limited control over situation. Coping efforts will involve satisfying their requirements with the limited benefits the event has to offer.
3. *Disturbance Handling* is undertaken when an event is appraised as threat and the user can control the situation. It involves managing the situation to restore emotional stability and minimise the effects of the event.

[140]While there are similarities between processes of coping and processes of sensemaking, they are essentially different. Through coping the individual aims to restore *a sense of well being* while the aim in sensemaking is to form a plausible understanding events. One may argue, consequently, that sensemaking is a prerequisite for coping - i.e. an individual can only cope with an event if he/she has managed to construct a plausible understanding of it.

[141]Beaudry and Pinsonneault (2005, p. 496)

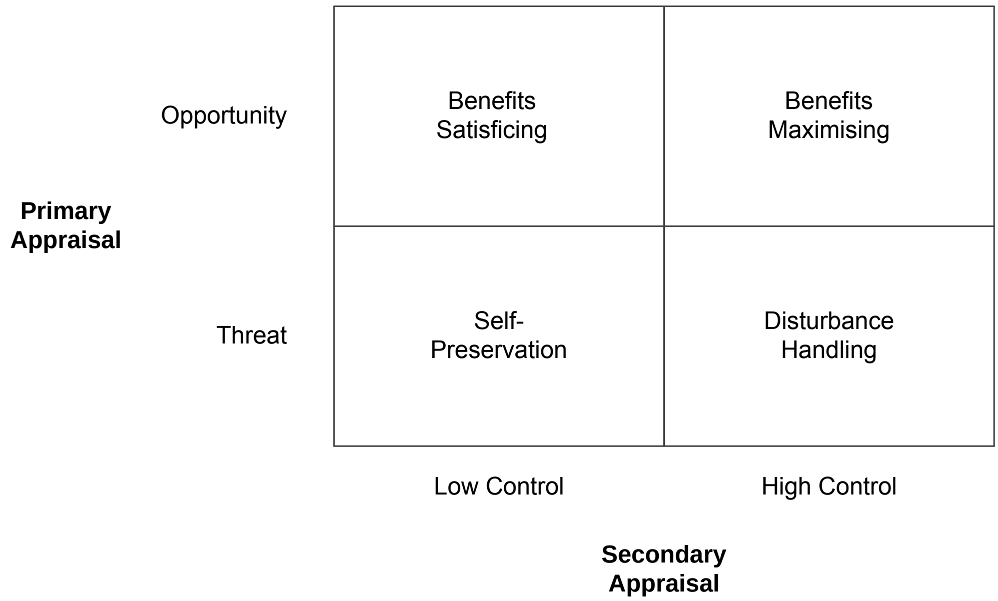

Figure 4.2: Beaudry and Pinsonneault's coping strategies.

4. *Self-Preservation* is undertaken when an event is appraised as a threat and the user has little control over the situation. Coping efforts will focus mainly on restoring emotional stability by minimising negative perceptions of the situation.

The authors emphasise the iterative nature of the process and the constant interplay between the appraisal and adaptation. This serves as a useful example of action driven sensemaking: acts of adaptation change individuals' perceptions about the situation and influences their future appraisals. This "loop is particularly important because it helps account for both the negative and positive recursive spirals of appraisal-adaptation-outcomes".[142]

The authors test their model in two case studies at American banks adopting new account management systems. Like the other researchers cited in this section, they opt to employ qualitative techniques and extract a narrative of the adaptation process from the subject. They analyse their data through coding and the construction of *chains of events* to identify "patterns in streams of adaptation acts" undertaken by users of the new systems.[143] They report that "the four strategies are different patterns in streams of actions that are initi-

[142] Beaudry and Pinsonneault (2005, p. 503)
[143] Beaudry and Pinsonneault (2005, p. 507)

ated by different appraisals and lead to different outcomes. What strategy one uses depends on one's assessment of an IT event and on a broader contingent of organizational factors".[144]

The authors note that while technology implementers may be inclined to encourage benefits maximising among users, it may involve considerable investment in various forms.

> "From an organisational point of view, the benefits satisficing and self-preservation strategies might at first appear suboptimal because individuals are not trying to maximize the potential benefits of an IT event. In some situations, however, inducing individuals to try to maximise IT benefits might require substantial organisational changes and investments (e.g., increasing job autonomy, decentralising decision-making authority, extensive user training, or empowering users) that might outweigh the benefits an organisation can achieve in doing so".[145]

In accordance with Griffith's findings the research emphasises the link between users' perceptions of IT events and the adaptation process - the sense users make of an IT event determines his/her actions in response to it. As illustrated in the model this process will undergo continuous cycles of perception-enactment which may reveal observable patterns in users' behaviour.

4.2.3 Structuration

Theories about the structuration process as influenced by IT artefacts typically range between two extremes. On one end are those that subscribe to technological determinism, the notion that the material agency of artefacts determines the structure of organisational work processes through the control these impose upon their user communities. On the other end are theories which favour the human agency of technology adopters in determining the outcome of IT projects in organisations.

While it is generally accepted that artefacts will have some degree of agency in the structuration process, Jackson *et al.* warn that all artefacts are not equal

[144]Beaudry and Pinsonneault (2005, p. 517)
[145]Beaudry and Pinsonneault (2005, p. 517)

in their impact on structuration. They also emphasise the need for sensitivity to, not only artefacts, but the broader range of aspects which influence structuration. They point out, accordingly, that structuration cannot be considered in isolation of the boundaries between technical systems or departments and managers or user communities. Researchers should not, they warn, "overemphasize either technology or organisation" in their studies, such "tipping" may limit the accuracy and relevance of findings.[146]

The authors follow the work of Zuboff[147] to argue that computerisation of work drastically changes the nature of work but in a different way than the automation of manual labour does. They expand this idea by adopting Zuboff's distinction between *automating* and *informating*. The distinction dictates that computers should not be seen as merely automating work but as informating work, implying that they enable people to "reconceptualise, restructure and improve their work":[148]

> "The informating view rests on managers' ability to grasp the 'smart' nature of computers and the potential they offer for enabling workers to improve operations through higher order reasoning based on the information the computer provides".[149]

The authors note that successful informating depends on task-technology fit and warns that the computerisation of work is always based on an "artificial and idealised account of action as it should occur from the point of view of someone not doing the action".[150] The complexities and irregularities of real-world work processes are ignored when they are abstracted to *typical* or *standard* scenarios which form the basis for computerisation. They argue, consequently, that research of computerised work contexts should adopt a balanced perspective which recognises the roles of both organisation and artefact without favouring either as more or less influential in structuration.

There have also been studies that consider non-technological organisational issues (e.g., culture, role hierarchies and politics) as primary theme against a backdrop of computerisation. In such studies the causal relationships between

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[146] Jackson *et al.* (2002, p. 239)
[147] Zuboff (1988)
[148] Jackson *et al.* (2002, p. 241)
[149] Jackson *et al.* (2002, p. 241)
[150] Jackson *et al.* (2002, p. 242)

artefacts and work is not the central concern, focus falls rather on organisational processes and experiences. "What surfaces from these investigations is the insight that ICTs may have indirect impacts that come less from the use of a specific ICT than from the part the ICT plays in forming or insinuating larger organisational contexts".[151]

While Jackson *et al.* propose a balanced approach, Boudreau and Robey point out that IS scholars have, more recently, begun to favour human agency when investigating structuration in IS. "The interest in explaining information technology's organisational consequences has led increasingly to theoretical positions that privilege human agency over social structures and technological features".[152] This represents a move away from technological determinism towards the realisation that "technology is implicated in social change at the discretion of human agents, even with automated manufacturing technologies and especially with computer-based information systems".[153] While one may be inclined to argue that integrated artefacts like ERPs limit the extent to which human agency can influence structuration, they maintain that "even where technological constraints are 'hard wired' into programming routines"[154] organisational actors can dictate structuration by rejecting the adoption of artefacts.

They conclude that, in ERP environments, the emerging organisational structure cannot be predetermined but is a product of both the material agency of technology and the unpredictable social agency of its users. Social agency plays a dual role in these contexts by both maintaining structure and altering it through cycles of enactment.[155]

4.2.4 Conclusions

The application of sensemaking theory offers IS researchers a theoretical framework which describes the cognitive processes which underlie the operation of socio-technical phenomena like information systems. From the findings of the reviewed studies a number of principles which describe the cognitive dimension of information systems are identifiable.

[151] Jackson *et al.* (2002, p. 244)
[152] Boudreau and Robey (2005, p. 3)
[153] Boudreau and Robey (2005, p. 4)
[154] Boudreau and Robey (2005, p. 5)
[155] Boudreau and Robey (2005, p. 5)

- *Users' frames of a technology determine their behaviour around that technology.* The sensemaking principle that humans will act in a manner which justifies their beliefs about reality is supported in the reviewed studies. Users tend to *enact* a technology in accordance with their beliefs about its purpose in an organisation. It can be expected, consequently, that differences between users' and designers' frames of a technology will be reflected in differences between the envisioned and actual use of the technology.

- *Users' frames of a technology become shared (or congruent) when they utilise that technology in a shared environment.* In accordance with Weick's theory about the sharing of frames, the reviewed studies indicate that users sharing an organisational unit (department) develop congruent frames of technology. This principle is also supported by Henfridsson's finding that the cues users extract about a technology relate to their requirements which suggests that users sharing a requirement set are likely extract and enlarge similar cues about a technology.

- *Users' frames of a technology are influenced by perceptions of control and congruence.* Importantly, the findings of Askenäs and Westelius indicate that frames of a technology are influenced by its ability to satisfy users' requirements, as well as the degree to which it imposes structure upon their tasks.

- *Perceived features of a technology triggers sensemaking.* To make sense of a technology users extract and enlarge cues about its features. More specifically, the core, concrete features of a technology typically trigger sensemaking processes.

- *Users adapt to technologies by altering their frames of technology and enacting technologies to preserve control over their work environment.* Efforts to *cope* with the impacts of an IT event can be of a cognitive and/or behavioural nature. Importantly, through behavioural efforts users reinvent their work environments, *enacting* technologies in ways which afford them control and stability.

- *Users have influence over the agency of technologies in organisations through their enactment of technologies.* While the adoption of a technology may imply the imposition of structure upon organisation, the realisation of such imposition is determined by the enactment of the technology by its users.

4.3 Incongruence and User Behaviour

The studies reviewed in the preceding section primarily concern sensemaking in the context of the introduction of new information systems and their associated artefacts. While incongruence is not the prominent theme in the reviewed studies, there is evidence that it influences the construction and enactment of technologies in organisations.

In this section the focus shifts to studies that address the influence of incongruence on information system operation more explicitly. While concepts of sensemaking theory are used in some of these studies, they focus on identifiable behavioural patterns rather than the cognitive processes which underlie them.

Three themes are considered in this section. The first relates to users' efforts to promote congruence by acting as *mediators*;[156] the second addresses the informal development of computer applications among user communities as a means of overcoming artefact deficiencies/impositions;[157] and the third considers the development and adoption of *workaround* practices.[158]

At the end of the section the findings of the studies are considered with regards to the propositions identified in section 4.2.4. In doing so linkages are established, at least theoretically, between findings about sensemaking in information systems and behavioural responses to incongruence.

4.3.0.1 Users as Mediators

Formal user training programmes serve to refine and enhance users' frames of technology-in-use with the underlying aim of advancing fit at user-level. The premise is that more advanced frames of technology should, following sensemaking theory, enable users to make sense of a wider variety of cues when

[156] Bansler and Havn (2006)
[157] Kanellis and Paul (2005)
[158] Pollock (2005); Ferneley and Sobreperez (2006); Hayes (2000); Ignatiadis and Nandhakumar (2009); Azad and King (2008); Le Roux and Le Roux (2010)

interacting with an artefact, minimising experiences of incongruence and increasing their ability to handle task variance. While an important and necessary aspect of systems development projects, formal training and support mechanisms play only a partial role in the development of users' frames of technology. This point is well illustrated in a study by Bansler and Havn.[159] Their study illustrates the important role of informal training and support provided by members of the user community to their peers. They investigate "technology-use mediation"[160] in the context of an organisation's adoption of a *Computer-Supported Cooperative Work (CSCW)* application.

The authors build their argument upon the perspective that users have a degree of freedom in determining their work environment through selecting technologies based on personal preference and task requirements:

> "No communication medium exists in the workplace in isolation and users are not passive consumers of media. They use the medium that suits their purpose at a particular point in time. When users experience problems using a new communication technology or get the impression that it is unreliable or malfunctioning, they will switch to another medium in order to continue their work. The alternative can be fax, email, telephone, a shared LAN drive, ftp, etc. Even though these technologies may in certain regards be considered inferior, users may, nevertheless, prefer them because they are more familiar and well known".[161]

The study takes particular interest in the way users enable sensemaking of technologies for peers. The authors perform a longitudinal interpretive case study in large (16 000 employees) pharmaceutical enterprise and conduct 34 semi-structured interviews focussing on *ProjectWeb*, a CSCW system to enable information sharing on large, long-term pharmaceutical projects.

Their findings suggest that certain users voluntarily adopt informal roles as *mediators*. These users typically share an interest in new artefacts, motivating them to become proficient in it before their peers. Their proficiency position them to exercise control over the artefact by customising it to fit work contexts

[159] Bansler and Havn (2006)
[160] As defined by Orlikowski and Baroudi (1991).
[161] Bansler and Havn (2006, p. 56)

and they naturally assume the task of assisting colleagues in the usage and customisation of the artefact.

> "The mediator's job is to adapt the technology to the local context of use by modifying features of the technology, promoting use, establishing appropriate communication norms, etc. To accomplish this, the mediator has to make sense of the technology in relation to the specific, local context".[162]

Through their adaptation efforts mediators exert pressure on artefacts and have significant influence on their nature and effectiveness in the organisation.[163] Importantly, this adaptation process is unpredictable and leads to open-ended sensemaking processes which oppose ideas about technological determinism.

The authors identify two types of actions performed by mediators:

- *Human-centered* actions include promoting artefact use, supporting users and establishing conventions of use which fit the local context. *Technology-centered* actions include maintaining and adapting the artefact. Mediators play an important role in enabling congruence by collecting proposals for artefact modifications, but also by inventing work-arounds if the artefact obstructs process flow.[164]

From a sensemaking perspective mediation highlights the influence of mediators on sensemaking as a social process. Through their communication with peers and their earned expert status, they have the power to highlight cues and disseminate frames about technologies, making them powerful forces in, not only directing sensemaking efforts of peers, but also structuring organisation. "Mediators are not passive or neutral facilitators, but are, on the contrary, actively involved in defining what the technology is, how it should be used, for what purposes, and by whom. It is the essence of the mediator's job to make sense of the technology and this sensemaking is an active process where the mediator simultaneously enacts the technology and an environment in which it fits".[165]

[162] Bansler and Havn (2006, p. 62)
[163] Bansler and Havn (2006, p. 56)
[164] Bansler and Havn (2006, p. 71)
[165] Bansler and Havn (2006, p. 75)

4.3.0.2 End-User Computing

Kanellis and Paul take particular interest in incongruence which results from the failure by organisations to effectively and efficiently maintain technological artefacts.[166] Users, while waiting for artefact updates, are often prompted to develop their own applications, however basic, to overcome instances of artefact-task incongruence. The idea of users acting as developers is, of course, not a new or rare phenomenon - the traditional boundary between these stakeholder groups have been particularly vague in the IT arena.[167] More commonly known as end-user computing or EUC, the practice is generally contributed to the inability of developers to deliver applications due to backlogs.[168] Users, in response to the resulting experiences of incongruence, use self-taught skills to produce basic applications such as programmed spreadsheets or VisualBasic (VB) scripts to overcome their obstacles for the time being. They are often quite successful in their efforts as they have the "advantage of knowing the requirements of their part of the business very well".[169] Coupled with this advantage the development of increasingly *easy-to-use* and advanced desktop applications, and the rising proficiency of the average end-user to utilise them, contribute to the likelihood of EUC proliferating in organisations.

Kanellis and Paul[170] investigate the role of EUC practices in enabling the continuation of work processes despite a high degree of incongruence experienced by a UK-based electricity supplier. The organisation, following various structural changes, failed to maintain their artefacts to satisfy requirements emerging due to these changes. During an 11-month case study the authors investigate EUC at the organisation and report a number of interesting findings.

The absence of a policy stipulating the use of specific artefacts in business processes, coupled with the availability of stand-alone tools created an environment where users were empowered to develop their own applications. Users seized the opportunity and "added value to the business in the form of some kind of informal application" and shared these applications with colleagues.[171]

[166] Kanellis and Paul (2005)
[167] Pollock (2005, p. 500)
[168] Avison and Fitzgerald (2006, p. 85)
[169] Avison and Fitzgerald (2006, p. 85)
[170] Kanellis and Paul (2005)
[171] Kanellis and Paul (2005, p. 75)

They point out that IS/IT departments tend to view such applications negatively. Not only are they often poorly written and unmaintainable, users tend not to test them sufficiently before implementation creating potential risks for the accuracy of data. Nonetheless, they report that users replaced formally designed artefacts with their own applications when, due to incongruence, their information requirements were not met. To users "a system has fit if it at least replicates faithfully a business process in place or takes the process to a new dimension in terms of adding value".[172] The sharing of end-user developed applications among users and user groups meant that EUC practices spread through the organisation quickly. A manager commented:

> "Just about everybody, everywhere, is taking data out of the main systems, and either re-keying it in, or use whatever method is available to them to get data into little applications, so that they can then move the data around and use it the way they want to, because they see the system they access as inflexible".[173]

According to the authors the IT department viewed these users as "a kind of underground alliance" with a disregard for the formal system imposed upon them. While the image implies that EUC was seen as an unwanted practice, there was a broad realisation (also among management) that it was essential to organisational operation.[174] EUC does not, per definition, imply resistance to (or working around) formalised systems. Users may adopt stand-alone tools for information processing to enhance their task performance in ways that do not contravene formalised information systems policy.

4.3.0.3 Reinvention through Workarounds

While EUC may be useful in overcoming certain deficiencies in formalised information systems, other experiences of incongruence may require users to contravene the system by working around it. ERPs, in particular, tend to impose policy adherence and limit users' freedom to develop their own information processing practices.[175] Boudreau and Robey argue, however, that users are

[172] Kanellis and Paul (2005, p. 76)
[173] Kanellis and Paul (2005, p. 80)
[174] Kanellis and Paul (2005, p. 81)
[175] Boudreau and Robey (2005, p. 3)

particularly innovative and creative in developing workarounds to counter such impositions. Despite various calls for research into workaround practices,[176] this area of IS remains notably under-researched.[177] "IS researchers have generally focused their theoretical energies on the intended use of information systems, devoting much less attention to computer workarounds"[178] and our understanding of these phenomena remains rudimentary. Fundamentally, the existence of workarounds rejects the idea that the outcome of information system projects can be predicted (as per technological determinism). It implies, rather, that human agency influences technology adoption by "shaping the enactments" of artefacts.[179]

Boudreau and Robey investigate these enactments in the context of an integrated system, referred to as *Compass*, after its implementation in a large government agency. Their aim is to explain how and why these enactments take on different forms over time. The study is performed over a 15 month period utilising interpretive techniques and focussing on "the subjective descriptions of users' practices and their expressed thoughts and feelings about the software package".[180] Their findings suggest that users enact technologies in different ways during the adaptation process. Three phases of this process are identified, along with two types of enactment:

1. In the first phase the most common form of enactment observed was *inertia*. Inertia refers to the enactment of a technology aimed at maintaining the existing organisational structure by reinforcing and preserving familiar practices. This implies that users invent ways to avoid the use of a new technology to preserve a sense of control over their environment. The authors report that, to achieve this, users continued using "shadow" systems (legacy support systems) or requested other users to interact with the artefact on their behalf.

2. The second phase observed is referred to as *improvised learning* and occurred around 14 months after the implementation of the new information system. During this phase the increasing pressure to adopt the

[176] Orlikowski and Iacono (2001); Kellogg *et al.* (2006)
[177] Azad and King (2008); Ignatiadis and Nandhakumar (2009); Pollock (2005)
[178] Azad and King (2008, p. 264)
[179] Boudreau and Robey (2005, p. 3)
[180] Boudreau and Robey (2005, p. 6)

new system forced users to familiarise themselves with it. Peers and power users became reluctant to interact with the artefact on behalf of other users but acted as unofficial trainers assisting them in learning to use the new artefact.

3. In the third phase of adaptation they identify a second type of enactment: *reinvention*. In this phase "users developed new practices that allowed them to accomplish their work using Compass despite technical problems with the technology and limitations in users' knowledge of the system".[181] The authors report that users initially felt "crippled" by the constraints (or impositions) of the new system but found ways to tweak or work around it. "In some cases, users established workarounds to compensate for what they considered deficiencies within the system. In other cases, workarounds were devised to compensate for users' ignorance of the system's features".[182] The authors note that actors also used the artefact's features is unintended ways to achieve their goals. One example given was the practice of using a data field assigned for one variable to enter another.

The authors conclude that although integrated artefacts "may be designed and implemented to restrict user discretion, especially when former systems are removed, the users studied consistently found ways to overcome intended restrictions".[183] They emphasise that the role of informal knowledge sharing practices among users in the adaptation process. While these practices encourage the progression from inertia to reinvention they also stimulate the development and sharing of workarounds.

Azad and King argue that, ironically, attempts to minimise business process variation through the adoption of integrated artefacts may be the very reason workaround practices emerge. The latent structures of such artefacts and the impositions they create force user communities to find alternative ways of coping with variances in processes. Impositions, then, do not minimise, but advance workaround practices.

The authors hypothesise that workarounds often depend on the joint action of user communities:

[181] Boudreau and Robey (2005, p. 10)
[182] Boudreau and Robey (2005, p. 13)
[183] Boudreau and Robey (2005, p. 13)

> "It is our contention that some computer workarounds often have an important social component alongside their IT component, and that they therefore entail spontaneous collective action (i.e., lack organisational sanction)".[184]

Underlying spontaneous collective action, they argue, are "tacit working agreements" that allow actors to "substitute" formalised practices with workarounds (i.e., *deviations* from formalised practices).[185] These agreements are continuously negotiated and re-negotiated among actors to enable their enactment. "Social actors negotiate to enact a 'deviation', since without such negotiations there is little chance that any deviation would be enacted in practice".[186] They refer to this "negotiative property of a rule-in-practice" as *interpretive flexibility* and define it as "the malleability of organisational artefacts, including computer-based procedures".[187] The organisational practices which emerges as a result cannot be predetermined and remains open to future change. "We conceptualize such practices as being enabled via a distinct social dynamic characteristic of professionally oriented organisational environments, that is, a negotiated order".[188] While designed order is inherently linear and typically inflexible, negotiated order emerges dynamically to align processes with requirements that were not envisaged during systems design.

The authors investigate the "behavioural underpinning" of workarounds through a qualitative case study of a hospital's medication dispension system, focussing, in particular, on workarounds as collective actions. They define the basis for collective action as involving, at a minimum, "a dialogical communication (although more than two people can be involved) in two parts: social interaction and information transfer".[189] Social interaction is defined as "any communication between two or more parties, either direct or artefact-mediated, that affects an action" while information transfer refers to "the informational aspects of communication, and can include attempts to notify, retrieve, collect or transmit information".[190]

[184] Azad and King (2008, p. 266)
[185] Azad and King (2008, p. 266)
[186] Azad and King (2008, p. 266)
[187] Azad and King (2008, p. 266)
[188] Azad and King (2008, p. 266)
[189] Azad and King (2008, p. 267)
[190] Azad and King (2008, p. 267)

Their findings suggest that negotiated order is observable in the existence of informal, enacted policies guiding information processing. These policies are often implicit and hidden from those outside the particular process but do not, per definition, oppose formal policies. On the contrary, they may be developed specifically to satisfy these more effectively, in spirit if not in letter. The existence of negotiated order cultivates the acceptance of informal policies by a user community, enabling once-off deviations to solidify in habitual workarounds. They note two examples:

1. The *verbal signature* workaround represents a scenario where social interaction replaces formalised activity as a means of bypassing certain steps in a designed process. An actor may, for example, request medication to be dispensed through social interaction rather than by filling in the appropriate request form.

2. The *fail-safe* workaround represents a scenario where multiple actors worked together to bypass impositions of an artefact which obstructs the completion of a task. In their case study nurses and pharmacists worked together to bypass formal system checks and provide patients with medication.

The authors emphasise that a workaround's reliance on collective action implies agreements or shared understandings of interpretive flexibility. Absence of agreement in this regard may lead to specific actors obstructing workaround practices for the sake of policy adherence. This may be observable in actors' reluctance to adopt alternative roles in a work process (i.e., act on behalf of others). Maintaining agreements about interpretive flexibility to enable collective action implies ongoing negotiation among actors. These "underlying social interactions exhibit significant variety while following a repetitive pattern",[191] serving to both communicate understanding and transfer information.

While workaround practices may be enacted to promote organisational performance, deviation from standard operating procedures may be undesirable to those actors aiming to control operations. Ignatiadis and Nandhakumar, while acknowledging the need for viable, flexible organisational processes, take particular interest in the negative impact of workaround practices on organisational control. They, too, follow an interpretive case-study approach to

[191] Azad and King (2008, p. 72)

investigate workarounds in a large multi-national organisation employing the SAP R/3 ERP. As a basis for their study they propose a balanced approach to structuration where human agency is defined as *intentionality* and artefactual agency as *affordances*.[192]

Their research site is a business unit within the organisation which experiences a large degree of incongruence with the adopted artefact creating a rich milieu for the study of workaround practices. The authors identify four distinct types:

1. *Workarounds in access profiles.* Due to limited tailorability of access profiles within SAP, users reported either having too little or too much access to data and functionality. To counter this deficiency they adopted the practice of using each other's profiles when logging onto SAP. While this practice held certain risks for the users themselves, they generally trusted each other enough to allow the use of their profiles by colleagues.

2. *Workarounds by interpretive flexibility.* Users also misused certain data fields within SAP to record variables they required but were not catered for in the design of the system. In some cases this was done not because the correct field did not exist, but to streamline data capturing. Surprisingly users had little understanding that such misuse would negatively affect later activities of the business process.

3. *Workarounds by using external systems.* Users favoured applications other than SAP to manipulate data when they perceived it to be more efficient and effective. Extraction of data from SAP and its subsequent manipulation in Microsoft Excel was a common practice. The produced spreadsheets were often used as a medium for data dissemination among actors, effectively bypassing the constraints of access control in SAP.

4. *Workarounds in data manipulation.* To overcome imposition enforced through mandatory fields in SAP users adopted the practice of entering dummy values into such fields. While this enabled business processes to continue it had a detrimental impact on the overall integrity of the organisation's data.

[192] The approach is based on a model developed by Rose and Jones (2005) which incorporates aspects of structuration theory and actor-network theory.

The authors come to the following conclusion:

> "Our findings indicate that workarounds can occur because of user ignorance of system functionality (which can be traced back to poor training), organizational policies (e.g., of the IT department) on the setting of system properties and characteristics (e.g., access profiles), as well as uncertain user requirements during the implementation of the ERP system (as may be the case when a new business unit is built)". [193]

Le Roux and Le Roux corroborate these findings in their investigation of an engineering firm's ability to continue operation despite a large degree of incongruence after the adoption of a new ERP artefact (*Sage ERP*). In accordance with Ignatiadis and Nandhakumar they report that incongruence is the product of mistakes made during the analysis and design phases of the implementation project. They also note, however that continuous organisational change implies that some degree of incongruence will remain an ongoing concern in ERP-utilising organisations.[194]

Their findings, following an interpretive case study, suggest that the network of informal information processing practices adopted by actors form a socio-technical buffer between the artefact and the organisation's requirements. These activities enable "the formation of a particularly dynamic, unformalised information system" which is continuously enacted by its stakeholders.[195]

> "The technological resources that form the backbone of formalised information systems are often cushioned from turbulent business processes by unformalised, socio-technical systems in which actors dynamically construct information management strategies. These socio-technical systems have the dual purpose of enabling flexibility in the information system and supporting the operation of technological artefacts despite misfit".[196]

The authors' primary focus falls on the "built-up repertoires of tacit knowledge"[197] (frames) that enable the undertaking of informal practices by organ-

[193] Ignatiadis and Nandhakumar (2009, p. 81)
[194] Le Roux and Le Roux (2010)
[195] Le Roux and Le Roux (2010, p. 7)
[196] Le Roux and Le Roux (2010, p. 7)
[197] Le Roux and Le Roux (2010, p. 2)

isational actors. They adopt, as starting point, those frame domains defined by Orlikowski and Gash (see section 4.2.1.1) and report that "users with more advanced technology-in-use frames have the ability to gather and manipulate data better than co-workers".[198] These frames, however, also enable them to develop informal information processing practices like workarounds (i.e., the better users know the artefact the greater their ability to work around it).

The authors also define a second frame domain which, they believe, underlie actors' ability to process information informally. They refer to the domain as *people frames* and define at as "the understandings that stakeholders of an information system come to have of each other on a personal and professional level".[199]

> "People frames played a vital role in actors' ability to develop information management strategies as it enabled them to identify not only the sources of data required to perform organisational work, but also the most effective method to access those sources (e.g., verbal, e-mail, phone). End-users of the ERP were well aware that misuse of the system at various points in the production chain meant that they could not fully rely on the accuracy and timeliness of Sage-data. This, coupled with their lack of meaningful technology-in-use frames, prompted them to find more accurate, real-time data from other actors through the utilization of their people frames and alternative technologies".[200]

4.4 Conclusions

The findings of the studies reported in the preceding sections highlight the argument that an *enacted technology* tend to differ significantly from the technology as envisioned by its designers. While various factors influence technology enactment, the reviewed studies suggest that the existence of incongruence in information systems plays a particularly important role in determining users' behaviour around artefacts.

[198] Le Roux and Le Roux (2010, p. 8)
[199] Le Roux and Le Roux (2010, p. 8)
[200] Le Roux and Le Roux (2010, p. 8)

4.4.1 Information System Enactment Defined

Based on the literature reviewed in this chapter it is possible to formulate a general definition for information system enactment. Before doing so, however, it is prudent to avoid conceptual confusion by briefly addressing the relationship between the concepts of *technology* and *artefact*. In research which concerns the enactment of information systems scholars tend to utilise the term *technology* in combination with or rather than *artefact*. It is emphasised that the two concepts denote different phenomena in this dissertation. In Chapter 3 the term artefact is defined to denote the *material nature* or *physical, deep and surface structures* of a technology. The term *technology*, however, denotes both the artefact and the human activities that design or use it. Hence, a particular ERP package is considered an artefact while a work system which utilises it is considered a *technology*. Following this perspective an information system may involve multiple technologies including formally designed technologies like ERP-based work systems as well as technologies like e-mail and spreadsheets which facilitate informal information processing.

Following sensemaking theory it may be stated that users in an organisation *enact* an information technology when they utilise it in accordance with their frames of the technology within the context of a particular organisational setting. Consequently, *enacted technologies* are jointly shaped by the material properties of artefacts and the actions of user communities. On a higher level of analysis the enactment of an information system denotes the enactment of the set of formalised and unformalised information processing technologies utilised within an organisation.

4.4.2 Theoretical Propositions

In much the same way that research on incongruence in information systems tend to focus on its generative mechanisms rather than its implications, the behavioural studies reviewed in this chapter pay little attention to the technical complexities which prompt certain responses by user communities. There is, consequently, a notable disconnect between research on the technical antecedents of incongruence and research on behavioural responses to incongruence. It is argued that, through the adoption of a sensemaking perspective, it is possible to investigate the relationship between incongruence and user behaviour in greater detail. This involves the study of user behaviour in information systems as the *enactment* of information technologies based on their individual and shared frames.

Following this perspective the findings made in the studies reviewed in this chapter can be used in the formulation of three theoretical propositions about the influence of incongruence on the enactment of technologies in information systems.

1. Proposition 1: *Experiences of incongruence in information systems advance the alignment of users' frames of technology and, as a result, increases correspondence between enactments of technologies in an information system.*

   Bansler and Havn's study of mediation in information systems reveals that one of the key ways in which frames of technology become shared by members of an organisation involves human-centered mediators assisting and supporting peers experiencing incongruence. Importantly, these experiences may be due to the users' ignorance and/or instances artefact-task incongruence. By triggering mediation among users incongruence has two important consequences. Firstly, it prompts frame sharing which advances the alignment of users' frames of technology. Secondly, following the principles outlined in section 4.2.4, it is expected that the alignment of frames will promote correspondence between the *enactments* of a technology by a user community.

2. Proposition 2: *Experiences of incongruence in information systems advance the design and enactment of informal information processing technologies in an information system.*

   The findings about EUC practices by Kanellis and Paul suggest that, when confronted with incongruence, users design their own technologies by utilising artefacts other than those which regulate formalised work systems. In doing so they are able to satisfy information processing requirements which are not catered for in the work system. Importantly, these *informal* technologies become shared, through mediation, when they satisfy requirements shared by multiple users.

3. Proposition 3: *Experiences of incongruence in information systems promote variance between a formally designed technology and the enactment of that technology.*

   The reported findings about workaround practices suggest that, when confronted with incongruence, users can choose to reject the impositions of formally designed technologies like ERP-based work systems by utilising alternative artefacts and creating new process flows. In doing so users limit the agency of designed technology in the organisation and gain control over their work environment.

It should be emphasised, firstly, that these propositions are the result of inductive reasoning guided by findings reported in literature and the principles of sensemaking theory. Underlying the propositions is the argument that the notion of *enactment* provides a means of exploring linkages between users' experiences of incongruence as influenced by technological antecedents and users' behaviour to maintain control over their work environments. Secondly, while it is possible that the propositions do apply to information systems in which ERP artefacts are utilised, they are based on studies which were performed in a variety of organisational contexts.

4.5 Summary

This chapter commences with an overview of Weick's theory of sensemaking in organisations. The theory is widely recognised and various IS scholars have adopted Weickian sensemaking to aid the investigation of cognitive processes in information systems. These investigations generally concern the processes during which individual users and user communities adopt new IT artefacts as part of information system projects. The disruption such IT events create in work environments necessitate that organisational actors adapt to new ways of work, a process which is influenced by characteristics of both the individual and his/her context.

A less prominent line of research provides some insight into users' responses to experiences of incongruence. A collection of studies which fall in this category suggest that users can, through various forms of improvised learning, resolve certain experiences of incongruence by updating their frames of technology and reinventing the features of a technology. A prominent form of reinvention is the development of workarounds which enable users to *bypass* certain artefactual impositions to complete tasks.

The studies reviewed in this chapter only partly address the effects of incongruence on the enactment of information systems. There have not been efforts to, for example, link enactment models with typologies of incongruence. Accordingly, there seems to be a lack of research which analyses the incongruence-enactment relationship on the level of the individual user. In the final section of the chapter a number of propositions are formulated to summarise and integrate the key findings of reviewed literature.

Part II

Empirical Analysis

Chapter 5

Planning and Preparation

The theoretical analysis reported in the first part of this dissertation reveals that research in IS has only implicitly or indirectly addressed the implications of experiences of incongruence for the enactment of information systems. While the antecedents of incongruence have been well researched by IS scholars, there have been few efforts to explore, at a high level of detail, their implications for user behaviour. In contrast, behavioural IS scholars have noted the impact of incongruence on the operation of information systems without considering the sources thereof in a systematic manner.

In Chapter 4 it is argued that the relationship between incongruence and user behaviour can be better understood through the adoption of a theoretical framework which describes the cognitive processes by which organisational actors perceive and enact their work environments. Weickian sensemaking theory provides such a framework and has been adopted by IS scholars in an array of studies. From these studies there is evidence that sensemaking theory provides a useful perspective for the analysis of the implications incongruence has for the construction and enactment of information technologies in the workplace. By utilising this perspective three propositions about the implications of incongruence for the enactment of information technologies were formulated in section 4.4.

The second part of this dissertation reports the execution of an empirical analysis which takes the form of a single, cross-sectional case study. The purpose of the empirical analysis is to address the primary research question through the collection, analysis and interpretation of data from an organisations utilising ERP technology. The empirical analysis is presented in three chapters. The first (current chapter) describes the planning and preparation which preceded the execution of the investigation. The second (Chapter 6) provides an in-depth overview of the execution of data collection including descriptions of the instruments utilised. The final chapter (Chapter 8) discusses the analysis and results of the investigation.

5.1 Research Design

Based on the aims of the empirical investigation and the findings of reviewed literature a number of important, high-level design decisions were made. This section outlines these decisions and their associated motivations.

5.1.1 Unit of Analysis

The investigation of *experiences of incongruence* and their implications for information system enactment necessitate the investigation of organisational actors on an individual level. This argument is supported, firstly, by the model of Goodhue and Thompson[1] which illustrates the impact of an individual's personal and task characteristics on fit and, secondly, by the findings of Strong and Volkoff[2] which suggest that both deficiencies and impositions are experienced by individuals. Hence, the *individual organisational actor* is the primary unit of analysis in this investigation.

While it is recognised that, at a higher level of abstraction, incongruence is experienced by *user communities* or organisations, Weick's theory dictates that the perceptual frameworks which facilitate sensemaking are only partially shared by the community. Experiences of incongruence, accordingly, are unique to individual subjects. By integrating findings about individual users it is possible to extrapolate findings to form more general conclusions about incongruence as experienced by organisational subgroups (e.g., units, departments etc.). This enables the researcher to consider sensemaking processes (and enactment) at the intersubjective and generic subjective levels of analysis.

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[1] See section 3.1.2.

[2] See section 3.3.4.

It should be noted that this approach is significantly different from those adopted in the reviewed studies of incongruence[3] where the unit of analysis is an instance of incongruence. In these studies the role of the user is implicitly recognised (i.e., the user *reports* incongruence), but little attention is paid the role users' frames of technology play when they experience incongruence. In this study the emphasis shifts, through sensemaking, from *instances* to *experiences* of incongruence.

5.1.2 Case Study Design

In the vast majority of the research studies covered in the preceding chapters of this dissertation, the empirical investigation performed took the form of a single case study. While often criticised by the broader academic community for its inability to produce generalisable results,[4] this form of research has been popular in IS with Chen and Hirschheim reporting that 36% of IS studies adopted it between 1991 and 2000.[5]

The interpretivist IS scholars, in particular, tend to favour case studies over surveys, the other popular design adopted in the field. While surveys are typically utilised in positivest studies, case studies are well-suited to interpretive research as they enable the researcher to utilise a range of qualitative techniques to investigate a particular information system at a high level of detail. "Case studies involve research in an organisation, either single or multiple site, over a certain period of time and such inquiries usually rely on multiple sources of evidence."[6] Yin defines it as an "empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident."[7] In contrast to surveys which serve the positivest aim of the hypothetic-deductive testability of theories,[8] the qualitative case study is well-suited to the goal of interpretivist research - to understand the deeper structure of a phenomenon with the aim informing other settings.[9]

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[3]Strong and Volkoff (2010); Sia and Soh (2007); Soh and Sia (2004)
[4]Yin (2009)
[5]Chen and Hirschheim (2004)
[6]Avison *et al.* (2008, p. 14)
[7]Yin (2009, p. 18)
[8]Chen and Hirschheim (2004, p. 201)
[9]See section 2.1.3.

Investigating phenomena at a high level of detail is a resource intensive and time-consuming process, mainly as a result of the techniques utilised during the elicitation and analysis of data. This is not only a consideration for researchers, organisations themselves may feel reluctant to participate in such studies when it involves, for example, interviewing employees during the workday. More importantly they may feel intimidated by or uncomfortable with such an in-depth investigation of their structures.

Despite these challenges the nature of the research problem under investigation in this study necessitated an empirical enquiry at a level of detail that could only be achieved through the execution of an in-depth case study. Four main reasons for this decision in the context of the research problem are:

1. *Level of detail.* Researching experiences of incongruence requires a detailed investigation of an organisation, its information systems, their associated artefacts and user communities. Case studies enable IS researchers to, through a single empirical enquiry, investigate the range of phenomena which structures the information system and the organisational reality of the end-user. It is not surprising that the vast majority of investigations in this line of IS research utilise the case study design with qualitative methods to achieve the level of detail required to address research problems.

2. *Multiple data sources.* The strength of the case study is its ability to deal with "a full variety of evidence", including interviews, documentation and artefacts.[10] Based on the findings of Chapter 3 incongruence is a complex phenomenon which can only be studied through the investigation of multiple sources of evidence. Coupled herewith the investigation of sensemaking processes against the backdrop of incongruence requires qualitative techniques that are sensitive to subtle differences between users' frames of technology. An accurate understanding of the incongruence-enactment relationship can only be gained through the triangulation of these data sources.

3. *Phenomena in situ.* Case studies are well suited to information systems research due to their sensitivity to the organisational context of the phe-

[10] Yin (2009, p. 11)

nomena under scrutiny.[11] Yin, accordingly, states that case studies are appropriate when the researcher wishes to study contemporary events without manipulating the behaviour of actors.[12] This is of particular importance in this study due to the role users' context plays in shaping instances of incongruence and actors' responses to it. The proposed problem is, as a result, not researchable through experimentation. Even if experiments can be performed in the field through some manipulation of the research site (e.g., by explicitly creating instances of incongruence), accurate replication of the range of contextual factors which will influence enactment would not be possible.

4. *Lack of research instruments.* The relationship between incongruence and enactment in information systems is not well-researched and the field's understanding of these phenomena is limited. There is, consequently, a lack of broadly accepted research instruments or protocols. Consequently, the proposed enquiry is explorative in nature, adopting the style established by like minded IS scholars.

The decision to perform the empirical enquiry using a case study raises three further design decisions. The first is whether multiple case studies or a single case study should be performed, the second relates to the duration of the case study while the third involves selecting the appropriate methods for data collection and analysis.

5.1.2.1 Multiple v.s. Single Case Studies

The majority of interpretive IS studies reviewed in the theoretical analysis involves single case studies. Importantly, their findings suggest, firstly, that users in a single organisation construct the same information system in a variety of ways[13] and, secondly, enact this system in accordance to these constructions.[14] It is expected, based on these findings, that within the scope of a single case study different individuals will experience and respond to incongruence in different ways. Two implications follow from this: Firstly, it implies that the

[11] Avison and Pries-Heje (2005)

[12] Yin (2009, p. 11)

[13] Askenäs and Westelius (2003); Orlikowski and Gash (1994); Henfridsson (2000); Griffith (1999)

[14] Beaudry and Pinsonneault (2005); Kanellis and Paul (2005); Bansler and Havn (2006); Ignatiadis and Nandhakumar (2009); Azad and King (2008)

incongruence-enactment relationship would only be partially determined by environmental factors and, secondly, that a single set of environmental factors is not shared by all actors in a single organisation.

The advantage to be gained from multiple case studies is that the researcher would be able to compare individual actors across cases under the assumption that differences between the organisations may illuminate the influence of environmental factors on the incongruence-enactment relationship. This would only be possible, of course, on the basis of a single account of the organisational environment in each case. The reviewed literature contradicts this notion suggesting that members of an organisation only partly share a single account of what the organisation is and that definition of an organisation depends upon the particular perspective taken. When multiple perspectives are generalised to a single *account of the organisation*, the result is an abstract, idealised framework which may correspond poorly with the perspectives of its constituents.

Based on this argument the decision was made to follow the interpretive research tradition in IS and perform a single case study in which the organisational environment is seen to be constructed and enacted by individual actors in the manner described by Weickian sensemaking theory.

5.1.2.2 Duration

A cross-sectional case study collects data from an organisation at a single point in time. Unlike longitudinal studies which aim to investigate changes in phenomena over time periods, cross-sectional studies investigate the dynamics of a phenomenon through a single *snapshot* thereof.[15] In this section the limitations inherent to this form of research are briefly addressed.

Studies of sensemaking in the context of information systems have shown that end-users' enact such systems in different ways over a period of time.[16] These changes are indicative of the development of the user community's frames as part of the adaptation process and the evolution of the artefact itself through cycles of development. While these studies inform the investigation undertaken here, it should be emphasised that their aims are significantly different. Unlike those of the reviewed longitudinal IS studies, the aim here is

[15] Chen and Hirschheim (2004, p. 206)

[16] See Chapter 4.

not to investigate the process of user adaptation from the introduction of a new artefact to some later point in time. It is, rather, to investigate users' experiences of and responses to incongruence at a particular point in the system's life cycle. In this regard, the key limitation of the cross-sectional approach is that it cannot investigate changes in these phenomena as products of the adaptation of a single unit of analysis over time.

While acknowledging this limitation, there are a number of reasons why it is only partially applicable here. Firstly, it is possible to, through the use of qualitative techniques such as narrative, elicit from the subject changes in his/her frames, experiences and actions over a time period. Secondly, it can be expected that within the context of large organisations utilising integrated artefacts, perpetual iterations of artefact development and refinement will create an environment where users are required to continuously iterate through cycles of adaptation. As a result, a cross-sectional study can investigate and compare users in different phases of enactment (e.g., inertia, improvised learning and reinvention[17]). Finally, as argued in Chapter 3, experiences of incongruence are not only products of a systems life cycle phase but of a great variety of variables (e.g., accuracy and completeness of requirements elicitation, quality and flexibility of the artefact, proficiency of the development team, training of the user community etc.). Kanellis and Paul, for example, illustrate how incongruence can increase, as opposed to decrease, over time due to organisational changes and poor artefact maintenance.[18]

Based on these arguments the decision was made to perform a cross-sectional case study and counter the above-mentioned limitations by:

- Reporting the history and current phase of the system's life cycle.
- Paying attention to changes in users' experiences of and responses to incongruence over time.
- Identifying differences between users in terms of their progression through the phases of enactment as identified by Boudreau and Robey.[19]

[17]See Chapter 3.
[18]Kanellis and Paul (2005)
[19]Boudreau and Robey (2005)

5.1.2.3 Flexibility of Design

Yin argues that the design of a case study may be adapted during its execution based on the initial analysis of findings.[20] He warns, however, that such changes should not "lessen the rigour with which procedures are followed" or influence the original objectives of the investigation.

While heeding these warnings the nature of the research problem investigated here require a degree of flexibility in the design of the research. In particular, the design of research instruments would depend upon the findings of higher level investigations like the review of documentation. By adopting an iterative approach by which collected data sources are partially analysed prior to the design of instrumentation for further elicitation the researcher can ensure greater instrument validity. Rather than altering the original objectives of the investigation such iteration may serve to ensure that the research is continuously aligned with its original aims.

In accordance with these arguments the researcher adopted a flexible design. Hence, the methods and protocols adopted for data collection were influenced, partly, by findings made during the execution of the investigation. Chapter 6 presents a detailed, chronological overview of this process and indicates how the initial analysis of data sources influenced subsequent data collection methods and instruments.

5.2 Research Site

Having adopted the case study method the first goal was to identify a suitable research site or case organisation. It was accepted that further design decisions would be influenced, partly at least, by aspects of the selected organisation. In this regard it was particularly important that data collection processes were designed with sensitivity for the organisational context. This implied the need for familiarity with the information systems in operation before finalising interview or survey questions. This section briefly outlines the selection of the research site followed by a detailed overview of its purpose, goals and regulatory environment.

[20] Yin (2009, p. 62)

5.2.1 Research Site Requirements

The objectives of the empirical investigation implied certain criteria for the selection of an appropriate research site. Most important, and fundamental to the aims of the investigation, the research had to be conducted in an organisation utilising an integrated enterprise system. As argued in Chapter 3 congruence between organisations and integrated artefacts is influenced by the latent structures of artefacts which are, through implementation, imposed upon the adopting organisation.

Coupled with this requirement the research site had to be large enough to present the researcher with a diverse user community. While smaller organisations often implement integrated artefacts, enterprises with large user communities offer a particularly rich context for the investigation of incongruence and enactment. Not only do they offer a greater sample of the primary unit of analysis, they also offer a larger and more intricate collection of business processes, complicating the achievement and maintenance of congruence.

Another key consideration was the extent to which the organisation defined its policies and standard operating procedures explicitly. For the researcher to identify instances of incongruence an initial analysis would need to investigate what, in the context of the research site, constitutes congruence. A detailed and refined description of how the information system is supposed to operate in the flow of standard business processes would provide the researcher with a basis from which instances of incongruence can be explored. If, on the other hand, the organisation's information system is predominantly the product of negotiated order and informal practices, as one may expect to find in smaller, less structured organisations, operating procedures would be in a constant state of flux. In such contexts the distinction between congruence and incongruence becomes problematic.

Finally, in accordance with the objectives of case study research the organisation needed to grant the researcher access to multiple data sources.

Based on these requirements the researcher identified three organisations as potential research sites. They included a large retailer chain, a food and beverage producer, and a metropolitan municipality. Each organisation was briefly analysed through a review of documentation available in the public domain and a contact within each organisation was identified. An invitation to participate in the study was sent to each contact. Two of the organisations reacted positively and, based on the initial analysis of each, the decision was made to select the metropolitan municipality. Two primary motivations for this decision are worth noting at this point. Firstly, the organisation is particularly large. It has a workforce of over 30 000 people of which over 10 000 are active users of a single integrated artefact. Secondly, because it is a local government organisation its structure and operation is dictated, to a large extent, by legislation. This provides a particularly attractive environment for the investigation of incongruence as the organisation's operating procedures have to conform to the specifications prescribed by legislative bodies external to the organisation itself.

5.2.1.1 Agreement of Institutional Permission

An important (and particularly difficult) aspect of the study was to finalise an agreement of institutional permission to perform the research with the organisation. Within the context of the high levels of fraud and corruption generally associated with South African municipalities,[21] one may expect that these organisations would shy away from close scrutiny of their operations by outsiders.

The municipality was initially approached through the Director of *Information Systems and Technology (IST)* and a meeting was scheduled to explore the possibility of it being used as research site. During this meeting the researcher presented a brief overview of the study and its objectives after which the Director was asked to, in broad terms, provide an overview of the organisation's information systems, focussing on how these had been developed and implemented. It was agreed, following this discussion, that the organisation would, in principle, be a suitable research site. Furthermore, the Director offered to act as the primary contact within the organisation.

The next part of the meeting involved outlining parameters for the execution of data collection. While the Director agreed that the user community as a whole could be investigated through the dissemination of a survey, a smaller subset of users had to be identified if qualitative techniques such as interviewing were to be adopted. From an incongruence perspective *Supply Chain Management (SCM)* presented a particularly attractive area for investigation. The reasons for this were, firstly, that it is an area identified by the *Auditor*

[21] An analysis of the state of local governance in South Africa is presented in section 5.2.3.

General of South Africa (AGSA) as particularly problematic in terms of adherence to policy and, secondly, municipal SCM activities are subject to strict legislation. The combination of rigorous regulations enforced by legislation and the need for efficient, accurate operation create a context likely to produce information system incongruence. The Director agreed with this argument and offered to approach the Director of SCM with the request to perform data collection within his Department. A second meeting was arranged in which both Directors were present. Permission was granted to the researcher to perform the investigation under the following conditions:

1. Researcher(s) will, to the extent possible, conduct data collection in a manner that is non-disruptive and respectful to the business activities of the organisation.

2. Individual participants will be asked provide informed consent (either web-based or paper-based) before participating in the research.

3. All individual participation will be done anonymously and voluntarily. Any publications utilising the data collected at the institution will uphold the anonymity of the individual participants.

4. Research publications utilising the data gathered at the organisation will not contain the name of the organisation or the names of its constituents.

In accordance with these conditions the organisation is referred to using the pseudonym *Metro* in the remainder of the dissertation. The final part of the meeting involved the specification of a time framework for the execution of data collection activities.

5.2.2 Background and Context

Having established Metro's participation in the study a review of literature regarding local government in South Africa was performed. The purpose of the review was to gain an understanding of the mandate South African municipalities are expected to fulfil and identify the legislation pertaining to their activities.

Through the use of, primarily, Internet search engines a collection of documents from these categories were compiled, categorised, reviewed and summarised based on their relevance to the research problem. Of particular interest were those documents addressing aspects of municipal SCM operations. The objectives of metropolitan municipalities are set out by the South African Constitution[22] and various aspects of their operations are determined by legislation available in the public domain. Furthermore, Metro provides, via its website and other communication channels, a large collection of documentation about its executive structure, policies and operating procedures. Finally, as local government organisation Metro is frequently a topic or sub-topic of articles published by news outlets or other popular media channels. The next section presents an overview of the findings of this review.

5.2.3 Local Government in South Africa

The South African Constitution[23] sets out the objectives of local government as follows:[24]

- To provide democratic and accountable government of local communities.
- To ensure the provision of services to communities in a sustainable manner.
- To promote social and economic development.
- To promote a safe and healthy environment.
- To encourage the involvement of communities and community organisation in the matters of local government.

The vehicle through which local governance is achieved in the South African context is municipalities, of which 283 currently exist.[25] The Municipal Demarcation Board has the mandate of ensuring that every part of the country

[22] Republic of South Africa (1996)
[23] Republic of South Africa (1996)
[24] Department of Cooperative Governance and Traditional Affairs Republic of South Africa (2009, p. 7)
[25] Department of Government Communications and Information System (2012, p. 259)

falls under local government jurisdiction.[26] The government divides its municipalities into three distinct constitutional categories, these are:

- Metropolitan Municipalities (of which there are currently nine)[27]
- District Municipalities
- Local Municipalities

Each municipality is further divided into *wards* that form the mechanisms through which community participation in matters of local government is achieved. Wards "form the basic units for participatory and democratic local government" and municipalities have between 10 and 109 wards based on their size and population density.[28] While these categories are generally used in government reports, an alternative system of categorisation is utilised by *The Department of Cooperative Governance and Traditional Affairs (COGTA)* which has the mandate of developing national policies and legislation for local government, and to monitor the implementation thereof. The aim of their system is to categorise municipalities in a manner that is reflective of the variations in the challenges that different municipalities face. The categories are:[29,30]

- A: Metros. Metros are large urban complexes with populations over 1 million.
- B1: Local municipalities with large budgets and containing secondary cities
- B2: Local municipalities with a large town as a core.
- B3: Local municipalities with small towns, with relatively small population and significant proportion of urban population but with no large town as a core.

[26] Department of Cooperative Governance and Traditional Affairs Republic of South Africa (2009, p. 7)

[27] Department of Government Communications and Information System (2012, p. 261)

[28] Department of Cooperative Governance and Traditional Affairs Republic of South Africa (2009, p. 22)

[29] Department of Cooperative Governance and Traditional Affairs Republic of South Africa (2009, p. 22)

[30] Figures represent pre-2011 data.

- B4: Local municipalities which are mainly rural with communal tenure and with, at most, one or two small towns in their area.
- C1: District municipalities which are not water service authorities.
- C2: District municipalities which are water service authorities.

An extensive set of legislative requirements regulate the structure and operation of municipalities. These are set out in a combination statutes which include:

- The Constitution[31]
- Local Government White Paper[32]
- Local Government Municipal Demarcation Act[33]
- Local Government Municipal Structures Act[34]
- Local Government Municipal Systems Act[35]
- Disaster Management Act[36]
- Local Government Municipal Finance Management Act[37]
- Local Government Municipal Property Rates Act[38]

5.2.3.1 The State of Local Governance in South Africa

Reports on the state of local governance in South Africa reveal an interesting contradiction. On one hand it is generally accepted that access to basic services has increased over recent years, particularly in poor, isolated and rural areas. A key driver of this expansion process has been the White Paper on Local Government published in 1998.[39] COGTA reports, accordingly, that

[31] Republic of South Africa (1996)
[32] Republic of South Africa (1998*c*)
[33] Republic of South Africa (1998*a*)
[34] Republic of South Africa (1998*b*)
[35] Republic of South Africa (2000*a*)
[36] Republic of South Africa (2002)
[37] Republic of South Africa. National Treasury (2003)
[38] Republic of South Africa (2004)
[39] Republic of South Africa (1998*c*)

"there is clear and demonstrable progress made by local government in accelerating access to basic services for the poor" which includes a 10% increase in access to electricity, a 6% increase in access to flush toilets and a 4% increase in access to clean water.[40] Moreover, these developments were achieved "at an unprecedented pace and extent hardly seen anywhere else in the world".[41] In contrast to these encouraging expansions, however, reports indicate that the ability of municipalites to effectively govern locally has deteriorated rapidly, with COGTA itself admitting that "a culture of patronage and nepotism is now so widespread in many municipalities that the formal municipal accountability system is ineffective and inaccessible".[42] Ironically, it has been service delivery which, despite its apparent expansion, has triggered ongoing stakeholder criticism. Dissatisfied citizens have expressed their frustration through an increasing number of major public, often violent, protests, with 52 of these occuring in 2009 alone.[43] COGTA concedes, accordingly, that "the overall positive progress and success of the local government system in South Africa is increasingly being overwhelmed by a range of factors and negative practices both internal and external to municipalities".[44]

In an attempt to quantify the extent of the problem *The Institute for Democracy in Africa (IDASA)* developed the *Local Governance Barometer (LGB)*, "a holistic model that generates a collective opinion about the state of governance in a certain locality".[45] Through the model the opinions of the relevant stakeholder of a municipality are captured and translated to indicators relevant to the locality where it is utilised. The model embodies the view that the quality of governance "is measured in terms of how well various actors handle the rules that make up the basic dimensions of the political regime".[46] Five main criteria are measured:

- The effectiveness of the municipality.

[40] Department of Cooperative Governance and Traditional Affairs Republic of South Africa (2009, p. 34)
[41] Memela *et al.* (2008, p. 10)
[42] Department of Cooperative Governance and Traditional Affairs Republic of South Africa (2009, p. 11)
[43] Department of Cooperative Governance and Traditional Affairs Republic of South Africa (2009, p. 12)
[44] Department of Cooperative Governance and Traditional Affairs Republic of South Africa (2009, p. 21)
[45] Memela *et al.* (2008, p. 2)
[46] Memela *et al.* (2008, p. 1)

- The application, compliance and enforcement of legislation and policies regulating local government.
- The accountability of political actors.
- The participation of the community.
- The extent to which citizens have equal access to services.

Based on their investigation of 16 municipalities, using the LGB, the organisation reports that, on average, South African municipalities score 51 out of a possible 100 points with adherence to legislation emerging as the most problematic dimension. Their data further reveals that, in general, municipalities have very limited or no audit reporting capabilities, poor managerial leadership, a lack of performance reporting systems and a lack of acceptable organisational structures. They emphasise, also, that councillors and administrators generally disregard all forms of legislation and that, in most municipalities, no anti-corruption strategies are in place to negate unlawful activity.

Symptomatic of the deterioration of local governance is a growing degree of dissatisfaction among stakeholders. "South African citizens are increasingly dissatisfied with the quality and quantity of services provided by local government"[47] and experience disillusionment about the ability of municipalities to create and uphold operating procedures which enforce legislation.[48] While COGTA accepts the validity and importance of municipal legislation, their report argues that various challenges impede its implementation, conceding that the "intent of the policy and legislation to guide organisational performance is often not matched by practice".[49] Particularly problematic is the *one size fits all* approach which requires municipalities with vastly differing resources to adhere to a common set of legislative requirements.

> "Cities such as Cape Town, eThekwini and the Gauteng complex for example, may require special legislation and functional planning authority to maximise their role in building the national economy, whilst rural municipalities in former 'homeland' areas for example,

[47]Memela *et al.* (2008, p. 1)

[48]Memela *et al.* (2008, p. 1)

[49]Department of Cooperative Governance and Traditional Affairs Republic of South Africa (2009, p. 32)

> need to be released from the complexities of compliance with an integrated development plan that is way beyond their capacity to implement".[50]

Apart from specific legislative requirements municipalities, as public organisations, are under significant pressure to adhere to and embody the goals of human development and are, with this aim, governed by "human rights principles, i.e. equality and non-discrimination, participation and inclusiveness, accountability and the rule of law".[51] This normative pressure is further augmented when political leaders make unrealistic promises, creating "a crisis of expectation" for municipal executives.[52]

5.2.3.2 Key Areas of Concern

Among the host of challenges experienced by municipalities, financial and supply chain management have emerged as areas of particular concern. In rural and poor municipalities the problem is accentuated by the scarcity of skills which makes it particularly difficult for municipalities to fill managerial positions with capable personnel, a problem which is further complicated by the absence of regulations to ensure staff competency.[53]

The main source of income for municipalities is service charges and ensuring that these are collected is critical to their financial viability. Despite the expansion of basic services failure to enforce debt collection and an increasing amount of aged debts (i.e., outstanding debts of more than 90 days) have pushed many municipalities into bankruptcy.[54] Coupled herewith is the issue of an increasing number illegal water and electricity connections.

The second largest source of municipal revenue is government grants. The management of these grants is based on a complicated "system of redistribu-

[50] Department of Cooperative Governance and Traditional Affairs Republic of South Africa (2009, p. 53)

[51] Memela *et al.* (2008, p. 2)

[52] Department of Cooperative Governance and Traditional Affairs Republic of South Africa (2009, p. 35)

[53] Department of Cooperative Governance and Traditional Affairs Republic of South Africa (2009, p. 31)

[54] Department of Cooperative Governance and Traditional Affairs Republic of South Africa (2009, p. 60)

tion" with the aim of redressing inequalities inherited from past administrations.[55]

> "Due to our country's history of inequity, there remain significant areas of poverty with limited social and economic development in spite of 15 years of attempted redress. This was sought through the intergovernmental fiscal system, which is based on a redistributive approach across all municipalities through the system of transfers".[56]

In the 2007/8 financial year government grants amounted to 22.4% of the total operating revenue for municipalities with 57 municipalities receiving more than 75% of their revenue from national transfers and 16 municipalities conceding that they are completely grant-dependent.[57] These municipalities cannot be considered financially viable.[58]

While generating income poses various challenges, ensuring accurate budget expenditure is equally problematic for municipalities. In 2007/8 the total over expenditure amounted to R2.6 billion, while total under expenditure amounted to R19.1 billion.[59] The inability of municipalities to manage finances and their failure to comply with MFMA policy have resulted in a lack of controls, opening the door for abuse and fraudulent activity. Among these, fruitless and unauthorised spending have emerged as the major culprits. At the heart of this problem lies the particularly vulnerable area of *Supply Chain Management (SCM).*

Chapter 11 of the MFMA sets out the regulations for SCM in municipalities. These regulations aim to ensure that "procurement processes, contract management and the controls in place to ensure a fair, equitable, transparent, competitive and cost-effective SCM system that complies with legislation and that minimises the likelihood of fraud, corruption, favouritism as well as unfair

[55] Department of Cooperative Governance and Traditional Affairs Republic of South Africa (2009, p. 54)

[56] Department of Cooperative Governance and Traditional Affairs Republic of South Africa (2009, p. 54)

[57] Department of Cooperative Governance and Traditional Affairs Republic of South Africa (2009, p. 58)

[58] Department of Cooperative Governance and Traditional Affairs Republic of South Africa (2009, p. 59)

[59] Department of Cooperative Governance and Traditional Affairs Republic of South Africa (2009, p. 62)

and irregular practices".[60] Given the general poor state of financial management within municipalities, it is not surprising that the implementation of the SCM policy has been dismal. The AGSA reports that, for the 2009-10 financial year, irregular spending by municipalities were almost always a result of the contravention of the SCM policy and legislation, accounting for 94% (R3.9 billion) of all irregular municipal expenditure. This figure increased to 98% (R 6 billion) in the 2010/11 financial year.[61]

The AGSA identifies six main areas of concern with regards to the implementation of SCM policy. These are:[62]

- *Limitations on the planned scope of audit of awards.* This resulted mainly from inadequate documentation of the procurement processes followed or missing documentation as a result of inadequate record keeping and document management. It occurred in 18% of municipalities.

- *Awards to persons in service of the state.* SCM policy "prohibits awards to persons or entities whose directors, members, principal shareholders or stakeholders are in the service of the state."[63] A vendor must declare "whether he/she is in the service of the state or, if not a natural person, if any of its directors, members, principal shareholders or stakeholders are in the service of the state."[64] 56% of municipalities were found not to uphold this regulation.

- *Awards to close family members of persons in service of the state.* SCM officials or those otherwise involved with SCM processes must declare any interests they have in vendors of goods or services to municipalities. In 26% of municipalities this was not done.

- *Uncompetitive or unfair procurement processes.* The SCM policy aims to ensure competitive and fair procurement by stipulating, firstly, that "formal written price quotations should be obtained for procurement of goods and services of a transaction value between R10 000 and R200

[60] Auditor General of South Africa (2011, p. 70)
[61] Auditor General of South Africa (2012)
[62] Auditor General of South Africa (2011, p. 71)
[63] Auditor General of South Africa (2011, p. 72)
[64] Auditor General of South Africa (2011, p. 72)

000 (VAT included)".[65] Secondly, the procurement of goods and services above a value of R200 000 (VAT included) must be done through a fair bidding process. Thirdly, that adequate public invitations should inform all bidders of the municipality's intention to obtain goods or services. Fourthly, any vendor must provide valid proof of tax clearance to the municipality and, finally, municipalities must employ the "preference points system" as outlined in the Preferential Procurement Policy Framework Act.[66] The AGSA found that 56% of municipalities fail to implement competitive, fair bidding processes.

- *Inadequate contract management.* Where vendors provide goods or services to municipalities on a contract basis, written versions of these contracts must be available. Accordingly, payments in excess of the amount approved in the written contract may not be made (this accounted for R46,5 million in irregular expenditure in 2009/10). Finally, these contracts must be monitored on a monthly basis to track the performance of vendors and avoid the unfair or non-compliant amendment, extension or renewal of contracts. 28% of municipalities were found to contravene these regulations.

- *Inadequate controls.* Included in this category are a number of factors: the lack of proper record keeping, failure to perform risk assessment, lack of effective internal monitoring and inadequate fraud prevention plans. 61% of municipalites failed to implement adequate controls.

Based on his findings the AGSA concludes:

> "The disregard for adherence to SCM legislation at the majority of the auditees are evidenced by these findings and are receiving attention to varying degrees at all levels of oversight. Based on the audit of fundamental SCM internal controls the findings are however showing that strong ethical leadership and monitoring, well established policies, processes and procedures for SCM and fraud prevention and detection and active governance by internal audit and audit committees can solve the problem."[67]

[65] Auditor General of South Africa (2011, p. 76)
[66] Republic of South Africa (2000*b*)
[67] Auditor General of South Africa (2011, p. 81)

5.2.3.3 Challenges Specific to Metros

Following general global trends the nine South African metropolitan municipalities (metros) have, in recent years, expanded considerably due to urbanisation and in-migration. This process has placed an increasing amount of pressure on the resources available to metros as the demand for the expansion of service delivery steadily climbs. Particularly challenging in this regard has been the rapid growth of informal settlements surrounding metropolitan areas as homeless, and often jobless, citizens migrate closer to the urban centres in the hope of improving their standard of living.[68] Unemployment levels in metros range between 26% and 50%.[69] Apart from these challenges the size of metros implies that they require "more sophisticated urban management capacity and skills to deal with spatial planning, land-use management and infrastructure life-cycle management."[70]

In the face of these challenges COGTA realises the strategic importance of metros in the broader economic landscape. Based on a review of municipal infrastructure by the Development Bank of Southern Africa the "transport systems in the cities (particularly road, rail and ports) have deteriorated over the last decade through increasing congestion, capacity constraints and lack of maintenance" and this threatens economic growth.[71] These findings are corroborated by a report by Council of Scientific and Industrial Research which concludes that municipal infrastructure is particularly poorly maintained in the long-term.[72] The combined expenditure of metros accounts for close to 60% of all municipal spending and they employ about half of all staff in local government.[73]

[68] Department of Cooperative Governance and Traditional Affairs Republic of South Africa (2009, p. 39)

[69] Department of Cooperative Governance and Traditional Affairs Republic of South Africa (2009, p. 23)

[70] Department of Cooperative Governance and Traditional Affairs Republic of South Africa (2009, p. 22)

[71] Department of Cooperative Governance and Traditional Affairs Republic of South Africa (2009, p. 39)

[72] Council of Scientific and Industrial Research

[73] Department of Cooperative Governance and Traditional Affairs Republic of South Africa (2009, p. 68)

5.2.4 Conclusions

Based on the findings reported in the reviewed literature it was possible to form an initial understanding of the challenges faced by municipalities in general and Metro in particular. By considering these findings from the perspective of incongruence in information systems, it is possible to draw some basic conclusions:

- The operations of South African municipalities need to adhere to an extensive set of legislative requirements. It can be expected, accordingly, that, following the adoption of a proprietary ERP package, the municipality would need to undertake extensive customisation of the package to ensure alignment between its operations and legislation.

- Findings suggest that, in general, South African municipalities are unable to achieve alignment between their internal operations and legislative requirements. As a result municipalities are generally associated with poor management and corrupt or fraudulent practices. Based on this general trend it may be assumed that municipalities generally fail to design and implement information systems which impose legislation upon operations.

- The areas of financial and supply chain management have been identified as particularly problematic in terms of adherence to legislation. Because these functions are integrated in most proprietary ERP packages it is expected that the adoption of such a package may serve to address the concerns raised by the AGSA under the premise that the package can be customised in accordance with legislative requirements.

- Together with pressure from legislative bodies, metropolitan municipalities are also under growing pressure from stakeholders to increase the quality of service delivery. The combination of these two forms of pressure on metros implies the need for information systems that impose structure in the organisation while also enabling and supporting efficient operation. This combination forms a context which is likely to produce experiences of incongruence.

- Lastly, the high degree of fraud and corruption in municipalities has sparked extensive debate in the public domain which can be expected to influence Metro's users' frames of technology strategy. In the context of this debate users can be expected to extract and enlarge cues about the artefact which relates to its role as a counter mechanism for fraud and corruption. This may encourage constructions of the artefact as manipulator which controls the work environment and imposes legislation upon users.

5.3 Summary

The planning and preparation activities which preceded the execution of data collection are reported in this chapter. Based on the findings made in the reviewed literature and the research problem of this study the decision was made to perform a single, cross-sectional case study at a large, ERP-utilising organisation. This decision is motivated and elaborated upon in section 5.1.2. While the limitations of the case study design are acknowledged, the conclusion is made that it is the most appropriate design to address the research problem.

The chapter outlines the decision making process which led to the selection of a research site: *A South African Metropolitan Municipality*. A detailed overview of the context and goals of South African municipalities is provided and key areas of concern are discussed. Municipalities operate in an environment which is regulated by a variety of statutes but reports suggest that they are often incapable of upholding these due to a range of challenges. Particularly problematic is the high degree of fraud and corruption in municipal supply chain management processes.

Chapter 6

Data Collection

Based on the review of public domain documentation, as reported in Chapter 5, the researcher gained an understanding of Metro's context and mandate. The next part of the study involved the collection of data from Metro itself. Following the principles of case study research the key objective is to form a holistic and in-depth understanding of the case through the collection and analysis of multiple sources of data. In accordance with this aim and in the context of Metro's large user community, a decision was made to employ both quantitative and qualitative techniques (i.e., a mixed methods approach) and triangulate the various data sources to establish an accurate understanding of the operation of Metro's information system.

It is interesting to note that, despite its apparent suitability to the IS discipline, a very small portion of IS studies adopt mixed methods.[1] Mixed methods can be employed in various ways to investigate phenomena depending on the aims of the research project. A common application thereof involves the use of qualitative techniques to form a broad understanding of the dynamics of a phenomenon enabling the formulation of relevant hypotheses and the development of quantitative instruments to test them. Alternatively, quantitative instruments can be used to recognise patterns or trends underlying phenomena, followed by a qualitative investigation which analyses these in more detail.

The collection of data involves four phases:

- Phase 1 involved the collection and analysis of data describing, in broad terms, the structure and operation of Metro's executive with particular

[1] Avison *et al.* (2008, p. 14)

focus on SCM.

  - Phase 1.1 involved high-level interviews with the Directors of IST and SCM.
  - Phase 1.2 involved the review of Metro's internal documentation.

- Phase 2 involved the design and deployment of a survey to Metro's ERP users involved in SCM business processes.
- Phase 3 involved semi-structured interviews with selected users working within the SCM Department itself.
- Phase 4 involved a group interview with the management team of Metro's ERP project (generally referred to as *the developers*).

The data collected in phases 2 and 3 of the investigation formed the primary sources as they related specifically to individual users. The secondary sources enabled the researcher to form an in-depth understanding of the users' organisational environment and were used to contextualise and corroborate findings made based on the primary data sources.

The order of the phases was important as it enabled the researcher to utilise findings made through the initial analysis of collected data in subsequent phases ensuring the relevance and validity of the instruments used. The sections which follow describe the design and execution of each of the four phases.

6.1 Phase 1: Organisational Background

6.1.1 Interviews with Director of IST and SCM

The execution of data collection at Metro commenced with an interview with the Directors of ITS and SCM. The aim of the interview was to obtain a high-level understanding of, what Metro termed, the *procure-to-pay process (P2P)* and how the organisation's information system(s) supported it. The P2P represents the SCM functions within Metro and includes a large set of business processes which enables the acquisition of goods and services by Metro from external suppliers (generally referred to as *vendors*). While the SCM Department itself lies at the heart of the P2P, the process is typically initiated by other departments with needs for goods or services from vendors. Together these departments utilise a large collection of vendors, each instance of which must be checked and verified by SCM in accordance with the regulations outlined in the MFMA. Hence, the main flow of the P2P is not determined by Metro itself but by the MFMA. To ensure that Metro's internal operations uphold the regulations set out by the MFMA close cooperation between the SCM and IST departments is essential.

By interviewing the two Directors together the researcher was able to form an accurate understanding of how Metro achieves this. During the interview the Directors outlined the main P2P flow and explained the purposes of the various checks and decision points therein. The Director of IST explained how the ERP package aligned with the process and which parts of it posed challenges Metro's developers. Finally, the Directors discussed their strategy for future implementation of ERP functionality within the P2P. The interview lasted 45 minutes and was transcribed for analysis.

Following the transcription of the interview the researcher analysed its findings in the context of Metro's SCM policy (which is available from its website). By combining the two sources a high-level description of the P2P was produced. While not explicitly stated in the policy document the interview data enabled the researcher to form a general understanding of the ERP's role in the P2P. The data did not, however, provide specific detail of the user roles, process flows, decision points or system use cases of the P2P. To ensure that the research instruments used to collect data from the users themselves were reliable, a more in-depth understanding of the P2P was required. The researcher approached the Directors of IST and SCM with a request for internal documentation which could satisfy this requirement.

6.1.2 Review of Internal Documentation

The set of internal documentation provided by Metro contained a total of 118 documents. It included:

- Organisational structure diagrams.
- Authority matrices for each branch of SCM.
- The structure and key functions of each branch of SCM.

- Activity diagrams describing the business processes of SCM including the P2P itself.
- Policy and regulation documentation applicable to various facets of the P2P.

These documents were reviewed and categorised based on their purpose and area of concern and played a key role in enhancing the researcher's understanding of Metro and the P2P. They provided an extensive description of Metro's structure and activities which assisted the researcher in contextualising the interview conducted in phase 1.1. Particularly useful were the formal definitions for *in-house* terminology used by interviewees and the activity diagrams (with partitions) which enabled the researcher to associate role-players with specific activities. Also indicated on the activity diagrams were the various ERP system use cases enabling the researcher to trace the role of the ERP throughout the P2P.

6.2 Phase 2: User Survey

The next phase of data collection involved the design and deployment of a survey to the ERP user community participating in the P2P. The size of Metro's user community enabled the researcher to utilise a survey to address certain dimensions of the research problem. While the Directors agreed to the dissemination of a survey to the user community they requested that it be designed in such a way that subjects would not have to spend more than 10 minutes on its completion. The researcher agreed to this limitation and decided to utilise the survey to focus on the second and third propositions formulated in section 4.4.2.

The second proposition states that

> Incongruence in information systems advances the design and enactment of informal information processing technologies in an information system.

While the third proposition states that

> Incongruence in information systems promotes variance between a formally designed technology and the enactment of that technology.

In accordance with these propositions the researcher expected, firstly, to find positive correlation between the regularity of misfit experiences and the adoption of informal information processing technologies (i.e., technologies other than the ERP itself). Secondly, positive correlation was also expected to be found between the regularity of misfit experiences and the tendency to use the ERP in unintended ways (e.g., *work around it*). However, based on the findings about workarounds[2] and EUC,[3] it was expected that these practices would be intertwined in the workplace. Following this view Boudreau and Robey's concept of information system *reinvention* was adopted as a proxy representing users' adoption of both practices.

While the survey focussed mainly on the incongruence-enactment relationship, a small set of items relating to the subject's role in the organisation were included. This was done, firstly, to determine whether, as proposed by Goodhue and Thompson, experiences of incongruence were influenced by particular characteristics of the individual's task portfolio. Secondly, the items were included to enable differentiation between user groups based on their functional area and positions in the organisational hierarchy. Finally, during phase 1 of the data collection process the importance of users' knowledge of Metro's SCM policy emerged as an important theme. Following this finding an item representing users' evaluations of their knowledge of the policy was added.

Based on these aims the survey was used to evaluate two primary propositions:

> P1: *The frequency of misfit experienced by users will be influenced by characteristics of their task portfolio and their knowledge of Metro's SCM policy.*

> P2: *The frequency of misfit experienced by a user will positively influence the degree to which he/she reinvents the information system.*

[2]See section 4.3.0.3.
[3]See section 4.3.0.2.

6.2.1 Survey Items

6.2.1.1 Section 1

To decide which individual/role characteristics to elicit the researcher followed three steps. The first was to build upon Goodhue and Thompson's TTF model, secondly reviewed literature on fit in ERP contexts were used and, finally, the data collected in phase 1 informed the decision. Three primary variables were chosen: Department (and Directorate), Requirements Diversity and Usage Frequency.

- *Department (DEP).* Azad and King's study reveals that, following the adoption of an ERP package, certain organisational units may experience a large degree of misfit due to failure of the package to satisfy their requirements set.[4] One can expect that units where tasks produce non-standard information system requirements would be most vulnerable to this pitfall. Accordingly, the researcher expected to find correlation between the subject's department and the degree of misfit he/she experiences within Metro. The survey displayed a list of the relevant departments based on the respondent's selection of his/her *Directorate (DIR).*

- *Requirements Diversity (RDV).* It is evident from the literature review that certain organisational roles are more prone to experiences of misfit than others. These roles typically involve task portfolios which require access to a greater or unique variety of information and information processing functionality. Because ERP packages are developed to satisfy general requirement sets users in such roles may be disappointed by the quality of proprietary ERP systems. A three-item scale, RDV, was developed to measure this aspect of the user's role. The scale included:

  - *Seniority (SEN).* Goodhue and Thompson report that misfit is experienced more by users in mid-level positions that are, due to their task portfolios, regularly confronted with "data incompatibilities".[5] Senior managers, contrarily, are shielded from these type

[4] Azad and King (2008)
[5] Goodhue and Thompson (1995)

of problems because they generally access data only after such incompatibilities have been dealt with (e.g., during reporting). The researcher expected to find similar results at Metro. While the various Metro departments employed different role hierarchies the researcher synthesised these to a general list including *Senior Manager, Manager, Supervisor, Administrator and Clerk*. Subjects could also select *Other* and specify their role.

  - *Task Variety (TVR).* Goodhue and Thompson report that users performing non-routine tasks are often frustrated with artefacts because they require non-standard functionality or data.[6] Users in clerical-type roles, on the contrary, are more likely to be responsible for well-defined, repetitive tasks and have, as a result, a less diverse requirement set. TVR was elicited through a five-point Likert scale question with indicators ranging from *very repetitive* to *a lot of variance*. It was expected that SEN and TVR would correlate.

  - *Reliance on Personal Judgement (RPJ).* A third variable closely related to SEN and TVR was the user's reliance on personal judgement during task completion. Underlying this variable is the argument that reliance on personal judgement is more readily associated with users in roles where information requirements are unpredictable or emerging. This variable was elicited through a five-point Likert scale question.

- *Usage Frequency (UFQ)* The regularity with which the user utilises the artefact is expected to influence fit. Goodhue and Thompson argue that while high usage frequency may produce better fit, it also produces greater reliance on and a more critical appreciation of an artefact.

The final question in the first section measured *SCM Policy Knowledge (SPK).* Based on the interviews with the Directors of SCM and ITS the user's knowledge of the SCM policy was identified as an important variable. The Directors suggested that user frustration is often a result of their lack of policy

[6] Goodhue and Thompson (1995)

knowledge rather than the artefact's quality. SPK was elicited through a five-point Likert scale question asking subjects to rate their familiarity with Metro's SCM policy.

6.2.1.2 Section 2

The second section of the survey aimed to measure the frequency of incongruence experiences of a user. To achieve this the researcher utilised the misfit typology of Strong and Volkoff[7] to develop a scale. The items in the scale measure the frequency with which the subject experiences the various misfit types through Likert scale questions. A problematic aspect of this part of the survey was the distinction between deficiencies and impositions. Strong and Volkoff make this distinction based on their theory of the latent structures of integrated artefacts. It was expected, however, that users would be unable to make the distinction accurately based on a concise survey question and the decision was made not to focus on it in this part of the investigation.

The final scale included a total of 11 questions testing five of the six misfit types defined by Strong and Volkoff. *Organisational Culture* misfit was omitted from the scale because phase 1 of the investigation revealed the utilisation of the ERP had become so ingrained in Metro's culture that it had become synonymous with organisational norms. Items included in the scale were:

- *Functionality misfit* was measured through two questions. The first measured the subject's perception of the efficiency of artefact usage *(FMF1)*, while the second measured perceptions about their effectiveness when using it *(FMF2)*.
- *Data misfit* was measured through questions relating to data accuracy *(DMF1)*, data completeness *(DMF2)* and data timeliness *(DMF3)*.
- *Usability misfit* was measured through two questions. The first related to ease of use *(UMF1)*, while the second, *(UMF2)*, related to the speed and satisfaction of artefact use.
- *Role misfit* was measured through questions about the fit between the subject's skills and tasks *(RMF1)* and the subject's ability to access data and functionality within the ERP *(RMF2)*.

[7] Strong and Volkoff (2010)

- *Control misfit* was measured through questions about the ERP's ability to handle variations and exceptions in the subject's tasks *(CMF1)* and the degree to which artefact impositions obstructed the subject's ability to complete tasks *(CMF2)*.

6.2.1.3 Section 3

The final section of the survey measured the degree to which the subject reinvented the information system by performing informal information processing activities or work-arounds to counter experiences of incongruence. Using, primarily, the findings of Chapter 4 the researcher identified five practices evident of reinvention which, based on phase 1 of the investigation, were likely to occur within Metro. In this section the deficiency/imposition distinction was utilised to enable the formulation of two questions for each reinvention practice. In the case of *verbal signature*, however, only a single question was used since this practice is almost exclusively a product of impositions.

- *End-user computing.* While generally discouraged by management the Directors were aware that users often extracted data from the ERP to spreadsheets for various reasons. This practice was not explicitly prohibited but the Directors noted the risks associated with it and hoped to stamp it out in future. It was measured as EUC1 and EUC2 based on different questions phrased for deficiencies and impositions.

- *Shadow systems.* EUC is, for obvious reasons, generally accompanied by the use of artefacts other than the ERP. Phase 1 of the investigation revealed that the use of a spreadsheet application *(Microsoft Excel)* was common among users. While the motivation for and purpose of shadow system utilisation would be addressed in phase 3 of the investigation, the survey enabled the researcher to determine the extent to which this practice was adopted in Metro.

- *Artefact misuse.* The practice of misusing the ERP typically takes two forms. In some instances users enter dummy variables in mandatory fields to counter impositions,[8] this was measured through *AMU2*. In other instances users may require a data field not available in the ERP.

[8]As reported by Azad and King (2008)

To overcome this deficiency they utilise an alternative, unused data field to record the required information. This was measured through *AMU1*.

- *Verbal signature.* The practice of bypassing formal information system regulations by verbally, as opposed to through the artefact, providing consent for the continuation of a process is typically adopted in response to imposition. It was measured through *VSG*.
- *Access profile.* The practice of accessing the ERP using the credentials of users other than oneself can be adopted to overcome either deficiency, measured through *ACP1*, or imposition, measured through *ACP2*.

While subjects were assured that their participation was anonymous, it was expected that some would not answer the questions in this section truthfully due to the *covert* nature of some reinvention practices. To counter this an indirect approach was followed in the formulation of the questions. In particular, the researcher utilised, what De Vaus refers to as, "the everybody approach".[9] This involves providing, prior to the question itself, a statement that informs the user of the popularity of the practice among ERP users in general. E.g., *To overcome problems users experience with large ERP packages they often have to find alternative ways to work with information.*

6.2.2 Survey Dissemination

Metro's entire ERP user community includes around 10 000 members of staff. While a large portion of these users only utilise a small part the ERP's functionality (specifically HR-related functions like viewing payslips or managing leave of absence), the system use cases embedded in the P2P involved close to 5 000 users. The SCM Department itself is relatively small (around 150 members) so the majority of these users work in one of 69 *line departments*. While the purpose of the survey was not to investigate the P2P in particular the researcher aimed to distribute it to users whose task portfolio involved regular and diverse ERP use cases. Such users, it was argued, would be more sensitive to a range of experiences of incongruence due to their reliance upon the technology. After consultation with the Director of IST the decision was

[9] De Vaus (1995, p. 85)

Item	Scale (if applicable)
Characteristic of individual and task portfolio	
Directorate (DIR)	n/a
Department (DEP)	n/a
Seniority (SEN)	Requirements Diversity (RDV)
Task Variety (TVR)	
Reliance on Personal Judgement (RPJ)	
Usage Frequency (UFQ)	n/a
SCM Policy Knowledge (SPK)	n/a
Regularity of misfit experiences	
Efficiency (FMF1)	Misfit Experienced (MFX)
Effectiveness (FMF2)	
Data Accuracy (DMF1)	
Data Completeness (DMF2)	
Data Timeliness (DMF3)	
Ease of Use (UMF1)	
Speed and Satisfaction of Use (UMF2)	
Skills Fit (RMF1)	
Access Fit (RMF2)	
Variation Handling (CMF1)	
Task Obstruction (CMF2)	
Adoption of reinvention practices	
End-user computing due to deficiency (EUC1)	Reinvention (RIN)
End-user computing due to imposition (EUC2)	
Shadow Systems due to deficiency (SWS1)	
Shadow Systems due to imposition (SWS2)	
Artefact Misuse due to deficiency (AMU1)	
Artefact Misuse due to imposition (AMU2)	
Access Profile due to deficiency (ACP1)	
Access Profile due to imposition (ACP2)	
Verbal Signature (VSG)	

Table 6.1: Summary of indicators and scales used in survey.

made to distribute the survey to all the users involved in the P2P. The final distribution list included 4 523 users.

Because the researcher would not be present when subjects completed the survey the clear, unambiguous formulation of questions were important. To achieve this the 16 principles outlined by De Vaus[10] were followed. The survey was developed in a web-based format using XHTML, CSS, PHP and MySQL. It was uploaded to the internet and a link to its URL was sent to the users in an e-mail which invited them to complete it. In the e-mail users were informed of the aims of the research project and that their participation was voluntary and anonymous.

6.2.3 Initial Analysis

The survey was available online for two weeks following the dissemination of invitations to participate. At the end of that period a total of 794 submissions were received, representing a return rate of 17.55%. The data captured through the survey were imported to and analysed with IBM SPSS Statistics (v. 19).

The initial analysis commenced with the preparation of the data for analysis. This involved, firstly, the recoding of variables. The Seniority (SEN) variable was recoded to an integer value ranging from 1 to 5 with 1 representing the most junior role (clerk) and 5 to the most senior role (senior manager). Also, certain items in the misfit scale required recoding to ensure consistent scale direction. This was followed by the analysis of missing values using *Little's MCAR (Missing Completely At Random)* test. While the test's result was statistically insignificant (Chi-Square=1412.147, DF=1395, $p>0.3$)[11] it is worth noting that the question producing the largest percentage of missing values related to the respondent's knowledge of the SCM policy (33 missing values, representing 4.2% of cases). Two actions were performed to minimise the effect of missing data on the analysis. Firstly, cases with four or more missing values were removed from the dataset (11 cases) and, secondly, remaining missing data were replaced using *EM (Expectation-Maximisation)*. Apart from these techniques the large sample size would minimise any effect missing data may have on the analysis.

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[10] De Vaus (1995, pp. 83-86)

[11] Statistical insignificance, in this context, implies that data are missing completely at random.

	Frequency	Percent
City Health	16	2.0
Community Services	101	12.9
Corporate Services	97	12.4
Deputy City Manager	36	4.6
Economic, Environmental and Spatial Planning	32	4.1
Finance	102	13.0
Human Settlements	48	6.1
Not Specified	7	.9
Safety and Security	63	8.0
Social Development and Early Childhood Development	4	.5
Tourism, Events and Marketing	5	.6
Transport, Roads and Stormwater	63	8.0
Utility Services	209	26.7
Total	783	100.0

Table 6.2: Number of respondents in each directorate.

Following the preparation of the data, analysis was performed to gain a basic understanding of the sample.[12] The items in the first section of the survey, those relating to characteristics of the individual and his/her task portfolio, were considered first. The analysis revealed that respondents hailed from each of Metro's 12 directorates (see table 6.2) and a total of 69 departments.

Initial analysis of the items in the second section of the survey confirmed that users throughout the organisation experienced various types of misfit on a regular basis (see table 6.3) and afforded the researcher an understanding of what types of misfit were experienced more frequently. This knowledge was utilised in the planning of phase 3 of the investigation.

Similarly, initial analysis of the items in the third section confirmed that Metro's users had adopted some of the reinvention practices reported in literature (see table 6.4). EUC, in particular, seemed to be a rather common practice.

[12]Detailed results of the statistical analysis are presented and discussed in Chapter 7, this section only provides broad descriptive statistics for each section of the survey.

	N	Mean	Std. Deviation
Efficiency (FMF1)	783	2.52	.951
Effectiveness (FMF2)	783	2.02	1.062
Data Accuracy (DMF1)	783	1.95	.982
Data Completeness (DMF2)	783	2.06	.977
Data Timeliness (DMF3)	783	2.15	1.033
Ease of Use (UMF1)	783	2.20	.975
Speed and Satisfaction of Use (UMF2)	783	2.59	.946
Skills Fit (RMF1)	783	2.13	1.031
Access Fit (RMF2)	783	2.13	1.051
Variation Handling (CMF1)	783	2.46	1.065
Task Obstruction (CMF2)	783	2.51	1.024

Table 6.3: Descriptive statistics of misfit experienced.

	N	Mean	Std. Deviation
End-user computing due to deficiency (EUC1)	783	3.06	1.272
Shadow Systems due to deficiency (SWS1)	783	2.49	1.171
Artefact Misuse due to deficiency (AMU1)	783	2.44	1.106
Access Profile due to deficiency (ACP1)	783	1.38	.804
End-user computing due to imposition (EUC2)	783	2.91	1.216
Shadow Systems due to imposition (SWS2)	783	2.34	1.176
Artefact Misuse due to imposition (AMU2)	783	1.74	.955
Verbal Signature (VSG)	783	2.48	1.178
Access Profile due to imposition (ACP2)	783	1.19	.575

Table 6.4: Descriptive statistics reinvention practices adopted.

	N	Mean	Std. Deviation
Efficiency (FMF1)	45	2.64	.712
Effectiveness (FMF2)	45	1.93	1.214
Data Accuracy (DMF1)	45	1.67	1.044
Data Completeness (DMF2)	45	1.87	1.057
Data Timeliness (DMF3)	45	1.98	1.033
Ease of Use (UMF1)	45	2.09	1.041
Speed and Satisfaction of Use (UMF2)	45	2.67	.798
Skills Fit (RMF1)	45	2.24	1.190
Access Fit (RMF2)	45	1.89	1.071
Variation Handling (CMF1)	45	2.36	1.004
Task Obstruction (CMF2)	45	2.44	.918

Table 6.5: Descriptive statistics of misfit experienced in SCM.

Because the third phase of the investigation (interviews with users) would involve only users from the SCM department, analysis of the same variables was performed for cases from this department (see tables 6.5 and 6.6). A total 45 respondents from the SCM department completed the survey and the descriptive statistics for this subgroup correlated well with those of the entire population. It was argued, accordingly, that users from the SCM department would offer an adequate sample for interviewing.

6.3 Phase 3: User Interviews

6.3.1 Aims and Objectives

The third phase of data collection involved conducting interviews with selected members of the SCM Department. The initial analysis of the data collected through the survey confirmed the existence of both experiences of misfit and informal information processing activities within SCM. In this phase of the investigation the aim was to utilise interviews to gain an in-depth understanding of the users' sensemaking processes as influenced by experiences of misfit.

The structure of the interviews were influenced by three aspects of the study. Firstly, Weick's theory of organisational sensemaking, as summarised

	N	Mean	Std. Deviation
End-user computing due to deficiency (EUC1)	45	3.33	1.243
Shadow Systems due to deficiency (SWS1)	45	2.71	1.141
Artefact Misuse due to deficiency (AMU1)	45	2.44	1.013
Access Profile due to deficiency (ACP1)	45	1.38	.984
End-user computing due to imposition (EUC2)	45	2.93	1.321
Shadow Systems due to imposition (SWS2)	45	2.27	1.095
Artefact Misuse due to imposition (AMU2)	45	1.58	.839
Verbal Signature (VSG)	45	2.51	1.199
Access Profile due to imposition (ACP2)	45	1.16	.638

Table 6.6: Descriptive statistics reinvention practices adopted in SCM.

in Chapter 4, provided an overarching framework for the interpretation of user attitudes and behaviour. Secondly, the findings of studies where sensemaking or aspects thereof are investigated in information system contexts provided a more specific set theories applicable to Metro's user community. Finally, knowledge gained from the initial analyses of secondary data sources enabled the researcher to formulate interview questions.

The first aim of each interview was to establish an understanding of the subject's frames relating to Metro's information system. This included, but was not limited to, the various categories of frames of technology as defined by Orlikowski and Gash.[13] While it was obvious that users' understanding of Metro's information system would be incontrovertibly tied to their frames of the ERP artefact, the researcher was sensitive to the role of other categories of frames.

The second aim of each interview was to extract from subjects narrative accounts of their experiences of incongruence and how these were handled. Based on the results of the survey the researcher expected that a single user would be able to provide several such accounts detailing various types of incongruence experienced. Also, in accordance with the findings of reviewed studies, the researcher expected that some coupling would exist between the subjects' frames and their responses to misfit.

[13]Orlikowski and Gash (1994)

Metro's SCM Department consists of six main branches:

- *Demand Management* oversees the management of the demands of line departments and the associated risks.
- *Tenders and Contracts (TAC)* manages the processes related to the sourcing of service providers and the administration of contracts awarded to them.
- *Procurement* provides services which enable the procurement of goods and services from vendors, including petty cash and emergency purchases.
- *Supplier Management* manages the verification and maintenance of the *Vendor Database* through regular communication with the vendor community.
- *Inventory and Stores Management* manages Metro's inventory and stock through a series of functions including maintenance, disposal and general administration.
- *Support Services* provides a variety of services to other SCM branches to ensure productivity and financial control as well as the management of SCM's personnel.

Based on an analysis of the SCM work-flow diagrams the Procurement and TAC branches utilised the ERP most extensively and in the most critical areas of the P2P. Coupled herewith the SCM regulations applicable to these areas were particularly rigorous. Based on these findings it was argued that incongruence would be experienced most frequently in these branches, both in the form of deficiencies and impositions. Consequently, a decision was made to target users from these branches for interviews.

Following this decision the authority matrices of each branch were further analysed to identify the roles which would be most prone experiences of misfit. Based on the findings of Chapter 3 focus fell on mid-level roles associated with task variation and reliance on personal judgement. A list of candidates was compiled and requests to participate in the interviews were e-mailed to 92 members of the SCM Department. Twenty-four users agreed to participate

Branch	Role	Number of Interviewees
Procurement	Team Leader	3
	Buyer	5
	Assistant Buyer	5
Tenders and Contracts	Practitioner	1
	Professional Officer	1
	Admin Officer	2
	Clerk 3	1
	Clerk 2	2
	Support Staff	1
Supplier Management	Clerk 3	2
	Head	1

Table 6.7: Branches and roles of interviewees.

and interviews were scheduled with each. The branches and roles of the 24 interviewees are displayed in table 6.7.

To ensure that the interviews caused minimal disruption to Metro's work processes two principles were followed. Firstly, they were conducted within a board room on the premises of the SCM Department. Secondly, they were, with the exception of four interviews, no longer than 40 minutes each.

The interviews were semi-structured and followed the same general pattern. At the start of each interview a short overview of the research project and the purpose of the interview was provided after which the interviewee was asked to give his/her consent to participate by signing a standard form in accordance with the ethical guidelines of the researcher's institution.

Following this introduction the interview involved eight primary questions:

1. Please give us a brief overview of your role and its associated tasks at Metro?

2. How do you use the ERP system during these tasks?

3. What is your general opinion of the ERP system?

4. Do you experience any problems or issues when working with the ERP system?

a) Could you describe one?

b) What do you do when this happens?

c) How did you learn to handle it this way?

d) Are there any problems which result from this way of doing things?

During the interviews the interviewer iterated through questions 4(a)-4(d) to allow the interviewee to discuss the various types of misfit they experienced and how they responded to each. The interviewer, based on responses from the interviewee, asked more specific questions where required.

All the interviews were recorded using a digital Dictaphone and the researcher made field notes after completing an interview to summarise the key aspects thereof.

6.3.2 Initial Analysis

To prepare for the fourth and final phase of data collection the field notes of the interviews were reviewed and a summary of the main themes was developed. While the users' perspectives of the ERP system and its role in Metro provided the researcher with an understanding of how the system was socially constructed by its user community, this understanding had to be contextualised in Metro's broader information systems strategy, particularly developers' efforts to promote ERP adoption. The user community raised a variety of views about the quality of service and support they were receiving from the developers and it was necessary to reconcile these with those of the developers themselves.

6.4 Phase 4: Group Interview with Developers

6.4.1 Aims and Objectives

Following the user interviews the researcher arranged a group interview with the team responsible for managing the implementation, maintenance and ongoing development of the ERP system, generally referred to as the *ERP Team* or *the developers*. While earlier interviews with the Director of IST afforded the researcher a historical understanding of Metro's ERP strategy, the interviews with the users raised a number of questions which necessitated a more detailed understanding of the ERP Team's post-implementation approach. The group consisted of four individuals including the Manager of the ERP Support Centre, the ERP Project Manager, a Senior Analyst and a Logistics expert.

During the interview the researcher raised key topics by posing a question to the group which led to a discussion among the group members. The topics raised included:

- The original development methodology followed.
- The techniques used during requirements elicitation and analysis.
- How successful the project is perceived to be by various stakeholder groups.
- How well the ERP aligns with Metro's requirements.
- User training.
- The key problems users experience and how they (users) overcome them.
- The functions of the ERP support centre.

The interview lasted 51 minutes and was recorded using a digital Dictaphone. Field notes of key contributions were made during the interview and elaborated upon afterwards. Because this was the final phase of the investigation the analysis of the interview was done as part of the main analysis reported in Chapter 7.

6.5 Summary

This chapter outlines the execution of data collection activities at Metro. Data was collected in four phases, each utilising the findings of earlier phases to ensure valid and accurate findings:

- Phase 1 involved the collection and analysis of data describing, in broad terms, the structure and operation of Metro's executive with particular focus on SCM.

  - Phase 1.1 involved high-level interviews with the Directors of IST and SCM.
  - Phase 1.2 involved the analysis of Metro's internal documentation.

- Phase 2 involved the design and deployment of a survey to Metro's ERP users involved in SCM business processes.
- Phase 3 involved semi-structured interviews with selected users working within the SCM Department itself.
- Phase 4 involved a group interview with the management team of Metro's ERP project (generally referred to as *the developers*).

Condensed summaries of the results initial analyses of data source are presented, together with the aims and objectives of each phase. A diagrammatic representation of the data collection process is presented in figure 6.1.

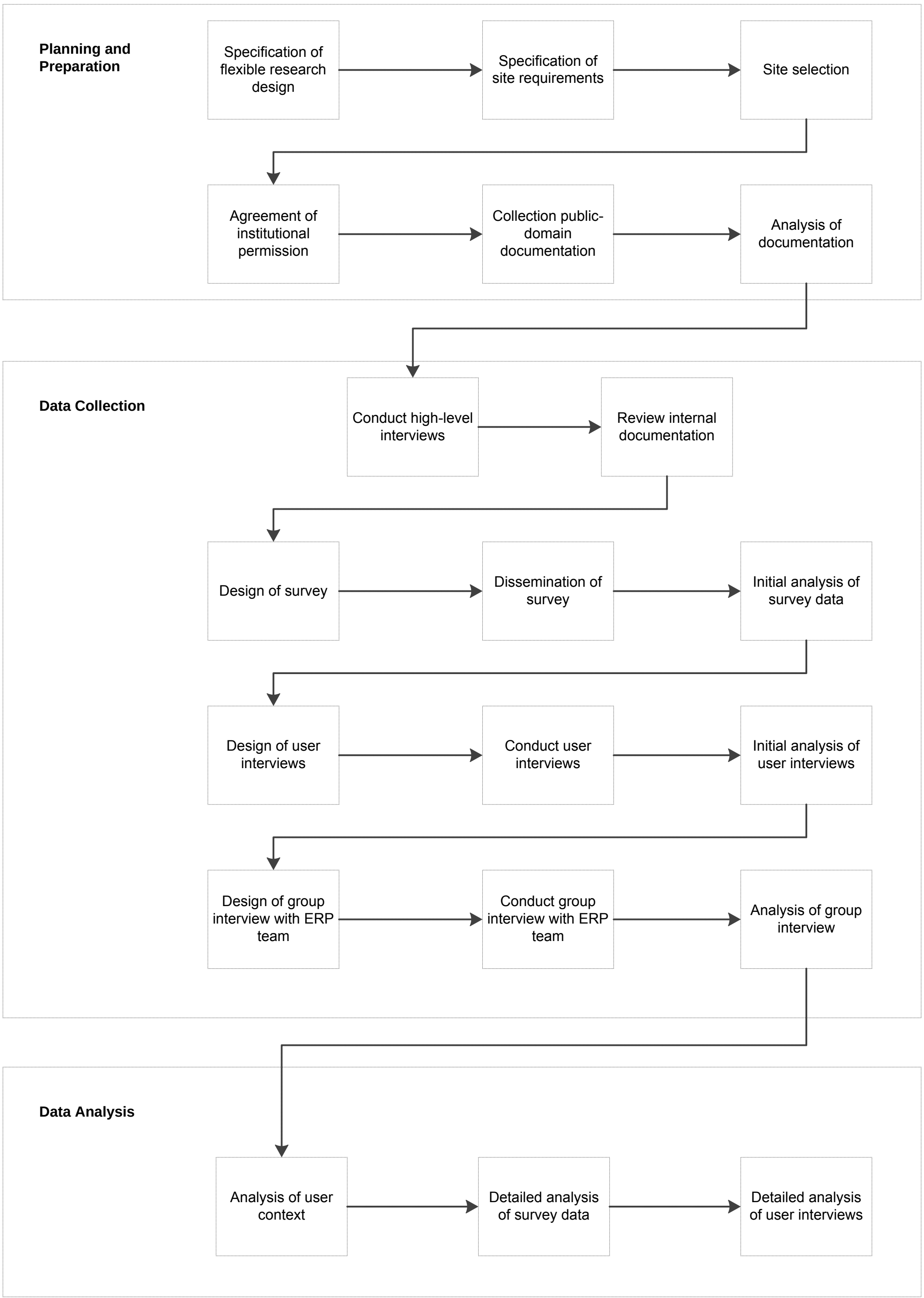

Figure 6.1: Diagrammatic representation of the empirical investigation.

Chapter 7

Data Analysis

Upon completion of the various data collection activities the researcher commenced with the in-depth analysis and triangulation of the data sources. This process involved three phases which are described in the three main sections of this chapter. The first phase involved the analysis of the secondary data sources to form a detailed understanding of the users' organisational environment. This involved plotting out the P2P and the role the ERP played in it as well as outlining the ERP project lifecycle to understand how Metro handled the implementation and adoption of the artefact. The second phase involved statistical analysis of the survey data, while the third phase involved the analysis of user interviews using descriptive and pattern coding.

7.1 Organisational Environment

This section reports findings made based on the analysis of secondary data sources It consists of two main parts. The first presents a brief summary of Metro's SCM systems and their associated business processes. The second outlines the organisation's IST strategy with particular focus on the role its ERP system plays in the SCM business processes.

The purpose of the section is to provide a detailed description of the organisational environment of the users. It is based, firstly, on the two high-level interviews conducted with the Directors of IST and SCM and the ERP project management team. The interviews were transcribed and analysed using a set of descriptive codes. Descriptive codes are used to attribute a "class of phenomena to a segment of text" in order to organise and cluster pieces of data

Code	Description
DEV	References made to the aspects of the individual developers or the development team.
ERP	References made to aspects of the ERP artefact.
ALI	References to the alignment between the ERP system and Metro's business processes.
TRA	References made to the training and support of users.
COL	References made to collaboration with the members of Metro outside the IST Department as part of the development process.
CON	References made to the role of the ERP in controlling the flow of business processes.
ADO	References made to users' adoption of the ERP system.
POL	References made to the SCM policy and its role in the organisation.
FUT	References made to future adaptations or extensions of the ERP system.

Table 7.1: Taxonomy of descriptive codes used in the analysis of user interviews.

for the purpose of interpretation.[1] The descriptive codes that were used are presented in table 7.1.

Together with these interviews Metro's internal documentation was analysed. Following Yin the primary role of documentation review in case study research is to "corroborate and augment evidence from other sources".[2] In this investigation it played an important role in providing the researcher with an understanding of Metro's structures. Two sections of the reviewed documentation was of particular importance to the researcher:

- The first was activity diagrams outlining the basic flow of business processes followed within the P2P. In addition to outlining business processes, these diagrams mapped out the primary system use cases in each, including the departments/branches and actors involved. Podeswa defines the basic flow (or "happy scenario") as "the most common way that the use case plays out successfully".[3] In the context of Metro these basic flows represented standard operating procedures and staff members were familiar with their composition. The evidence enabled the researcher to

[1] Miles and Huberman (1994, p. 57)
[2] Yin (2009, p.103)
[3] Podeswa (2009, p. 109)

model the various business cases in which the ERP was utilised as well as the pre- and post-conditions for success in each of these cases. Following this process the researcher could define what, in principle, constituted artefact-organisation congruence in the context of the P2P and, importantly, identify areas of the P2P prone to instances of incongruence.

- The second set of documents worth highlighting included the authority matrices outlining the roles and responsibilities of the various positions in each SCM branch. These authority structures play a crucial role in countering fraud and corruption by separating responsibilities in a manner which ensures transparent and unbiased decision making throughout the P2P and, as can be expected, the ERP was set up to impose these structures. A consequence of this rigidity are experiences of incongruence when business processes do not, for one of a variety of reasons, conform to the basic flow. By analysing the authority matrices in the context of the business process diagrams the researcher could identify example cases likely to create experiences of incongruence (specifically impositions). These cases were utilised in the interviews conducted with users during phase 3 of the investigation.

7.1.1 Overview of Metro's P2P

Metro was established as one of South Africa's metropolitan municipalities following municipal elections in 2000. The process involved the amalgamation of seven previously autonomous municipalities under a single local authority. Metro has a workforce of just over 30 000 people and is responsible for the delivery of municipal services to around 3,5 million citizens. Its population is spread over an area of 2 500 km^2.

As a local government organisation Metro is governed by a legislative council elected through municipal elections. The council at the time of the investigation was elected on 18 May 2011 and consisted of 221 seats. The council elects, from its membership, a mayor which is appointed as the head of the municipality's executive structure. The mayor, in turn, appoints an 12 member council representing the organisation's 12 directorates. Each directorate is managed by an executive director and divided into various functional departments. Metro's largest directorate (Finance) has 10 departments while the smallest (Social Development and Early Childhood Development) has two.

While unique in certain aspects of its implementation, Metro's P2P reflects the standard principles of organisational SCM. Its primary aim, accordingly, is to satisfy the demands for goods or services emerging from the work performed by the organisation's *line departments*. During interviews the SCM staff generally used the term *line department* to refer to any one of Metro's departments utilising the goods or services offered by the vendor community in the achievement of their mandates.[4] Hence, the process is typically triggered by the specification of a demand for goods or services by line departments. Where required the SCM Department's *Demand Management Branch* liaises with line departments to ensure the accuracy of demand specification.

In accordance with the MFMA the key attribute determining how line departments' demands are handled is the estimated transaction value thereof. Metro's SCM policy enforces these MFMA regulations through the specification of various demand *brackets* each triggering a different flow of the process.

Demands exceeding an estimated cost of R200 000 are handled through a competitive bidding process. Also handled in this manner are contracts awarded to bidders which exceed a one year term. The competitive bidding process involves an intricate set of activities which ensures that the demand is accurately specified, effectively communicated to the vendor community and, finally, awarded to a bidder following a transparent adjudication process of the bids received. At the time of the investigation this branch of the process (i.e., competitive bidding) was performed *manually* (i.e., not integrated with the ERP). The primary reason for this design decision was that the process involved complex document sets unique to the particular bid. The Directors believed that the advantages to be gained by digitalisation did not justify the effort involved in developing the required functionality. Apart from the nature of the input involved, the MFMA regulations for the bidding process involves various manual checks and balances which could not be automated. However, once a tender or contract has been awarded the relevant information is captured in the ERP system.

The next bracket involves estimated transaction values between R10 000

[4] The SCM Department itself does, of course, also utilise vendors from time to time in which case it acts as a line department.

and R200 000. A key decision point in this bracket is whether Metro can satisfy the demand through the utilisation of an existing contract. If a contract is in place for the supply of the particular demand the *Procurement Branch* creates a purchase order and sends it to the relevant supplier. If the demand cannot be fulfilled by a contracted supplier a formally written quotation process is followed. This involves obtaining formally written quotations and relevant supporting documentation from a minimum of three vendors prior to selecting one. Quotations may only be obtained from vendors already listed in Metro's supplier database (registered suppliers) or vendors meeting the criteria applicable to registered suppliers. A similar quotation process is followed for values between R2 000 and R10 000 but formally written documentation, apart from the quotation itself, is not required from bidders. Finally, transactions under R2 000 are handled through petty cash purchases and are formally reported on a monthly basis to the Department's Chief Financial Officer (CFO).

Due to the less complicated nature of capturing and communicating demands, the quotation processes are much better suited to automation with standard ERP functionality. Metro, accordingly, utilises the ERP extensively in this part of their supply chain. As a result the organisation has managed to shorten the timespan of a quotation-based procurement cycle dramatically. They have also, in the interest of efficiency, focused on ensuring that contracts are in place for the provision of regularly utilised goods or services.

The SCM policy outlines a series of conditions which, in accordance with MFMA regulations, must be met by vendors before Metro can consider their bids or quotations. These conditions include, among others, that the vendor must have a valid tax certificate and that the City Manager may reject a bid if the bidder's municipal service charges are in arrears for more than three months. Also specified in the policy are various exceptions which may be followed in scenarios where the standard process cannot be followed, e.g., emergencies.

On average Metro handles close to 30 000 supply-chain transactions every month. The bulk of these transactions involve the utilisation of contracts for the supply of products which Metro require on a regular basis. Once such a contract has been awarded, following the formal bidding process and the specification of an item's cost, the organisation can bypass the time-consuming processes of collecting and adjudicating quotations for a large part of these transactions.

7.1.2 The ERP Project Lifecycle

As a major part of its establishment Metro faced the challenge of integrating more than 100 smaller, fragmented legacy systems used throughout the municipalities which were amalgamated. Based on a high-level requirements analysis process the organisation realised the need for a large, integrated solution and a decision was made to implement a proprietary package. Following this decision Metro, in consultation with Gartner Research, initiated a rigorous selection process to identify the most suitable supplier. The process involved over 250 members of staff (mainly senior and middle management) and culminated in the selection of an international supplier. While the supplier had experience in the implementation of their product in local government contexts, Metro posed a significant challenge. The project was labelled as the largest of its kind (i.e., local government ERP implementation) ever undertaken.

The first phase of the project life-cycle involved a 4-month analysis and design process with the aim of ensuring alignment of the ERP with Metro's requirement set. The second phase involved the implementation of the accounting, procurement, materials management and human resources functionality and was completed in 10 months. The final phase of the project involved the release of the remaining functionality (consisting mainly mainly income and maintenance functionality) and was completed by mid-2003.

While Metro initially faced quite a lot of criticism for the project, mainly due to the costs involved, it was widely hailed as a success after the organisation reported a 14% rise in income generated through billing from 2004 to 2005. This improvement, it was argued, could be directly contributed to the improvement of Metro's information system. The return on investment meant that project effectively covered its own costs in the two years following implementation and future gains could be utilised to improve service delivery.

7.1.3 Key Aspects of Metro's Information System Strategy

The interviews conducted with the Directors and the ERP Project Team revealed a number of key aspects of Metro's information system strategy. This section outlines these aspects. Apart from providing some background on the project itself, they are evident of the various forces which have shaped the projects since its inception. The section combines findings from the group interview with the developers with findings from the interview conducted with the Directors of IST and SCM.

7.1.3.1 Single Artefact

From the outset of the project Metro made a commitment to rid itself of all legacy systems and integrate the ERP in every aspect of its business. Their philosophy was that project success could only be achieved through fully integrating all business processes within a single artefact. This implied heavy reliance on the product selected at the outset. A team member summarised this view:

> *Our strategy from the start has been to use [the ERP] standards only, or Vanilla [ERP]. We don't try to build new reports or functionality, we stick to the straight forward version. When it comes to upgrades its easy to upgrade. When you sit on the old systems [the ERP] refuses to do updates on it because of all the customisation they've done so they can't move forward. So we try to stick to [the ERP] standards as far as possible. You need a very good reason to move outside that!*

The team members were well aware of the risks associated with fragmenting the information system through the adoption of multiple artefacts and they were motivated to avoid such a scenario. There non-negotiable commitment to this policy was stated by a team member:

> *It goes all the way back to the strategy you choose when you implement. Because if you choose to only do Finances and leave out Stores, or anything else, you can't integrate with [the ERP]. Then you'll have a mess. There is one version of the truth and that's it.*

While realising that committing to a single artefact would lead to certain restrictions, the team firmly believed that the advantages generated through integration trumped these. As can be expected this principle created some friction with the user community. A team member explained:

> *I think what also helped was that the strategy with [the ERP] was to put it in as a wall-to-wall system. I mean, we got rid of so many legacy systems. It was a deliberate choice to go with [the ERP] and [the ERP] only. It's got all the integration, it's got all the functionality, so you don't allow all these other things and force people to use it. Even now we get loads of requests from users for other systems and the architect always asks whether it can be done in [the ERP]. If it can, then its done in [the ERP]. If [the ERP] can't deliver for you now then you wait until it can.*

It was interesting to note that, in the event of users querying this approach, the team viewed themselves to be in a position of power. This power was the product of their technical expertise and their ability to manipulate business processes through the artefact. In accordance with this view they exerted their power by refusing to provide support to departments wishing to adopt alternative artefacts. The team's manager explained:

> *Just from an architectural perspective we are very draconian in that regard, we are not very entertaining. We are not nice guys. We are actually quite ruthless, its our way or the highway. If you don't want to work with us, go on your own and three years later you'll come on your hands and knees to us because the Mayor needs to see [reports]. So it helps to have a draconian architecture and leadership. So we're not nice guys, you have to be cruel to be kind.*

While the developers generally subscribed to the view that the artefact could be integrated into every aspect of Metro's business, the Directors held a more conservative view. Integrating all facets of the P2P under the ERP, they argued, was not a feasible strategy. These opposing views were observable in the context of the *Supplier Relationship Management (SRM)* functionality the developers were deploying at the time of the investigation. The SRM functionality would, essentially, provide a web-based business-to-business platform to enhance and simplify interaction with the vendor community. SRM, the developers argued, would streamline procurement processes for Metro while also ensuring accurate, real-time communication to vendors. The primary area of the P2P which would benefit from SRM functionality would be low-value, high-volume procurement. Metro's strategy in this regard was to formalise their relationship with vendors through contracts. A vendor would, for example, be given a two-year contract for the supply of a particular, typically low-cost, product (e.g., cement) and these contracts would be utilised during the procurement process. Naturally, this frees Metro from undertaking the process of sending out RFQ's and evaluating quotations at every instance that the particular product is required. The Director of SCM explained:

> *What we focus on is getting everything out on contract, it's an 80/20 principle. For 80% of what we do on a regular basis, we need to have a contract in place. That contract must go through the tender process after which it is loaded onto [the ERP]. [Metro] has 10800 stock items on the track, we are going to put every one of those on contract.*

Because these contracted vendors would be interacting with Metro on a regular basis during their contract period, the SRM functionality would be particularly beneficial to them, providing them with a single view of their business transactions with Metro. Obstructing this strategy, however, was the fact that many of the vendors operating on this level were not used or able to utilise online SRM functionality and preferred more traditional modes of communication. On the contrary, vendors targeting the high-value, low-volume tenders were, in the view of the Directors, better candidates for SRM. The nature of high-value tenders, however, negated much of the value which could be gained from SRM. The Director of IST explained this contradiction:

> *When you talk about the high-value, low-volume stuff it's such complicated, procurement tendering documentation that you start saying is it worth building those into an online application in every instance, and I would say perhaps not. So this whole notion of automating the sourcing and the bidding is caught in the sort of trap of reality. On the one end where it is low-complexity, high-volume where you really want to do it, some of your vendors can feel excluded. On the other side where your vendors are enabled to respond to it, it is too complex. It's technically one-off's so why configure this whole thing for a special road? So I think we have*

> *got to be very careful to think to what extent we want to automate this and always ask ourselves is this really going to be, in the long run, the right thing to do. To ask a system to automatically do the adjudication for you on the big end tenders is probably asking too much and would actually create more problems than be benefits.*

The Directors' sensitivity to the requirements of the vendor community, as stakeholders of the information system, influenced their view. This sensitivity curbed their enthusiasm for the SRM roll-out. More specifically, they knew that vendors were quick to publically criticise Metro when their expectations were not met. The Director of SCM explained:

> *The vendor community is a very fickle community and the sense is that we have got 17 000 that are registered and can do business with us of which 10 000 don't get regular work so they are upset with us. The other 7 000 think we are great. And that is the disparity you get every time you talk to the vendor community. Also, they are not the most informed community.*

The role of differences which exist between the frames held by developers and business managers have been explored in the reviewed literature.[5] While agreeing with Orlikowski and Gash that the alignment of stakeholders' frames may be beneficial to the information system, Henfridsson's argument that their incongruence promotes innovation seems particularly applicable here. Understanding and managing the complexity of Metro's relationship with its vendor community is the prerogative of the SCM Department. If the developers failed to, at least partially, align their own frames with those held by the SCM staff their implementation of SRM would miss its mark. Conversely, SCM staff can only advise developers if they become aware of the possibilities created through SRM adoption. The tension resulting from these incongruent frame sets, it seems, creates a context for innovation.

7.1.3.2 Diversity of the Project Team

From its outset the project was driven, primarily, by the Director of IST. Metro utilised the services of five external firms throughout the implementation

[5] See Henfridsson (2000); Orlikowski and Gash (1994); Le Roux and Le Roux (2010)

including the supplier of the ERP. Working in close collaboration with the Director was the lead consultant from one of the external firms and a systems architect from the ERP supplier. Emphasis was placed on ensuring that the project team had a diverse set of capabilities and experience. One of the developers noted the following:

> *We were lucky with our implementation! It was really built by only three people: [The Director of IST], [the Software Architect] and [the lead consultant]. [The lead consultant] was from [a consulting partner] with a lot of project management knowledge. [The Director of IST] was an engineer with a lot of business experience and [the Software Architect] was the architect of the whole thing.*

This principle of ensuring that the project team is composed of individuals with diverse expertise was also reflected in the composition ERP Project Team at the time of the investigation. Another team member noted this about their current composition:

> *We've all got these different views and the meshing of all these skills makes this concoction work. It helps us to relate to the user. And that's why there has been this good uptake.*

The diversity of expertise and skills within the project team implies, in sensemaking terms, a greater variety of frames. While some overlapping would occur over time, frame diversity affords the project team the ability to make sense of development challenges in different ways. It was clear during the interviews that Metro understood the problem of information systems development as being only partially technical and realised the need to diversify their capabilities accordingly.

7.1.3.3 User Collaboration and Training

Despite their rigorous policy on adoption the developers placed heavy emphasis on collaborating with the user community to ensure ERP adoption. They realised the importance of user collaboration on two levels: firstly, they believed that success could only be achieved through management buy-in and, secondly, that artefact-organisation alignment depended upon a real understanding of the way users work.

They viewed management buy-in as a critical step in the development process and the key to ensuring adoption. To achieve this they aimed to earn the trust of directors and senior managers prior to the introduction of the artefact to one of Metro's departments. A team member explained how this was achieved with the SCM Department:

> *[The Director of SCM] has a very structured mind, and he is very dynamic. But he listens to good reason which is critical. We wouldn't get half the stuff done unless he buys in, that buy-in is very important. We do our work with the view that we've got their trust and we've got their interest at heart, always. That's the way we are doing it, as a collaboration. We say 'this is going to be good for you because of these reasons', its not just [an ERP] sell, I mean if you know [ERP] you'll know it's a lot about selling. Here it's more explaining to them how it will operate in their day-to-day lives and it makes sense to them because of that. It's never a hard-sell and it's always listening to what they want.*

Another team member noted that not all directors and senior managers shared their vision:

> *One of the advantages with [the Director of SCM] is you have committed process owner who wants to make it work, that makes a big difference. And there are few of them around in Metro.*

Interview data about the team's approach to working with the users themselves revealed some interesting findings. Initially their policy was that training sessions could be attended on a voluntary basis but the team soon realised that this was insufficient and devised a system of courses and assessments through which users had to pass before being granted access to the various ERP functionalities. A team member explained:

> *We don't profile a user to work on SCM processes unless he has done the training and passed our assessments. And we want an 80% pass rate, not 50%, 80%! If they fail we don't penalise them and make them leave their jobs we just make them sit the course again, and assess them again. Luckily nobody has failed by the*

> *fourth time. But it really works! Because now you ensure that the users in the system know what they are doing. And that really does help. It has been a shortfall based on the queries that we get.*

By conducting these learning programmes and monitoring user performance they made a rather interesting discovery. While users were often comfortable with the ERP's setup and knew how to complete transactions, they had difficulty dealing with cases which did not conform to the typical flow of a process. The developers believed that, while users had good enough knowledge of the ERP system itself, they lacked knowledge of the SCM policy and how to apply it in non-standard business cases. A team member explained this:

> *You get an efficient [ERP] user by getting a person to understand [the ERP] in itself, know where to click, know the shortcuts, know how to operate the system. But still we find that when they take that knowledge back to their work environments they can do all the basics - process an RFQ, adjudicate it, do the purchase order, send it out etc., but when it comes to things like expediting or reporting they are not sure what their own processes are. Then we get a lot of questions. As an [ERP] user they know exactly what to do, but the business knowledge is lacking. So the problem is not so much system-wise as business-wise, but because the two are married together you cannot divorce one from the other.*

Another team member agreed, offering an alternative angle to the problem:

> *Actually, we often have to limit them too. They'll say why can't we also have this and that and we'll have to say you can't because it is not your process. I can give you access to it, it's in the system, I can give you anything... But the reality is that you're not allowed to do it. It's about enlightening them so that rather than getting frustrated with the system, they understand that it's the policy behind the system that dictates it. The more they know about the policy the better it works for them.*

To counter this problem they started conducting user workshops during which a group of users would be in a training environment while conducting transactions on *live* data. One of the effects of this approach was that users felt they could attend a training session without falling behind on their work. It also enabled the trainer to guide the users through the more complicated use cases in the context of actual P2P data as opposed to dummy scenarios. A team member outlined this strategy:

> *The user actually sits in a group, in front of people, and he is told 'OK, this is your task, go'. Now everybody in the room learns from it and that's a really effective way of teaching. It works because it's live data, so he is doing his job and getting trained. He's not sitting there thinking 'Oh, I'm wasting my time with these meetings'. He's doing his job and he is understanding. He also gets a lot of questions from his colleagues, it's working really well. But you need to have buy-in from his director and his manager to pull it off because you are taking people away from their desks. We have a massive user base so when you make a system change you can't just bring them all in. It's a huge project to re-train and re-educate them.*

The size of the user community necessitated careful planning and execution in the event of changes to the artefact. While the team realised that the ERP needed to be updated and maintained, they were aware that such changes could destabilise business processes if they were not done in collaboration with all the users effected by them. This necessitated the adoption of a holistic view of processes dictating that if a single activity in a process lacks efficiency the process as a whole becomes problematic due to the creation of back-logs and bottlenecks. A member explained:

> *What we also found with these workshops is that by targeting a certain portion of the P2P cycle you will not fix anything. So we have to speak to every user along the chain of activities in the process and get them all in line. Otherwise you'll create a silo-effect where people sit in their area and think they are doing good. They might be doing good for themselves but the rest of the process suffers, and then you get the bottlenecks and stuff. You need to speak to everybody involved if you want to make things work.*

7.1.3.4 Fit and Control

The developers did not regard their strategy to work within the standards and specifications of the ERP product as an obstruction to ensuring artefact-organisation fit. Their view was, rather, that the artefact could and should be manipulated to conform to organisational policy while still upholding the vendor's standards. A developer explained:

> *The system should reflect the business process. The moment [the ERP] and the process are not aligned, things go wrong. So the moment you constrict [the ERP] to that role then it's fine. [The ERP] can be tweaked but you can't build your business rule around it, that's the wrong way around. You need to build it to make your business work and if your business changes you need to change [the ERP], otherwise you'll lose out. So from this side we try to adhere to their business processes.*

Based on the interview data it was apparent that the developers viewed the artefact as a control mechanism through which the accuracy and integrity of processes could be ensured. Most importantly the artefact had to uphold and enforce the organisational policy. To ensure this artefact-policy fit the team emphasised the analysis organisational policies as a crucial step in their development process. Their view is evident in the following statement made by a team member:

> *That's, to me, one of the advantages of ERP - you can basically hard-code the business process into the system and users have to follow it. Like the adjudication of RFQ's, for example, there is a whole lot of legislation that dictates the process, and that is all built into the system. The user can't get around that. So I think users, if they don't understand that, then they will query the system. But the more they understand that, the more they will understand why the system does it, and they'll trust the system to do it. You know to me that's one of the big advantages that we've had in [Metro], the ability to hard-code processes, so there is one P2P process that the whole [organisation] must use and they don't have an option.*

> *Then you can ensure consistency in your organisation. Whereas previously it was all done on paper, I mean, there was no control.*

While acknowledging that the ERP played a crucial role in facilitating the P2P, the Directors were less convinced of its ability to control users. Their view was that the users themselves had responsibility to act in accordance with policy and could, if they wished to, work around the ERP. The Director of SCM was careful to distinguish control from management when referring to the role of the artefact in his department:

> *There is a lot of work being done to use the [ERP] system to control the procurement environment. No sorry, rather to 'manage' the procurement environment.*

The primary instrument of control, in his opinion, is the SCM policy itself and he emphasised that the specification of policy is not a once-off exercise but a continuous balancing act between the prescriptions of the legislative and the capabilities of the executive.

> *The vision coming out of the policy has been an on-going work of art for the last three years. [The challenge is] conceptualising a policy which has to align 100% with legislation and enable you to have contracts in place for everything.*

The Directors also held a different view of the relationship between the policy and the artefact. While agreeing that the artefact can, in principle, support policy implementation, they noted that the reality of organisational work is not always as controllable as the developers envision it to be. The Director of SCM explained:

> *Enshrined in the [ERP] system is the concept of the policy and this is why the people need to understand it before they launch a requisition. Even before they open their mouths to a vendor because in real terms they are not supposed to be opening their mouth to a vendor before they have done a whole lot of other stuff. You are never going to get a policy that is encapsulated into the system but you are going to have facets of this policy in it. From this policy comes procedures, approved ways that we do business.*

The Director of IST shared this view:

> *This is a topic that we talk about often, at the end of the day the system can go so far but there is a good old thing called management. People need to do certain things and, sometimes, there is a notion to hide behind the system or to withdraw behind the system and make up for your own shortcomings by saying 'well, it's a system problem' or 'the system should have done that'. The reality is the system will take it up to a point but people, the managers, their oversight, the controls that are built into an organisation's policies, its delegations and so forth, need to be enacted on.*

The Directors were of the opinion that users could, at various points in the P2P, circumvent the impositions of the artefact and contravene the policy. The Director of SCM provided a hypothetical example:

> *So you RFQ under R200 000, we have technically catered for that, but it doesn't mean that if, for example, a funny buyer wants to be clever and try to produce an order for R4 million that the system is going to stop it just because the policy says you must have a tender above R200 000. There has to be other checks and balances too.*

Besides questioning the ability of an artefact to enforce policy, the Director of IST was weary of possible negative implications of enforcing control through the artefact. He argued that too much imposition would limit process flexibility and ultimately lead to inefficiency:

> *Let's say policy says you are going to go out on tender for an item over R200 000. The system isn't going to know whether such a tender exists, so if a buyer wants to circumvent the thing he can. But because you created an order for that amount, it will escalate to a senior buyer for approval. So it is this whole notion of pro-active v.s. re-active controls and trying to find that balance. The more pro-active controls you put in, the more you actually lock the organisation down. So we have a lot of pro-active controls but sometimes you also need to rely on people to do the job and that is where you have more re-active controls. Escalation, authorisation,*

> *reports that pop out, management information etc. You can spin an organisation into an absolute standstill with unnecessary controls.*

It is interesting to note that, like their view on the roll-out of SRM functionality, the Directors adopt a more balanced view of structuration. Their understanding of the information system is one which recognises the agency of the user community and the limitations of the artefact as control mechanism. Accordingly, they are less convinced that every instance of the P2P cycle can be catered for by a single set procedures but argue, rather, that some flexibility should be maintained by allowing users to rely on their personal judgement when making decisions. This, inevitably, creates a scenario where users are not forced, but trusted to act in accordance with Metro's policy.

7.1.4 Expressing Metro's Dynamics through a Checklandian Rich Picture

Checkland utilises, as part of his Soft Systems Methodology, a technique referred to as *rich pictures*.[6] Rich pictures enable systems analysts to express complex organisational problem scenarios and are typically used in the early phases of analysis. While there are few explicit specifications which guide the design of rich pictures they aim to express an organisational scenario by visually representing the various systems involved and how these relate to each other. The main concerns of each system are typically expressed through the use of *thought clouds*.

To visualise and summarise the findings made based on the secondary data sources a rich picture was developed. While normally aiding communication between analysts and their clients, its purpose in this instance is to provide a holistic overview of the various systems shaping Metro's organisational reality and how these impact the user community. This high-level understanding forms the basis for the interpretation of findings from primary data sources as it is within these dynamics that users experience incongruence and enact information systems.

The rich picture includes two systems external to the Metro executive. The first is the legislative which, at national, provincial and local levels, develop legislation which Metro needs to execute through the specification and

[6] Checkland and Holwell (1998); Checkland and Scholes (2000)

enactment of its policies. Adhering to legislation is non-negotiable and the relationship between the executive and legislative is a politically sensitive one requiring careful management. In the context of the P2P and, in particular, the AGSA's findings on fraud and corruption in local government, Metro has to design its internal operations with careful consideration of the prescriptions of legislation. Failure to accurately execute legislation would not go unnoticed by the AGSA and would be detrimental to the image of Metro's political leadership.

The second external system is the vendor community which plays an integral role in Metro's ability to serve its citizenship. While Metro depends heavily upon its vendor community, it also has, within the bounds of its SCM policy, the prerogative to evaluate and select vendors. The Directors realised the complexity of this relationship and the need to carefully manage interaction with vendors. Importantly, the majority of direct interaction with vendors is performed by SCM staff (particularly by members of the *Suppliers Branch*) on a daily basis.

The rich picture includes five more systems which fall within the boundaries of Metro's executive. Three of these systems are social collectives. The first, executive management (i.e., directors and senior managers), specifies and implements organisational policy which, in turn, upholds legislation. The second, developers, controls the artefact, collaborates with management and trains the user community, which is the social system. The remaining two systems are the artefact itself and Metro's policy. While susceptible to control by the developers, the artefact's latent structures also restricts the degree to which it can be manipulated. This is, to some extent, a result of the developer's decision to work within the artefact's standard protocol but, more specifically, a consequence of the original decision to adopt a proprietary integrated artefact. Much like the artefact, the policy can be considered as a system which needs continuous maintenance and adaptation with the aim of striking a balance between upholding legislation and efficient operation.

It is, at this point, worth focussing on the users in the context of these systems dynamics. As found in the analysis of the secondary sources the policy and the artefact both impose upon the user community specific operating procedures. Reviewed literature suggest, however, that users have a degree of freedom to accept or reject these impositions through their enactment of

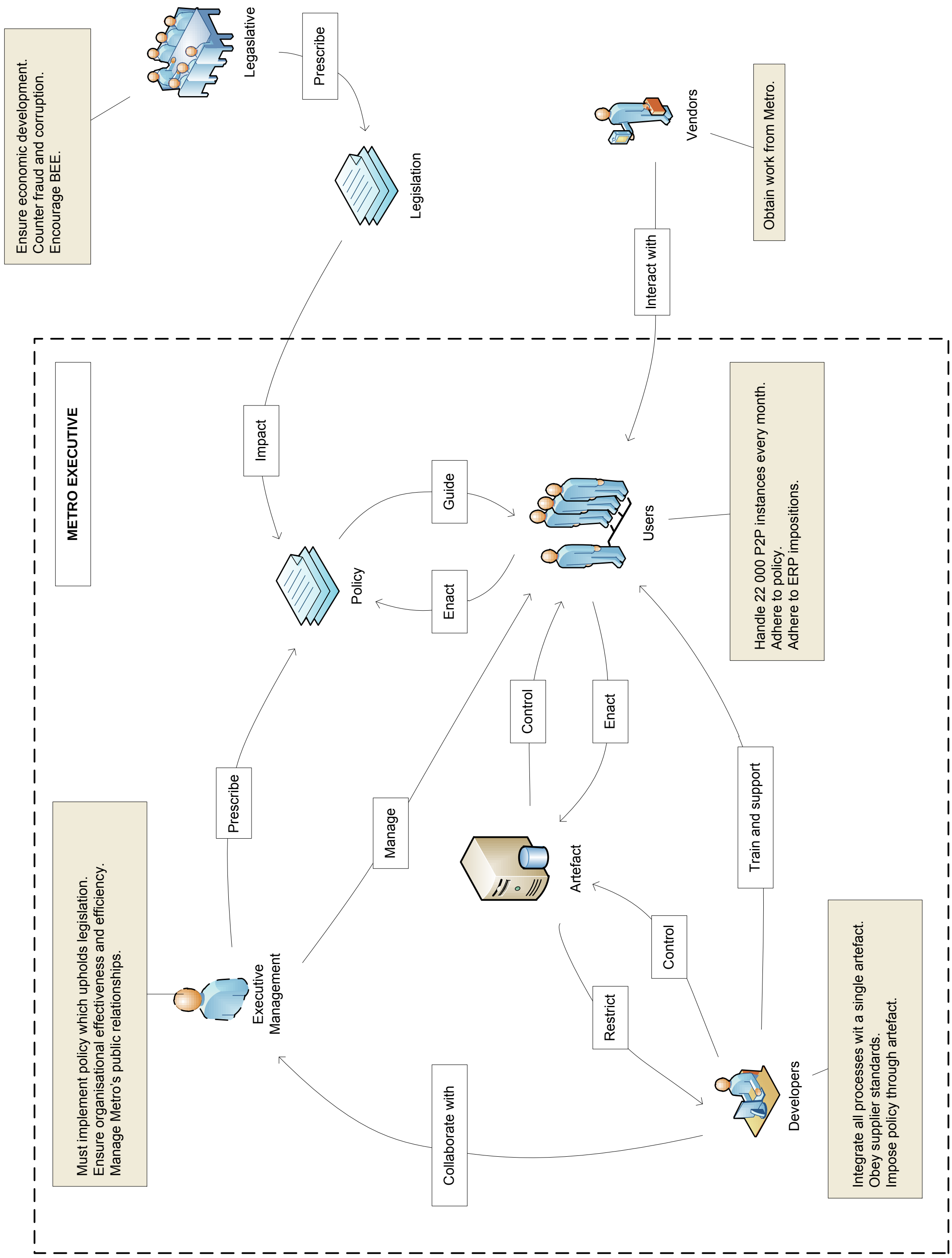

Figure 7.1: Rich picture describing the context of Metro's P2P.

the organisational reality. Importantly, the leadership style adopted by both the SCM Department and the ERP Project Team is characterised by strong controls with the aim of rigorously enforcing adherence to policy. Users, consequently, have little control over the structure of their work environments.

The combination of strong leadership and policy/artefact adoption is significant. Absence of either one would weaken the other's agency in the work environment. The Directors were well aware of this and realised the need to, firstly, maintain and refine policy on a regular basis while, secondly, realign the artefact with policy after changes have been made. The researcher expected that these factors would dramatically lessen users' capacity to reinvent the information system.

7.2 Analysis of Survey Data

The next phase of the investigation involved the statistical analysis of the data gathered using the survey. Initial analysis of this data was performed prior to the user interviews and is reported in Chapter 6. In this section the results of further analysis of the data is reported.

7.2.1 Survey Sections

7.2.1.1 User Characteristics

The first section of the survey included items relating to respondents' position in the organisation and the nature of their task portfolio. Three items from this section were used to form a scale measuring the diversity of the respondent's information system requirements (RDV). The three items were Seniority (SEN), Task Variety (TVR) and Reliance on Personal Judgement (RPJ). The data collected for each of these indicators are briefly discussed below.

As shown in table 7.2 the majority of the 783 respondents perform clerical work (34.9%) while 15.5% and 20.8% work as administrators and supervisors respectively. 28.9% of respondents hold positions as either managers (19.8%) or senior managers (9.1%). Table 7.3 indicate that 28.9% of the respondents perform tasks which are either very (8.2%) or mostly (20.7%) repetitive. Roughly the same number of respondents (29%) indicated that their tasks are subject to some variance with the remainder reporting thet they perform either

	Frequency	Percent	Valid Percent	Cumulative Percent
1	273	34.9	34.9	34.9
2	121	15.5	15.5	50.3
3	163	20.8	20.8	71.1
4	155	19.8	19.8	90.9
5	71	9.1	9.1	100.0
Total	783	100.0	100.0	

Table 7.2: Frequency table for Seniority (SEN).

	Frequency	Percent	Valid Percent	Cumulative Percent
1	64	8.2	8.2	8.2
2	162	20.7	20.7	28.9
3	227	29.0	29.0	57.9
4	199	25.4	25.4	83.3
5	131	16.7	16.7	100.0
Total	783	100.0	100.0	

Table 7.3: Frequency table for Task Variety (TVR).

mostly (25.4%) or very (16.7%) variant tasks. The final item in the RDV scale measured respondents' reliance on their personal judgment during task completion (see table 7.4). The majority of respondents (41.9%) indicated that they usually apply their personal judgement during tasks.

Underlying the RDV scale is the proposition that task portfolios of positions higher in the organisation's role hierarchy are more complex and unpredictable than those of clerks or administrators and, consequently, produce a more diverse set of requirements. Based on this view, positive correlation between the three items was expected. The scale was analysed, firstly, for unidimensionality and, secondly, for reliability. While the unidimensionality analysis revealed that all item-to-scale correlations were acceptable (ρ>0.3),[7] Cronbach's Alpha for the scale was α=0.563 (below the generally accepted

[7] De Vaus (1995, p. 255)

	Frequency	Percent	Valid Percent	Cumulative Percent
1	26	3.3	3.3	3.3
2	140	17.9	17.9	21.2
3	151	19.3	19.3	40.5
4	328	41.9	41.9	82.4
5	138	17.6	17.6	100.0
Total	783	100.0	100.0	

Table 7.4: Frequency table for Reliance on Personal Judgement (RPJ).

norm of 0.7 as minimum for reliability).[8] In the context of the large size of the sample, the acceptable item-to-scale correlations and the small number of scale items a decision was made to use the scale despite its relatively low reliability score. Interestingly, the item with the lowest item-to-scale correlation was TVR (ρ=0.351). Also, while SEN and RPJ correlated well (ρ=0.33, p<0.01),[9] TVR's correlations with both items were lower, mostly so with RPJ (ρ=0.27, p<0.01). Importantly, this finding seems to contradict the authority matrices investigated as part of phase 1.2 which indicate that task variety increases considerably as one ascends the hierarchy. One explanation for this finding may be that respondents considered the variety of their tasks more in terms of content than action. For example, based on the matrices clerks are mainly responsible for data capturing tasks which, one might argue, are mostly repetitive. They do, however, capture data for a variety of ERP transactions.

The last two items in the first section measured respondent's knowledge of the SCM policy (SPK) and the frequency with which they utilised the ERP (UFQ). Half of all respondents (50.1%) indicated that their familiarity with the SCM policy was average and 27.7% indicated that it was above average (see table 7.5). In terms of UFQ, almost half of the respondents (47.1%) indicated that they always use the ERP to complete tasks, while 23.2% indicated that they ususally use it to complete tasks (see table 7.6).

Interestingly SPK correlated poorly with the other items in the section, with its correlation with RPJ being the strongest (ρ=0.28, p<0.01). Again,

[8] De Vaus (1995, p. 256)

[9] Because the data was non-parametric Spearman's Rho correlation coefficient was used throughout the analysis.

	Frequency	Percent	Valid Percent	Cumulative Percent
1	30	3.8	3.8	3.8
2	90	11.5	11.5	15.3
3	392	50.1	50.1	65.4
4	217	27.7	27.7	93.1
5	54	6.9	6.9	100.0
Total	783	100.0	100.0	

Table 7.5: Frequency table for SCM Policy Knowledge (SPK).

	Frequency	Percent	Valid Percent	Cumulative Percent
1	3	.4	.4	.4
2	101	12.9	12.9	13.3
3	128	16.3	16.3	29.6
4	182	23.2	23.2	52.9
5	369	47.1	47.1	100.0
Total	783	100.0	100.0	

Table 7.6: Frequency table for Usage Frequency (UFQ).

this was surprising since one would assume, for example, that more senior actors are more familiar with the policy (correlation between SEN and SPK was ρ=0.15, p$<$0.01). As expected, UFQ had significant negative correlation with SEN (ρ=-0.35, p$<$0.01) indicating that the system is utilised more frequently by junior staff.

7.2.1.2 Frequency of Misfit Experiences

Initial analysis of the survey data (see section 6.2.3) indicated that experiences of misfit were common phenomena within Metro. This section presents a more detailed analysis of this data. The five indicators used for the Likert scales in this section of the survey were *never, rarely, occasionally, frequently* and *always*.

Descriptive statistics for the items (see table 6.3 and figure 7.2.1.2) indicated that Speed and Satisfaction of Use (UMF2) was the most frequently

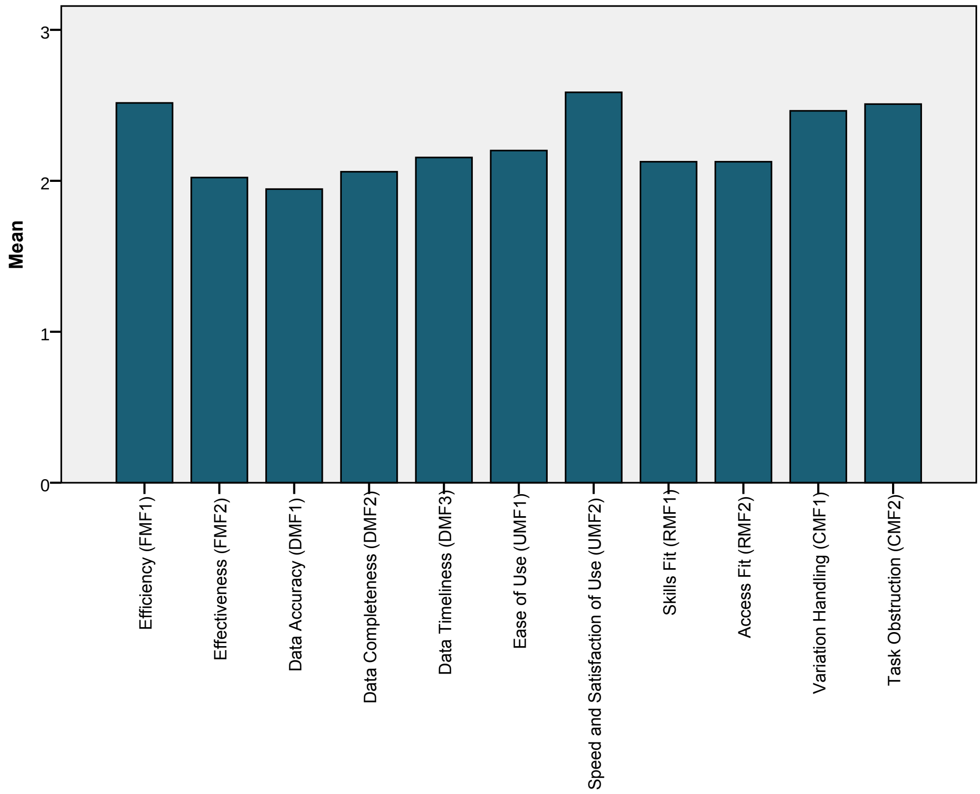

Figure 7.2: A bar graph presenting the mean values of scores for each of the misfit types.

experienced type of misfit with a mean value of 2.59. Also relatively high was Efficiency (FMF1) (2.52) and Task Obstruction (CMF2) (2.51). The least frequently experienced type was data accuracy (DMF1). These mean values suggested that users were primarily frustrated with the cumbersomeness associated with ERP utilisation and the control it imposes upon tasks.

Respondents' scores for each of the 11 items in this section were aggregated and the result was stored in a variable representing the misfit experienced scale (MFX). Analysis of the scale indicated that it is both unidimensional (all item-to-scale correlations were greater than 0.38) and reliable (α=0.861). The minimum score on the scale was 11, the maximum was 47 and the mean was 24.71.

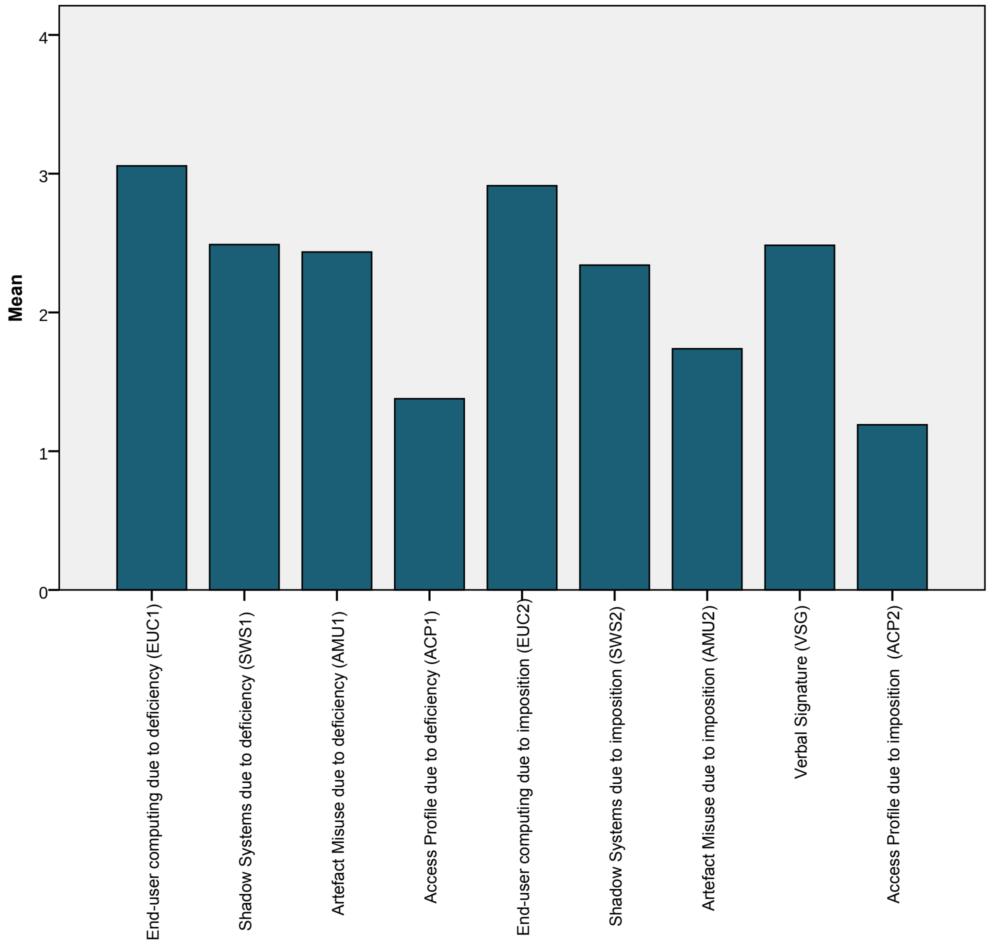

Figure 7.3: A bar graph presenting the mean values of scores for each of the reinvention practices.

7.2.1.3 Adoption of Reinvention Practices

Analysis of the items in the third section of the survey (see table 6.4 and figure 7.3) indicated that end-user computing was the practice most frequently performed by respondents with mean values of 3.06 (EUC1) and 2.91 (EUC2). Other practices performed relatively frequently were artefact misuse due to deficiency (2.44) and verbal signature (2.48).

Respondents' scores for each of the nine items in this section were aggregated and the result was stored in a variable representing the reinvention scale (RIN). Analysis of the scale indicated that it is both unidimensional (all item-to-scale correlations were greater than 0.3) and reliable (α=0.763). The minimum score for the scale was 9, the maximum was 41 and the mean was

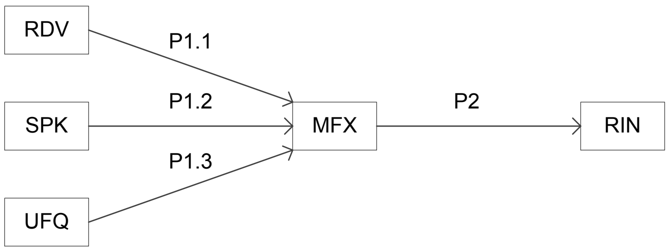

Figure 7.4: Propositions P1.1 - P2 visually presented.

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7.2.2 Evaluating Propositions

The next phase of the statistical analysis involved evaluation of the propositions formulated in Chapter 6 (see section 6.2). They are:

> P1: *The frequency of misfit experienced by users will be influenced by characteristics of their task portfolio and their knowledge of Metro's SCM policy.*

> P2: *The frequency of misfit experienced by a user will positively influence the degree to which he/she reinvents the information system.*

To test P1 the relationships between MFX the three first section items (of which the first is the RDV scale) were analysed. Three sub-propositions (P1.1 - P1.3) represent these relationships. The propositions are visualised in figure 7.4.

The analysis of P1.1 revealed that correlation between RDV and MFX, while significant, was weak (ρ=0.15, p<0.01). There is, accordingly, little support for the proposition that experiences of misfit are associated with diverse information processing requirements of actors in senior organisational roles. Due to the low reliability of the RDV scale further analysis was done to determine the correlations between MFX and the three items in the scale. In the cases of TVR and RPJ no correlation was found, while SEN had weak positive correlation with MFX (ρ=0.22, p<0.01).

Support for P1.2 was also weak with a correlation of ρ=-0.18 (p<0.01) between SPK and MFX. Despite its relative weakness the close alignment between the artefact and the policy is a theme which emerged often during the user interviews. Because Metro used the artefact to, where feasible, impose policy upon its user community experiences of misfit may be evident of policy inadequacies rather than artefact deficiencies. In such instances the user's knowledge of policy is likely to determine their experience of the event. If they comprehend the artefact's behaviour as enforcing policy their frustration, one may argue, would be directed more at the policy than the artefact and *vice versa*.

Support for P1.3 was stronger with a correlation of ρ=-0.369 ($p<0.01$) between UFQ and MFX indicating that users experience less misfit if they use the artefact more frequently. This finding partly supports DeLone and McLean's[10] model which suggests that frequent use of an artefact cultivates higher user satisfaction. Their model also suggests, however, that frequent use may lead to greater awareness of the artefact's deficiencies and, consequently, lower user satisfaction. To investigate the relationship between UFQ and MFX in more detail the influence of usage frequency influences the different types of misfit was analysed. Figure 7.5 shows the relationship between usage frequency and experiences of misfit with different bars representing each of the misfit types.

Three aspects of figure 7.5 are worth highlighting.[11] The first relates to ease of use (UMF1) and effectiveness (FMF2) which, for respondents with low usage frequency, are prominent types of misfit. For respondents with high usage frequency, however, they measured lower. Secondly, the opposite applies to experiences of misfit related to efficiency (FMF1) and speed and satisfaction of use (UMF1). These types of misfit become more prominent for users with high usage frequency. The third aspect worth highlighting is that the two indicators for control misfit (CMF1 and CMF2) measure relatively high independent of usage frequency. This is indicative of the artefact's impositions upon users' tasks.

It can be argued, based on the above findings, that while regular use of the artefact leads to greater ease of use and effectiveness, it has less influence on the user's efficiency, speed and satisfaction of use. To support this argument the

[10] DeLone and McLean (2003)

[11] When interpreting figure 7.5 it should be noted that only three respondents indicated that they never use the ERP (scoring 1 for UFQ) so the left-most set of bars can effectively be ignored.

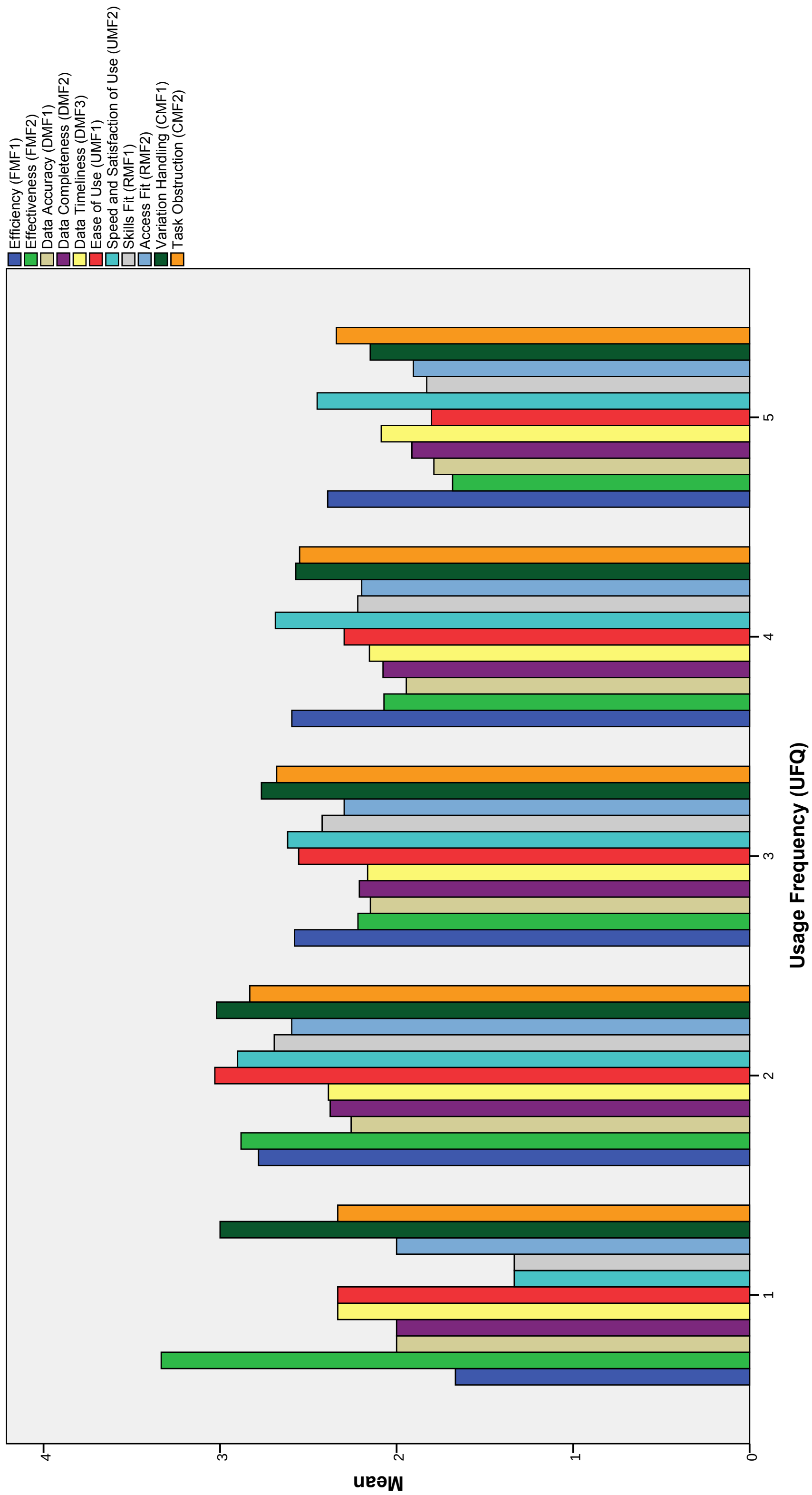

Figure 7.5: Experiences of misfit influenced by usage frequency.

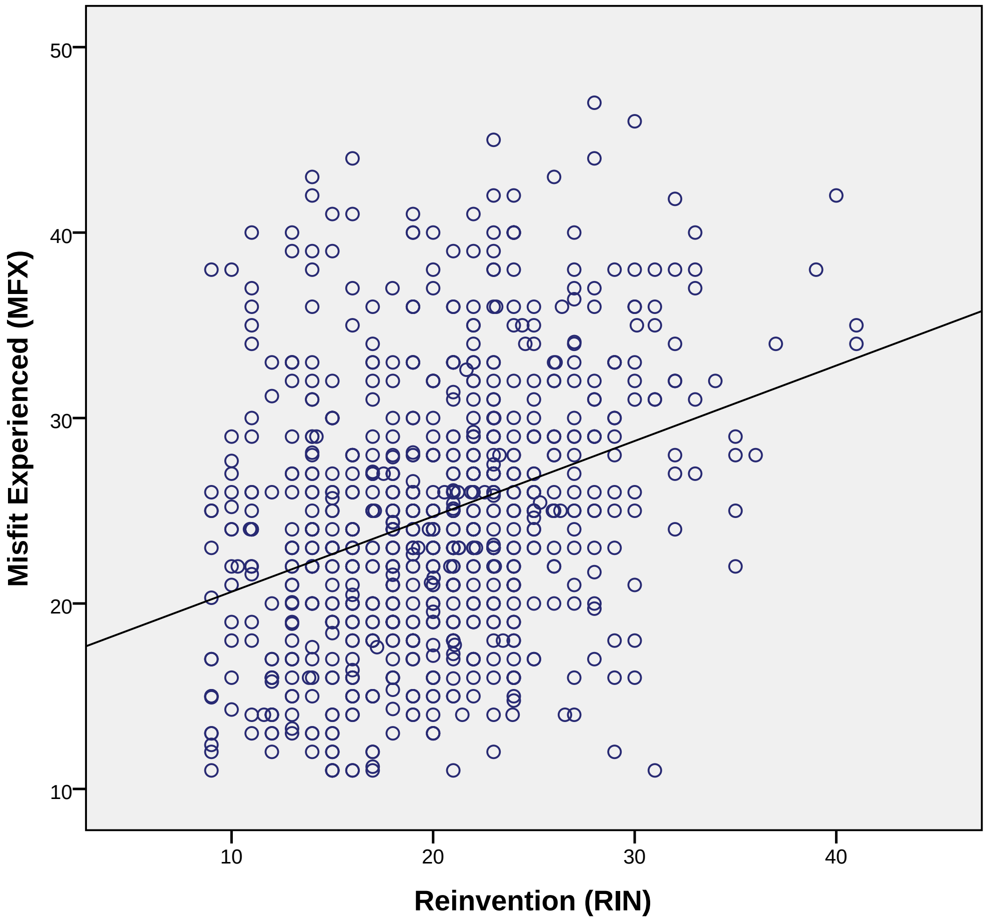

Figure 7.6: Scatterplot with a regression line for MFX and RIN.

correlations between UFQ and the various types of misfit were determined. Its strongest correlation was with UMF1 (Ease of use) measuring ρ=-0.427 ($p<0.01$), while the second strongest was with FMF2 (Effectiveness) measuring ρ=-0.407 ($p<0.01$). As expected UFQ's correlations with FMF1 (Efficiency) and UMF2 (Speed and Satisfaction of Use), while still significant ($p<0.01$), were weaker measuring ρ=-0.134 and ρ=-0.127 respectively. This dynamic is further elaborated upon in the analysis of the user interviews (see section 7.3).

The final part of the analysis involved proposition P2. With a correlation of ρ=0.315 ($p<0.01$) between MFX and RIN there is moderate support for the proposition that misfit experienced by a user positively influences the degree to which he/she reinvents the information system. The correlation is visualised in figure 7.6.

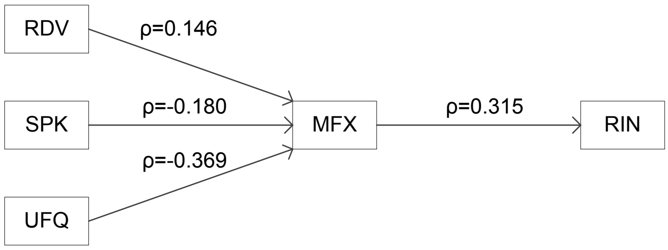

Figure 7.7: Propositions P1.1 - P2 with correlation values.

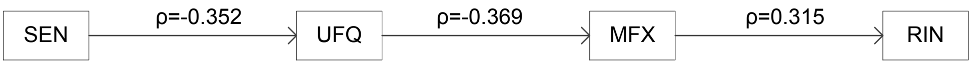

Figure 7.8: Adapted model of propositions.

7.2.3 Findings Elaborated

7.2.3.1 Updated Model

The correlation values for P1.1 - P2 are presented in figure 7.7. Of the individual and task characteristics tested for, UFQ had the strongest correlation with MFX. While both RDV and SPK had statistically significant correlations with MFX, they were considerably weaker. These findings prompted further investigation of the items in the RDV scale to determine their individual correlations with MFX and, as reported in section 7.2.2, only SEN showed significant correlation with MFX.

An important question emerging from this finding is how the three items (seniority, usage frequency and misfit experienced) related. Based on the documentation analysis it was clear that clerks and administrators performed more tasks using the artefact and negative correlation between SEN and UFQ was expected. The data confirmed this expectation with correlation of ρ=-0.352 ($p<0.01$) between SEN and UFQ. A crosstabulation for the two variables is presented in table 7.7. As indicated in the table subjects in more junior roles (clerks or administrators) generally used the artefact more frequently than senior staff (managers and senior managers).

Based on this finding the argument can be made that usage frequency is determined by the subjects' seniority and the proposed model can be adapted as shown in figure 7.8.

Because SEN also correlated significantly with MFX the role of UFQ as

		Usage Frequency (UFQ)					Total
		1	2	3	4	5	
Seniority (SEN)	1	1	17	25	53	177	273
	2	1	7	18	27	68	121
	3	0	19	33	35	76	163
	4	1	44	42	38	30	155
	5	0	14	10	29	18	71
Total		3	101	128	182	369	783

Table 7.7: SEN and UFQ crosstabulation.

a mediator between these items were tested using Sobel's test for mediation. The result ($p<0.01$) confirmed that UFQ is indeed the factor which mediates the influence of SEN on MFX. It can be argued, consequently, that senior users tend to experience more misfit due to infrequent use of the artefact. It should be noted that this is not the case for the relationships between UFQ, MFX and RIN. While significant correlation was found between MFX and RIN, UFQ had no correlation with RIN. Hence, MFX was not a mediator between UFQ and RIN.

7.2.3.2 Reduction of Misfit Dimensions

Analysis of the various misfit types as influenced by usage frequency (see figure 7.5) prompted further investigation into the MFX scale and its items. In particular, the prominence of certain misfit types in the graph changed for higher usage frequency. Initial interpretation of this effect suggested that misfit types fell in two categories. The first related to the user's ability to utilise the artefact to achieve task outcomes, while the second category related more to task performance.

To test this interpretation a principal component analysis was performed to reduce the scale to two components. The analysis revealed that the first component (Eigenvalue=4.96) included DMF1, DMF2, DMF3, RMF1, RMF2, FMF2 and CMF1, and explained 38.4% of the scale variance. The second component (Eigenvalue=1.814) explained a further 21.4% of the scale variance and included UMF1, UMF2, FMF1 and CMF2. The structure matrix of the

	Component	
	1	2
Data Accuracy (DMF1)	.876	.207
Data Completeness (DMF2)	.857	.255
Effectiveness (FMF2)	.843	.329
Data Timeliness (DMF3)	.764	.152
Access Fit (RMF2)	.747	.282
Skills Fit (RMF1)	.693	.293
Variation Handling (CMF1)	.686	.414
Speed and Satisfaction of Use (UMF2)	.216	.796
Efficiency (FMF1)	.283	.741
Task Obstruction (CMF2)	.243	.722
Ease of Use (UMF1)	.271	.710

Table 7.8: Structure Matrix of misfit indicators.

two components is presented in table 7.8.[12]

It is important to consider the two components emerging from the analysis in the context of Strong and Volkoff's deficiency/imposition classification. Classification of an experience of misfit as deficiency/imposition involves the interpretation of a particular instance of incongruence in the context of artefactual structures. Strong and Volkoff's analysis enables this because the study considers reported experiences of misfit in the context the artefact's deep, surface and latent structures. However, if a *blackbox* view of the artefact is adopted, as would be the case for most (if not all) subjects in this study, distinction between deficiency and imposition becomes less clear. A user may, for example, perceive a formally designed imposition as a deficiency (and vice versa) due to insufficient knowledge of the artefacts deep and latent structures. Hence, the two components extracted from the scale in this survey represents the classification of misfit experiences as perceived by the users themselves, not the interpretation of these experiences by technically informed analysts.

The items included in each of the two extracted components confirmed the

[12]Variation Handling (CMF1) has relatively high scores for both components. While it is grouped with the first component for the remainder of the analysis, its position in the second component can also be justified statistically.

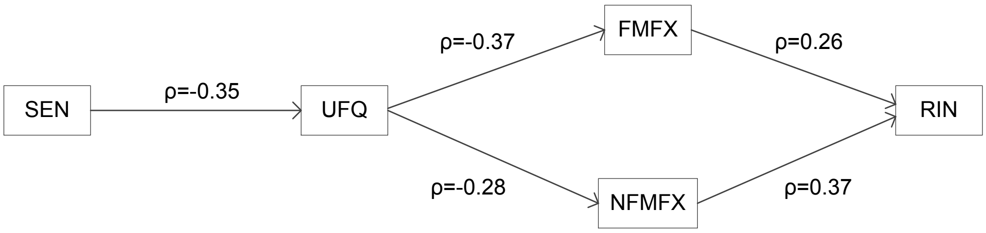

Figure 7.9: Updated model after principal component analysis of MFX scale.

initial interpretation made based on the effect of UFQ on MFX. The first of the two components, which will be referred to as *Functional Misfit (FMFX)*, included misfit types which obstructed the effectiveness of user performance. The second, which will be referred to as *Non-functional Misfit (NFMFX)*, included misfit types which concern the efficiency of task performance. While functional misfit is concerned with the user's ability to utilise the artefact to achieve his/her task outcomes, non-functional misfit concerns *the manner in which* outcomes are achieved. Using the findings of the principal component analysis two variables were created to store scale scores for FMFX and NFMFX.

The differentiation between experiences of functional and non-functional misfit prompted analysis of the relationships of these two misfit categories with usage frequency. As was expected, UFQ had stronger correlation with FMFX (ρ=0.37) than with NFMFX (ρ=0.28) suggesting that regular artefact usage has a stronger influence on minimising experiences of functional misfit. Steiger's z-test was performed to test the difference between the two correlations and the result ($p<0.01$) confirmed its statistical significance. This finding is reflected in an update model (see figure 7.9). Interestingly non-functional misfit was a stronger indicator of the adoption of reinvention practices with a correlation of ρ=0.37 ($p<0.01$) between NFMFX and RIN. RIN's correlation with FMFX, in turn, is somewhat weaker (ρ=0.26, $p<0.01$).

Based on the findings one may argue, firstly, that the regularity with which actors utilise the artefact in the context of Metro's operations depends upon their seniority. Secondly, senior staff members experience more misfit as a result of irregular use of the artefact. Thirdly, while regular use has a negative influence on experiences of functional and non-functional misfit, its influence on functional misfit is stronger. Finally, while both functional and non-functional misfit promote the adoption of reinvention practices, non-functional misfit does so more than functional misfit.

7.2.4 Conclusions

Analysis of the survey data uncovered important findings about experiences of incongruence, as well as the relationship between incongruence and user behaviour in Metro's information system. In accordance with the models proposed by DeLone and McLean,[13] as wells as Goodhue and Thompson[14] the data support the argument that use of an artefact impacts user's appreciation thereof. In this regard the analysis revealed that more frequent use has a positive impact on users' perception of how well the artefact fits their tasks. Through the utilisation of the fit dimensions proposed by Strong and Volkoff the survey enabled the elaboration of this finding in two ways. Firstly, through the identification of two primary categories of perceived fit and, secondly, through the finding that use impacts these two fit categories in different ways. The first fit category, *functional misfit*, concerns users' perception of their ability to achieve task outcomes when using the artefact, while the second category, *non-functional fit*, concerns users' perception of their ability to achieve these outcomes efficiently. Importantly, the data revealed that, while use of the artefact impacts both these dimensions, its impact on functional fit is stronger. This finding correlates with the argument by Goodhue and Thompson that high usage frequency, while promoting fit, cultivates a more critical appreciation of the artefact. The data further suggest that this critical appreciation concerns the manner in which the artefact supports users' desire to increase their performance when utilising the artefact. Stated differently, high usage frequency creates the need for artefact features which support non-functional aspects of tasks like efficiency.

As argued in section 7.2.3.2 it is important not to equate the functional/non-functional distinction to the deficiency/imposition distinction proposed by Strong and Volkoff. Because the functional/non-functional distinction concerns the perception of a user it should be seen as complimentary to the deficiency/imposition distinction which concerns the latent, deep and surface structures of the artefact. Consequently, by utilising both these dimensions

[13] DeLone and McLean (1992, 2003)

[14] Goodhue and Thompson (1995)

	Deficiency	Imposition
Functional	When users perceive missing or inadequate artefact features as obstructions to their ability to achieve task outcomes.	When users perceive the inherent characteristics of the artefact as obstructions to their ability to achieve task outcomes.
Non-Functional	When users perceive missing or inadequate artefact features as obstructions to their performance when conducting tasks.	When users perceive the inherent characteristics of the artefact as obstructions to their performance when conducting tasks.

Table 7.9: Combining two dimensions to describe instances of incongruence.

an instance of incongruence can be described with sensitivity to users' perceptions (see table 7.9). Given adequate knowledge of the artefact's structure the instance can be classified further in accordance with Strong and Volkoff's typology (i.e., as data/usability/role/control/culture misfit).

In terms of the incongruence-enactment relationship the data support the proposition that experiences of misfit encourage the adoption of information system reinvention practices. Interestingly, this effect is stronger when users perceive experiences of misfit as non-functional. A plausible interpretation of this finding is that experiences of functional misfit are more likely to encourage improvised learning practices than reinvention practices. In a strictly controlled work environment, as is the case at Metro, users that are unable to achieve task outcomes are more likely to consult mediators for advice than, for example, utilise a workaround. Experiences of non-functional misfit, however, pose a different challenge. The relative popularity of end-user computing and the adoption of shadow systems (see figure 7.3) in Metro suggest that users' perception of artefact usage as slow and cumbersome is countered by the development of personal information management systems using alternative applications.

It is important to recognise the limitations of the survey in terms of the research problem. While it provides evidence that users experience misfit and counter it through the adoption of reinvention practices, the data has little, if any, explanatory power over the individual and shared beliefs upon which behaviour is based. Sensemaking theory dictates that users' beliefs about Metro's information system would be updated continuously based on, among other cues, experiences of misfit. These beliefs, in turn, are enacted. Hence, an in-depth analysis of the incongruence-enactment relationship depends also upon the analysis of users' beliefs and the consideration of their behaviour as the enactment thereof.

7.3 Analysis of Interview Data

The final data source analysed was the interviews conducted with members of the SCM Department. The data set involved 24 interviews (see table 6.7 for a breakdown of the branches and roles of interviewees). The analysis was performed through a process of coding which, following the method proposed by Miles and Huberman,[15] involved two stages.

The first stage of the analysis involved a set of *descriptive codes*. Based on Weick's theory of sensemaking and reviewed literature of sensemaking in information systems contexts a set of descriptive codes were developed. The set included three primary code categories:

- *Frames (FRM)* included codes used for references made by users which reflects their frames of reference of technology, their colleagues (including developers, other users and managers) and Metro itself.
- *Experiences of Misfit (MFX)* included codes used for references users made to their own or others' experiences of misfit. Using Strong and Volkoff's typology this category included codes for the various types of deficiencies and impositions.
- *Enactment (ENA)* included codes for references made to the various stages or types of enactment and the practices indicative of each.

The full set of descriptive codes is presented in table 7.10.

Following the descriptive coding of the interviews the researcher was able to identify a number of key themes emerging from the data. These themes were further investigated in the second stage of the coding process during which emergent patterns in the data were traced through the use of *pattern codes*. Pattern codes represent a deeper level of analysis at which themes underlying the data can be inferred.[16]

In the sections which follow the main themes emerging from the data are discussed. The first section provides an overview of the predominant paradigms shared by the interviewees relating specifically to the ERP artefact. In the second section users' experiences of misfit and the influence of these on their

[15] Miles and Huberman (1994, p. 57-69)
[16] Miles and Huberman (1994, p. 70)

Category	Subcategory	Code	Description
Frames of reference			
FRM	FRM-ORG	FRM-ORG-STR	Frames of the organisational structure.
		FRM-ORG-CUL	Frames of the organisational culture.
	FRM-TEC	FRM-TEC-STR	Frames of technology strategy.
		FRM-TEC-NAT	Frames of the nature of technology.
		FRM-TEC-USE	Frames of technology use.
	FRM-PPL	FRM-PPL-MNG	Frames of managers.
		FRM-PPL-TEC	Frames of technologists.
		FRM-PPL-USR	Frames of other users.
Experiences of misfit			
MFX	MFX-DEF	MFX-DEF-FUN	Experiences of functionality deficiency.
		MFX-DEF-DAT	Experiences of data deficiency.
		MFX-DEF-USE	Experiences of usability deficiency.
		MFX-DEF-ROL	Experiences of role deficiency.
		MFX-DEF-CON	Experiences of control deficiency.
	MFX-IMP	MFX-IMP-FUN	Experiences of functionality imposition.
		MFX-IMP-DAT	Experiences of data imposition.
		MFX-IMP-USE	Experiences of usability imposition.
		MFX-IMP-ROL	Experiences of role imposition.
		MFX-IMP-CON	Experiences of control imposition.
Enactment			
ENA	ENA-IML	ENA-IML-MED	Improvised learning through mediation.
		ENA-IML-FOR	Improvised learning utilising formal channels.
		ENA-IML-EXP	Improvised learning through experimentation.
	ENA-RIN	ENA-RIN-WAR	Reinvention through work-arounds.
		ENA-RIN-IFX	Reinvention justified through interpretive flexibility.
		ENA-RIN-NOR	Reinvention enabled through negotiated order.
		ENA-RIN-EUC	Reinvention through end-user computing.
		ENA-RIN-SWS	Reinvention through the use of shadow systems.
	ENA-INE	ENA-INE	Inertia.

Table 7.10: Taxonomy of descriptive codes used in the analysis of user interviews.

understanding of the information system are addressed. In the final section focus falls on the enactment of the information system. In all sections relevant excerpts from the interviews are provided as examples of statements relating to the theme discussed in that section.[17]

7.3.1 Predominant Paradigms of the Artefact

Because the interviewees all occupy mid-level positions their task portfolios generally involve regular interaction with the artefact. Accordingly, the artefact controls their tasks and involvement in workflows to a large extent. Two of the five ERP roles identified by Askenäs and Westelius[18] (see section 4.2.1.2) were found to be applicable to interviewees. The maturity of the ERP and its close alignment with Metro's SCM policy meant that the majority of interviewees constructed the artefact as a Bureaucrat. Some interviewees, however, experience misfit frequently and constructed the ERP as Manipulator as a result. Despite this variance users, with very few exceptions, subscribe to three paradigms about the artefact that summarise their shared frames of the technology.

7.3.1.1 Paradigm 1: The Artefact is Reputable

The first paradigm which emerged from the analysis of users' frames relates specifically to their understanding of the nature of the ERP artefact Metro utilises. The interviewees held a particularly positive view of the artefact and its impact on their own and the organisation's performance. When prompted to substantiate their beliefs about the artefact users often related it to their beliefs about the organisation which developed the artefact. Users were well aware that the ERP's supplier is a global market leader and that their product is used by reputable firms worldwide.

- *I know a lot of countries in Europe use it and companies from America, so it must be a fine system. When I talk to companies I ask them if they*

[17] Most of the subjects were not English (first language) speakers. In some cases interviews were conducted in an alternative language the transcriptions were translated. In other cases subjects opted to be interviewed in English and basic language errors were, where feasible, corrected during transcription.

[18] Askenäs and Westelius (2003)

use [the ERP] and how they find it and I know they are all quite happy with it.

- *I find [the ERP] extremely helpful, the technology involved is very updated, complete. I mean if you go to companies they are also using it in their information systems and stuff. From what we hear it is extremely useful to be using [the ERP].*
- *Its a great tool, its large and all the big firms use it. So when I'm, working with them we talk the same language, we understand each other.*

The supplier's standing as a market leader played an important role in encouraging beliefs about the artefact as the best available. It was clear that users took pride in the fact that Metro, as public sector organisation, could afford to utilise the same artefact as large corporate enterprises. An important result of this paradigm was that it encouraged users to distinguish the artefact itself from the activities in which and actors by who it is utilised. This distinction enabled the users to make sense of experiences of misfit which result from factors other than the artefact itself. This theme is further analysed in sections which follow.

7.3.1.2 Paradigm 2: The Artefact is Usable but Complicated

The second paradigm users subscribed to dictated that the ERP system is a complicated artefact which only becomes usable after the user has passed through a necessary learning curve. Accordingly, most users reported that their initial interaction with the artefact was daunting and confusing. Independent of these primary appraisals the SCM Department's management, together with the ERP developers, were, by their own admission (see section 7.1.3.1) uncompromising in their efforts to ensure the artefact's adoption. Users had no choice but to undertake adaptation and become familiar with the artefact.

- *At first I was so nervous, it's not a user friendly system you know. But if you just keep on using it, then you become friendly with it.*
- *The system is actually really user-friendly, though it doesn't seem so at first. It all depends on your dedication.*

- *In the beginning I did not enjoy using [the ERP], but now, the more I get to know it, its really user-friendly.*

It is important to recognise the role of fit in this learning curve. Analysis of the survey data revealed that infrequent use of the artefact is associated with experiences of functional misfit which, one can expect, would be frequent among inexperienced users. As the user develops more advanced frames of the artefact these experiences are likely to decrease not due to artefactual changes, but due to the user's increased ability to effectively utilise the artefact's features during tasks. Experiences of functional misfit will remain frequent, however, if artefactual deficiencies exist. In such scenarios the progression from constructions of Manipulator to constructions of Bureaucrat is obstructed by poor fit.

Users reported that they adopted different coping strategies during the adaptation process. While some relied on formal training initiatives and support, the majority undertook different forms of improvised learning. Metro's organisational culture was supportive of this and users generally share their knowledge freely.

- *If I know or find out something I will share that with everybody. But I'll tell them 'if you learn something then you must also come back and tell me about it so that I also know'.*
- *Now in my office I've come to be seen as an expert in [the ERP], so everybody with problems or errors send their things to me. Even the managers would call me.*
- *I had in-house training when I started at [Metro] at my desk for a week. But most of it, well, its that you have to want to learn. So if you have an accounts payable query and you don't know how to handle it, you get up and you walk to someone and say 'please help me, I don't know how to do this' so that next time you can do it on your own. So, yes, most of it was self-taught.*
- *Sometimes when I have a problem I will ask one of the assistants just to come and help me or show me.*

- *You know my training, it was so fast, and just the one day, then suddenly you're back in the office and you have to start working with it. So I was like, 'oh no, what am I going to do? These people need the goods!' So what I did was to start with [the ERP] and when I finished a screen and it allowed me to proceed I printed that page and wrote on it: Page 1, so that I can remember what happened. That was just reservations. Then comes a requisition! But I just kept on practising, practising. But it was a disadvantage to me later on because when I got to training they'll say 'oh, you're a quick learner!' But they don't realise how I'm struggling. They say I succeed with the things I'm doing but they have no idea how I suffer behind this closed door! Now other people come to me and say they've heard I know how to use [the ERP].*

- *I still have to explain things to my buyers, everyday, because each has a different setup to work with, each tender is different. I get frustrated after a while, anyone would, but I've learnt to relax and handle each one on its own merits.*

The artefactual impositions also played an important role in enabling improvised learning through experimentation. Users felt that they could, with relatively low risk, learn through trial and error while performing their work.

- *It is a bit of trial and error thing. You do it, and learn by doing it. So if you get an error, then in future you'll know how to correct it. But it could be dangerous in some cases.*

- *There are so many little places where you can go in and get information, but it takes time to get acquainted with everything. Every week you learn something new. I don't think you ever stop learning to work this thing. I can know so much more, I must just go in and look for stuff. I can do my job with what I know now but if I know more I can be more effective.*

- *You can get everything you need from one transaction, but you gotta know how. You can mess around also! That's one good thing about [the ERP] - it doesn't allow you to make catastrophic mistakes. Catastrophic mistakes are because of your errors, it's a human thing. But if you go a bit to far in [the ERP] it actually tells you - you get your yellow alerts,* *it tells you 'hold it!' And if you ignore that completely it gives you the red alert where you can't go any further. Obviously there are times when you mess around that you create nonsense but, again, with [the ERP] you can always rectify that. I mean that's why the different profiles and transactions have been created because people make mistakes! It's there for a reason.*

- *You need to learn [the ERP]! Play with it, have fun with it.*

While experimentation enabled users to overcome experiences of functional misfit, non-functional misfit posed a different challenge. Certain users adopted more advanced techniques to perform tasks efficiently but not all users felt comfortable with these. Users expressed their awareness of artefactual features which could improve their efficiency and many aspired to becoming proficient in applying these.

- *I know there are ways to load data in [the ERP] faster, but I think it's a bit riskier. One girl showed me how to do it. I just felt I can make mistakes doing it that way so I prefer doing it the long way and getting it right.*
- *It's not difficult, its just cumbersome. I know there are faster ways of doing it but I think they are too risky, mistakes can creep in.*
- *She knows a lot of stuff that I still need to learn from her. She can do everything in [the ERP].*

7.3.1.3 Paradigm 3: Computerisation Improves Organisation

The third and last paradigm involves users' beliefs that the computerisation of their work improves various aspects of the organisation. Three sub-themes from the data relate to this paradigm. The first sub-theme relates to the use of paper-based documents in the information system. The second relates to the role of the artefact in improving the traceability of tasks and the third relates to users' primary appraisal of the expansion of the artefact.

Users' initial ideas about the artefact were centered around the promise that it would enable a paperless work environment. Users extracted and enlarged this cue in the early phases of the project and it became a belief which drove their initial sensemaking of the new information system. Not surprisingly, however, certain workflows within the P2P remained reliant upon paper-based documentation (see section 7.1.3.1). The disconfirmation of their expectation prompted users to adjust their beliefs through sensemaking.

- *I was involved with the initial requirements analysis process when [the ERP] was introduced. It all works well to my mind, except that I think we are generating a lot more paper.*
- *The only problem is - they said that [the ERP] was going to decrease the amount of paper but I don't think so, not in our environment. With [the ERP] its definitely not a paperless environment. I think we now use more paper than ever before.*
- *At first, I hated it, when it was just introduced. The transformation was difficult because we had to take data out of the old system and put in the new system. And people said it will be a paperless system, and we were like, but I need something in my hands! Then the transition happened and all was fine but we still had all this paper.*
- *I remembered when we started with [the ERP] people said it was going to be a paperless system. I still don't believe that. There are still a lot of documents going around.*
- *Our problem is that we're not fully integrated. We get in paper-based forms from some processes which need to be recorded in spreadsheets for our records. There is a standard sheet which everyone use. It's just for record keeping, so there isn't any formulas or such. But problems creep in when data are captured, but its not major things. We have to do it for now, until [the ERP] can handle that as well.*

The theme of having a paperless work environment is closely linked to another aspect of the information system which users extracted and enlarged during adaptation - the influence of the artefact in improving the traceability of their work. Users' frames of Metro's technology strategy were, as expected,[19]

[19] See section 5.2.4.

dominated by their beliefs about its role in countering fraud and corruption through the traceability of tasks. While controlling their tasks as Bureaucrat, the artefact was also constructed as an *Invigilator* which exposed every aspect of the user's work. This role of the artefact evoked a variety of emotions from users but it was broadly accepted that it encourages integrity, thoroughness and transparency.

- *For me it makes things very easy because it allows me to monitor the use of a contract, to access information on a contract, it also makes it easy to track the performance of the vendor.*
- *It's very user-friendly because it gives you the history of everything. Even for auditing purposes, you just take your reference number and you search for it. It shows you everything.*
- *It records everything we've done. For example, suppliers like to complain that they don't get work from us but you can just put in the supplier number and it will show you all the work that the supplier has done. So it's easy if you have queries.*
- *There is no way that you can cheat [the ERP].*
- *Everything is now so transparent, I sometimes think they are going too far. We can access information we never could in the past. There was so much red tape back then, now you can just go in and check it yourself.*
- *We use [the ERP] to avoid corruption, everything is visible. Everything is logged there.*
- *What I like about [the ERP] is that it records whatever is entered. So chances of fraud are very limited. It limits those chances to a very high degree.*
- *In the past there was no connection between the buyers and the tenders except for hard copies. Now everything is loaded onto [the ERP] and the user departments reference the contract number and everything pulls through to the buyer.*

- *The system gives you a chance to prove yourself in terms of performance. In the past you were just a person doing a function. So many times I've said to my colleagues I wish I can be paid for what I'm doing or achieving.*
- *When we moved over to [the ERP] you saw a lot of resignations, there were a lot of resignations - because people were being exposed.*
- *The system doesn't have a problem, when it comes back it doesn't come back to the system, it comes back to us. So we have to cover our backs. [The ERP] doesn't have a problem if you put the banking details in and change them. It's fine with the system, it won't give you any error.*

The third sub-theme relating to this paradigm was users' attitudes towards the expansion of the artefact and the automation of more facets of the P2P. Some users, for example, were aware that the developers were working on the integration of an SRM module (see section 7.1.3.1) which would require further adaptation by users in SCM. The researcher expected that users would feel, at least partly, threatened by artefact expansion as it would disrupt their current work environment and a prompt a new learning curve. On the contrary, users framed it as opportunities and were eager to maximise the benefits it had to offer for them.

- *We are looking more to SRM now, so what we couldn't do before we are hoping will be possible now. Especially in services where a lot is still done manually, a lot of forms and things going between people. That's the main part we must improve.*
- *SRM will be a good thing because at the moment we are still manually capturing everything. And its easy to make mistakes with the way people are writing its difficult to see if its a '6' or an '8' or whatever. With the new system we won't have to worry about reading that from a hard copy.*
- *I do building repairs and maintenance so there are site meetings that need to take place. Those are not on [the ERP] so we use a spreadsheet to track them. Only after vendors have handed in quotations do we put it on [the ERP]. It would be nice if [the ERP] could track them too.*
- *I do not want to do anything manually. If the system can do it, why not?*

7.3.1.4 Conclusions

The three paradigms outlined above provide a good summary of the shared frames users held of the nature of the artefact and its role in the organisation. Due to the relatively good fit Metro achieved in this part of the information system users did not object to the control the artefact imposed upon them. It seems, rather, that users developed a sense of trust in the artefact's ability to control workflow and expose obstructions to their projects. Despite having to adapt their original utopian ideas about a paperless work environment users remained optimistic that further computerisation would continue to improve their effectiveness and efficiency.

It should be noted that the researcher was somewhat surprised to find very little negativity towards the artefact among users. A number of reasons may explain this. The most obvious is that, due to the maturity of the information system, most of the users' major concerns have been dealt with through cycles of artefact refinement over the last 10 years. A second reason, which is elaborated upon in a later section, is the (surprisingly) good relationship users had with ERP support staff. The researcher expected to find a degree of antagonism between these two stakeholder groups due to the uncompromising leadership style of the developers.

A final observation worth noting is that the results of the survey suggest that users in SCM do indeed experience incongruence quite regularly (see table 6.5). Users' frames of the artefact seem, *prima facie*, to oppose this finding. Two explanations for this must be considered: It may be, firstly, that the results of the survey or interviews were, for some reason, an inaccurate reflection of users' experiences. Alternatively, it may be that users did not attribute experiences of misfit to aspects of the artefact. This line of thinking is further elaborated in the next section.

7.3.2 Experiences of Incongruence

The narrative accounts users provided of their experiences of incongruence provided an answer to the contradiction noted in the preceding section. While users felt that the artefact fit their tasks rather well, they raised concerns relating to a range of underlying aspects of the information system which, while involving the artefact, stemmed from non-technical matters. Accordingly, a common property of these narratives was that users, while not explicitly stating it as such, clearly distinguished between *artefact* and *information system* as separate phenomena. Three themes are discussed in this section. The first, which emerged as the most prominent, is the effect of user error or ignorance on workflow and experiences of misfit. The second is the role of users' knowledge of the SCM policy in the operation of the information system. The third is misalignment between the artefact and organisational policy.

7.3.2.1 User Error or Ignorance

A particularly prominent theme which emerged from the data was users' agitation and frustration due to errors or ignorance on the part of their colleagues. The integrated nature of EPR artefacts implies strong interdependencies between tasks and mistakes made by a user affect users at a later point in the workflow. A common example of this phenomenon involved users that, due to various factors, failed to capture complete or accurate data when performing a task using the artefact. Subsequent tasks in the workflow were then obstructed due to the error leading to antagonism between the users involved.

- *Problems? It's user problems! To be honest with you I think it's just people's attitude towards their work. Like if you and I are working together on [the ERP] and I can see you're not doing what you are supposed to do I know it's going to make my work difficult.*
- *Users don't understand that it takes some time for requisitions to come through. You know it goes through various steps before I get it. So they must do it in time for us to process it. So they'll phone and say: 'The mayor needs transport' and I'll say 'OK, but when did you load it?' 'No, on Friday afternoon.' So I will get it in my inbox, but it may be late.*
- *What the requisitioners do is they fail to differentiate between services and goods when doing their requisition. So that means if they did not create it under my commodity but under goods, I can't create that order. It will be wrong. I am not allowed to do the changes, it's gotta go back to them.*

- *What happened some time back is someone was doing a requisition but they were not trained to do it, so they phoned us and asked us how to do it. When they send it in there are a lot of mistakes to the requisition and I have to reject it. But when I reject they have no idea why I did it. So I'll have to tell them correct this, correct that, correct this. So sometimes I get so tired! They are supposed to do it right, then I can create the order.*

- *I don't think all the people know to use the internal notes.*

- *It is one of the best tools the city bought, it's just the people using it that's a problem.*

- *It's a good system, I just think, and it's not [the ERP]'s fault, that all the people don't know how to use it correctly.*

- *There are some guys who, when they send you a requisition, you can see they know what they are doing. They won't make mistakes easily. But they are few and far between, most of the time I have to double check everything and sometimes I don't know that it is 100% correct so I trust them to follow the procedures correctly.*

Considering this theme in the context of Strong and Volkoff's misfit typology provides further indication that *experiences* of incongruence do not always involve an instance of artefact-task incongruence. The basic argument for this distinction is made in section 3.4. A (particularly vocal) *Assistant Buyer* provided a hypothetical example which serves to substantiate this argument:

> *What makes me crazy is when, for example, the city must buy balls. And the requisition comes through but there is no delivery address on there. And there is a field for a delivery address. But now the delivery address says Recreational Offices wherever, that's the offices of the council, not the delivery address. Or they'll say the delivery address is the Health Department, but there are how many Health Departments out there. And you can't keep phoning up people and asking them for the correct information. Now the goods end up in the wrong address and they phone me and say you*

> *created the order where must the goods go? Then I look like the fool. So I phoned a lady and said to her I'm sick and tired, can't you people think for yourselves, you can see there is an address field. And she said can't I be a bit nicer. So I say I've been saying this a hundred million times, I don't think being nice works.*

In the above scenario the *Assistant Buyer's* initial frustration emerged from an instance of *data misfit*. The artefact does, however, provide a field for this variable but the requisitioner failed to complete it (either accurately or completely). A more accurate description of the incident, therefore, would be to categorise it as an instance of *role misfit* due to the requisitioner's lack of skill to utilise the artefact correctly. One may also argue, however, that it is an instance of *control misfit* as the artefact should be configured to impose completion of the address field upon the requisitioner. Such imposition would not, however, ensure that the requisitioner provides the correct data which suggests that it may be an instance of *user-task incongruence*. Finally, it should be considered that the actual source of the problem may be an instance of incongruence occurring even before the requisitioner captured the data on the artefact (e.g., a poorly designed or completed paper-based form which the requisitioner used as input for his/her task).

This theme highlights an important finding. Investigations of experiences of incongruence expose problematic factors in the information system that may have no real connection to artefactual structures. These factors have organisational or *human* dimensions but become incontrovertibly tied to the artefact which, as the facilitator of workflow, spreads their influence through the organisation. Instances of incongruence, one may state, have ripple effects which may be experienced at different points in the workflow. Metro's users, however, made sense of experiences of misfit by placing them in frames of the information system as a socio-technical activity system rather than an artefact. This enabled them to maintain a positive attitude towards the artefact despite the role it played in transferring the effects of incongruence along the workflow.

7.3.2.2 Business Knowledge and Fit

A second underlying factor which users recognised related to the influence of policy knowledge on fit. In Chapter 3 [20] it is argued that users' lack of task knowledge may trigger an experience of incongruence. This theme was also addressed in the survey and the results revealed a significant but weak negative association between a users' knowledge of the SCM policy and the frequency with which they experience misfit. The interviews shed some light on this relationship and its role in the information system's operation. Because Metro established a high degree of organisation-level congruence, the artefact played an important role in ensuring policy adherence. This was achieved through impositions which, where applicable, guided users' interaction with the artefact in accordance with policy regulations. An interesting illustration of the role policy knowledge played in enabling fit emerged from users' comments relating to Metro's rotation policy.

Within the *Procurement Branch* users were subdivided in teams which were associated with particular commodities. The underlying rationale for this structure was that the procurement of each commodity involved specific knowledge of, not only the policy relating to that commodity, but also the more intricate (sometimes technical) rules and regulations relating to its procurement. The term *policy knowledge* is, following this argument, not quite sufficient and should be replaced with *business knowledge* to describe more accurately the *content of knowing* or *frames* applicable here. The rotation policy dictated that users in certain roles ha to rotate among the various commodities Metro procured to ensure that staff did not build long-term relationships with specific suppliers. Such relationships, it was argued, may encourage corruption. A side-effect of rotation was that users, with each instance thereof, had to learn the particular details of procuring a new commodity.

- *We used to rotate staff every six months but we've realised it creates huge problems because you've just come to know what your job is and, you know, what you are allowed to buy and limits of the contracts and now we're changing you to something else. So now we're changing it to*

[20] See section 3.4.

at least a year or a year and a half so that the buyer gets sufficient time to get to know the job and pass on that knowledge to someone else.

- *Users rotate between commodities every 18 months, so they never really specialise in anything. To me the rotation principle is one of the worst ideas around here. There are so much details in the processes of different commodities which you need to know to work with it.*
- *I see myself as a services specialist. I've been around since previous administrations so I've rotated through all the different units. For somebody else to step into my position... Well, they will manage but they won't know where all the holes are that you can step into. It's a good thing to rotate but there are also disadvantages because every time I need to train staff again on how to deal with this and how to deal with that. I'm permanently in the training environment.*

While the procurement of various commodities involved largely similar systems use cases, an in-depth understanding of the commodity itself and the regulations relating to its procurement was required to be effective in a particular procurement team. Users with advanced frames of the artefact may, when rotated, lack this knowledge and experience misfit as a result. These differences between the artefact's behaviour for different commodities triggered sensemaking and prompted users to update their technological frames but, more importantly, expand their business knowledge. Following this finding it may be argued that to effectively utilise an artefact users require not only knowledge of the artefact itself, but also knowledge of the rules the artefact is designed to impose. In the same way that a user-artefact incongruence may create bottlenecks in the workflow, user-task incongruence will have a negative impact on a user's performance. Failure to distinguish the two types of incongruence may lead to ineffective interventions.

7.3.2.3 Organisation-Level Incongruence

The third theme which emerged from the data relates to alignment between artefact and policy. Users were aware that, in particular scenarios, the misfit they experienced was a result of disparity between Metro's policy as expressed in formal documents and the behaviour of the artefact. Consequently, a scenario was created where users had to disregard the imposition of either artefact or policy to complete particular tasks.

An example of such a scenario reported by users relates to the artefact's handling of vendors' tax certificates. In accordance with SCM policy a vendor is only eligible to supply products or services to Metro if the *South African Revenue Service (SARS)* has certified that it has paid all outstanding taxes. The proof provided by the vendor is a tax certificate and it forms part of the required quotation and tender documentation. Two problems typically occurred in this regard.

The first occurred when vendors failed to provide their tax certificates as part of their quotations. In such cases Metro would notify vendors of this and, after obtaining the required certificate from SARS, the vendor would supply it. This practice, however, created a timing problem. Metro would capture the received vendor certificate on the ERP but if this occurred after the closing date for that quotation the vendor would not be eligible. The ERP *assumed* that the vendor was not tax cleared at the time the quotation closed due to the absence of the certificate. A manual (and time-consuming) process had to be followed to select the appropriate vendor when this occurred.

- *The problem creeps in when the quotation is closed and the vendor's certificate is captured only after that. Then [the ERP] ignores the date of validity on the certificate itself but assumes that its only valid from the day it was loaded. Then we have to go and check the stamps on the certificate and see what the dates are on them. If they were valid prior to the quotation closing we have to start a manual process.*

- *The vendors' certificates must be loaded on [the ERP]. If those certificates are not up to date on the day we close the quotation [the ERP] doesn't see it. Even if it gets loaded in the meantime, [the ERP] does the check on the day the quotation is closed.*

A variation of this problem occurred when a vendor received a long-term (2-year) contract from Metro and its tax certificate expired during that period.

- *This is difficult because the two policies oppose each other. Ours and the one from SARS. Our policy says that if you have a contract with a* *vendor and he is valid at the start of the 2 years, you have to use him. Now in the meantime his tax clearance expires, you must carry on till the end of the contract period. SARS, on the other hand, says that he isn't tax cleared.*

- *When a supplier is blocked [by SARS] but he is on contract for a specific tender, they'll open him up for that tender. Because the project must continue and he must provide the materials. But that's through an e-mail, to the vendor master, and you give them the tender number because it will be open only for use with that contract. The vendor will be followed up to bring the tax clearance certificate, but until then we will still create the order because we are bound by the contract.*

The first problem scenario represents, essentially, an instance of data misfit. The artefact should provide data fields which represent the validity period of the certificate rather than utilising the capture date for this purpose. In terms of Metro's efficiency it was a rather costly deficiency as the workaround triggered by this misfit required the use of intricate spreadsheets and an extensive decision making process. The second scenario, however, is more complicated. The problem was not so much aligning artefact with policy as it was choosing which policy the artefact had to impose. Such a scenario is likely to occur whenever an artefact is designed to impose multiple, contradicting policies.

7.3.2.4 Conclusions

Users' narrative accounts of misfit experiences reveal that these events play an important role in shaping their understandings of the information system and, in a broader sense, the organisation. The frustration users experienced due to misfit encouraged them to make sense of the information system by extracting and enlarging cues that explained underlying sources of misfit (e.g., user ignorance, contradicting policies etc.). They could differentiate quite clearly, as a result, differences between the *designed* information system (how it is supposed to operate) and the *enacted* information system (how it does operate). Central to these frames are beliefs about the information system as a *social* work system which relies more on the capabilities of human actors than those of an artefact.

7.3.3 Responses to Incongruence

The final part of the interview analysis concerned users' responses to experiences of misfit. Findings about users' technological frames indicated that they generally constructed the artefact as *Manipulator*, *Bureaucrat* or *Invigilator* (see section 7.3.1) which, coupled with the high degree of organisation-level congruence achieved, suggest that users had little need nor freedom to enact the information system through reinvention. The results of the survey, however, indicated, firstly, that users still experienced some misfit and, secondly, that they did reinvent the information system as a result of such experiences. Analysis of the interview data revealed that users adopted particular coping strategies in response to experiences of different types of misfit. These are discussed thematically in this section.

7.3.3.1 Responses to Functional Misfit

To overcome experiences of functional misfit users adopted a combination of two strategies which can both be classified as methods of *improvised learning*.[21]. The first is experimentation and the second is consultation with a human-centered mediator.

In accordance with the findings of Bansler and Havn[22] certain users at Metro naturally adopted roles as human-centered mediators. Such users typically experimented with the artefact to refine their frames of the technology-in-use and were eager to disseminate their knowledge to peers.

- *Well, you know, I am that sort of person. I don't relax until I find out exactly how this thing works. Sometimes I'll come in at 6:00 so that when the other people come in at 8:00 I have solutions to their problems.*

- *I'm always helping them. You know I've experienced that when one asks for help people say 'Go away, are you crazy?' So I took a decision and closed my door and tried it on my own.*

[21] See section 4.3.0.3

[22] See section 4.3.0.1.

- *Now in my office I've come to be seen as an expert in [the ERP], so everybody with problems or errors send their things to me. Even the managers would call me.*
- *This morning the one assistant, she's new here, so in [the ERP] she was looking for the reference number but she couldn't find the request where it came from. So I showed her where to do it all.*

Other users relied on mediators to facilitate their own improvised learning.

- *If I don't know something I always ask the team leader and she knows codes and things, functions I don't even know are there. It's just that I'm new and she has more experience so she knows about these things.*
- *When there is something that I can't do I just have to ask for the code, and unless it's something I'm not authorised to do I can just go on and use it. So I'll either ask the buyer or the team leader for the code.*
- *People help each other out all the time.*
- *If you have an accounts payable query and you don't know how to handle it, you get up and you walk to someone and say 'Please help me, I don't know how to do this.' So that next time you can do it on your own.*

In accordance with the findings of the survey users in the SCM Department did not experience a great degree of functional misfit. Most occurrences thereof reported during the interviews can be attributed to inexperience due to recent appointments or transfers of staff, rather that instances of incongruence.

7.3.3.2 Responses to Non-Functional Misfit

While functional misfit could be overcome through improvised learning, experiences of non-functional misfit posed a different challenge to users. The interviews corroborated the finding, made through the survey, that non-functional misfit was more frequently experienced by Metro's users. Many interviewees, accordingly, commented that interaction with the artefact was cumbersome and frustrating.

- *If you load a contract for goods, you've got to load it first and then you must go into another screen and source list it. And I've been asking that I want it to be one whole run, one screen. Load the contract, click on source listing and do the whole thing. Because that's where people will make mistakes. Or if I have multiple vendors I want to go into one screen, because sometimes we use different vendors to source the same item and I have to go to different screens. The system can't link the whole thing into one flow. I'm doing one transaction to load and one transaction to source list.*

- *We capture everything onto [the ERP] and that takes forever, believe me. It sounds like it's just capturing, but it's such a lot of prices and details.*

- *What frustrates me is that you can't have all your information on one screen, you have to go into different programmes to get everything you need to know. My issue is why do I need to go into that programme or that screen to find it, why can't it all be on one screen.*

- *It's not difficult, it's just cumbersome.*

- *It's all about transactions, if you don't know transaction numbers you're lost. Just name the things for us. If the transaction is to create purchase orders, say there 'Create Purchase Order'. Not some other code that doesn't make sense.*

- *Sometimes [the ERP] is very slow and that is a huge hindrance. Especially if you have to go through multiple transactions to get things done, it takes time and it's slow.*

To overcome non-functional misfit users developed personal information management strategies to augment their ability to manipulate data and increase task efficiency. In most cases these strategies involved exporting data from the ERP and processing it in accordance with their requirements using a spreadsheet application. While users could not import processed data back into the ERP, the use of spreadsheets afforded them the ability to manipulate exported data in various ways and for various purposes.

- *We use Excel for reporting purposes, it's easier to manipulate the format depending on how you want it to read. But [the ERP]'s reporting is fine, just sometimes you want to change it for others.*
- *I still do spreadsheets, but via the ERP. Sometimes there is too much information, there is a lot of unnecessary information on there. Then I do it in [a spreadsheet] to make it simpler for other people. Like when I send it out to off-site branches I try to simplify it, because when you send them ERP documentation you see blocks and letters and things. So they get confused and they don't know what to do now they phone me back and I have to explain. So I make it simpler and there you go.*
- *We extract data from [the ERP] quite often. Sometimes you have to combine information from to different transactions as one piece of information. It's still the right figures, just in a different format. But we are not allowed to import data back into [the ERP], we are limited there.*
- *I download spreadsheets from [the ERP]. When information is sent out to vendors to update their details there are e-mails coming back about delivery failure, so someone's address is not right. So I download a complete list of vendors and check the ones that are incorrect, then you are working on one sheet and you don't have to go in every time to check things. It's a lot easier.*
- *We do use spreadsheets but we still need to manually go into [the ERP] and change it all the time. That is quite a mission.*
- *I export to [a spreadsheet] for my own purposes, because it is easier to have a big spreadsheet, you know when you need to search quickly. For example, if you want to check if it's the same person that works in two companies. It's easy to pick that up in [a spreadsheet] if you search for the name. You know in [the ERP] you'd have to look at each company individually. The guy in charge did it that way, so I also started doing it.*

Some users developed more advanced spreadsheets in which formulas were used to process data. While the data generated based on these formulas did not get imported into the ERP itself, they influenced users' decision making and did, therefore, pose a threat to the accuracy of users' work. More importantly, however, the *static* data stored in users' spreadsheets did not reflect changes made to *live* data on the ERP. There was, accordingly, some degree of risk involved even if spreadsheets were only used to organise data. The interviews suggest, however, that the use of spreadsheets played a prominent role in users' ability to work efficiently and disallowing the practice would hamper their performance.

7.3.3.3 Responses to Organisation-Level Incongruence

The nature of organisation-level incongruence implies that, to ensure policy adherence, the artefact needs to be bypassed in some way. The SCM Department, accordingly, overcame this form of incongruence through institutionalised *workarounds*. Over time the Department formalised a collection of workarounds which enabled business processes to continue despite instances of misalignment between the artefact and the SCM policy. Importantly, these workarounds formed part of the Department's standard operating procedures and involved workflows documented using UML activity diagrams. Like the covert workarounds reported by Azad and King[23] the ones adopted by the SCM Department also involved multiple actors agreeing to follow a manual process. However, to ensure that the integrity of the business process was maintained, the workarounds typically involved authorisation by senior management.

- *It does happen that people work outside the system. But there are formal ways of doing it. It happens far less now than it did one or two years ago. We've tightened down on departments and we've made people paid for their own items! So we've clamped down on it.*
- *We don't work around [the ERP], we work around a difficulty. We don't have to go outside [the ERP]. That happens very rarely. For instance, when a vendor submits a quotation but his not in our database, then we will adjudicate outside [the ERP] in a spreadsheet, with the same principles and we'll get the same result. It's not bending the system it's just utilising it to make it work. It's all done within the principles of the SCM policy, it doesn't violate the policy.*

[23] See section 4.3.0.3.

- *Sometimes we have to sidestep [the ERP] completely and do a manual adjudication. We have to physically put it in excel and run formulas, we can't do it in [the ERP] at all. It's not problematic but it takes longer and all the checks must be done manually.*

- *When there is a deviation from the standard process it has to run through the Directors. There are forms which the line department's Director needs to complete that come to our Director stating why the deviation occurred.*

- *If a guy, for example, buys a car and orders all sorts of extras that weren't in the original order there will be a price difference. [The ERP] will not let the payment go through because of the price difference between the order and the invoice. Then the Department's director has to provide reasons for the difference to our Director and if everyone's happy the process will continue. There has to be signed forms because the auditors will look for them when they audit the system. They'll see the discrepancy and question it immediately.*

The formalisation of these manual workflows ensured that the SCM policy was not disregarded for the sake of artefact compliance. More importantly, by formalising specific workaround procedures the SCM Department's management discouraged the development informal, covert workarounds and ensured that users had no reason to disregard policy.

7.3.3.4 Conclusions

The themes discussed in this section indicate that experiences of misfit influence the enactment of the information system on two levels. Individual users cope with functional misfit through improvised learning which involves experimentation and consultation with a human-centered mediator. Through mediation frames of technology become shared and aligned among the user community emphasising the role of mediators in making the artefact sensible to colleagues. This corroborates the findings of Bansler and Havn. Responses to non-functional misfit involve practices users adopt to satisfy requirements of a more subjective nature. Users develop *personal information systems* using external applications to advance their efficiency and counter frustrations they experience when utilising the artefact. Interestingly, these practices, much like frames of technology, are passed from more experienced users to colleagues. On an organisational level the SCM Department counters artefact-policy incongruence through the institutionalisation of workarounds. Underlying this practice is the SCM Department's realisation that the artefact, as manipulator, is inflexible and some form of intervention is required to handle non-standard business cases. While these workarounds have a negative impact on efficiency, they serve to ensure that policy is upheld.

7.4 Conclusions

Following the analysis of the different data sources it is possible to triangulate the findings made and draw a number of conclusions.

The first conclusion concerns the degree of information systems incongruence experienced in Metro's P2P. While analysis of the survey data suggests that users experienced incongruence quite frequently, the other data sources indicated that Metro managed to achieve relatively close alignment between organisation and artefact. Analysis of the user interviews revealed that, with the exception of particular instances of artefact-task incongruence, the organisation had been able to configure the artefact to effectively impose adherence to the SCM policy within the relevant P2P workflows. Where this was not achievable or desired, alternative workflows were formalised by management. It can concluded, based on these findings, that the majority of users' experiences of incongruence, in this particular case, can not be attributed to failure to align the artefact with organisational structures.

Secondly, despite the existence of a high degree of organisation-level congruence, there is strong evidence that users still experienced incongruence due to a lack of artefact or policy knowledge. This finding confirms the basic premises of the incongruence ontology developed in Chapter 2. The evidence also revealed that experiences of user-artefact or user-task incongruence may lead to secondary experiences of incongruence when users misuse the artefact due to ignorance. While developers emphasised the importance of their training programmes in combating these forms of incongruence, the interview data suggested that users found random, *ad hoc* occurrences of improvised learning particularly beneficial.

Thirdly, the survey data revealed that distinction is required between experiences of functional and non-functional incongruence. This finding is supported by the interview data which indicated that users differentiate between the usability of the artefact and its alignment with the SCM policy. While both types of incongruence were experienced less by users utilising the artefact more frequently, data from both the survey and interviews indicated that non-functional misfit was more likely to trigger the adoption of informal information processing practices like the use of spreadsheets.

The interviews revealed that human-centered mediation played a particularly important role in users' progression through the phases of adaptation. While some users chose to learn through experimentation, most opted consult a particular knowledgeable colleague when experiencing incongruence.

Finally, while Metro's users adopted numerous informal information processing practices, users did not bypass the designed information system through covert workaround practices. The high degree of organisation-level congruence achieved, the formalisation of workaround procedures, the established culture of discipline and the sensitive political context of the organisation combined to discourage this practice.

7.5 Summary

This chapter reports the results of detailed analyses of the various data sources collected at Metro. The chapter commences with a description of Metro's organisational environment based on the analysis of the various secondary data sources (review of documentation and interviews with directors). The basic flow of the P2P is outlined and key aspects of the ERP project lifecycle are discussed. A Checklandian rich picture is used to visualise the prominent systems and their relationships as they apply to the primary unit of analysis.

The next section reports the statistical analysis of data collected through the survey. The data suggest that users experienced more misfit when they interacted with the artefact on an infrequent basis. Interestingly, other aspects of a user's role (diversity of requirements, reliance on personal judgement, task variety) correlated poorly with experiences of misfit. Further analysis of the data revealed that users experienced misfit as one of two types: functional or non-functional. Functional misfit describes experiences where users are obstructed to complete tasks effectively and is more prominent among users that interact with the artefact infrequently. Non-functional misfit concern the efficiency of artefact users and is experienced more by users whose tasks involve regular artefact interaction. The data showed moderate support for the proposition that experiences of misfit lead to the reinvention of the information system by users. Findings suggest, however, that experiences of non-functional misfit, as opposed to functional misfit, are more likely to lead to reinvention.

In the third section of the chapter the results of the analysis of the user interviews are presented. Findings suggest that users' frames of the artefact were dominated by three paradigms. The first relates to the artefact's reputability. Users generally subscribed to the view that because the artefact is produced by a global market leader, its quality is beyond reproach. Secondly, users appreciated the complicatedness of the artefact but believed that frequent usage cultivates adequate artefact knowledge to enable effective utilisation. Lastly, users held a positive view of the computerisation of their work and do not feel threatened by disruptions this may cause. The analysis further revealed that users were able to identify a range of non-technical factors which underlie their experiences of misfit. Importantly, users were able to distinguish between misfit which results from artefactual attributes and misfit which results from other aspects of organisation. This distinction enabled users to maintain a positive view of the artefact despite experiences of misfit. The final part of the interview analysis revealed that users responded to different types of misfit in different ways. Functional misfit encouraged users to advance their technology-in-use frames, while non-functional misfit was countered through the development of personal information systems. Where experiences of misfit occur due to misalignment between artefact and policy, workaround practices were designed. To ensure policy adherence in such scenarios the SCM Department has formalised numerous workarounds as part of their standard operating procedures.

Part III

Findings and Conclusions

Chapter 8

Discussion of Findings

In this chapter the findings made in both the theoretical and empirical analyses are synthesised to address the research question formulated at the outset of the study. In the first section findings about information systems incongruence are outlined by triangulating the literature reviewed in Chapter 3 with the findings made in the case study. In the second section the same method is followed to provide a summary of the findings made concerning the enactment of information systems. In the final section the incongruence-enactment relationship is addressed through the discussion of the three propositions formulated in section 4.4.2.

8.1 Incongruence in Information Systems

In Chapter 3 the notion of incongruence in information systems is investigated through the review of literature. The chapter provides a detailed outline of the emergence of this line of thinking as an approach to the measurement of success in information systems. While initial applications of the notion address fit between an individual user and an artefact,[1] more recent studies have extended this line of research to incongruence between large, integrated artefacts like ERPs and organisations.[2] In section 3.4 an ontology is developed to integrate the findings made in the reviewed literature.

The empirical investigation corroborated the basic premises of the incongruence ontology. Two important findings emerging from the data are worth

[1] Goodhue and Thompson (1995); Kanellis and Paul (2005); Joshi and Rai (2000)

[2] Soh and Sia (2004); Sia and Soh (2007); Strong and Volkoff (2010)

emphasising in this regard:

- Strong and Volkoff's premise that failure to align integrated artefacts with organisational structures leads to experiences of incongruence by the user community was corroborated by the findings made in the empirical analysis. Despite the high degree of organisation-level congruence achieved at Metro, there remained a number of instances of incongruence between the organisation's requirements and the features of the artefact. Users were aware of these instances and could describe the business cases in which they were typically experienced.

- Apart from artefact-task incongruence, many incongruence experiences identified during the case study can be categorised as user-artefact or user-task incongruence. In accordance with the proposed ontology the data revealed that experiences of incongruence often occur despite artefact-task congruence. Experiences of user-artefact incongruence are particularly frequent for users that are undergoing adaptation or utilise the artefact infrequently. While experiences of user-task incongruence seem, *prima facie*, to be unrelated to incongruence in information systems, the case study revealed that correct use of the artefact relies on the users' understanding of both the artefact and the task at hand.

8.1.1 Key Findings

While corroborating certain findings reported in the reviewed literature, the empirical analysis contributed to this line of research in three key areas.

8.1.1.1 Instances and Experiences of Incongruence

The case study provided evidence that distinction should be made between *experiences* of incongruence and *instances* of artefact-task incongruence. Underlying this distinction is the argument that there is a fundamental difference between incongruence which occurs due to misalignment between task requirements and artefact features, and one which occurs due to a user's ignorance or personal preferences of usability.

In Strong and Volkoff's typology this distinction becomes ambiguous due to the inclusion of *usability misfit* as category. While it is acknowledged that artefactual features may be more or less usable in general terms, the empirical data revealed that users' perceptions of usability is strongly influenced by their progression through the phases of adaptation. Users consistently reported that their initial experiences of usability misfit became less, not due to changes to the artefact, but due to improvised learning (i.e., frame development).

Following this finding it is argued that IS researchers and practitioners should conceptually separate the notion of *usability* from other types of *congruence*. It is possible, based on this distinction, that an artefact's features may simultaneously be congruent with users' requirements and be characterised as having low/poor general usability.

8.1.1.2 Functional and Non-functional Incongruence

The empirical investigation revealed that experiences of incongruence typically fall in one of two categories.

Functional incongruence refers to an experience during which the user's ability to achieve a task's outcomes is obstructed and is more common among users during the early phases of adaptation.

Non-functional incongruence refers to an experience during which the user's ability to perform a task efficiently is obstructed. This type of misfit is more common among advanced users who are able to complete tasks effectively but seek to advance their performance by becoming more efficient.

Importantly, the functional/non-functional distinction does not oppose Strong and Volkoff's typology as it does not concern the technical/organisational antecedents of the experience. It provides, rather, an alternative dimension for describing incongruence by highlighting the nature of the experience. Accordingly, this study has found that both deficiencies and impositions may lead to experiences of either functional or non-functional incongruence.

8.1.1.3 Secondary Incongruence

The empirical investigation extended theory about incongruence in IS by illustrating the manner in which an integrated artefact can disseminate experiences of incongruence among users. This occurs when a user, due to an experience of incongruence, completes a task inaccurately or incompletely leading to inadequate inputs for tasks to be completed further down the work flow. To address this phenomenon in future research it may be conducive to distinguish between *primary* and *secondary* experiences of incongruence.

Following this distinction a single experience of incongruence may be the antecedent of one or more secondary experiences of incongruence in the system. This view raises the, potentially interesting, question of what portion of the incongruence experiences in an information system is secondary as opposed to primary.

8.2 Information Systems Enactment

In Chapter 4 a review of literature concerning the enactment of information systems by user communities is reported. In section 4.2.4 the findings of this review are summarised in the form of six general conclusions about information systems enactment. In this section the findings of the empirical analysis are considered in relation to each of these conclusions.

- *Users' frames of a technology determine their behaviour around that technology.* The empirical analysis corroborated this conclusion in various ways. The most prominent, it may be argued, relates to findings about the influence of ideas about the artefact as *invigilator* on users' behaviour. Because users constructed the artefact as an invigilator which made their actions transparent, they aimed to provide as much as possible supporting information or documentation when performing their tasks. Users were aware that the technology afforded managers and auditors the ability to inspect every aspect of their work and behaved in accordance with this belief. Furthermore, while most users constructed the ERP as either invigilator, bureaucrat or manipulator, there were a small number of interviewees who constructed it as consultant or administrative assistant. These users also behaved differently around the artefact. Contrary to their colleagues, they felt comfortable to experiment with the artefact in an attempt to learn its features and gain control over it.

- *Users' frames of a technology become shared (or congruent) when they utilise that technology in a shared environment.* This conclusion is supported by the empirical data through the existence of three predominant paradigms about the ERP artefact among the SCM user community. These paradigms represent users shared frames of the technology and confirms that, over time, beliefs about the nature, use and strategy of a technology become aligned by users sharing a work environment. While some variation remained, the paradigms confirmed extensive overlapping of users' frames of technology.

- *Users' frames of a technology are influenced by perceptions of control and congruence.* In accordance with the model proposed by Askenäs and Westelius, the empirical analysis revealed that users' frames of the ERP were influenced by their progression through the stages of adaptation. Users' initial ideas about the artefact as manipulator were altered when they became more knowledgeable in the use of its features. Importantly, it was the advancement of their knowledge, rather than changes to the artefact, which influenced their perceptions of artefact-task congruence the most. While adaptation led to less frequent experiences of functional incongruence, the interviews revealed that even the most skilled users still experienced a significant degree of non-functional incongruence. These experiences cultivated beliefs about the artefact as being in control of, as opposed to supportive of, users' tasks.

- *Perceived features of a technology trigger sensemaking.* Griffith's findings about the role particular features of a technology play in triggering sensemaking were corroborated in the empirical analysis by findings about users' initial ideas of the ERP technology as enabler of a paperless work environment. This finding also correlated with those made by Henfridsson in his investigation of the Swedish social services. Because Metro's SCM user community found the high volume of paper-based documentation utilised during their tasks particularly problematic, they extracted and enlarged cues about the artefact which affected this aspect of their work. In accordance with Weick's theory users focussed on these cues when making the technology sensible. Metro's decision not to integrate all the SCM workflows under the ERP meant that users' expectations were disconfirmed and their initial beliefs had to be adapted. Interestingly, the same phenomenon seemed to repeat itself at the time of the investigation as many users were expecting the introduction of SRM to reduce SCM's reliance on paper-based forms. Based on these findings it is argued that those aspects which users find problematic about their work environments are indicative of the cues they will extract and enlarge about technologies.

- *Users adapt to technologies by altering their frames of technology and enacting technologies to preserve control over their work environment.* The empirical analyses revealed that, in accordance with Beaudry and Pinsonneault, users appraise a new technology as either a threat or an opportunity. Through adaptation Metro's users replaced their Utopian ideas about the artefact with more realistic understandings of its nature and use. A particularly interesting finding made is that the ability of the technology to trace users' actions led to the resignation of employees at Metro. While the users interviewed appraised this feature of the ERP as an opportunity to eradicate corruption, users involved in corrupt or fraudulent activities would have perceived it as a threat to their agendas. By logging users' actions the ERP imposes control over their work environment, something which results not from the hard-coded rules of the artefact, but from the culture of discipline which is implied when ERP technology is adopted. Following this finding it is argued that the adoption of ERP technology necessarily implies a reduction in the degree of control users have over their tasks. While users will gain a certain amount of control from their ability to utilise the artefact's features, they will sacrifice control due to its impositions and the manner in which it makes their actions traceable.

- *Users have influence over the agency of technologies in organisations through their enactment of technologies.* While the empirical analysis revealed certain discrepancies between the designed technology and the enacted technology, these differences did not have a substantial impact on the agency of the ERP in Metro. This finding can be attributed to two aspects of the case. Firstly, the enforcement of a particularly strict, ERP-only adoption policy in the SCM Department meant that users had no real bargaining power to reject the artefact. Secondly, the united front created through collaboration between the Director of SCM and the developers ensured that SCM could enforce strict adherence to the artefact's impositions. It should be noted, however, that if the developers failed to achieve the high-degree of organisation-level congruence they did, it is unlikely that SCM's leadership would be willing or able to enforce adoption. It is argued, based on these findings, that the enactment of an artefact is strongly influenced by the management of the adoption of that artefact. Hence, while recognising that enactment does influence a technology's agency, this agency is also partly determined by adoption management due to its influence in shaping enactment.

8.3 The Implications of Incongruence for Information Systems Enactment

In this section the research question formulated at the outset of this study will be addressed through the discussion of the empirical findings as they relate to the three propositions derived from the findings of the theoretical analysis. The research question provided in section 1.2.1 is:

> What are the implications of *experiences of incongruence* among user communities for the *enactment of information systems* in organisations utilising proprietary Enterprise Resources Planning Systems?

The three propositions formulated in section 4.4.2 resulted from inductive reasoning guided by findings reported in IS literature and the principles of sensemaking theory. The empirical analysis enabled the systematic evaluation of these propositions through a case study. In the three sections which follow the findings of these evaluations are discussed.

8.3.1 Proposition 1

> *Experiences of incongruence in information systems advance the alignment of users' frames of technology and, as a result, increase correspondence between enactments of technologies in an information system.*

Based on the findings of this study it is argued that experiences of incongruence trigger concious deliberation about the nature of a technology, its role in an organisation, and the manner in which it is and/or should be utilised. Such deliberation may occur in various forms but often involves instances of improvised learning during which advanced users advise and support their colleagues. A result of this trend is that less experienced users adopt the frames of technology held by their mediators and, as a result, enact the technology in similar ways. The most common occurrences of this process result from experiences of functional misfit due to inexperienced users' lack of artefact knowledge and skills. The empirical analysis revealed that, while users found formal training to be useful, they relied heavily on this form of improvised learning during the early phases of adaptation. In most cases these instances of user-artefact incongruence are easily resolved.

The empirical analysis revealed that experiences of functional misfit which occur due to an instance of artefact-task incongruence prompt users to make sense of the degree to which organisational policies and artefactual impositions align. If the instance of artefact-task incongruence is known to mediators they are likely to be familiar with (and share) the appropriate method of handling it. However, if mediators are not familiar with it and unable to advise the user, he/she may need to seek support from managers or developers. In both cases the experience of incongruence triggers frame sharing.

Interestingly, experiences of non-functional misfit seemed to have a similar effect. In the case study users learnt about methods to cope with or overcome non-functional misfit from more experienced users. Importantly, this included, the use of technologies other than the ERP. As a result of this process users' frames and, consequently, enactments of technologies like e-mail and spreadsheets aligned.

There are three important aspects of this proposition which should be noted. Firstly, it depends upon experienced users adopting roles as human-centered mediators. While certain users at Metro voluntarily adopted such roles, this may not be the case in all organisations. The absence of mediators is likely to increase users' reliance upon experimentation during adaptation which may obstruct rather than promote adoption. Secondly, an organisational culture which discourages knowledge sharing among users will obstruct frame sharing and the alignment of enactments. Finally, while the case study provided various examples of the manner in which frame sharing promoted correct or acceptable use of the artefact, experiences of incongruence can, in much the same way, promote the misuse or bypass of the artefact. This is especially likely to occur if experienced users or managers promote practices like workarounds or the use of shadow systems during mediation.

8.3.2 Proposition 2

> *Experiences of incongruence in information systems advance the design and enactment of informal information processing technologies in an information system.*

This proposition is supported by the empirical data gathered during both the survey and the interviews. Analysis of the survey data revealed a moderate positive correlation between experiences of misfit and the adoption of reinvention practices. The interviews confirmed this finding and revealed a number of important aspects about the design and enactment of informal information processing technologies.

Triangulation of the data sources suggests that the *reinvention* of information systems should, like incongruence, be considered on more than one level. While individuals can, on user-level, develop personal information systems to enhance their information management capabilities, these technologies do not influence, or *reinvent*, the structure of the formally designed system. In accordance with the conceptual analysis performed in Chapter 2, it is argued that informal information processing activities performed in personal information systems are key elements of the *organisational information system* in it entirety, but should be separated (at least for analytical purposes) from the formally designed ERP technology. Importantly, the empirical analysis suggests the term *reinvention* does not accurately describe their role in the information system. A more accurate description is that users, through personal information systems, *augment* the information system to align it with their personal preferences. Augmentation is performed to counter experiences of non-functional misfit by enabling the user to align the technological features offered by the information system with his/her personal preferences and, as a result, achieve improved performance and satisfaction. It should be noted that the findings show that user-level augmentation poses some risks for the organisation as it may impact accuracy of users' tasks - particularly when it involves EUC.

The case study also revealed examples of information system augmentation on organisation-level. Where organisation-level incongruence obstructed the completion of a workflow the SCM Department designed and formalised alternative, *manual* workflows. These alternative workflows were triggered by business cases which did not conform to Metro's standard operating procedures and were, as a result, not catered for by the ERP (e.g., a vendor failing to submit a tax certificate). Like user-level augmentation, this practice was not adopted to change or *reinvent* the designed technology, but to provide a means for the organisation to cope with a wider variety of business cases. To control the use of alternative workflows the organisation outlined specific conditions under which users were allowed to follow them. In many cases the alternative workflow involved the use of spreadsheets to replicate the decision rules of the ERP.

It is argued, based on these findings, that Boudreau and Robey's concept of reinvention oversimplifies the complexities of technology enactment by user communities. While it is accepted that an information system can be *reinvented* if workaround practices replace the workflows imposed by a designed technology, this study has indicated that they may also play an important role in augmenting a designed technology to make it more robust.

Finally, the enactment of informal information processing technologies in an organisation may provide developers with useful information about the perceived limitations of designed technologies among a user community. In this regard it is argued that information systems will, over time and through the adoption of informal technologies, evolve to align better with the needs of a user community. These needs may, of course, be considerably different from those of organisational management. Reconciliation of these two perspectives will depend, firstly, upon the degree to which the artefact is customisable by developers and, secondly, upon management's ability to enforce adoption.

8.3.3 Proposition 3

> *Experiences of incongruence in information systems promote variance between a formally designed technology and the enactment of that technology.*

The empirical analysis revealed that Metro managed the enactment of their ERP system in two important ways. They ensured, firstly, that the designed technology provided a high degree of task-artefact congruence for users. This minimised the need for users to deviate from intended use of the artefact to achieve their task outcomes. More specifically, the achievement of organisation-level congruence implied that user-level reinvention of the information system would constitute contravention of the SCM policy. Secondly, they institutionalised formally designed workarounds which discouraged the development of covert workarounds. This enabled them to maintain strict adherence to artefact impositions for almost all business cases.

Despite these strategies the empirical data revealed that user ignorance often resulted in misuse of the artefact. This occurred, for example, when requisitioners captured orders. While the artefact could force users to provide values for all the required data fields, it could not ensure that those values were accurate. Importantly, such misuse occurred due to user-artefact incongruence, user-task incongruence or, quite often, a combination of both.

The results of the case study suggest that when users experience secondary incongruence due to erroneous use of the artefact by colleagues they may respond by confronting their colleagues and informing them of their errors and the associated effects. In such cases the secondary experience triggers negative feedback in the system through which accepted artefact use is regulated. One can expect that confrontations may involve a certain amount of conflict, particularly when the error is repeated multiple times. Nonetheless, these feedback loops are beneficial as they cultivate acceptable artefact usage and an awareness of the flow of information through the organisation among users.

It should be noted that failure to achieve and maintain organisation-level congruence will create instances of artefact-task misfit at user-level. While the empirical analysis did not provide evidence of this, it is expected that a high degree of organisation-level incongruence will limit managers' ability to control the enactment of a formally designed technology. Users can be expected to reject such technologies or enact them in unintended ways to satisfy their requirements.

Finally, while the empirical analysis revealed that experiences of non-functional misfit advance the adoption of informal technologies, there is little evidence to indicate that non-functional misfit influenced the enactment of the formally designed ERP technology. It is argued, based on this finding, that the nature of the ERP technology is such that it inherently controls the user's enactment thereof through impositions. While there seemed to be subtle variations between users in terms of their utilisation of the artefact's features, these variations did not lead to differences between the designed technology and the technology in operation.

8.4 Conclusions

In conclusion of this dissertation two aspects of the findings made in the study are extrapolated. The first concerns the *process* dimension of the incongruence-enactment relationship and addresses an argument briefly raised in section 2.3.2 - whether information systems evolve or decay when users enact information technologies. The second concerns the relationship between the features and impositions of computerised artefacts in general and their role in regulating socio-technical systems.

8.4.1 Evolution or Decay

There is strong evidence in the findings of this study that the implications of incongruence for the enactment of ERP-based information systems should be considered against the backdrop of the system's lifecycle. As the user community progresses through adaptation the types of incongruence they experience change, leading to different forms of enactment which, in turn, impact the structure of the information system. In figure 8.1 a UML state machine diagram is used to illustrate this process based on the findings made in this study. The diagram includes different system states representing the different phases of enactment and their interdependencies.

The process commences with the introduction of formally *designed* ERP technology to the user community. The introduction of the technology involves the technical implementation of the the required software and hardware as well as any formal change management interventions that occur prior to the system's operation commencing. Once the system's operation commences its state changes from designed to *enacted*.

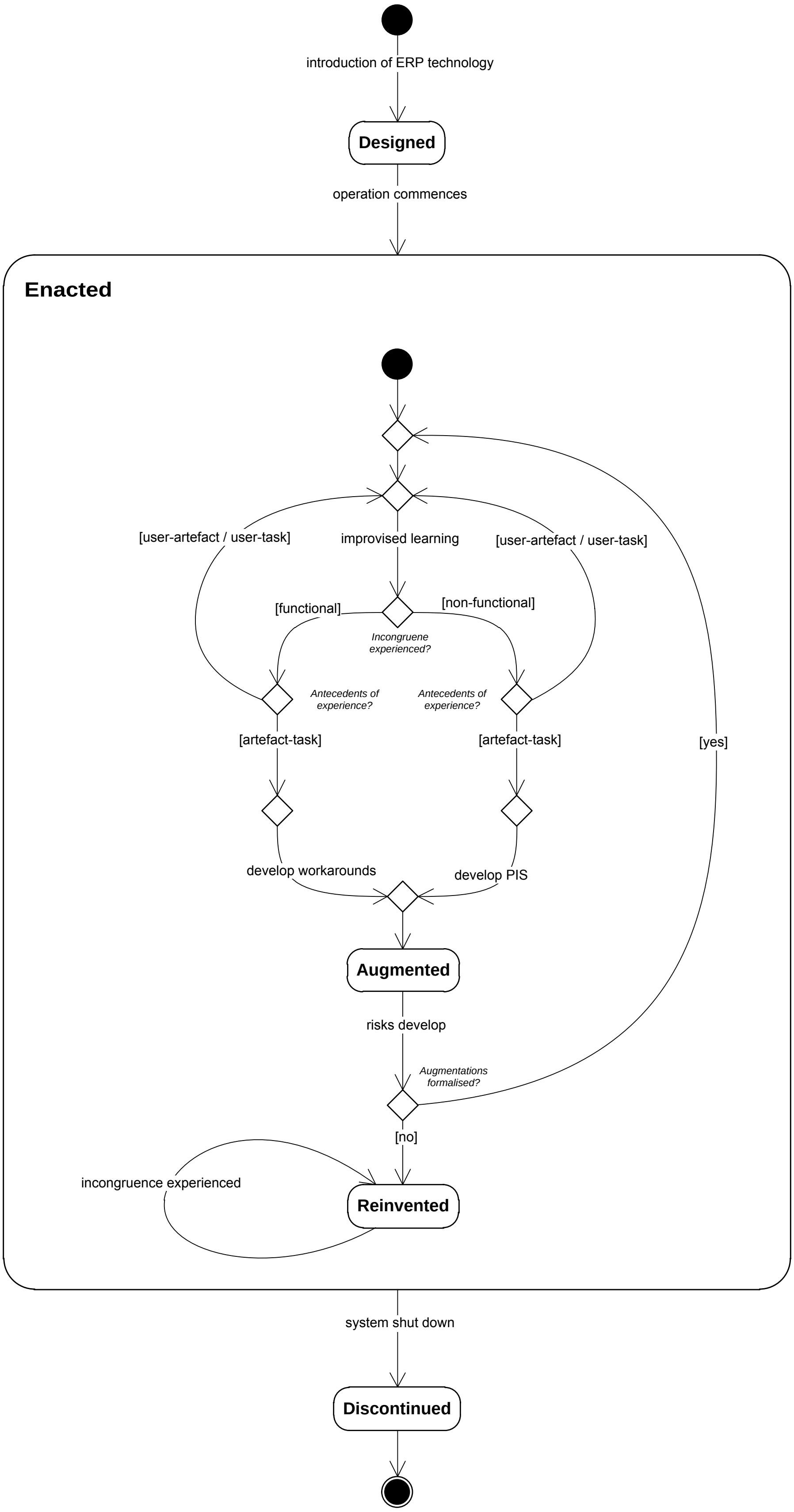

Figure 8.1: Enactment as influenced by incongruence.

Within the enacted state users undertake various forms of *improvised learning* (e.g., mediation and experimentation) to align their personal work patterns with the new technology (i.e., the adaptation process). During adaptation users are expected to experience both functional and non-functional incongruence. This study has indicated that users handle these experiences by seeking mediation from more experienced colleagues or by experimenting with the artefact. In doing so the antecedents of incongruence become known and users' frames of the technology develop accordingly. During adaptation the likely antecedents of such experiences are instances of user-artefact or user-task incongruence.

If, however, the organisation has not managed to align the technology with organisational structures, users' experiences will result from instances of artefact-task incongruence. If the experience is of a non-functional nature this study has shown that users will respond by augmenting the technology through the design of informal information processing activities using support technologies like spreadsheets (i.e., personal information systems). Once such activities become adopted by the user community the system enters the *augmented* sub-state.

While personal information systems may serve to counter experiences of a non-functional nature, experiences of a functional nature which occur due to artefact-task incongruence require users to bypass the artefact's impositions through the development of workarounds. In the reported case study such instances typically occurred as a result of non-standard business cases which were not catered for by the designed technology. Workarounds augment the enacted technology further by providing users with alternative workflows.

The continuous augmentation of the designed technology may afford users better congruence, but if this occurs in an uncontrolled manner informal workflows will eventually replace designed workflows. This is well illustrated in the case reported by Kanellis and Paul.[3] Organisations can manage this risk by formalising augmentations through expansion of the ERP technology or the institutionalisation of workaround practices. This will prompt further adaptation as users become familiar with the revised technology. However, failure to formalise augmentations leads to the *reinvented* sub-state in which users replace designed workflows with workarounds and personal information systems.

[3]See Chapter 4.

Through reinvention of the technology users gain control over its features and are able to counter incongruence with continuous cycles of reinvention.

Finally, once the organisation decides to shut down the ERP technology the system's state changes to *discontinued*.

Within the process outlined above three prominent *loops* or *cycles* are identifiable. The first cycle describes the process of adaptation and occurs when users experience user-artefact/user-task incongruence. These experiences trigger improvised learning and repetitions of this cycle enable the advancement of artefact knowledge and skills in the user community.

The second cycle occurs when the risks which develop due to augmentation are formally handled on an organisational level (as was done at Metro). When this occurs the system effectively *evolves* to address its changing and emerging requirements. Repetition of this *adapt-augment-formalise* cycle enables the system to handle a greater variety of business cases, but also increases its complicatedness through the addition of elements and relationships. While the cycle represents desirable co-evolution of artefact and information system, continuous repetitions will inevitably lead to an overly complicated system which becomes difficult, even impossible, to maintain. This problem is accentuated when parts of the system become redundant but are not formally discontinued or replaced. Importantly, however, formalisation ensures that managers protect their agency in the system's operation by dictating acceptable behaviour. This enables them to prioritise their own requirements (e.g., control, transparency, accuracy) over those of the user community (e.g., ease and satisfaction of use, customisability, flexibility).

The third cycle occurs when augmentations are not formalised and the system evolves through continuous cycles of user-driven reinvention. When this occurs users gain control over the system by replacing designed usage practices with ad-hoc, random processes which satisfy the requirements emerging from the specific business cases at hand. It can be expected that reinvented systems will stabilise over time as acceptable behaviour is agreed upon (at least tacitly) and become regulated by the community. This may involve the use or rejection of artefacts based on their ability to support the reinvented system. Importantly, managers and developers have little agency in or control over such systems.

8.4.2 Features and Impositions

In light of the cycles discussed above the findings of this study also reveal certain aspects of the features and impositions of IT artefacts that have not been addressed in IS literature.

By defining an artefact in terms of its features focus falls on that which the artefact enables or *affords*. It is important, however, to recognise that artefacts are not *sets* but *systems* of features. Implied by this argument is the view that an artefact must be considered not only in terms of its features, but in terms of that which emerge from the interconnectedness of its features as argued in Chapter 3. Two principles follow from this.

Firstly, this study has shown that incongruence/congruence is often determined by the manner in which the artefact's features are interconnected, rather than the features themselves. This is particularly apparent in ERPs which enable the integration of organisational information through the integration of the artefact's features. Secondly, in line with the argument above it is acknowledged that impositions tend to result from the interconnectedness of features or, stated differently, that impositions *are* features. They may be more abstract (or *tangential*) features, but they are the key enablers the culture of discipline which ERP adopters hope to achieve.

Based on these two principles it is argued that the feature/imposition distinction is flawed as both serve to regulate the work system. Such regulation is achieved by simultaneously *enabling* and *restricting* the activities which make up the system. Once the work system is augmented (or reinvented) to bypass artefactual impositions, the organisation sacrifices not only the advantages gained through computation, but also the artefact's agency in the work system.

In the light of these findings the management of computer-based information systems appear to depend upon an organisation's ability to achieve a sustainable balance between the agency of user communities which innovatively enact information technologies and the agency of artefacts which both enable and restrict such enactments.

8.5 Summary

The chapter provides a discussion of the findings made in this study by triangulating evidence gained form the empirical analysis with that reported in the reviewed literature. In the first section of the chapter concepts of incongruence in information systems is revisited and key findings made are outlined. The same is done for the notion of information systems enactment in the second section. In the third section the research question is addressed through the discussion of the findings based on the three propositions formulated in Chapter 4. These findings are summarised through the development of a process model for enactment as influenced by incongruence.

Chapter 9

Limitations and Recommendations

In this chapter the findings of the study are used to formulate recommendations for IS practitioners and researchers. These recommendations are, for the most part, grounded in the model of enactment states (see figure 8.1) which serves to integrate and summarise the study's findings. The chapter commences with recommendations for practice which includes both general recommendations and more specific recommendations for South African metropolitan municipalities. Thereafter recommendations for research are outlined.

9.1 Recommendations for Practice

The findings of this study suggest that information system success depends upon an organisation's ability to find a balance between, firstly, enabling users to enact an information system which is congruent with their requirements and, secondly, controlling these enactments to avoid risks resulting from undesigned information processing practices. Following this argument it is possible to outline a number of principles for the development and maintenance of such a balance in an organisation.

- *Do not introduce a technology with a low degree of organisation-level congruence.* The achievement organisation-level congruence prior to the introduction of a new technology is of cardinal importance for two reasons. Firstly, it enables managers to enforce artefact adoption. When managers become aware of discrepancies between organisational structures and artefactual impositions they are likely to lose confidence in the artefact, obstructing the adoption of the new technology. This creates fertile ground for the negotiation of new order as users' may perceive artefact-task incongruence as indicative of a lack of order and aim to rectify this through the adoption of informal practices.

- *Promote improvised learning.* While formal user training is a key driver of user-artefact congruence, the findings of this study has highlighted the role of informal learning processes in a user community. Opportunities for improvised learning typically arise when users experience some form of incongruence which obstructs their ongoing projects. As such, improvised learning is by nature unplanned, ad-hoc and void of formal conventions. However, because it occurs in the context of a task it enables the user to have an accurate and rich understanding of what he/she needs to know. This offers a more attractive learning opportunity than formal training sessions. The study has found that a key element enabling improvised learning is the availability of mediators and it is suggested that experienced users are encouraged to adopt these roles. While this was not explicitly addressed, findings suggest that such encouragement does not necessarily imply financial reward, but rather recognition and appreciation of their contribution.

- *Acknowledge and address artefact-task incongruence.* Scenarios where the particular attributes of a task require a user to either contravene policy or work around the artefact should be acknowledged formally addressed. Metro's handling of such scenarios through the formalisation of workaround practices offers the advantage of ensuring that managers retain control over workaround practices. This avoids the development of covert practices which may be abused by the user community. Importantly, if such formalised workaround practices are utilised rarely they may offer a more economical option than redesigning the artefact.

- *Accentuate the alignment of artefact and policy using artefactual features.* The use of an artefact to enforce policy adherence can serve the additional purpose of making users aware of the policy underlying impositions. Error messages and warnings which guide users' interaction with the artefact should include references to the relevant policies enabling users to refer to these and make sense of the imposition.

- *Ensure that up-to-date policies are easily accessible.* While this relates, first and foremost, to formally defined policy, the same principle applies for informal policy specific to a branch or working group. In this study it was found that such informal policies typically emerge when users agree on a method of handling exceptional business cases which raises inadequacies in formal policy. Ideally, users should have access to some form of knowledge base where parts of the formal policy can be augmented with examples of exceptional business cases and the accepted method of handling them when interacting with the artefact.

- *Utilise experiences of organisation-level incongruence as opportunities to review policy.* Experiences of incongruence may point to deficiencies in organisational policy and, if left unresolved, open the door for reinvention practices. This study has shown that experiences of incongruence are valuable, not only as learning opportunities for users, but also as indicators of opportunities to improve aspects of organisation.

- *Designers and managers should be familiar with the stages of adaptation.* It was found in this study the user-artefact incongruence is likely to develop over time. Users initially experience functional incongruence during the early stages of adaptation, while non-functional incongruence is more frequent among experienced users in later stages of adaptation. Interventions to support users should be sensitive to this progression and varying needs of users as a result thereof.

- *Harness users' personal information management strategies.* Findings suggest that users develop and refine their personal information management strategies as they advance through stages of adaptation. These strategies tend to become more helpful when users experience non-functional incongruence. While the risks of allowing EUC should be recognised, it is suggested that users should be given some degree of freedom to innovatively address experiences of non-functional incongruence as it influence their tasks. Because personal information management strategies are user developed, they serve to align the technology with a user's personal preferences. It was found that strategies are shared among colleagues but may be further refined by the receiver in accordance with his/her personal preferences.

- *Accentuate cues which support the artefact's reputability.* It was shown in this study that users' initial ideas about the artefact as being reputable encouraged them to undertake improvised learning. While not all organisations can afford market-leading artefacts, managers should show confidence in the artefact by accentuating cues which support its reputability. This may be particularly beneficial in early stages of adoption when there is ambiguity about the nature of the artefact. By accentuating such cues managers can, at least partly, dictate users' initial efforts to make the artefact sensible and encourage positive attitudes towards it.

9.1.1 Recommendations for South African Metropolitan Municipalities

Because of the context in which the empirical work was performed, the relevance of the findings for South African Metros deserves emphasis. The recommendations outlined in the preceding section are, of course, also relevant for such organisations, but in this section they are augmented by recommendations specifically aimed at Metros.

It is clear from the reports reviewed in section 5.2.3 that a culture of fraud and corruption is widespread in South African local government institutions. The case study revealed that information systems play a crucial role in a municipality's efforts to combat this culture. Two dimensions of this role are worth highlighting:

- *The information system as policy imposer.* Adherence to policy implies particular information management principles for municipalities. Aligning the design of the information system with the requirements of relevant policies is a challenging but crucial step towards policy adherence. If achieved, the information system serves the dual role of driving organisational operation and imposing policy adherence.

- *The information system as invigilator.* Closely linked to its role as policy imposer is the information system's ability to induce transparency and traceability in municipal operations. While the information system as bureaucrat/manipulator *guides* actors, the information system as invigilator *tracks* actors. The findings outlined in section 5.2.3.2 suggest that the absence of this function in local government is a major area of concern.

To design and implement an information system which performs the two functions described above presents a formidable challenge, particularly for smaller or isolated municipalities with limited access to the services of professional third parties. While they may have such access, metros face particular challenges due to the volume of transactions they handle implying heavy reliance on computation. The adoption of large, integrated artefacts is non-negotiable in such environments. This study has found that, to do this successfully, metros have to ensure that organisation-level congruence is achieved across its operations. The recommendations below provide guidelines for metros to achieve this ideal based on the findings of this study.

1. *Make sense of the implications of legislation for information system design.* The role legislation plays in dictating the operations of municipalities should be one of the first considerations for information system designers in metros. In the SCM environment, for example, the MFMA has numerous information system implications which translate to very specific requirements for design.

2. *Policy before package.* The decision to adopt packaged software should be made only after careful consideration of its potential to satisfy the organisation's requirements. This is only possible if decision makers have a clear understanding of the requirement set such a package needs to satisfy. An important step towards defining those requirements is the specification of standard operating procedures. These can be updated, if feasible, to adhere to artefactual impositions after implementation. However, if package acquisition precedes process specification the achievement of organisation-level congruence is encumbered.

3. *Acknowledge the limitations of integrated artefacts.* While the selection of an integrated artefact is an important step, executive managers should not equate artefact acquisition to information system design. The artefact alone does not guarantee either of the two functions described at the outset of this section. On the contrary, when congruence is not

achieved through the design of an information system the artefact may be more disruptive than beneficial to operations. In particular, this study has shown how even a mature information system still relies heavily on paper-based activities and the importance of aligning these with computerisation.

4. *Policy adherence trumps user preference.* Strong leadership from senior and line managers is critical to the establishment of a culture of policy adherence. This obviously involves a range of factors, but this study has shown how it affects information systems in particular. Experiences of incongruence may discourage policy adherence and prompt reinvention practices. In the absence of strong leadership enforcing adherence, users have the freedom to develop workarounds suited to their personal preferences rather than following formal procedures. Such preferences should be addressed where feasible, but policy adherence should not be compromised. Importantly, managers would only be capable of enforcing adherence if organisation-level congruence has been achieved or formal workaround processes defined.

9.2 Recommendations for Research

In this section recommendations for academic research in IS are outlined based on the findings of the study. The section commences with the acknowledgement of the limitations of the study, after which recommendations for future research are outlined.

9.2.1 Limitations of the Study

As is the case with any academic research this study is subject to certain limitations, three of which are worth briefly discussing:

1. The focus in this study is on ERP-based information systems designed for the purpose of organisational information management. There are, of course, a great variety of information systems which do not conform to this description and the relevance of the study's findings for such systems is debatable. While the findings made may indeed be applicable

to other types of information systems, this study has not addressed this possibility.

2. The method adopted for the empirical investigation is motivated in section 5.1.2. The limitations of this method (which are outlined in the same section) should be acknowledged. In particular the implications thereof for the generalisability of findings. The environment in which the empirical analysis was performed is characterised by factors like strong leadership, rigid operating procedures and a high degree of organisation-level congruence. The validity of the findings made in this study can be corroborated by the performance of a similar investigation in a less structured environment. It is suggested that a less formally structured organisation would be associated with greater degrees of incongruence which will cultivate more information system augmentation and reinvention.

3. It is important to consider that the relevance of the findings made in this study are bound to a particular time frame which is associated with particular trends in the development of computer technology. While, in this time frame, the adoption of large, integrated artefacts is a popular strategy for enterprises, the future will certainly characterised by other trends. To what extent the findings will remain applicable depends on the nature of these trends and how they impact the intersection of user, artefact and organisation.

9.2.2 Suggestions for Future Research

The findings of this study uncover an array of future research possibilities. These are, like the topic investigated here, socio-technical in nature and share a particular focus on organisational information systems. In this section six specific suggestions for future research are outlined.

1. Much can be learnt from the comparative analysis of the incongruence-enactment relationship in various organisations. Having multiple datasets would enable the researcher to draw conclusions about the relationship between organisational properties (e.g., private/public, industry, man-

agement style, culture etc.) and the incongruence -enactment relationship.

2. This study has found that reinvention practices pose certain risks to the accuracy, efficiency and transparency of business processes. It also found, however, that organisation-level incongruence necessitate reinvention practices for the sake of policy adherence. However, the relationship between reinvention practices and policy adherence can be studied in greater detail. It is hypothesised, based on the findings of this study, that organisations experiencing high degrees of organisation-level incongruence will rely extensively on reinvention practices to continued operation and uphold policy.

3. On a more technical level there is a need to consider the ability of organisations to harness effective/efficient reinvention practices which emerge when users innovatively design a new order (e.g., alternative workflow). It may be that these practices offer better alternatives (not only for users, but for the organisation as a whole) than those originally implemented by system designers. The question which should be considered is how organisations can adopt successful reinvention practices by mitigating the threats they pose to information management and integrating them with formal system structures.

4. From a social perspective an interesting challenge would be to investigate the relationships among users and the role these play in the organisational operation. One perspective on this topic is the role that personal social relationships play in facilitating the formation of workaround practices. Another is the role of mediation in facilitating functional and non-functional congruence through improvised learning.

9.3 Summary

The chapter provides recommendations for IS practitioners and researchers based on the findings of the study. A number of general recommendation for practice are outlined after which more specific recommendations are outlined for South African Metropolitan Municipalities. This is followed by the acknowledgement of the limitations of the study, as well as the specification of recommendations for future research.

Appendices

Appendix A

Survey Used in Empirical Investigation

A.1 Project Background

This questionnaire forms part of a research project which investigates how users engage with information systems. The study takes particular interest in users' experiences of 'misfit' - situations where the information system fails to satisfy their requirements. Completion of this questionnaire is done anonymously and voluntarily. By submitting the questionnaire you give your consent to participate in the study, the terms of which can be viewed here.[1]

A.2 Section 1

We wish to establish your position in the procure-to-pay process and the nature of you role.

1. In which directorate do you work?

   [user could select the correct option from a drop down list]

2. Which option best describes your position?

   [user could select the correct option from a drop down list]

[1] A hyperlink enabled subjects to access the consent form which contained all information prescribed by Stellenbosch University.

3. Are you responsible for a wide variety of tasks, or are your tasks more repetitive?

   [very repetitive] [mostly repetitive] [some variance] [mostly variant] [very variant]

4. Do your tasks require you to use your personal judgement on matters?

   [never] [rarely] [occasionally] [frequently] [very frequently]

5. How would you describe your familiarity with the official SCM policy?

   [extremely poor] [below average] [average] [above average] [excellent]

6. How frequently do you use [the artefact] to perform your tasks?

   [never] [rarely] [occasionally] [frequently] [very frequently]

7. Is it possible for you to 'work around' [the artefact] when required?

   [never] [rarely] [occasionally] [frequently] [very frequently]

A.3 Section 2

Large software packages, like [the artefact], often fail to satisfy the needs of users in various ways. In this section we wish to find out whether you experience any of them.

8. Would you say that [the artefact] makes the performance of your tasks slow or cumbersome?

   [never] [rarely] [occasionally] [frequently] [always]

9. Does [the artefact] help you to accomplish your tasks effectively?

   [never] [rarely] [occasionally] [frequently] [always]

10. Is the data you get from [the artefact] accurate?

    [never] [rarely] [occasionally] [frequently] [always]

11. Is the data you get from [the artefact] complete?

    [never] [rarely] [occasionally] [frequently] [always]

12. Is the data you get from [the artefact] timely?

    [never] [rarely] [occasionally] [frequently] [always]

13. Do you find it difficult to use [the artefact]?

    [never] [rarely] [occasionally] [frequently] [always]

14. Do you find using [the artefact] to be slow and frustrating?

    [never] [rarely] [occasionally] [frequently] [always]

15. Do you have adequate [the artefact] knowledge and skills to complete your tasks?

    [never] [rarely] [occasionally] [frequently] [always]

16. Do you have access to the required data and functionality within [the artefact]?

    [never] [rarely] [occasionally] [frequently] [always]

17. Does [the artefact] handle variations or exceptions in your tasks well?

    [never] [rarely] [occasionally] [frequently] [always]

18. Do you find it difficult to complete tasks due to the rules imposed by [the artefact]?

    [never] [rarely] [occasionally] [frequently] [always]

A.4 Section 3

To overcome problems users experience with packages like [the artefact] they often have to find alternative ways to work with information. In this section we want to find out what you do to cope with such problems.

19. Do you use software like MS Excel to develop your own reports or make calculations using data from [the artefact]?

    [never] [rarely] [occasionally] [frequently] [very frequently]

20. Do you need to use other software applications that have functionality not available in [the artefact]?

    [never] [rarely] [occasionally] [frequently] [very frequently]

21. Sometimes [the artefact] doesn't have fields for a specific piece of data and users have to enter the data into some other field. Do you need to do this?

    [never] [rarely] [occasionally] [frequently] [very frequently]

22. Do you need to access [the artefact] using someone else's username to gain access to data or functionality you require?

    [never] [rarely] [occasionally] [frequently] [very frequently]

23. Do you send data from [the artefact] to colleagues (or receive data from them) in spreadsheets (or other formats like text files)?

    [never] [rarely] [occasionally] [frequently] [very frequently]

24. Do you use other software applications because they support your tasks better than [the artefact]?

    [never] [rarely] [occasionally] [frequently] [very frequently]

25. Do you have to enter 'dummy' values into fields in [the artefact] to complete a task?

    [never] [rarely] [occasionally] [frequently] [very frequently]

26. Do you let a work process continue by phoning, e-mailing or speaking to a colleague as opposed to following [the artefact]'s procedures?

    [never] [rarely] [occasionally] [frequently] [very frequently]

27. Do you access [the artefact] using someone else's username to complete tasks?

    [never] [rarely] [occasionally] [frequently] [very frequently]

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