Key Factors and Underlying Mechanisms for the Enterprise Systems Lifecycle in Public Service Organisations

Case Study of an Irish PSO

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Abstract

This is a longitudinal Critical Realist case study in the Enterprise Systems (ES) area within the Information Systems (IS) domain. Based on the literature review, it is identified that the majority of the ES research is conducted around the implementation phase. It usually reports a myriad of critical success factors (CSFs) that are generally conceived to be static throughout the ES lifecycle. The literature review also notes that the literature on ES-mediated organisation change usually subscribes to only technological/organisational imperative, employs variance based theorising, and is normally confined to a single level of analysis. Finally, it also notes that the ES literature normally does not pay attention to the implementation context and often it is implicitly assumed that findings from the private sector organisations would also apply to the public service organisations (PSO). Therefore, this study seeks to move beyond a list of CSFs and offers a mechanism-based critical realist account that captures the processual dynamics of the ES lifecycle in the PSO context. Therefore, the research question for this study is: *"what are the key factors and underlying mechanisms that underpin the enterprise system lifecycle in Irish public service organisations?"* The fieldwork was conducted in the Irish Blood Transfusion Services (IBTS) that engaged in three ES implementations over the period 2000-2015.

The explanatory theoretical framework identifies four mechanisms underpinning the ES lifecycle in IBTS – affordance, control, institutionalisation, and market mechanism. These mechanisms manifest themselves via the emergence of various factors across the phases (Adoption, Acquisition, Implementation, Use and Maintenance, and Evolution) of ES lifecycle. The *affordance mechanism* at the work-system level is primarily associated with the features and constraints of the enterprise/legacy systems and business process requirements. The *control mechanism* operates at different levels during different phases of the ES lifecycle and public/health service context is found to be a major imperative for the prevalence of the control mechanism. The *institutionalisation* mechanism at the organisational level is associated with how different ES lifecycle activities are embedded in organisational activities. Finally, the *market mechanism* at the macrosocial level plays a crucial role due to the information asymmetry of the ES market and due to the existence of a dominant supplier in a niche (blood bank) market. These mechanisms and the interaction among them manifest in various CSFs during different phases of the ES lifecycle. A major finding of this study is that the relative importance of the CSFs varies not on *during* the phases of ES lifecycle but also *across* different instances of the ES lifecycle.

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Table of Contents

List of Tables

List of Figures

List of Abbreviations

BBCS	Blood Bank Control System
BECS	Blood Establishment Computer System
BoA	Biography of Artefact
BOSS	Blood Operations Support Software
BPR	Business Process Reengineering
BTSB	Blood Transfusion Service Board
CE	Chief Executive
CIO	Chief Information Officer
C&AG	Comptroller & Auditor General
CPA	Committee of Public Account
CRM	Customer Relationship Management
DoH	Department of Health
DPC	Data Protection Commissioner
eDMS	electronic Device Management System
EDMS	Electronic Document Management System
EIS	Electronic Information Systems
EMT	Executive Management Team
EOS	Electronic Ordering System
ERP	Enterprise Resource Planning
ES	Enterprise Systems
ESG	Executive Steering Group
GoI	Government of Ireland
HPRA	Health Products Regulatory Authority
HSE	Health Service Executive
IBTS	Irish Blood Transfusion Services
ICCBBA	International Council for Commonality in Blood Banking Automation
ICT	Information and Communication Technology
IMB	Irish Medicines Board
ISBT	International Society of Blood Transfusion
IT	Information Technology
MIS	Management Information Systems
MRP	Material Requirement Planning
NHS	National Health Service
NYBC	New York Blood Centre
OGCIO	Officer of the Government Chief Information Officer
PPARS	Personnel Payroll And Related Systems
PRG	Peer Review Group
PSG	Project Steering Group

PSO	Public Service Organisations
RtP	Request to Participate
SCM	Supply Chain Management
SDLC	Software Development Lifecycle
STS	Socio-Technical Systems
TAM	Technology Acceptance Model
TQM	Total Quality Management
URS	User Requirement Specifications
WIP	Work-in-Progress

CHAPTER 1
INTRODUCTION

"Research is formalised curiosity. It is poking and prying with a purpose."

- Zora Neale Hurston (1891-1960), Dramatist

1.1 Introduction

This chapter acts as an introductory chapter for the doctoral thesis which is the result of a formal research study. The study in conducted in the Enterprise Systems (ES) area within the Information Systems (IS) domain. Davis & Olson (1985, in Hirschheim & Klein, 2012) observe that the field of Management Information Systems (as IS field was called in the 1980s) is formed from the nexus of computer science, management and organisation theory, operations research, and accounting. This statement particularly fits well with the ES research. Schlichter & Kraemmergaard (2010) report that ES studies are primarily published in the areas of operations management (31%), IS (24%), computer science (15%), organisation and management (13%), and accounting (9%). It is acknowledged here that this study primarily falls within the IS domain but also selectively draws insights from the domain of organisation and management studies.

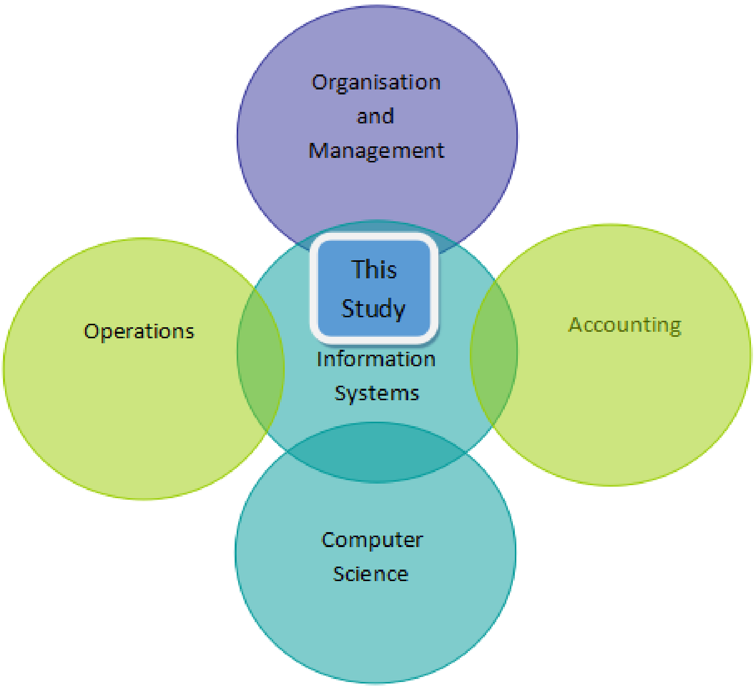

Figure 1.1 Research Domain for this Study

For this study, definition of the IS field is taken as: “*the field of study focussing on the interactions and relationships, whether fruitful or problematic and whether designed or spontaneous, between ICTs and their political, social and economic contexts, at and across the individual, group, organisational and societal levels”* (Willcocks & Lee, 2008, p. *xxx*). This definition is preferred here since it defines IS within its context and acknowledges that an IS can have a range of effects across levels. Though a single study cannot capture all elements of the context with all outcomes at all levels, this definition provides the focus for this study. Furthermore, this study does not claim to be within the realm of operations research, computer science, or accounting.

Section 1.2 presents research motivations and justifications respectively in terms of the background of the researcher and the gap in existing literature. Section 1.3 defines the key terms used in the research question and presents the research question for the study. Section 1.4 offers study contributions and summary findings. Section 1.5 presents the structure of the thesis. Finally, Section 1.6 concludes the chapter.

1.2 Research Motivations and Justification

This section describes the motivations and justifications for conducting this study. Subsection 1.2.1 discusses the research motivations that primarily stem from the professional experience of the researcher with enterprise systems implementations in Indian public service organisations (PSOs). Subsection 1.2.2 offers justifications for this study based on the gaps in the extant literature and available empirical evidence.

1.2.1 Personal Motivations

Maxwell (2012, pp. 17-21) argues that often research choices are shaped by researchers’ prior experience and their beliefs about the phenomenon they wish to study. Therefore, in this subsection, I explicitly present my personal beliefs and motivations for this research. After completing *Bachelor of Engineering in Information Technology* from an engineering college in India, I felt that I understood only one aspect of the technology and there is much more to learn about it from its application in organisations. Subsequently, to study the organisational aspect of IT, I enrolled for a *Masters in Industrial Management* from the Indian Institute of Technology. The seeds for this research were sown during my internship and my Master’s thesis when I focussed on change management associated with ES introduction in an Indian public R&D organisation. Due to the time constraints, however, I could study only the pre-implementation part of it. The interest remained dormant for few years when I switched my field to explore other interests. My interest in the ES field resurfaced during my two years' stint in Indian Space Research Organisation where I was part of a team developing in-house ES for administrative functions. It is where I fully realised that implementing an ES is not just a technical-managerial activity and that it is influenced by many internal and external factors. As my interest in the subject grew, I felt the need to conduct a formal longitudinal study of ES lifecycle in public service organisations to capture the rich details of the phenomenon. With this research motivation, I entered the Ph.D. program of Trinity Business School at Trinity College Dublin[1].

1.2.2 Justifications for the research

ES could easily be termed as a lifeline of modern business organisations. The global market for ES is consistently witnessing growth with an estimated market size of USD 24.5 billion in 2012 (Gartner Group, 2013 in Columbus, 2013) and is pegged to grow at a healthy rate of 7.2% for the period 2014-2020 (AMR, 2015). However, extant studies also report a high failure rate of ES projects. Different failure rates ranging from 50 to 90 percent are reported (Amid et al, 2012; Garg & Garg, 2013) in the ES literature. Perhaps therefore, the majority of ES research focusses on identifying critical success factors associated with ES implementation (Moon 2007, Grabski et al 2011, Shaul and Tauber 2013). Such research has typically focused on the identification of the critical factors through either case studies or surveys in the expectation that such research will provide the practitioner some guidance on where to focus attention and resources in planning a system implementation project (Loonam and McDonagh 2009). However, despite the focus on the success factors, it is evident from recent surveys (Panorama Consulting, 2016) that ES implementations still pose significant challenges for the organisations. This clearly points to some gap in the extant ES research on critical success factors. Chapter 2 discusses these gaps and develops a research agenda based on the gaps identified.

In recent years, especially after the global recession of 2008, PSOs have become an important clientele for ES vendors (Centre for Digital Government, 2016; Panorama Consulting, 2016). However, the literature review conducted for this study supports the assertion by Howcroft et al (2004) that extant ES studies by and large ignore the implementation context, a general trend also noted in the IS literature (Currie, 2009). The limited literature on this topic suggests that the PSO context poses unique challenges for those trying to implement ES (Sommer, 2006; 2011) and there is a need for more research on ES in PSOs. Therefore, this study explicitly focusses on the PSO context.

[1] To maintain the formal language of the thesis, I have refrained from writing in the first person except in this section and in a reflective piece in the last chapter.

1.3 Key Definitions and Research Question

This section presents definitions of the key terms used in this study and presents the research question. Section 1.3.1 offers a definition of the ES artefact which is the central focus of this study. Section 1.3.2 discusses the nature of the public service context. Finally, Section 1.3.3 presents the research question that this study seeks to answer.

1.3.1 Enterprise System

Within the IS domain, this study focusses on Enterprise Systems, also termed as Enterprise Resource Planning (ERP), or Enterprise Information Systems (EIS) in the literature[2]. ES definition is sometimes provided in terms of the business functions it supports such as finance, human resources, marketing, or production (Davenport, 1998). This study, however, subscribes to a wider definition of ES as *configurable information systems packages that provide seamless integration of information and information-based business processes within and across functional areas in an organisation* (Kumar & Van Hillsgersberg, 2000, p.23).

Scholars often take a lifecycle view of the ES introduction and use in organisations (Bajwa et al, 2004; Markus & Tanis, 2000; Parr & Shanks, 2000; Rajagopal, 2002; Ross & Vitale, 2000) but ES studies usually tend to focus mostly on the implementation phase (Esteves & Pastor, 2001; Esteves & Bohorquez, 2007; Eden et al, 2012) of the ES lifecycle. However, as Pollock & Williams (2009) and Williams & Pollock (2012) argue, implementation studies result in a partial understanding of the ES phenomenon because of their limited timeframe. Perhaps therefore, Grenci & Hull (2004) suggest that one way to evaluate the outcome of an ES project is to consider it on a stage by stage basis. This consideration is crucial since although an intermediate outcome may influence the final outcome, it need not necessarily determine it (Markus & Tanis, 2000). For example, there are reports of companies reporting a dip in their performance immediately after the system rollout (Deloitte, 1998) but eventually recovering from their initial setbacks. Wagner et al (2010) and Berente et al (2008) also show that the eventual fate of such projects is determined not by initial reaction after the 'go-live' but by the way organisations arrive at a 'working' ES. This working ES may not be the optimal solution as planned, but nevertheless is accepted by all the parties concerned. Therefore, this research takes a lifecycle view of the ES introduction and use in organisations. A lifecycle view stresses that there will be different phases of the process and there will be intermediate outcomes

[2] In this study, the term ES has been used to ensure consistency.

of each phase, often drawing from an underlying mechanism (Van de Ven & Poole, 1995). Hence, this research focuses on the identification of *key factors and underlying mechanisms that underpin the ES lifecycle*.

1.3.2 Public Service Context

While the majority of the vendors and consultants present the ES as a one-stop solution for PSO needs, scholars question the claim of ES implementations being context-free (Howcroft et al, 2004) and argue for contextualising the IT artefact (Currie, 2009; Currie & Swanson, 2009). As Warwick et al (1979, p. 204) puts it, *“it is not enough to pack a briefcase with concepts and measures developed in other settings, unload them in a public agency and expect them to encompass all of the worthwhile reality to which they are exposed.”* Willcocks & Currie (1997) also warn against the tendency to apply management tools and techniques from the private sector in the public sector without giving any consideration to the context. Therefore, this research explicitly pays attention to the PSO context to examine if it has a distinct impact on the ES lifecycle.

Therefore, it is imperative here that study defines the public nature of organisations as understood in this study. One common usage of the term equates public with government ownership and control. It is argued that government organisations’ status as public bodies have a major influence on their environment, goals, values, and hence on other characteristics. Bozeman (1987, p. xi) defines publicness as *“degree to which the organisation is affected by political authority”.* He contends that publicness leaves an indelible stamp on the organisation and affects its behaviour in important ways. At the same time, he also contends that all organisations are public to a certain extent. Perhaps therefore, instead of following a clear-cut dichotomy, Dahl & Lindblom (1953) map diverse organisations on a continuum between public and private. This study takes a view that although there might be some similarities among public and private organisations, the former also differ from the latter in some very important respects, primarily due to their government ownership and their institutional context. Furthermore, the institutional context of PSOs may also vary depending on the national context.

A second way of differentiating the public organisation from their private sector counterparts is in terms of their focus on the public values (Moore, 1995; Bozeman, 2007). As opposed to private sector’s motive of generating business and shareholder value which are generally clear and quantifiable, public values are usually abstract and non-quantifiable. For Moore (1995), public organisations create public values when they produce outputs that are needed by the citizens or for which citizens express a desire.

Therefore, he argues that apart from efficiency and effectiveness of outputs, the outcomes of PSOs must be judged against citizen's expectations for justice, fairness and provision of public values. In this regard, Bozeman (2007) offers the concept of public value failure which refers to the failure of the PSOs in fulfilling the expectations of the public.

This study subscribes to both the viewpoints and defines PSOs as *the organisations that work within a high level of government controls* and *are engaged in the delivery of public value*. However, it may be noted here that the study does not explicitly attempts to measure the public value. Rather, it explores how study participants understood and used the concept of public value. With this caveat in mind, the next subsection presents the research question that this study seeks to answer.

1.3.3 Research Question

Based on the research topic and the research context identified earlier, a detailed literature review was conducted which is presented in Chapter 2. At the same time, literature related to research methodology was also explored, which is discussed in Chapter 3. Based on the literature review and methodological considerations, the following research question is identified:

> **What are the key factors and underlying mechanisms that underpin the enterprise systems lifecycle in Irish public service organisations?**

1.4 Study Contribution and Summary Findings

This section presents a high-level discussion on the contribution and summary findings of this study. The discussion on contributions in this section remains general and specific details of the exact contributions are outlined in Chapter 6.

A key contribution of this study is that it takes a Critical Realist perspective that is usually ignored in the extant IS literature (see Section 3.3). The critical realist perspective allows the researcher to move beyond the surface level CSFs and to look for the mechanisms that underpin the process of ES lifecycle in organisations. The language of mechanisms also provides a useful handle to practitioners who may focus on specific mechanisms rather than a plethora of CSFs. Based on a longitudinal qualitative critical realist case study, this study identifies four underlying mechanisms that underpin the ES lifecycle – Affordance, Control, Institutional, and Market mechanism. At the same time, by integrating the Socio-technical Systems (STS) perspective within a critical realist inquiry, this study maps the CSFs and underlying mechanisms to three distinct levels – macrosocial, organisational, and work-system level (see Section 3.4). This conception enables the explanatory framework to capture the impact of the mechanisms within and across different levels. Table 1.1 presents a brief description of the four mechanisms that are discussed in detail in Chapter 5.

Table 1.1 Mechanisms Underpinning ES Lifecycle

Mechanism	**STS Level** (Trist, 1981)	**Description**
Affordance Mechanism	Work System	Action possibilities and opportunities that emerge from actors engaging with the enterprise system (Faraj & Azad, 2012)
Control Mechanism	Multi-level	A set of activities that are conducted in a project to regulate or adjust the behaviour of the stakeholders, to motivate participants, and to ensure that their capabilities are fully applied to advance the ES initiative towards its objectives (Kirsch, 1997, 2004).
Institutionalisation Mechanism	Organisational	A process by which a social structure attains a stable and durable state or property (Currie, 2009) that produces recognisable, repetitive patterns of interdependent actions, carried out by multiple actors within a pre-existing social context (Feldman & Pentland, 2003)
Market Mechanism	Macrosocial	Product availability, market structure, supplier-client relationship, and impact of these on the ES lifecycle.

The findings of this study suggest that the Critical Success Factors (CSFs) that are usually identified for the ES lifecycle are the manifestations of these mechanisms. As noted in Chapter 2, extant ES literature focuses on the implementation phase and takes a static perspective on CSFs. A major contribution of this study is to present a lifecycle based process perspective (see Section 3.2) on CSFs and underlying mechanisms. This perspective acknowledges that different CSFs might be crucial in different phases of the ES lifecycle and the importance and nature of the same CSFs might vary across the phases. For example, the findings suggest that while the role of top leadership remains crucial during initial stages, its relative importance lessens during later stages. Figure 1.2 (reproduced from Chapter 5) exhibits the relative importance of key CSFs during the phases of the ES lifecycle. Detailed findings are discussed in Section 5.3.6.

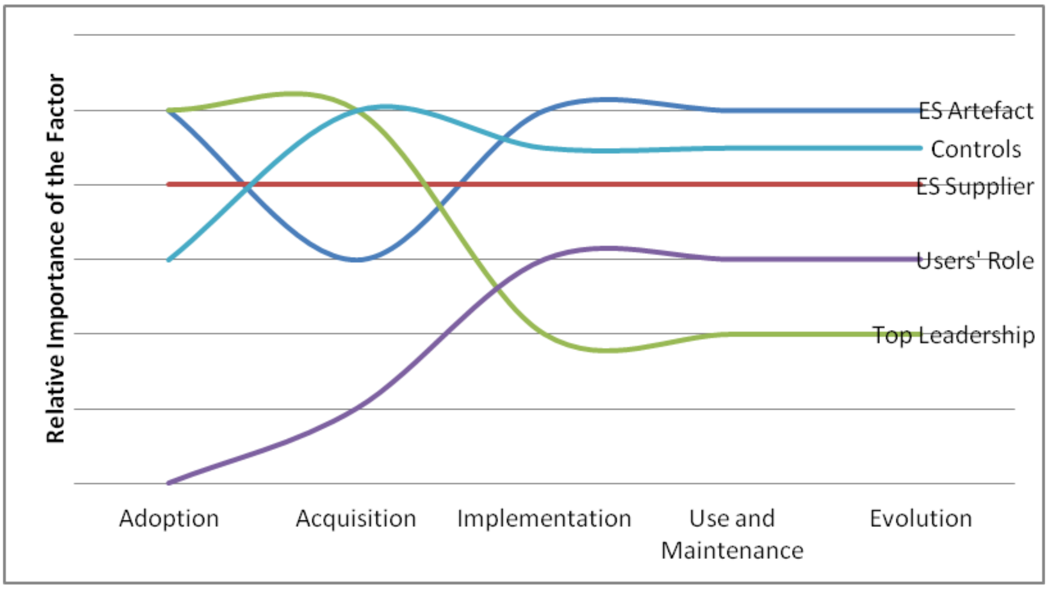

Figure 1.2 Relative Importance of Key Factors during the ES lifecycle

As noted in Chapter 2, most of the ES studies focus on the implementation phase of a single ES project, ignoring the impact of different times and locale (Pollock & Williams, 2009; Williams & Pollock, 2012) on the ES lifecycle. Due to its longitudinal nature, this study captures three instances of the ES lifecycle in a single organisation over the span of 16 years, and in the process, uncovers the changing nature of CSFs across projects. For example, while user training was a crucial factor in the first project, it was barely a concern in the latest project due to their experience with the system. Figure 1.3 (reproduced from Chapter 5) exhibits some key CSFs that experienced change in relative importance during three instances of the ES lifecycle. Detailed findings are discussed in Section 5.3.7.

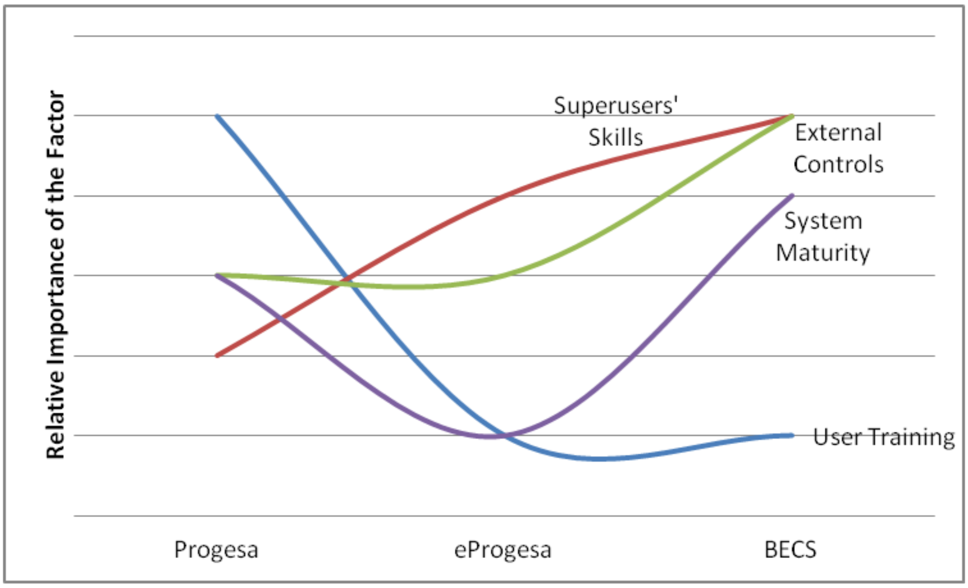

Figure 1.3 Relative Importance of Key Factors across three instances of the ES lifecycle

Therefore, in summary, the key contributions of this study are offering a mechanism-based, multi-level explanation based on the tenets of critical realist philosophy and tracing the key factors *during* and *across* three instances of the ES lifecycle. The next section presents the thesis structure in terms of chapter schematic and logical flow.

1.5 Thesis Structure

Figure 1.4 presents the schematic and logical flow of the thesis. Chapter 1 presents the background of this study in terms of research motivations and justifications, key definitions, research question, and the structure of the thesis. Literature review, which is presented in Chapter 2, is guided by the research topic (ES) and the research context (PSO) outlined in Chapter 1. Literature review combines a systematic approach and a narrative approach in reviewing the extant ES literature to develop a research agenda for this study. At the same time, the researcher also engaged in clarifying the philosophical assumptions related to the ontology, epistemology, and methodology of the research which are discussed in Chapter 3 on research methodology. Both the literature review (Chapter 2) and research methodology (Chapter 3) helped in precisely determining the research question as presented in Section 1.3. Fieldwork and analysis were conducted using a longitudinal case research strategy incorporating the socio-technical perspective within the process framework. The outcome of the fieldwork is presented in the form of case narrative in Chapter 4. The case narrative is longitudinal and does not explicitly include any theory. Chapter 5 presents a mechanism-based explanatory theory of the ES lifecycle in public service organisations based on the analysis of the empirical data. The links of the framework with existing literature are also established in this chapter. Finally, Chapter 6 concludes the thesis by identifying the research contributions, limitations and possible research directions.

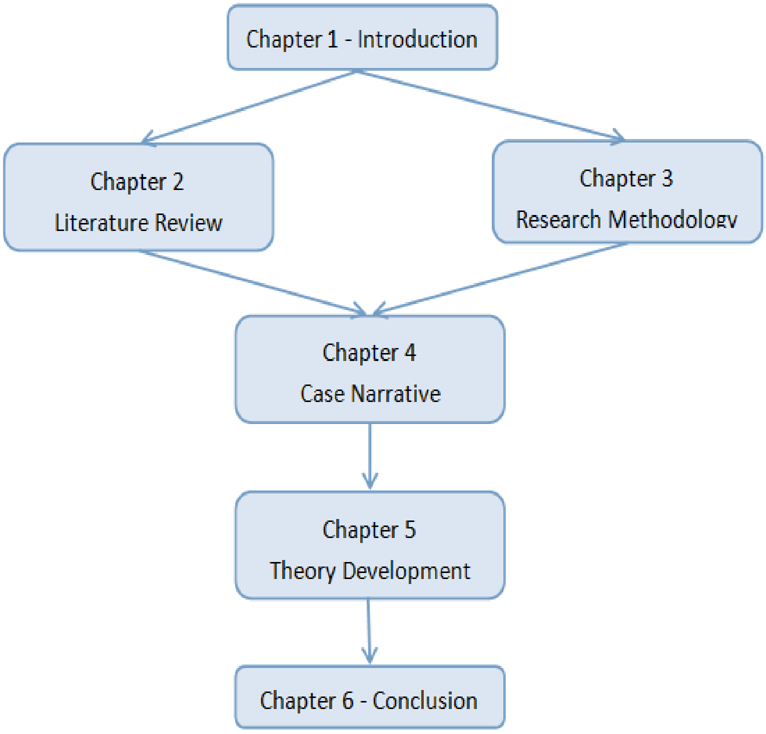

Figure 1.4 Schematic of the Thesis

1.6 Conclusion

This chapter presents a brief introduction to the thesis. Section 1.2 presents research motivations and justifications which are respectively grounded in the professional experience of the researcher and in the gaps identified in the extant ES literature. Section 1.3 defines the terms ‘enterprise system’ and ‘public service organisation’ as used in this study and outlines the research question. Section 1.4 presents a high-level discussion on the key contribution and summary findings of this study. Finally, section 1.5 presents the schematic of the thesis in terms of chapter structure and logical flow. The next chapter presents the literature review.

CHAPTER 2
LITERATURE REVIEW

“Every new beginning comes from some other beginning's end.”

- Marcus Annaeus Seneca (54 BC – AD 39)

2.1 Introduction

This chapter presents the literature review for this study. Instead of following a purely narrative structure, different theoretical frameworks are used in this chapter to systematise the review in different sections. Each section also includes a section summary to outline the main take away from the review. Section 2.2 discusses the chronological evolution and design related aspect of the ES artefact. Section 2.3 provides an overview of the ES research and reviews the literature related to the ES lifecycle phases other than the implementation phase. This section is structured as per the ES lifecycle phases proposed by Esteves & Pastor (1999, 2001). Section 2.4 focuses on the ES research related to the implementation phase, the most researched phase of the ES lifecycle. This section is structured in terms of differing views of the implementation process, and the literature on the critical success factor research. Research related to ES and organisation change is discussed in Section 2.5. This section is structured in terms of the framework proposed by Markus & Robey (1988) for IS-mediated organisation change. Section 2.6 focuses on ES research conducted in the PSO context. Based on the gaps identified in the literature review, Section 2.7 develops the research agenda for this study and presents the research question and the research model. Finally, section 2.8 concludes the chapter.

2.2 The ES Artefact

A frequent observation in the IS literature is that there has been a lack of attention given to the IT artefact (Orlikowski & Iacono, 2001; Kallinikos, 2004; Currie, 2009; Currie & Swanson, 2009; Faulkner & Runde, 2010). Therefore this section puts the ES artefact at the centre stage of the discussion. Subsection 2.2.1 outlines the evolution of the ES artefact and subsection 2.2.2 discusses the contextual factors that affect the design and development of the ES artefact. Finally, subsection 2.2.3 provides a succinct summary of this section.

2.2.1 Historical Evolution of ES

This subsection provides a quick overview of the evolution of ES development and use in organisations from its genesis in the 1960s to the present. Rather than focussing on a particular package or a company, the discussion is oriented towards the evolution of the ES artefact in general since the 1960s.

2.2.1.1. MRP: Predicting Material Requirement (1960-70s)

Material Requirement Planning (MRP) systems were developed in the late 1960s to assist organisations in determining the number of parts, components, and materials needed for the production of the final product in the production process. MRP systems calculated the product or parts requirements based on the bill of materials, inventory data and the master production schedule and determined when to release the material replenishment order (Alwabel et al, 2005). These systems were particularly useful for large production plants engaged in producing a variety of products using a number of components. MRP systems were adopted by the manufacturing industry to reduce the inventory cost and to maintain the safety stock. However, one limitation of MRP systems was that they worked only when the demand was predictable and when the master production schedule was available. Therefore, a need arose for additional functionality to support the planning process. This resulted in the advent of MRP-II systems.

2.2.1.2. MRP-II: Managing the Manufacturing Resources (the 1980s)

Manufacturing Resource Planning (MRP-II) system is defined by the American Production and Inventory Control Society (APICS) as a system for the effective planning of all resources required by a manufacturing business. MRP-II systems were introduced in the 1980s with a focus on optimising manufacturing processes by synchronising the material handling with the production requirements. It integrated the financial and production system and included activities such as purchasing, production planning, production scheduling, shop floor management, and distribution management. MRP-II systems provided long-range, intermediate, and short-terms plans which could be adjusted depending on the changing requirements of the plant. Some MRP-II systems also had simulation capability to enable predictions. However, MRP-II systems were challenging to integrate seamlessly and were prone to errors (Alwabel et al, 2005). Therefore, organisations looked for a seamless system which could be integrated with the other areas of the enterprise. This resulted in the advent of ERP systems in the next decade.

2.2.1.3. ERP: Integrating the Enterprise (the 1990s)

Enterprise Resource Planning (ERP) systems were developed at the beginning of the 1990s with the promise of providing enterprise-wide cross-functional integration and coordination. ERP systems were based on the technological foundations of MRP and MRP-II and provided tighter and real-time integration beyond merely integrating the manufacturing process. ERP systems integrated business processes like accounting, financial management, human resource management, project management, maintenance scheduling (Davenport, 1998) along with the standard functions provided by the MRP-II system such as inventory management, manufacturing, distribution and transportation, providing accessibility, visibility and consistency across the enterprise (Rashid et al, 2002). The ERP systems could also support a variety of production approaches such as Just-in-Time or lean production methods.

ERP systems were different from their predecessors in a number of ways (Alwabel et al, 2005). First, a distinctive feature of the ERP system was the seamless integration of various functions within the organisation (Davenport, 1998). This was made possible by the development of modern database systems that could support complex database operations. ERP systems used a single database to store the data. Therefore, changes made by one function were visible to other functions in real time. Second, ERP systems were also architecturally different from the earlier systems in the sense that they offered modular implementation. This meant that the different functionalities of the software were available to users as different modules of a single ERP package, and that depending on their needs companies could choose to include or exclude certain modules. Third, ERP vendors claimed to include industry 'best practices' in the software workflow which purported to provide a competitive advantage to the implementing organisation. As the decade progressed, vendors started offering new packages to cover additional functions of the organisation (Rashid et al, 2002). Towards the end of the millennium, ERP was also implemented in attempts to resolve the Y2K[3] problem (Markus & Tanis, 2000; Markus et al, 2000), as well as for harnessing the promised benefits of business process integration.

2.2.1.4. ERP-II: Going beyond the Enterprise (the 2000s)

After recovering from the burst of the dot-com bubble[4] in the 2000s and subsequent

[3] Y2K was the term given to the problem which could arise as a result of the transition from AD 1999 to 2000 whereby, computer systems, software, and chips using two digits to represent the year (i.e., 99 for 1999) might interpret 2000 as 1900.

[4] Dot com bubble is the name given to the rapid rise and subsequent fall of the share prices of internet-based companies for the period 1997-2000.

consolidation of the vendors (Jacobs & Weston, 2007), ERP vendors focussed their attention on providing extended functionality to their ERP systems, often termed as Extended ERP or ERP-II. This phase was primarily marked by the inclusion of modules which linked external stakeholders (e.g. customers and suppliers) of the organisation into the ES package (Alwabel et al, 2005; Rashid et al, 2002) to facilitate e-commerce. This resulted in the development and inclusion of modules such as Customer Relationship Management and Supply Chain Management in ERP packages. The second set of extensions were introduced to make better use of data stored in the ERP system by using advanced mathematical and decision-making techniques to optimise the business operations of the organisation. This resulted in the development of modules such as Business Intelligence, and Advanced Planning and Scheduling systems as an add-on to the core ERP package. Towards the end of the decade, due to the near saturation of the ES market covering large enterprises, ES vendors started to actively target Small and Medium Enterprises (Shaul & Tauber, 2012).

2.2.1.5. Recent Trends in Enterprise Systems Market

In recent years, in many countries (e.g. China, Taiwan, and South Korea), local vendors are providing solutions to satisfy local needs for much less cost (Liang & Xue, 2004). This is a significant development for the ES vendors since the Asia-Pacific market is anticipated to reach $9.77 billion (compared to global market size estimated at $41.69 billion) by the year 2020, making it one of the most lucrative markets in terms of growth (AMR, 2015). Recent years are also marked by the emergence of different system architectural approaches to ES implementation. ES are now being offered using new technological architecture such as Service Oriented Architecture (SOA)[5], web2.0-enabled ES[6], or Cloud-based ES[7]. While in-premises ES are expected to have the largest share (57%) of ES implementations by 2020, cloud-based ES are expected to enjoy 10% annual growth (as against overall ES market growth of 7.2%) for the period 2014-2020 (AMR, 2015), making it a more promising opportunity for ES vendors.

The above discussion on ES evolution also points to the dual nature of ES (Klaus et al, 2000; Jacobs & Bendoly, 2003). From one perspective, ES may be conceived as a business management concept that promises the streamlining and integration of the

[5] SOA is an architecture designed to improve group functionality in terms of interoperable services, based on business processes on top of the organization's existing enterprise system.
[6] Web 2.0 enabled ES incorporate features which include among others, social networks, wikis, mashups and tags in ES operations.
[7] Cloud-based ES are provided to its users by connecting with the computing 'cloud' which is hosted as the vendor's site and does not require ES installation at client's site, thereby significantly reducing the clients' infrastructure costs.

business processes of the organisation to achieve maximum efficiency. From an alternative perspective, ES may also be conceived as a software system that provides standardised data, systems integration, and uniform user interfaces across all application areas. As noted in Chapter 1, this study acknowledges both the aspects of ES artefact and defines it as configurable information systems packages that provide seamless integration of information and information-based business processes within and across functional areas in an organisation (Kumar & Van Hillsgersberg, 2000).

2.2.2 Design and Development of ES Package

While the majority of the ES literature treats ES packages as a given, or as a black-box, in recent years some scholars have examined the black-box by focussing on the design and development of ES packages. Kallinikos (2004, 2005) argues that the ES design reflects the techno-managerial conception of organisations consisting of various functions (e.g. production, finance and accounting, material management, marketing, human resources and so on) executed in the form of an extended series of procedural transaction. Kallinikos (2004) notes that an ES design involves the meticulous definition of data items, the precise identification of transactional steps, and the fashioning of such steps into clearly described procedures that cover the operations of the entire organisation. He argues that this sequential conception of organisational tasks may not necessarily coincide with what actually happens in organisations.

The space-time discontinuity in the design of a package and its implementation and use also creates a problem (Sawyer, 2000) in designing an ES. It is argued that the technology designers construct a technology to meet their organisational goals and are influenced by the institutional properties of their organisations (Orlikowski, 1992). Soh & Sia (2004) also suggest that technology developers' institutional contexts are reflects in the underlying structural features of the technology. The structures embedded in the ES package mostly reflect the context of the group of companies that the developers interacted with during the creation of the software (Williams et al, 2013). This structure may not match the institutional context of the organisation which is implementing ES. Also, even though the ES package may be presented as a stable entity, the inner working of the ES package may be continuously changing to meet emergent demands across time and space (Cho et al, 2013; Quattrone & Hopper, 2006; Williams & Pollock, 2012). In this sense, as Gosain (2004) argues, ES packages are *equivoques* that are often characterised by version multiplicity, overlapping product trajectories, product immaturity, and the constant need to upgrade composite components.

An important part of ES functionality comes from the inbuilt business processes which carry the notion of 'best-practices'. These practices are typically designed by the ES provider working in a partnership with a key reference customer to meet the unique requirements of a particular industry (Wagner & Newell, 2004; Pollock & Hyysalo, 2014). It is considered that the practices developed in this way are highly efficient and are based upon the practices of successful organisations. Therefore, usually ES literature and consultants suggest a minimal level of ES customisation (Davenport, 1995, 1998). However, the notion of best practices does not go uncontested and some studies (Collins, 2001; Wagner & Newell, 2004; Grant et al; 2006) have raised questions over its efficacy, suitability and the very nature of those practices. The argument against so-called 'best practices' is offered based on the contextual differences at the organisational, industry, and national level.

At the organisation level, Davenport (1998) observes that an ES pushes a company towards full integration even when a certain degree of business-unit segregation may be in its best interest. Further, Wagner & Newell (2004) argue that since organisational contexts are made up of very diverse epistemic cultures, the use of a standardising best practice model could be counter-productive because such a model mandates one epistemological position (usually techno-managerial) through the software design. Based on a case study on collaborative development of an ES module for universities, Wagner and associates (Wagner & Newell, 2004; Wagner et al, 2006; Wagner et al, 2010) demonstrate that the development of best practices is not only a political process, but also the resultant module may not be usable without customisation even in the organisation that partnered with the vendor in the package development. In a sense, therefore, the notion of 'best practice' reflects the 'dominant practice'.

Davenport (1998) observes that ultimately an ES is a generic solution. Its design reflects a series of assumptions made by the vendor about the way organisations operate in general. The ES modules and best practices are designed for a particular type of organisation and are then sold as a solution for a particular industry. It is assumed that with some amount of customisation, the solution could be used by all organisations within that particular industry. However, there are always inter-organisational differences even within an industry. As a result, in some cases the system's assumptions will run counter to the organisations' best interests and may even result in a loss of competitive advantage. Furthermore, once the set of best practices are available to all organisations in the form of an ES module, instead of being a source of competency, they tend to become a standard prerequisite for business efficiency (Davenport, 1998; Wagner et al, 2006).

Some scholars bring out the differences in the national context in outlining the inefficacy of the best practice approach. For example, in their study of SAP installation in a US organisation, Quattrone and Hopper (2006) note that as the SAP package is developed by a German firm, it is probably designed with an idealised German organisation in mind. This may not fulfil some requirements of a US firm. The difference in the business practices embedded in the ES and those followed in the organisation becomes wider when we consider ES implementations in non-western economies. For example, Amid et al (2012) in their study of ES implementation in Iranian industries note the fundamental misalignments between the functions of western ES and the requirements of organisations in developing societies. Soh & Sia (2004) also note such differences, especially in the case of national level laws and regulations. Similarly, economies, where the government is the major player, may not find a suitable fit with the systems developed in those economies where the corporate sector is a major player. For example, Newman & Zhao (2008) point out various gaps which exist between structure and processes supported by western ES and those existing in Chinese organisations.

2.2.3 Section Summary

Answering the call for including the consideration of IT artefact in IS studies, this section discusses the evolution and design of the ES artefact. It tracks the evolution of the ES artefact from the scheduling-based systems (the 1960-70s) to the material resource planning systems (1980s) to the enterprise resource planning systems (1990s) to inter-organisational system of the present day. It outlines the dual nature of the ES in terms of a business management concept and a software system. It also notes the influence of developers' techno-managerial assumptions and their organisational context in shaping the design of an ES. The contested nature of the best practices notion is also discussed in the context of organisational, industrial, and national differences. The next section provides a systematic overview of ES research in the IS domain.

2.3 Overview of ES Research

This section presents an overview of the ES research in the *IS domain* by conducting a systematic review of ES-related articles in the leading IS journals. The journals considered for the systematic review are confined to the IS domain since this study intends to primarily contribute to this domain as outlined in Chapter 1. However, contributions from other ES-related domains are also included in the narrative review if they provide a valuable insight. Also, to avoid any blind spots caused by this specific selection of literature, twenty-one ES literature review papers[8] from diverse domains (e.g. operations management, accounting) are also consulted in this review.

For determining the sources, the 2015 ABS journal rankings for the 'Information Management' category were consulted. Of these journals, only four-star and three-star journals (total 21 journals) were included in the review. Although this does not cover the full spectrum of the ES research within the IS domain, it may be considered representative enough to draw conclusions on overall trends in the ES research. From the identified journals, those papers were downloaded which had 'enterprise system', 'enterprise resource planning', 'ERP', or 'packaged software' in their title or abstract. This resulted in a download of 262 papers in total for the period 2000-2015. From an initial review of this set of papers, those papers were excluded in which ES were used only as an example to convey some other research objectives. Editorials were also excluded from the systematic review. Finally, after applying these criteria, 254 papers were included in the final systematic review. Table 2.1 shows the classification of the ES literature based on the research themes[9] along with the section in which they are discussed in this chapter. After ES package, which is already discussed in Section 2.2, next six themes refer to the phases of the ES lifecycle[10] framework by Esteves & Pastor (1999, 2001).

The six phases of the ES lifecycle framework considered in this review are - adoption, acquisition, implementation, use and maintenance, evolution, and retirement. *Adoption* decision includes the set of activities conducted to determine the requirement of a new ES for the organisation. The *acquisition* phase includes selecting and acquiring the product that best fits the needs of the organisation. This phase also includes the selection and appointment of the vendor, the implementation partner and/or the consultants. The *implementation* phase deals with the configuration and/or customisation of the ES package as per organisation's needs. The *use and maintenance* phase involve the continuous use of the system in the organisation and regular maintenance/upgrades whenever required. *Evolution* occurs when additional capabilities are included in the ES. This may include upward evolution (adding more capabilities/applications to ES) and/or outward evolution (including customers/supply chain partner). Finally, the *retirement*

[8] Klaus et al (2000), Esteves & Pastor (2001), Al-Mashari (2002), Dong et al (2002), Jacobs & Bendoly (2003), Lorenzo (2004), Shehab et al (2004), Cumbie et al (2005), Botta-Genoulaz et al (2005), Dery et al (2006), Pairat & Jungthirapanich (2005), Esteves & Bohorquez (2007), Moon (2007), Xu et al (2008), Schlichter & Kraemmergaard (2009), Tang & Wu (2010), Addo-Tenkorang & Helo (2011), Grabski et al (2011), Eden et al (2012), Elragal & Haddara (2012), Nazemi (2012)

[9] Analysis of research philosophy and methodology is included in Chapter 3.

[10] As Section 2.4 notes, there are more than twenty five ES lifecycle models. This particular model has been chosen in this study for its breadth of coverage and for maintaining consistency with existing reviews. The same framework is also used to explain the sequence of events in the case organisation.

phase refers to phasing out of the system and introducing the new system. Apart from the phase-based classification, the category *Change Outcomes* refers to ES research related to operational or economic benefits or organisation change associated with the ES implementation. Other categories relate to *ES Market and Trends*, and *ES Education*.

Table 2.1 Overview of ES Research in Leading IS Journals[11]

Primary Research Theme	Discussed in	Number of Papers	Percentage
ES Package	Section 2.2	13	5.12%
Adoption	Section 2.3	7	2.76%
Acquisition	Section 2.3	20	7.87%
Implementation	Section 2.4	94	37.01%
Use and Maintenance	Section 2.3	57	22.44%
Evolution	Section 2.3	6	2.36%
Retirement	-	0	0.00%
Change Outcomes	Section 2.5	47	18.50%
ES Market & Trends	Section 2.2	9	3.54%
ES Education	-	1	0.39%
Total		254	100.00%

Table 2.2 ES Research as per ES Lifecycle Phases

	Esteves & Pastor (2001)	*Esteves & Bohorquez (2007)*	*Eden et al (2012)*	*Present Review*
Duration	1997-2000	2001-2005	2006-2012	2000-2015
Phase-wise Papers	118	374	154	184
Adoption	5.93%	6.68%	8.44%	3.8%
Acquisition	9.32%	4.01%	5.19%	10.9%
Implementation	66.10%	55.35%	49.35%	51.1%
Use and Maintenance	14.41%	18.18%	25.97%	31.0%
Evolution	10.17%	15.78%	10.39%	3.3%
Retirement	0.00%	0.00%	0.65%	0.00%

Table 2.2 compares the findings of Table 2.1 with those from three prior reviews on this topic. As shown in Table 2.2, the majority of the ES research is concentrated in the area of ES implementation, which is consistent over the years as noted in other reviews as well. Another interesting trend to note is that there is just one study on the retirement phase. The main reason could be the fact that towards the end of the ES lifecycle, organisations focus more attention on the adoption, acquisition and implementation of the new system rather than systematically retiring the system in use. Due to its volume and its centrality to the research question, the ES implementation research is reviewed separately in Section 2.4. Research pertaining to other phases is reviewed in the following subsections.

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[11] Four star and three star journals as per Association of Business School List 2015 for the field of 'Information Management'.

2.3.1 Adoption

The Adoption phase typically includes the decisions and activities leading up to formal project approval and funding (Kumar et al, 2002). During the adoption phase, the organisation becomes aware of the possibility of implementing an ES as an alternative to developing a bespoke information system. This decision phase may include arriving at the definition of system requirements, determining its goals and proposed benefits, and conducting an analysis of the impact of adoption on the business (Esteves & Pastor, 1999, 2001). This phase generally results in the preparation of a business case document (Kumar et al, 2002). Based on the review, ES research related to the Adoption phase may be broadly classified into two categories – research related to the justifications/motivations for adopting ES, and research on the factors that influence the adoption decision. The first strand of Adoption research focuses on the **motivations** of the organisations or the justifications presented by them for their adoption decision. These justifications could be classified into three main classes - technological, operational and strategic (based on Oliver & Romm, 2002; Poba-Nzaou et al, 2014; Stefanou, 2001).

1. Technology related justifications

Technology related justifications relate to technological aspects such as dissatisfaction with the existing system, maintainability of the existing system, modernisation need of the systems, integration of IT systems, improvement in IT infrastructure, improved information access across organisations.

2. Operational justifications

Operational justifications relate to the business process aspects of the organisation. These include standardisation and integration of business processes, improvement in administrative data accuracy, and improvement in the effectiveness of business processes.

3. *Strategic justifications*

Strategic justifications relate to the long-term strategy associated with ES adoption. These include an organisational vision of integration, business considerations, improvement in service and quality, supporting organisation growth and expansion, and compliance with laws and regulations.

Perceptions of expected benefits are found to be an important factor in determining the adoption decision (Chung & Snyder, 2000; Kumar et al, 2003; Shiau et al, 2009). The higher the levels of perceived benefits, the higher are the chances of positive ES adoption decision. In this regard, Gallagher et al (2012) note that the stated goals for the ES adoption influence both the arguments used to 'sell' the project internally and also later decisions on staffing the ES project. As May et al (2013) suggest, context-specific and fundamental objectives could provide a means to the organisation for determining tasks and alternatives for ES selection and implementation.

The second strand of Adoption research focuses on the **factors** that affect the adoption decisions. The main factors identified in the literature are noted below.

1. Top Leadership

Based on their study of ES adoption by 19 Canadian organisations, Kumar et al (2002) note that in around three-quarters of cases, top management initiated the idea of ES adoption. Shiau et al (2009) also report that CEO characteristics such as their background and IS knowledge have an impact on ES adoption decisions. Based on the data obtained from 328 companies, they find a strong and positive relationship between rich IS knowledge of the CEO and ES adoption. Apart from the top leadership, other key players influencing adoption decision are senior management, functional and IT specialists, consultants, and parent company employees if the ES adoption was mandated from the parent company (Kumar et al, 2003).

2. Organisational Factors

Based on their study of small, medium and large organisations, Laukkanen et al (2007) note that organisation size in an important factor in adoption decisions. Though all three groups report some common concerns (e.g. cost and budget overrun), significant differences exist in their concern for other factors. While small and medium enterprises consider resource constraints an important factor in their ES adoption, larger organisations have to consider the integration complexity and change management issues. Apart from size, Raymond & Uwizeyemungu (2007) identify administrative intensity, type of production method, operational capacity, innovation capacity, and financial capacity as important determinants of ES adoption decisions.

3. Industry Context

There are contradictory findings on the importance of external factors in the ES Adoption literature. While Elbertsen & Reekum (2008) report that higher competitive pressure in the industry is associated with ES adoption, Seethamraju (2015) finds that competitive pressures faced by the enterprise have no impact on adoption decision. The role of external recommendations is found to have no impact on the adoption decision

(Laukkanen et al, 2007; Seethamraju, 2015), irrespective of the size of the company. However, Raymond & Uwizeyemungu (2007) report that commercial dependence on certain customers and networking intensity within the industry may affect the adoption decision.

Based on the motivations and factors discussed above, if the organisation makes a decision to adopt ES, the next phase in the ES lifecycle is Acquisition, which is the topic of the next subsection.

2.3.2 Acquisition

Howcroft & Light (2010) note three main stages of the acquisition phase in the existing literature – understanding user requirements, package evaluation, and final selection and procurement. During this phase, normally an implementation partner (who may also sometimes be the ES vendor) is also selected to help in the subsequent phases of the ES lifecycle, especially the implementation phase (Esteves & Pastor, 1999). Factors such as price, training and maintenance terms are also negotiated in this phase and are usually included in the contractual agreement. Reviewed literature on the ES Acquisition phase reflects two distinct orientations. The first orientation is more **technical-managerial** in nature. In this stream of research, scholars try to identify selection criteria and to devise algorithms for selecting the ‘best’ ES for the organisation using different mathematical/decision models. Following are the set of criteria which are normally used in such models and algorithms (based on Gürbüz et al, 2012; Kilic et al 2014; Kilic et al 2015):

1. Technical Criteria

These criteria relate to features of the ES software such as software functionality, system reliability, compatibility with existing systems, the functionality of cross-module integration, underlying technology standards and protocols, compliance to international standards ease of use, ease of customisation, maintainability of the system, and security aspectst.

2. Business-related criteria

These criteria usually flow from the business case put forward during the adoption phase and include business-related aspects such as business vision, brand image, market position, better fit with organisation structure, fit with parent/allied ES, references from other organisations in the same industry, and fit with business processes. Wu et al (2007) present a selection methodology exclusively based on ES and task misfit analysis.

3. Vendor-related criteria

The most important vendor related criteria in the extant literature is the project cost. The cost considerations include hardware, software and network cost, licence cost, consultancy cost, user training cost, support and maintenance cost. Other vendor related criteria include vendor's market position, vendor's domain knowledge, vendor's and product reputation, adequacy of consultants, and the quality of after-sales service.

The different techniques applied on these criteria include complex mathematical techniques such as fuzzy logic (Cebeci, 2009; Rouhani et al, 2012; Sen & Baraçlı, 2010; Karsak & Özogul, 2009), hybrid multi-criteria decision making (Gürbüz et al, 2012), or artificial neural networks (Yazgan et al, 2009). However, the other strand of the Acquisition research rejects the notion of completely rational acquisition decision and offers a **socio-political** view of the acquisition process. This view rests upon two main arguments. The first argument is based on the fluid nature of the organisations' requirements. Howcroft & Light (2010) note that the requirements of the organisation may be unclear or continually emerging and different units may present differing and competing sets of the requirement for an ES package. Similarly, although the ES package is often presented by the vendors as a complete solution, scholars (Cho et al, 2013; Pollock & Cornford, 2004) argue that an ES package is usually a work-in-progress which is in constant development and should be viewed in more fluid terms. Their precise characteristics are difficult to ascertain without *actually* implementing it. Although, the adopters may visit the potential 'reference site', such ES implementations may not be available or may not be completely similar to the adopting organisation (Pollock & Williams, 2007). The second argument in this strand relies on social and political nature of the acquisition process. Even if we view ES as a bounded system, the same technology may be evaluated differently by different social groups in the organisation. The formal evaluation process may not occur at all or it may be conducted only to support a pre-determined decision which is arrived at based on politics between senior management, IT managers, vendors, consultants, and end-users (Howcroft & Light, 2006, 2010).

Reconciling the technical-rational and socio-political view of the ES acquisition process, Pollock & Williams (2007) empirically establish that although the packaged software acquisition process is affected by social factors, organisations do not completely do away with the rational evaluation process. Therefore, although the acquisition process is not smooth and linear as suggested by the technical-rational strand, organisations still try to rationalise and formalise the decision process. Thus, the processes of rationality, organisational structures, and processes of legitimisation, all have an impact on evaluation decisions (Tingling & Parent, 2004). This is the view subscribed in this study. After the acquisition, the next phase in ES lifecycle is implementation. Since the literature related to the implementation phase is reviewed in Section 2.4, the next subsection reviews the literature associated with the use and maintenance phase that comes after the implementation phase.

2.3.3 Use and Maintenance

This phase refers to the post-implementation usage of ES, and the associated maintenance and support activities to sustain the use of the system. As noted in Table 2.1, this remains the second most-researched phase in the ES literature. Within the use and maintenance literature, ES researchers focus more on the *user acceptance* of the system (51 out of 57), compared to relatively less attention paid to the activities related *to maintenance and support* (6 out of 57).

The literature on **ES use** may be classified based on the focus of the studies on the levels of analysis which are – individual level, organisation level, and macro level. Most of the *individual level* works focus on identifying the variables and proposing a model in order to predict user acceptance for the ES. The majority of the models draw from the Technology Acceptance Model (TAM) outlined by Davis (1989). As per the original formulation of TAM[12], intended system use is determined by the perceived usefulness and perceived ease of use of the system. The popularity of TAM may be assessed from the fact that as on March 2017, Google Scholar notes more than thirty-three thousand citations to Davis (1989), making it one of the most cited IS papers. The majority of the works based on TAM focus on the addition of additional variables to predict intended use of the system. Table 2.3 notes the different variables added to TAM over the years.

Apart from TAM, IS scholars have utilised other theories from individual psychology such as Expectation Confirmation Theory (Chou & Chen, 2009), external and internal motivation (Chou et al, 2014; Hwang, 2014; Ke et al, 2012), Expectancy Theory (Lim et al, 2005). However, one major limitation of this stream of research is that for the most part, it measures the intention to use the system instead of measuring actual usage. A second limitation of this stream of research is that with the exception of Schwarz et al (2014), the majority of the studies are single-snapshot and do not explore the process by which users accept and use ES.

[12] It may be noted here that all three constructs are defined as the self-reported evaluation by the users. Therefore, ease of use and usefulness, both are 'perceived'. Similarly, system use in most studies refers to intention to use rather than actual use in the model.

Table 2.3 Extensions to Technology Acceptance Model in the ES Research

Paper	Added Variables
Amoako-Gyampah & Salam (2004)	Project communication, Project training
Calisir & Calisir (2004)	System capability, System learnability
Amoako-Gyampah (2007)	Prior usage, Argument for change, User involvement (intrinsic and situational)
Hwang (2005)	Uncertainty Avoidance, Enjoyment
Kwahk & Lee (2008)	Perceived personal competence, Organisational commitment (both leading to readiness for change)
Chou & Chen (2009)	Individual differences (in the form of computer efficacy and innovativeness with IT)
Sun et al (2009)	Perceived work compatibility, Perceived behavioural control
Xue et al (2011)	Punishment expectancy, Perceived justice of punishment (both leading to compliance intention)
Liang et al (2013)	Reward expectancy, Punishment expectancy (both leading to compliance behaviour)

The second stream of **ES use** research focuses on the *organisational level*. This stream of research is primarily concerned with the factors that have an impact on the organisation-level assimilation of ES. One of the most researched factors in this stream is training and learning. While Davis & Hikmet (2008) stress the requirement to match the learning needs of the user with the training provided, Karuppan & Karuppan (2008) focus on the timing of the training. They argue that since go-live dates are usually not met and there may be a large gap between the initial training and the final go-live date, refresher courses should be organised for the superusers. Noting the recurring nature of the ES training, Macris (2011) proposes a prototype model for the design and development of the ES training material in which the resources and the knowledge built into the resources are captured and fully reusable. Apart from training, organisation's learning and absorptive capacity is found to be an important variable that mediates the training outcomes and ES usage (Nwankpa & Roumani, 2014; Nwankpa, 2015; Park et al, 2007; Saraf et al, 2013).

Liu et al (2011) relate organisation-level assimilation to individual-level assimilation. They empirically show that the characteristics of individual level ES assimilation directly impact the level of organisational level ES assimilation. They suggest that the key for organisations to move to the next level of assimilation is to increase the number of superusers of the ES. Mu et al (2015) find that efforts by the IS unit to scan for emerging ES-related organisational needs have a direct positive effect on ES assimilation within the organisation as a whole. They suggest that actively gathering more information by the IS unit about the needs of the organisation is beneficial for facilitating ES assimilation only if the process is conducted with careful attention to local differences and performed with an awareness that new opportunities might challenge expectations and assumptions. In this regard, Allen (2005) reports that when the users perceive that the conflicts are accommodated in a balanced and legitimate way, they chose to use information resources within the ES. However, when the conflicts are perceived as too great, participants may choose to ignore the ES or develop their own competing information resources.

Some of the works in this stream focus on the mandatory nature of the assimilation process. Bagchi et al (2003) observe that since ES are costly investments, not using an ES is an option that is not available to organisation users. In this regard, while Liang et al (2013) find that the punishment expectancy (stick) is more effective than the reward expectancy (carrot) in mandatory IT settings such as an ES, Xue et al (2011) find that perceived justice of punishment has an even higher impact than the punishment expectancy. In other words, users decide to comply with mandatory IT usage when they perceive the organisational IT policies to be fair, rather than just based on punishment expectancy. However, Chae & Poole (2005) note that while ES mandates seem to be simple directives on paper, in terms of execution they are complex social constructions with diverse meanings for different parties. There are usually some potential points of contention in executing ES mandates. Therefore, it might be a good strategy to respect competing practices and to carry forward some of the legacy practices, what Wagner et al (2010) term as 'selective accommodation'.

Finally, although limited in number, some studies on **ES use** include the *macro level* factors in exploring ES use in organisations. Alhirz & Sajeev (2015) and Hwang & Grant (2011) investigate the role of national culture on ES acceptance and use. Apart from national culture, the institutional pressure is the other macro level factor that is found to have an impact on the ES adoption and use. Some studies (Lai et al, 2010; Liang et al, 2007; Saraf et al, 2013) suggest that all three forms of the institutional pressures (mimetic, coercive, and normative) affect ES assimilation in organisations.

Although the use and maintenance phase remains the second most researched phase after implementation, relatively few papers from this phase focus on the **maintenance, upgrade, and support**. For *maintenance*, Kwon & Lee (2001) propose and develop an agent-based system to adjust the ES to the change in the organisation and its environment. Based on a case study of a high-performing ES-service provider in Australia, Ng & Gable (2010) show the ES maintenance practices require some additional activities when compared with standard software maintenance activities outlined in the IEEE standard. In particular, ES maintenance activities require a high level of coordination with the vendor and a deeper level of impact analysis of the system. As far as ES *upgrades* are concerned, Khoo & Robey (2007) identify different internal and external factors that affect the upgrade decision. Key internal factors include business needs, corporate and IT risk mitigation policies, and availability of internal resources. External pressure by vendors also affects the upgrade decisions due to the organisation's reliance on ES to conduct its day-to-day business. Khoo et al (2011b) report that this external pressure may further be used by the organisation to create urgency and commitment for the upgrade project. As far as ES *support* is concerned, Ramasubbu et al (2008) find that both the technical and the behavioural skills of the customer support representatives are important to users in influencing overall customer satisfaction with the ES. Tong et al (2015) dig deeper and report that the type of support should be aligned with the type of system use. Specifically, while personal support is found to be useful during non-standard use of the system, automated support is sought during standard use of the system.

Khoo et al (2011b) investigate the impact of packaged software upgrades from the perspectives of users. They note that such impacts arise from interdependent relationships among the ES software and different stakeholders, particularly IT staff, users, and vendors. They find two essential costs relevant to an upgrade – the cost of implementation and the costs of users' learning. During the upgrade and immediately after the upgrade, the IS staff tend to bear additional burden since they have to negotiate with the vendor, as well as support the users in coping up with the changes, notwithstanding the learning curve that they themselves need to follow. Khoo et al (2011b) also report that all users may not have the same experience from the upgrade. Their experience of beneficial impact will be contingent upon their explicit adoption of new features that are useful to them and improvement in features that they normally use in their day to day work. The next phase of the ES lifecycle in evolution, which is discussed in the next subsection.

2.3.4 Evolution

The evolution phase in the ES lifecycle refers to the inclusion of additional capabilities in the already functioning ES. This may involve ES integration with the Supply Chain Management (SCM) systems and/or with the Customer Relationship Management (CRM) systems (Karimi et al, 2009; Koh et al, 2011). Extant literature tends to put less focus on this phase of ES lifecycle, with only 6 articles from the review basket belonging to this phase. Shaw (2000) presents a framework for ES-enabled e-business by connecting with the suppliers and customers. Karimi et al (2009) find that the decision of CRM or SCM integration with ES depends upon the extent of the ES implementation and digital readiness of the organisation. Based on a case study of ES and SCM integration in a

Chinese firm, Bose et al (2008) identify challenges such as data management, interface design, localisation needs, the capacity of the computer network, choice of devices, initial project management and coordination, and user training. Koh et al (2011) report more barriers to SCM integration with ES than the drivers for the same. They note barriers such as organisational inertia, cost, lack of business understanding, lack of extended enterprise understanding, the scale of complexity/change, cultural clash, different partner goals/objectives, and lack of data standards that hinder ES evolution. In terms of critical success factors (CSF), they note the applicability of traditional ES CSFs, but also identify additional CSFs for ERP-II. Most of these CSFs relate to partner aspects which include common partner goals, similar partner priorities, partner culture similarity, collaborative partner support, partner trust, and relationship change management. Other CSFs for ES evolution in SCM context include operational efficiency, efficient enterprise legacy systems, and extended enterprise understanding. In terms of impact, based on eleven case studies across diverse organisations, Ash & Burn (2003) show that while the early adopters of e-business exhibit a trend towards cost reductions and operational efficiency, more mature e-business users focus on relationship building and creating strategic advantage. Hsu (2013) also reports that the complementary effect between ES and e-business in creating business value is stronger than the main effects of either of these alone.

2.3.5 Section Summary

This section provides a systematic review of ES research in leading IS journals. It notes the concentration of ES research around the implementation phase and the absence of research on the retirement phase. It notes that ES research related to the adoption phase primarily focuses on the motivations (strategic, operational, and technical) put forward by the organisations, and the factors at multiple levels (industrial, top leadership, and organisational) that affect the adoption decision. The review of ES acquisition related research uncovers two distinct views of the acquisition process. While one view presents the process as technical-managerial in orientation focussing on formal gap analysis and rational decision making, a socio-political view of the acquisition process puts forward a perspective that focuses on the transient nature of ES functionality, the contested nature of the business processes, and the political nature of the acquisition decision. This study takes an intermediate position and conceives ES acquisition both as a socio-political and a technical-managerial process.

After implementation, the use and maintenance phase remains the most researched phase in the ES domain, but the majority of the research related to ES use stems from the

Technology Acceptance Model and focuses on perceived use rather than actual use. While this study acknowledges the importance of such variance based studies, it also stresses the need for longitudinal qualitative studies on ES use in organisations. Research related to ES maintenance and upgrades remains relatively scant and has only emerged in recent years. Finally, evolution research focuses on CSFs for implementing ES for e-business and the impact of ES application on e-business. However, the research on this phase remains very limited and primarily focusses on the private sector organisations. By conducting a longitudinal study of ES lifecycle in a public service context, this study seeks to develop a richer and context specific understanding of post-implementation phases. The next section presents the review of ES implementation research, which remains the most researched phase in the ES domain.

2.4 ES Implementation Research

As noted earlier, the implementation phase remains the most researched phase in the ES lifecycle. In the review basket of 254 papers from leading IS journals, more than one-third of the papers (37%) are classified under the implementation phase. This is understandable since business processes and the ES are open to modifications and require considerable resource investment during the implementation phase. The research on the implementation phase encompasses two distinct strands. The first set of the implementation research focuses on the process of the implementation, which is reviewed in subsection 2.4.1. The second set of the implementation research focuses on the critical factors that are crucial to the success of the implementation. Critical factor research is reviewed in subsection 2.4.2.

2.4.1 The Process of ES implementation

The first set of implementation research focuses on how the process of ES implementation takes place in organisations. Similar to other phases, perspectives on the implementation process also exhibit two major orientations – technical-managerial, and socio-political. While the technical-managerial view of the implementation presents it as a series of (more or less) distinct stages largely independent from the implementation context, the socio-political view of the implementation depicts it as a continuous and fluid process influenced by internal and external context.

However, before moving on to discussing these alternative perspectives on the implementation process, some observations on the ES lifecycle are in order. The introduction of ES in organisations is usually described in the literature as a sequence of phases. These phases are variously referred to as the ES lifecycle, ES implementation model, ES experience cycle. The phase-based view is so prevalent that scholars (Huang & Yasuda, 2014; Shaul & Tauber, 2013) note more than twenty-five phase-based model of ES. A representative sample of models is shown in Table 2.4. Depending on the level of granularity, these models outline three to six phases/stages. These models differ in their coverage of the activities and use of the term implementation in diverse ways. While some models equate ES implementation with the complete ES lifecycle (Markus and Tanis, 2000; Parr & Shanks, 2000; Al-Mashari et al, 2003; Rajagopal, 2002; Bajwa et al, 2004), other works refer to the term implementation as a specific phase of the ES lifecycle (Esteves & Pastor, 1999, 2001; Ross & Vitale, 2000; Shanks et al, 2000; Chang & Gable, 2000). This study subscribes to the second conception of ES lifecycle and considers implementation as one of the phases in ES lifecycle. As shown in Table 2.5, although the naming may slightly be different, the implementation phase consists of five stages that relate to the activities that incorporate business process analysis, configuration/customisation, testing, and go-live. Catersels et al (2010) also observe that these five-stage models are most widely used by consultants, perhaps due to the close resemblance with Accelerated SAP (ASAP) methodology advocated by the market leader SAP.

Irrespective of the coverage in the model, phase-based models tend to be **technical-managerial** in nature. Therefore, studies following this orientation of implementation process focus on IT and business management aspects of the ES lifecycle. Kræmmergaard & Rose (2002) discuss managerial activities and associated competencies that are required across different phases of the ES lifecycle. During the pre-implementation phase, software selection, project planning, and employee communication are considered to be important activities. During the implementation phase, business process modelling, human resource management, configuration and customisation are considered to be the important activities (Chang, 2006; Fan et al, 2000). During the use and maintenance phase, system performance tuning, user training, and communication are considered to be important activities. Finally, continuous business process improvement, system upgrades, ES knowledge management are considered to be important activities during ES evolution phase. Similarly, Teoh et al (2012) outline various resource management activities during different phases. They suggest focussing on structuring the resource portfolio during the pre-implementation phase, bundling and leveraging resources during the implementation phase, and maximising resources during the post-implementation phase.

Table 2.4 Phases of ES Lifecycle

ES Lifecycle	Adoption	Acquisition	Implementation	Use & Maintenance	Evolution	Retirement
Ross & Vitale (2000)			Design, Implementation	Stabilisation	Continuous Improvement, Transformation	
Markus and Tanis (2000)	Chartering		Project	Shakedown	Onward and Upward	
Parr & Shanks (2000)	Planning		Project	Enhancement		
Roseman (2000)	Business Engineering	System Selection	System Implementation	System Use and Change		
Shanks et al (2000)	Planning		Implementation	Stabilising	Enhancement, Modification	
Chang & Gable (2000)	Pre-implementation		Implementation	Post-implementation		
Al-Mashari et al (2003)	Setting-up		Deployment	Evaluation		
Rajagopal (2002)	Initiation	Adoption	Adaptation	Acceptance, Routinisation	Infusion	
Bajwa et al (2004)	Awareness	Selection	Preparation, Implementation	Operation		
Pishdad et al (2012)	Initiation	Adoption	Routinisation			

Table 2.5 ES Implementation Stages

Implementation Stages	Stage-I	Stage-II	Stage-III	Stage-IV	Stage-V
Bancroft et al (1996)	Focus	As-IS	To-be	Construction & Testing	Implementation
Ehie & Madsen (2005)	Project Preparation		Business Blueprint	Realization	Final Preparation, Go-live and Support
Parr & Shanks (2000)	Set-up	Reengineering	Design	Configuration	Testing & Installation

Some ES scholars also note the multi-level nature of ES implementations. Al-Mudimigh et al (2001) classify the managerial activities at strategic, tactical, and managerial level. Strategic level activities include evaluation of the current legacy system, development of business vision, the decision on implementation strategy, the hiring of consultants, and benchmarking. Tactical level activities involve client consultation, business process reengineering, software/vendor selection, and decision on the implementation approach. Finally, operational level activities include business process modelling, system configuration, final preparation and go-live. Fenema et al (2007) also note different processes that operate during a multi-site ES implementation. While site level processes include intensification of IT-user contacts at the local site, corporate level processes involve standardisation, formalisation, centralisation, and in some cases, cross-site learning.

However, the technical-managerial perspective on the implementation process has certain limitations. First, the end-point of various phases may not be clear in practice. Second, the process may not be as linear as depicted in most of the ES models. In reality, the implementers may need to go back to the earlier stage to make certain changes or to deal with unforeseen problems. Third, these models assume that all participants are rational in nature and are committed to the implementation. This may not be the case in real-life situations. Fourth, it discounts the role of internal and external context of the implementation. ES Implementation, as Kallinikos (2004, p. 10-11) observes, *"is not a procedure of unproblematic installation but rather a complex socio-technical process of renegotiation and redevelopment."* This is where the **socio-political** perspective on the implementation process becomes pertinent in dealing with these limitations.

The first group within the socio-political approaches focuses on the *continuous and fluid nature* of the implementation process. Using the Actor-Network theory, Elbanna (2006, 2008, 2009) presents the ES implementation as a process of continuous improvisation and drift. Instead of presenting ES implementation as a rigid stage-based process, she empirically shows with the help of case studies that project drift and improvisation are inherent in ES projects. She also notes that the application of different strategies for project buy-in results in multiple perceptions of the projects and goals, which at times may not be reconcilable. Elbanna (2006) notes that in this situation, improvisation is required to find a convergence point for working and delivering coherent parts of the system, keeping the stakeholders interested and enrolled in the project. The improvisation and drift of the ES implementation depend upon the relative push by different stakeholders.

This brings us to the second group of the socio-political conception of ES implementation based on *power*. Dhillon et al (2011) identify four dimensions of power in the context of ES implementation – resources, process, meaning, and system. The first dimension relates to ownership and allocation of resource in the organisation. The resource allocation may be used to facilitate the ES implementation and enforce its use. Process-based power resides in bureaucratic processes and can be used to impose ES-enabled functions in the organisation. Meaning-based power resides in discursive practices of the organisation and may be used to legitimise and institutionalise the ES implementation and use. Finally, system-based power is based on entwinement of ES into the fabric of the enterprise, in which system use becomes the norm in the organisation. It may be noted that these dimensions of power are inter-related and the eventual outcome of the implementation process depends upon the interaction among these dimensions. To focus more on power struggles during ES implementation, Silva & Fulk (2012) use the concept of 'circuits of power'. The circuit of systemic integration relates to the enforcement of system rationality and discipline on the organisation by the use of ES. However, if there is a lack of fit with existing work practices, it may increase the workload of the users and they may look for workarounds. The circuit of social integration focuses on legitimising and institutionalising the ES use in the organisation. However, if there are contradictory interpretations of ES in the organisation, the users may bypass the system or may refuse to cooperate.

Finally, some scholars take a social constructionist viewpoint and present ES implementation as a *discursive* process. Discursive interpretations of ES implementation put the linguistic devices and meaning-making process at the centre of their explanation. Through a multi-method study, Shepherd et al (2009) show that two interpretive repertoires – 'improving efficiency' and 'administration being everyone's responsibility' – were constructed by the project team as the justifications for implementing ES and to devolve HR and administrative tasks to all employees. It was countered by the end users by creating the notion that ES was 'inefficient use of resources' and was 'taking away hours' from their job. Similarly, Willis & Chaisson (2007) note the use of normative grammars through the use of terms and phrases to legitimise the ES and to ignore the alternate voices. They note that focus on the so-called 'best practices' of ES often redirects attention away from context-specific local practices. The use of the phrases like 'a new way to manage' and 'a need to control' made it difficult for the users to articulate an alternative vision beyond 'this is the way we have always done things'. In other words, the terms 'best practices', 'new way to manage' and 'professionalism' were linguistically hard to resist. As a result, software-focused change dominated the implementation and it inscribed upper management interests into the software.

Therefore, we find diverse views of the implementation process in the ES literature. The conception of the implementation process ranges from being technical (Bancroft et al, 1996; Ehie & Madsen, 2005; Parr & Shanks, 2000), managerial (Markus and Tanis, 2000; Kræmmergaard & Rose, 2002; Teoh et al, 2012), political (Dillon et al, 2011; Silva & Fulk, 2012), or constructionist (Shepherd et al, 2009; Willis & Chaisson, 2007). In conclusion, perhaps Nandhkumar et al (2005) capture the essence well when they identify ES implementation as a product of technology affordance, managers' intentions, power and cultural context with the cycles of control and drift. This study also subscribes to this notion of the implementation process. Having discussed the nature of the implementation process, the next subsection discusses ES studies associated with the identification of critical factors.

2.4.2 Critical Factors for ES Implementation

The concept of 'success factors' was first introduced by Daniel (1961) in his seminal HBR article 'Management Information Crisis'. He differentiates among three types of useful data for companies – environmental, competitive and internal. He stresses that a company's IS must be discriminating and selective in reporting internal data. To him, in most companies, the IS function should focus on three to six success factors which are defined as those key jobs which must be done exceedingly well for a company to be successful. Rockart (1979) refined the concept further and introduced the notion of CSF as those few critical areas where things must go right for the business to flourish. If the results in these critical areas are found to be inadequate, the organisations' efforts for the period are bound to be less than desired. He notes that the CSF areas should receive constant and careful attention from the leadership and management. Despite the CSF method's alleged limitation of bias towards top management (Davis, 1979), it gained immense popularity. Though originally proposed for designing management information systems (Daniel, 1961; Rockart, 1979), the CSF approach has been extensively used in diverse areas of IS and business, including ES implementation.

However, the concept of CSF seems to be over-used in the ES domain. Multiple reviews of the ES literature note that critical factor research remains the most researched area within the ES implementation research with estimates ranging from 27% (Nazemi, 2012) to 57% (Cumbie et al, 2005; Pairat & Jungthirapanich, 2005) depending on the review duration and review basket. In the review conducted for this research, nearly two-third of the papers from the implementation phase (and nearly one-third of the overall basket) belong to this category. A content analysis of 22 CSF review papers across all disciplines resulted in 36 different CSFs (see Appendix-1 for more details). For a practitioner, identification of too many factors creates a puzzle rather than solving her problems. As Martin & Huq (2007) note, there are too many factors to consider and it seems that we know ‘too little about too many’ variables. At the same time, it may also be noted that many elements that are considered a ‘factor’ could be understood as variables belonging to the same management area (e.g. project management, project scope, project champion, project planning). In such a case, perhaps it would be a good idea to return to the original definition of CSFs in focussing on few critical ‘areas’ (Rockart, 1979) instead of working with different variables in isolation. Therefore, this section is structured in terms of those key areas where existing IS literature provides empirical evidence. For this reason, instead of citing the studies that provide a list of critical factors, this review focuses on the research conducted on the specific factors. After identifying the relevant factors based on their coverage in the review basket, papers outside the review basket are also included if they provide additional insights on a specific factor. Also, discussion of change management is not included here since ES and organisation change is discussed separately in the next section due to its centrality to the research problem.

2.4.2.1 Business Process Reengineering

Business Process Reengineering (BPR) is the re-design of business processes of the organisation for achieving maximum efficiency (Hammer, 1990; Davenport and Short, 1990). Though BPR may also be conducted without an accompanying ES strategy, it is often an initial stage of ES implementation (Davenport, 1998; Davenport et al, 2004). Some scholars (Koch, 2001; Huq et al, 2006; Huq & Martin, 2006) argue that there are more chances of BPR success if it is driven by an ES. One stream of BPR research within the IS domain focuses on developing tools and algorithms for business process configuration for ES (Dreiling et al, 2006, 2008; Xu et al, 2008) and is more technical in orientation. However, the majority of the research on BPR in the IS domain focusses on the ES-organisation fit/misfit.

Hong & Kim (2002) note three types of ES-organisation fit – data fit, process fit, and usage fit. Soh & Sia (2004) and Sia & Soh (2007) discuss the ES-organisation misalignments due to external and internal context. They find that country-specific and industry-specific practices (*imposed context*) may cause the misalignments. At the same time, there are idiosyncratic organisational differences (*voluntary acquired context*) that create misalignments. Based on the analysis of 400 misalignments over three implementation sites, they find that the majority of imposed misalignments were resolved via package customisation since the organisations often do not have much control over the imposed context. A delayed implementation was often found to be a useful strategy in the case of imposed misalignment since the ES package provider may customise its package in the meantime. Misalignments related to voluntary acquired context were more often resolved through BPR since organisations usually have control over their business processes. Wei et al (2005) classify ES-misalignments according to ES lifecycle phases. They find that Industry, business, and regulation related misalignments are a consideration in the pre-implementation phase. The implementation phase is usually associated with more system-specific misalignments such as user interface, business process flow, and reporting misfits. Post-implementation misalignments are associated with information and functionality misfits. They also report that the misalignments and corrective actions typically have a cascading impact on the ES outcomes.

Some scholars discuss the issue of ES-organisation fit for niche organisations. For example, Pollock & Cornford (2004) and Wagner & Newell (2004) find that ES implementations often create tensions in the university environment since the rigid structure imposed by the ES often do not match with the relatively flexible structure found in the university departments. Similarly, Currie et al (2009) suggest that a monolithic ES may not be a perfect choice for integration in the health sector due to the existence of heterogeneous systems in the health sector. Liang & Xue (2004) discuss ES-organisation alignment for Chinese small and medium enterprises. Based on a case study of a local ES vendor, they uncover three different strategies adopted by the vendor to bridge the gaps in social, economic, and regulatory context. First, ES is often localised to reflect the local management practices. Second, ES is customised at different levels keeping in mind the organisational growth of the client. Finally, BPR may be carried out in an incremental manner to match with a culturally change-resistant context such as China. Davenport (1998) also argues that differences in regional markets sometimes may be so profound that strict process uniformity would be counter-productive for most of the companies. Therefore, he suggests that rather than implementing a single global ES, it might be better for the organisation to implement customised versions which are tailored to support local operating practices in each regional unit.

2.4.2.2 Top Management Support

Top Management Support (TMS) remains one of the most cited CSF for ES implementations. In terms of empirical evidence, Sarker & Lee (2000) find TMS as a necessary condition for a successful implementation. Similarly, Dezdar & Ainin (2011) find that TMS has a stronger influence on ES impact than enterprise-wide communication, and user training and education have. Young & Jordan (2008) also find that TMS has a stronger impact on project success compared to the impact of project management. However, Ifinedo (2008) finds the relation between TMS and ES success only moderately supported. Clearly, TMS is one of the most important factors, but not the only factor that determines implementation outcomes.

In terms of TMS activities, Martin & Huq (2007) contend that if top management focuses its effort on managing cultural and contextual factors, there are high chances of implementation success. Young & Jordan (2008) identify the following activities of TMS – provision of financial, material, and human resources; establishment of a clear and well-communicated project framework coupled to new organizational structures; frequent formal and informal communication between the top management, the project team, and the rest of the organisation; developing an adequate degree of knowledge of, and interest in, the ES project; and the use of formal power in resolving conflicts and supporting the project team. Dong et al (2009) classify TMS activities into three sets of actions – resource provisioning (supplying key resources such as funds, technologies, staff and user training programs), change management (fostering organisational receptivity of new IS), and vision sharing (ensuring that lower-level managers develop a common understanding of the core objectives and ideals for the new system. They report that resource provisioning affects project completion, change management has an impact on the formation of user skills and attitudes, and vision sharing helps in middle manager buy-in.

It is generally assumed in the ES literature that top management support will be consistent throughout the project. However, recent findings suggest that top management support may not be readily available and its nature may change during the implementation. Dong (2008) and Dong et al (2009) report that top managers adjust their support following the dynamics of the implementation process and change the level and content of the support with time to guide the implementation. This finding is echoed by Boonstra (2013) who reports that top management may vary or even withhold their support due to resource scarcity, due to change in goals or context, or due to a lack of clarity on the type of support needed. Elbanna (2013) investigates the role of TMS in multiple-project environment and reports that in such an environment, management support is likely to shift from one project to another under the pressure of market changes, competition, and management’s constant quest for remedies.

2.4.2.3 Business Vision and Strategic Alignment

As noted in earlier paragraphs, one of the key activities identified for top management is developing a business vision and ensuring that there is strategic alignment between the business goals and ES implementation (Davenport, 1998; Dong et al, 2008). Ifinedo (2008) finds business vision to be positively related to the project success. Based on a survey among the Chief Information Officers of Nordic countries, Velcu (2010) reports that the the alignment of the ES strategy with the business strategy usually results in on-time and within-budget completion of the project. However, Grant (2003) finds that although strategic alignment is considered important by managers, it is extremely difficult to attain. He further argues that exact alignment may be an almost impossible goal given the volatile and dynamic business and technological environments surrounding organisations. Lee & Myers (2004) echo the same in their critical ethnography of an ES implementation. They find that the translation from the development of strategic objectives to strategy execution by the ES is by no means straightforward. During the implementation, the strategy of the firm itself may change. At the time of completion, an ES project might be reflecting the vision developed by top management during the adoption decision but could be completely at odds with the business vision at the time of project completion. Therefore, Velcu (2010) suggests that in the long run, changes in business strategy must be coordinated with those available in the ES.

2.4.2.4 Project Management

Weston (2000) is perhaps the first article which discusses project management in the context of ES implementation. He discusses different project management activities in the different stages of an ES project and identifies the use of project management software as a critical requirement for an ES project. Chen et al (2009) report a case study of an ES failure and subsequent success from a project management perspective and identify six distinct areas of ES project management namely, scope management, HR management, risk management, communication management, procurement management and integration management.

Based on the analysis of four case studies, Sammon & Adam (2010) support the oft-repeated advice that the *project team* members should be the best and the brightest and should have both the technical and the domain knowledge. Rothenberger et al (2010) also find that an experienced multi-skilled team that consists of experts in both organisational and technical knowledge is crucial for the ES project success. In this regard, Gallagher et al (2012) report that for the transfer or assignment of personnel, successful negotiations by the project manager with functional unit managers is very crucial to project team formation. They find that two particular project team structures are normally used by the organisation to facilitate the work and social exchange during the implementation – formal group, and formal roles. While the formal group may be defined as the permanent standing team that operates within the existing hierarchical structure, formal role strategy relies on domain experts participating in the project on an as-needed basis. After the project completion, while the technical members usually go back to an IS role; implementation team members from the business act as a superuser, and facilitate knowledge transfer to the end users (Volkoff et al, 2004; Gallagher et al, 2012). Apart from the skill-sets, Gefen & Ridings (2002) also report that responsiveness of the project team to the users and the nature of the social exchange during the implementation positively affects project success.

Using ES implementation data from 141 organisations, Santamaria-Sanchez et al (2010) find that, in terms of *project scope*, business support modules (e.g. Accounting and Finance, Human Resource Management) take less time compared to the time taken by the value-chain modules (e.g. Production and Supply Chain modules). This happens due to complex inter-dependencies in the value-chain modules. They also support earlier findings that the size and complexity of the implementation negatively affect the implementation outcome. Therefore, Ghosh & Skibniewski (2010) argue that since an ES project consists of multiple sub-projects (business process re-engineering, technical infrastructure development, and change management to name a few), an ES project should be seen as a complex project. They outline different areas of project complexities that require attention in order to avoid ES failure. These are structural complexity (due to interrelated tasks and levels), technical complexity (due to interrelated inputs, and outputs), directional complexity (due to unclear goals and hidden agendas), and temporal complexity (due to shifting environment and strategic directions).

However, Elbanna (2010) asserts that traditional project management tools and techniques are often insufficient to handle ES projects since ES project boundaries are constantly negotiated among different organisational actors. Wagner et al (2012) also find that ES implementation teams work in what they call ‘liminal space’ that is fluid and lies between the status quo and the new environment. From the perspective of the implementation team, liminality offers them a space where they are relatively free from existing institutional constraints and can focus on the intrinsic details of the ES. This, in turn, helps them to produce creative solutions and at the same time, to develop a strong sense of kinship with each other.

2.4.2.5 Knowledge Management

Knowledge Management (KM) is approached in two different ways by ES scholars. In the first approach, KM systems are treated as closely related but as a distinct system from an ES. Consequently, studies following this approach tend to work towards inter-relationship of these two systems. For example, Newell et al (2003) find that if a knowledge management system is implemented in tandem with an ES implementation, both the systems may be mutually reinforcing. Xu et al (2006) develop and propose a framework for integrating KM systems and ES. In the second approach, KM is considered as one of the important activities during the ES implementation. Since an ES also transfers the business rules inherent in the package, Lee & Lee (2000) argue for an explicit requirement of handling KM aspect during an ES implementation. This section discusses KM in the second context.

The issue of knowledge management in the ES context is considered at all three levels – knowledge transfer from the consultants to the client, knowledge management within the implementation team, and the knowledge transfer from the implementation team to the end users. This may require role and responsibility redistribution, new knowledge requirements for the end users and, often a new knowledge structure in the organisation (Lee & Lee, 2000). Hung et al (2012) report that from the client side, top management support and the implementing firms' internal incentives have a positive impact on creating a conducive climate for the transfer of knowledge from the consultant to the client. From the consultant's perspective, they find that the consultants' industry experience and their project management capabilities have a positive impact on transferring their knowledge to the clients.

Volkoff et al (2004) find superusers or power-users as the most important mechanism that facilitates knowledge transfer from the ES implementation team to the end users. Superusers are often the members of the user community with existing business roles but are also part of the implementation team working as an interface between business and ES team. Since usually there is a lack of common goals and common language between the ES team and the end-users, superusers act as a bridge and, at the same time, also allow each group to pursue their own agenda. These superusers are the example of 'train the trainer' approach where superusers are trained first, and then they train the end users (Haines & Goodhue, 2003). Karuppan & Karuppan (2008) suggest that scheduling of the superuser training may be conducted based on their learning styles, and refresher course should be organised for them if there is a long gap between initial training and go-live.

2.4.2.6 Partner Relationship

An ES implementation is usually a tripartite relationship among implementing organisation/client, ES supplier/vendor, and ES implementation partner/consultants. In some cases, the vendor and the consultant may be the same entity. IS literature on the partner relationship in the ES context signifies the role of long-term relationship and trust and the quality of interactions during the implementation phase. Scholars report (Gefen, 2004; Ko, 2014; Ko et al, 2005) that the trust in the implementation partner positively affects the client's evaluation of the ES project outcomes. Client's trust in the implementation partner is found to be positively associated with shared cultural characteristics, institution-based guarantees and good process-based experience. Shared cultural characteristics ensure that client and the implementation partner share the same reference frame. Ko et al (2005) also report that shared understanding is an antecedent of effective knowledge transfer between the consultants and the client.

Apart from the trust, Tsai et al (2011) find that the implementing organisation's satisfaction with the ES is highly associated with the degree of satisfaction with the service quality of the ES vendor and the degree of satisfaction with the service quality of the implementation partner/consultants. In terms of dynamics of the client-consultant relationship during the implementation, Pozzebon & Pinsonneault (2005) argue that the initial power balance between the client and the consultant strongly influences the definition of respective roles, the business process negotiations that follow, and the nature of the results of the implementation. In their longitudinal case study, they find that where the client granted total control over the project to the consultants, the project had fewer customisations and at the end, the client had significantly less knowledge of the system. However, they also remind us that the consultant-client relationship is not cast in stone and it is constantly open for renegotiation during the implementation.

2.4.2.7 Organisational Factors

Most of the CSF reviews note organisation culture and organisation structure having an impact on the ES implementation. *Organisation culture* may include learning and development, decision-making style, power sharing, support and collaboration, and tolerance for risks and conflicts (Ke & Wei, 2008). In particular, Chen et al (2009) and Scott & Vessey (2000) emphasise the importance of organisation learning from failures. Using the concept of organisational learning through intelligent failure (Sitkin, 1992), Scott & Vessey (2000) argue that fulfilling certain conditions, organisations may learn even from their ES failure and use the learning for successful implementation in the next iteration.

From the analysis of two case studies, they find that if the organisation has a process focus and has an open and adaptive organisation culture; there is a high probability of ES success in later iterations. Chen et al (2009) also present a case study where having learned the lessons from the failure of its first ES implementation, the company modified its project management practices to successfully carry out its second ES implementation.

In terms of *organisation structure*, Ifinedo (2007) finds that organisation size is positively associated with success, with larger firms enjoying more implementation success. He reports that the ES success may be higher where specialisation and formalisation are well-entrenched, and where a command and control structure is in place (Morton & Hu, 2008). In this regard, interdepartmental coordination and communication (Gosain et al, 2005) are shown to be contributing to the implementation success. Apart from formal organisation structure, Sasidharan et al (2012) demonstrate the important role played by the *social network structure* in the organisation. They find that group-level social capital (knowledge sharing among members of the group) has an impact on ES outcomes at the organisation and individual level. Therefore, they suggest moving beyond formal training and suggest the inclusion of learning via social interactions in the ES implementation plans.

2.4.2.8 Macro Factors

Some studies focus on macro-level factors that affect the ES implementation process. Kaniadakis (2012) argues against restricted project-based depiction of ES implementations and presents an ES implementation within a broader socio-economic context of the agora (the Greek word for marketplace) of techno-organisational change. Krumbholz et al (2000) discuss the impact of different national and corporate cultures inherent in the ES package and those prevalent in the organisation. Sheu et al (2004) also report that factors such as language, culture, politics, government regulations, management style, and labour skills have an impact on the implementation process in different countries.

Institutional theory, particularly the idea of institutional isomorphism (DiMaggio & Powell, 1983; Currie, 2012) has sometimes been used to explain the impact of macro-level factors on the ES implementation. Put simply, the theory of institutional isomorphism argues that various pressures operating at a sectoral or institutional level induce organisations to become similar to their competitors. While coercive and normative pressures often come from outside entities (e.g. a regulator) with no scope for non-conformance, the mimetic pressure is often from within to imitate the competitors' strategy. Benders et al (2006) add the idea of ‘technical isomorphism’ to it, which refers to the structure and processes embedded in the ES artefact. Together, they argue, institutional and technical isomorphism dictate the trajectory of ES implementation.

While the theory of institutional isomorphism tends to apply institutional analysis at the sectoral level, the theory of institutional logics (Friedland & Alford, 1991) focuses on linking organisation practices with the rationalities that operate within the organisation. Berente & Yoo (2012) find four institutional logics that have an impact on ES implementations – managerial rationalism, project management professionalism, scientific professionalism, and organisational persistence. Based on an ES case study conducted in NASA, they report that while an ES fits well with the institutional logic of managerial rationalism, it is loosely coupled with the other institutional logics. Lyytinen et al (2009) also see ES as a carrier of managerial institutional logics. However, they find that the process of institutionalisation is not linear and incremental, as often depicted in the models of planned change. Rather, they propose that the institutionalisation process goes through sudden, non-linear disruptions, unfolding the change in unpredictable ways.

2.4.2.9 Stakeholder Management

An ES implementation has different sets of stakeholders at different levels. Boonstra (2006) identifies diverse stakeholders of an ES implementation and empirically shows that these stakeholders influence the ES implementation in diverse ways depending on their power, legitimacy, and urgency. Soh et al (2011) identify the organisation’s corporate headquarters, implementation consultants, and business units as significant stakeholders and remind us that these stakeholders need to be aligned with the implementation goals. In the health service context, Currie et al (2016) also report diverse stakeholders such as medical professionals, management professionals, regulators, government agencies, and technology suppliers and suggest a stakeholder-based approach to managing such multi-stakeholder projects. Rose & Schlichter (2013) emphasise the importance of stakeholder trust of the implementation team during an ES implementation. Based on a longitudinal case analysis, they find that trust among stakeholders change as the implementation proceeds and it may even break down at some point. They suggest that often, a series of smaller outcomes help in regaining stakeholder trust, rather than solely focussing on the eventual roll-out of the system.

For engaging with end-users, *user involvement* is cited as a CSF in most of the CSF lists. It is assumed that involving the users in the implementation process will enhance their commitment to the ES. However, Wagner & Newell (2007) argue that user involvement in the early stages of the implementation is neither feasible nor productive. It may be infeasible because users may find it difficult to see beyond their current practices during the initial phases. Due to their lack of exposure to the new system and limited technical knowledge of the ES artefact, they may fail to anticipate how things could be done differently if they get new tools to enable more integration across the business. Even genuine attempts made by the users to be involved may fall short because they may be busy with their day to day responsibilities (Wagner & Piccoli, 2007). Similarly, user involvement during customisation and configuration may be counter-productive since they may look for automating their business process instead of re-engineering it (Hammer, 1990) since their conception of work practices is rooted in the existing norms. Perhaps that is why, as Lyytinen & Newman (2015) report in their case study, management and the implementation team marginalised the user community in order to successfully implement the ES. Although there were opportunities for users to express their views and system requirements, in reality, most of their requests were dismissed during the implementation process in order to enforce a technical-managerial view of the organisation. Willis & Chaisson (2007) also report a similar situation where users were silenced using a normative grammar focusing on ‘a new way to manage’ and ‘best practices’, which ensured that the project was considered a success by management.

2.4.2.10 Risk Management

Risk management is noted as one of the important CSFs in most of the reviews. However, existing ES research focuses more on the identification of risk factors (Aloini et al, 2007; Sumner, 2000), rather than exploring the ways of managing risks. For the most part, lists of risk factors, also sometimes called critical failure factors, include lack of or inadequate execution of certain CSFs (e.g. lack of top management support, lack of change management program, inadequate BPR, poor data quality, and so on). In terms of managing risk, the majority of the ES literature does not go beyond offering prescriptions (e.g. steering committee, project sponsor, adequate testing) based on the identified risk factors and very few studies investigate the execution of such risk management strategies. Based on a case study, Ojala et al (2006) put forward a risk management approach that involves risk assessment in adoption, acquisition, and implementation phases of the ES lifecycle. During the use and maintenance phase, they suggest re-assessment of risk each year. Zafeiropoulos et al (2005) offer a dynamic risk management tool to support the modelling, optimal adaptation and implementation of an ES.

Chang et al (2014) develop and empirically test a 12-dimensional audit framework for internal control of ES projects. The 12 audit dimensions identified by them are – definition of functions and responsibilities in the data processing department, system development and control over program modifications, control over the compilation of system documents, access control of programs and data, control of data inputs and outputs, control of data processing, security control of files and equipment, control over the procurement, use, and maintenance of hardware and software systems, system recovery plans/systems and control of testing programs, control over the processes of information disclosure on the assigned websites, independent information audit units, and control of outsourced operations. Apart from audits, testing is identified as a powerful risk management mechanism (Aloini et al, 2007; Grabski et al, 2001). In this regard, Jiang et al (2012) suggest an alternative release policy for ES projects that allows testing to continue for an additional period after the software product is released.

However, as Berente et al (2010) report, apart from functional controls, the ES implementation process may also embody elements of demonstrative controls. Unlike functional controls that are exercised for corrective purposes and intended to make work processes more efficient, demonstrative controls serve to advance the appearance of a neatly ordered organisation, thereby focussing on the public display of compliance.

2.4.2.11 Limitations of ES CSF Studies

One key limitation of CSF research is that there are too many factors to consider and it seems that we know 'too little about too many' factors (Martin & Huq, 2007). McDonagh (2016) also notes that by and large existing factor studies only focus on the surface level pathologies and do not pay attention to underlying mechanisms driving the implementation process. Perhaps this is the reason why we end up with so many CSFs. Another limitation of CSF studies is that by and large extant studies do not pay adequate attention to the implementation stages (Shaul & Tauber, 2013). Although, some CSF *reviews* provide a list of CSFs based on the ES lifecycle phases based on the synthesis of existing studies (e.g. Nah et al, 2001; Al-Mashari et al, 2003; Bajwa et al, 2004; Esteves & Pastor, 2006), very few studies empirically report CSFs as per ES lifecycle phases or as per implementation stages (e.g. Ang et al, 2002; Somers & Nelson, 2004). With few exceptions, existing literature does not pay attention to this aspect. Therefore, Aladwani (2001) suggests that critical factor research should drop the static view since it limits its adequacy in explaining the dynamics of the implementation process. He suggests undertaking process research which may help in understanding how ES implementation efforts have happened, providing a dynamic picture of the implementation process.

Another limitation of CSF literature is that it tends to underplay the overlap and interrelationship between CSFs. McDonagh (2016) stresses that while extant CSF studies highlight strategic, organisational, and technological factors associated with the introduction and exploitation of such systems, the links between such factors have been rather under-explored. The exceptions in this regard are Akkermans & van Helden (2002) and Wainwright & Shaw (2013). For example, Akkermans & van Helden (2002) empirically show that appointment of a project champion positively affects project management which in turn positively affect interdepartmental communication and collaboration. Wainwright & Shaw (2013) report similar findings in a public sector context. Beyond these works, this issue at best is addressed indirectly. For example, the three important set of activities identified by Dong et al (2009) for top management support are – resource provisioning, change management, and vision sharing – which could be considered a CSF in themselves. Huq et al (2006) also find training, communication and change management as important activities for top management. Similarly, knowledge management is found to be closely associated with partner relationships (Haines & Goodhue, 2003; Hung et al, 2012).

Finally, a major limitation of extant CSF literature is that it largely ignores the issue of implementation context. Even though CSFs were originally conceived as being context-specific (Daniel, 1961; Rockart, 1979; Boynton & Zmud, 1984), most of the CSF studies tend to underplay the sectoral context (Shaul & Tauber, 2013). Although there were calls for adopting a context-aware perspective (Howcroft et al, 2004) in ES research, very few studies pay adequate attention to implementation context. This aspect is explored in more detail in Section 2.6.

2.4.3 Section Summary

The first part of this section notes four different views of the implementation process in the extant literature – technical, managerial, political, and constructionist. Each view tends to stress on the specific aspects of the implementation process. Reconciling the diverse viewpoints, t*his study conceives the implementation process as a context-dependent and multi-level process unfolding through technology affordance and managerial actions, mediated by power and politics and variously interpreted by diverse stakeholders*. The second part of this section identifies the prevalence of CSF studies in the ES domain and notes the empirical evidence associated with key factors. It also notes that the CSF studies mostly deal with (too many) surface level factors, usually present a rather static picture of the implementation process, often disregard the implementation contexts, and largely treat the factors in isolation. For this reason, this study seeks to trace key factors across ES lifecycle and intends to uncover underlying mechanisms that result in the emergence of those CSFs. The next section discusses perhaps the most important aspect of an ES implementation in organisations – organisation change.

2.5 ES and Organisation Change

In their seminal article, Markus & Robey (1988) outline three dimensions of theories concerning IS-mediated organisation change – causal agency, logical structure, and level of analysis. *Causal agency* refers to the beliefs about the origin of causality – whether technology causes organisations to change (technological imperative), whether organisation modifies the technology to suit its needs (organisational imperative), or whether there is an interplay of both technology and organisations (emergent perspective)[13]. *Logical structure* refers to the temporal aspect of the theory and the logical relationships between the causes and the outcomes. This is a question of whether the explanation of change is measured in terms of the difference in variables (variance theory), or the explanation is continuous and follows the gradual change in differing contexts (process theory)[14]. The *level of analysis* refers to the entities about which the theory develops the concepts – individuals/groups, organisations, or sector/society. Markus & Robey (1988) observe that the majority of theories underpinning IS-mediated organisation change assume the technological imperative, employ a variance based conception, and ignore a multi-level analysis. A similar trend is noted by Paré et al (2008) based on the literature on IS-enabled change published during 1991-2005. This section reviews the studies on ES and organisation change using the same framework. Subsections 2.5.1 to 2.5.3 analyse the ES research on organisation change in terms of its causal agency, logical structure, and level of analysis respectively. Subsection 2.5.4 presents the empirical evidence related to management of change associated with the introduction of ES in organisations. Finally, subsection 2.5.5 summarises the discussion on ES and organisation change.

2.5.1 Causal Agency

Consistent with the analysis by Markus & Robey (1988) of research on IS and organisation change, present review also finds that the ES research on change outcomes

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[13] Section 3.2.1 discusses in detail the ontological assumptions on technology in organisations.
[14] Section 3.2.2 discusses in detail the process ontology of organisations.

also reflects three distinct orientations in terms of technological, organisational, and emergent perspective. As shown in Table 2.6, the majority of the literature on ES and organisation change takes a **technological imperative** – studying the effect of ES implementation on the organisation. A similar trend reflects on a much larger scale in research on IS associated organisation change (Pare et al, 2008). However, technological imperative does not mean that adequate attention is paid to the features of the ES. Rather, this stream of literature treats ES as a black box and focuses on its impact on organisations without any regard to underlying features of ES. Organisations' actions and structure are usually ignored, or at best, treated as moderating variables.

Table 2.6 Causal Agency in Organisation Change Research

Causal Agency	**ES-mediated Change** (present review)	**IS-mediated Change** (Pare et al, 2008)
Technological Imperative	23 (49%)	61.5%
Organisational Imperative	9 (19.1%)	21.7%
Emergent Perspective	15 (31.9%)	16.8%
Total	47 (100%)	100%

Table 2.7 lists different change outcomes that are conceived and empirically investigated by ES change literature driven by a technological imperative. Studies adopting an organisational imperative study ES implementation by analysing the impact of various organisational factors (usually CSFs) on the implementation outcomes and associated benefits.

Table 2.7 Impact of ES on Organisations (Technological Imperative)

Study	Impact on Organisations
Aburub (2015)	Organisational Agility
Ayal & Seidmann (2009)	Operations, Customer Satisfaction, Financial
Bala & Venkatesh (2013)	Perceived job characteristics (job demand and job control)
Beard & Sumner (2004)	Sustained Competitive Advantage
Chang et al (2008)	Supply Chain Performance
Chang et al (2010)	Financial, Business Processes, Customer, Learning and Growth
Chen & Lin (2009)	Information Flow
Chung et al (2014)	Perceived job performance
Cotteleer & Bendoly (2006)	Operational Performance Improvement
Hitt et al (2002)	Financial Performance
Holsapple & Sena (2005)	Decision Support Benefits
Ifinedo (2010)	System Quality, Service Quality, Individual Impact, Workgroup Impact, Organisational Impact

Ignatiadis & Nandhakumar (2007)	Organisational Resilience
Karimi et al (2007a, 2007b)	Business Process Outcomes (Efficiency, Effectiveness, Flexibility)
Morris & Venkatesh (2010)	Perceived job characteristics, Perceived job satisfaction
Murphy & Simon (2002)	Tangible and intangible Benefits
Ranganathan & Brown (2006)	Shareholder returns
Shang & Seddon (2002)	Operational, managerial, strategic, IT infrastructure and organisational benefits
Su & Yang (2010)	Supply Chain Performance
Tian & Xu (2015)	Risk reduction
Uwizeyemungu & Raymond (2009)	Automational, Informational, Transformational
Vannoy & Salam (2010)	Firm Performance

Table 2.8 presents the organisational imperatives and corresponding ES outcomes considered in the reviewed studies. Finally, a good number of studies adopt an emergent perspective and explain ES outcomes both in terms of technological and organisational aspects. Table 2.9 shows the technological and organisational imperatives considered in some of the reviewed studies with corresponding ES outcomes.

Table 2.8 Impact of Organisational Aspect on ES Outcomes (Organisational Imperative)

Study	**Organisational Imperative**	**ES Outcome**
Elbanna (2007)	Social disintegration	Business Integration
Galy & Sauceda (2014)	Top management knowledge, top management support, long-range plans, information sharing between departments, Relationship with outside experts, Technological competence in organisation	Financial performance
Gattiker & Goodhue (2004, 2005)	Interdependence among sub-units	Coordination improvements, Data quality, Task efficiency
Law & Ngai (2007)	Senior management support, CEO-IT distance, Strategic intent	Organisational performance
Shao et al (2012)	Transformational leadership, organisational culture, knowledge sharing	ES success
Sykes et al (2014)	Advice networks	Job performance
Sykes (2015)	ES support structures, Peer advice ties	Employee outcomes
Yoon (2009)	Organisational citizenship behaviour	Information quality, Work efficiency, Intention of IT innovation

Table 2.9 Emergent Perspective on ES and Organisation Change

Study	Technological Aspect	Organisational Aspect	ES Outcome
Chou & Chang (2008)	Customisation	Organisational mechanisms	Coordination improvement, task efficiency
Seddon et al (2002)	Functional fit, integration, process optimisation, improved access to information	Overcoming organisational inertia, ongoing business improvement projects	Organisational benefits
Srivardhana & Pawlowsi (2007)	Organisational knowledge/memory, social integration mechanism	ES system constraints	Sustained business process innovation
Tsai et al (2012)	System selection criteria	Supplier selection criteria, consultant selection criteria	System quality, Service quality
Volkoff et al (2005)	Data definitions, Level of data details	Business processes, Business unit objectives, Time horizons, Relative focus on timeliness vs accuracy	ES-enabled integration
Wu & Wang (2007)	ERP product	Contractor services, User knowledge and involvement	Key-user satisfaction in ES environment

Exploring an emergent perspective, Boersma & Kingma (2005) focus on the mutual shaping of technological artefact and organisational culture within an organisation. In their case study, they find that an ES implementation is more than an adaptation of a packaged system to the organisation, and the organisational adaptations are more than a BPR exercise relative to the ES. That is why Scott & Wagner (2003) include ES as a non-human actor in their analysis based on the Actor-Network theory. They note that technological capabilities of ES also acts as an agency among a broad range of agencies across which actors negotiate as they seek to inscribe their preferences into the ES. As Srivardhana & Powlowski (2007) show, ES system constraints also moderate outcomes along with organisational actors. At the end, it is a case of structure influencing agency and agency influencing structure at the same time (Staehr, 2010). Whether a study focuses on such dynamics or ignores them altogether, depends on the logical structure of the study. This is the topic of next subsection.

2.5.2 Logical Structure

As noted earlier, Markus & Robey (1988) find two logical structures in the theories of IS-mediated organisation change. While the variance structure tries to measure the change in certain variables that undergo change, process structure follows the gradual patterns of change in order to understand its dynamics. As shown in Table 2.10, the majority of work on ES-mediated change in this review is found to be of variance type, following similar pattern to the research on IS-mediated change. Since most of the variables of the variance approach are already been in subsection 2.5.1, this subsection focuses on the process dimension of ES-mediated change.

Table 2.10 Logical Structure for in Organisation Change Research

Logical Structure of Theory	**ES-mediated Change** (present review)	**IS-mediated Change** (Pare et al, 2008)
Variance Theory	33 (70.2%)	78.9%
Process Theory	14 (29.8%)	20.5%
Variance and Process	0	0.6%
Total	47 (100%)	100%

The most basic form of process theory in the ES domain is the consideration of the ES lifecycle in the analysis. For example, Wei et al (2005) classify different misalignments along the phases of the ES lifecycle and suggest technology and organisational change required to overcome those misalignments. Vannoy & Salam (2010) develop their own four-stage model to explain the role of ES in competitive action decisions and in improving firm performance. Other process theories from the review basket conceive ES-mediated change as a continuous process in the form of continuous negotiation between human and non-human actors (Scott & Wagner, 2003), a cycle of creating power differentials and subsequent drift (Ignatiadis & Nandhakumar, 2007), reproduction of existing social structure (Elbanna, 2007), or the mutual shaping of technology and organisation culture (Boersma & Kingma, 2005). The processual aspect of change is explored in greater detail in Chapter 3.

At a general level, process-based theories essentially conceptualise change as movements in time. Interestingly, the conception of time does not remain the same for all the stakeholders. As Scott & Wagner (2003) note, ES implementations are subject to multiple perceptions of project time. In their longitudinal study of an ES development and implementation in a university, they show that multiple project times existed each resulting in a different interpretation of the project. The main reason for this is the cross-departmental nature of ES resulting in different professional communities coming together during the implementation process. Sawyer & Southwick (2002) note two particular conceptions of time in this context. One conception is the normally used linear conception of measured clock time. The second conception of time is socially defined and often non-linear in nature. For example, they report that while the project team adjusted their perception of available time depending on changing project milestones, users outside the project team still referred to the original plans in determining the project delays.

2.5.3 Level of Analysis

The level of analysis refers to the unit of analysis to which theoretical concepts and empirical data relate (Markus & Robey, 1988). As shown in Table 2.11, the majority of the research on ES-mediated organisation change focusses on the **organisational** level. This pattern is similar to research on IS-mediated change (Pare et al, 2008). However, unlike IS-mediated change, ES change research seems to pay somewhat less attention to the individual level, perhaps because ES is a more enterprise-level phenomenon. There is only one paper (Bannister, 2001) in the review basket that corresponds to the sectoral level. Since organisation-level research is largely discussed in earlier subsections, this subsection focuses on individual and multi-level research on ES-mediated change.

Table 2.11 Level of Analysis for Organisation Change Research

Level of Analysis	**ES-mediated Change** (present review)	**IS-mediated change** (Pare et al, 2008)
Individual	6 (12.8%)	23%
Organisational	32 (68.1%)	58.4%[15]
Sectoral	1 (2%)	4.3%
Societal	0	0.6%
Multi-level	8 (17%)	13.7%
Total	47 (100%)	100%

At the **individual** level, Venkatesh and associates (Morris & Venkatesh, 2010; Bala & Venkatesh, 2013) focus on the changes in employee job characteristics due to ES implementation. Based on a study of approximately 2800 employees of a telecommunication company, Morris & Venkatesh (2010) report that ES implementation moderates the relationship between three job characteristics (autonomy, skill variety, and feedback) and job satisfaction. Bala & Venkatesh (2013) find that during the post-implementation phase, there is an increase in job demands on the employees primarily due to perceived process changes, and decrease in job control primarily due to perceived process complexity. In terms of supporting the employees in dealing with the changes in job characteristics, Sykes et al (2014) and Sykes (2015) report that advice provided by peers have more impact on the ES job outcomes for employees than the impact of traditional support structures (e.g. training, online support, help desk support, and change management support).

Apart from capturing views from different levels *within* the organisation, e.g. individual, project team, department, or senior management (Sawyer & Southwick, 2002; Scott &

[15] Includes organisational, group, task, and departmental levels.

Wagner, 2003; Staehr, 2010), **Multi-level** studies on ES-mediated change try to go beyond the organisation level and include macrosocial level outside entities such as supplier, consultants, or industry environment. For example, Tsai et al (2012) note the impact of supplier selection criteria (international market position, training support, and technical support) and consultants selection criteria (their experience, and level of support after go-live) on ES-mediated outcomes. Wu & Wang (2007) include domain knowledge, previous experience, project management, technical competence, and training support as the variables pertaining to consultants and suppliers that have an impact on key-user satisfaction in an ES environment. The uncertainty in the firm's environment mediates the impact of ES on a firm's level of risk (Tian & Xu, 2015). Wei et al (2005) focus on ES misalignments at technological, business, industry and regulation-specific levels. Staeher et al (2012) also offer a multi-level explanation of ES benefit realisation by including environmental and organisational context along with project specific details.

2.5.4 Change Management

An ES may introduce change at various levels in the organisation and is also influenced by the processes operating within and outside the organisation. This may explain why the majority of CSF reviews include change management in top three CSFs that require management's attention. These change management activities are often scheduled towards the latter stages of ES implementation and are intended to bring individuals and groups in line with the deployed system (Aladwani, 2001; Markus, 2004; Finny & Corbett, 2007; Loonam & McDonagh, 2009). Most of the studies/prescriptions on change management suggest training and communication as a two-pronged strategy for successful change management. Amoako-Gympah & Salam (2004) report that both training and project communication have a positive impact on the perceived usefulness and ease of use of the ES. Klaus et al (2010) also find training and communication as successful strategies for addressing change resistance groups in ES implementation.

Variance based studies on ES find a strong association between ES **training** and ES outcomes (Amoako-Gyampah & Salam; Chou et al, 2014). Chou et al (2014) report that training strengthens employee self-efficacy with the system, which in turn facilitates effective knowledge sharing in the ES context. In terms of training method, Noudoostbeni et al (2009) find lecturing, on-the-job-training, computer-based training, and team training as preferred training methods and suggest a combination of these methods for successful change management. Koh et al (2009) find that test database and training CDs, software release notes, and telephone support to users act as effective support tools for ES training.

Sykes (2015) also report the efficacy of traditional training, online support, and help desk support as a significant predictor of ES outcomes for employees. However, the most important predictor of employee ES outcome is found to be peer advice or the social capital (Chou et al, 2014; Sykes et al, 2014; Sykes, 2015) that facilitates knowledge sharing among employees. Karuppan & Karuppan (2008) find the timing of the training extremely important and report that employee performance worsens as the time elapsed between training and system roll-out increases.. Along with pre-implementation training, Lee & Lee (2004) suggest post-implementation training since there is often a performance dip immediately after the go-live (Deloitte, 1998; Wagner et al, 2010; Berente et al, 2008). Post-implementation training supports the users in overcoming the shock created by the new system and processes.

In terms of training content, Coulson et al (2003) conclude that including the system integration and workflow concept in the training with the procedural training significant improves the users' mental model accuracy over time. This is because it allows the users to put the knowledge in context. Sedmark (2006) also argues for both communicating the job details and communicating the bigger picture during ES training. Since ES implementation usually brings significant changes in business logic and processes, procedure based training (such as training for data entry or report preparation) would not be sufficient in preparing the employees for the higher-order changes that accompany ES implementation (Davis & Hikmet, 2008). Therefore in order to be effective, they suggest training that supports the development and transfer of the tacit knowledge, and that makes use of social capital.

The second recommended strategy for successful change management is ES related **communication**. In this regard, many change management studies (Aladwani, 2001; Huq et al, 2006; Finny, 2011) bring the insights from the field of marketing communication. Huq et al (2006) suggest the use of multiple communication channels, interactive media, and continuous communication with the users. Sedmark (2006) suggests media such as posters, intranet sites, project meetings, and away days for increasing the organisation-wide communication relating to the project. The communication channels may also depend upon the implementation stage and the stakeholders of the project. For example, Finny (2011) suggests that while the acquisition-related decisions could be communicated to all the users through e-mails, face to face communication should be the preferred method thereafter, especially during training. She suggests adopting a stakeholder perspective by adapting the message, method, and media to suit the needs of different stakeholders.

In this regard, Sedmark (2006) suggests different types of communication at different levels. At the leadership and strategic level, she suggests communication on the needs of the company and the scope of the ES project, especially during the adoption phase. At the management level, she suggests communication regarding the operationalising of the ES project. Finally, at the individual employee level, she suggests communication regarding the change in the nature of their jobs and giving an insight into the overall picture of the ES-mediated change. She suggests that the project managers, communication managers, heads of department, and business implementation managers could act as facilitators for the communication processes during and after implementation. Huq et al (2006) and Kemp & Low (2008) find open and honest communication crucial for ES change management, particularly by offering a realistic preview of the expected outcomes and possible changes in the workplace. However, Sarker & Lee (2003) report that open and honest communication may not be a necessary condition for ES success.

Like training, timing is crucial for communication associated with ES implementations. Huq et al (2006) argue that since it takes a long time for employees to understand the implications of change and to adjust to the change, ES communication plans should offer enough lead times to the employees in order to get them used to the new systems and processes. At the same time, Kemp & Low (2008) remind that if there is too much gap between different stages of the implementation, communication may be required to assure staff members that the ES is still being implemented and it would be rolled out whenever it is ready. Sedmark (2006) also stresses the importance of keeping the users informed and engaged with the project by providing them with regular updates throughout the ES project.

Finally, ES studies report that these twin change management activities are highly correlated with the critical success factor of top management support. For example, the three important sets of activities identified by Dong et al (2009) for top management support are – resource provisioning, change management, and vision sharing. While resource provisioning includes providing resources for training (apart from other resources), vision sharing involves communication with different stakeholders across the organisation. Huq et al (2006) also include training, communication, and change management as important activities for top management.

Recent works on ES related change management also suggest that change management is crucial *across* the ES lifecycle, rather than just being important towards the end of the implementation. Based on a survey, Somers & Nelson (2004) find change management as relevant to all the ES stages. Finny & Corbett (2007) also support the contention that while many of the ES success factors are important, the need to approach the implementation from a change management perspective is central to the success of any ES project. Ash & Burn (2003) and Huq et al (2006) empirically demonstrate the importance of change management activities in order to create cultural readiness and support the cultural transformation for the ES project. Using a longitudinal case study, Kemp & Low (2008) underscore the importance of change management activities to sustain employee interest in the case of delays in implementation. Lee & Lee (2004) specifically bring out the importance of change management activities in the post-implementation phase in order to sustain the initial performance dip immediately after go-live. Perhaps, therefore, Loonam & McDonagh (2005) consider it vital that issues related to change management are dealt with in tandem with ES implementation, not after the project is completed.

2.5.5 Section Summary

This section reviews the literature on ES-mediated organisation change using the framework proposed by Markus & Robey (1988). In terms of causal agency, it notes that the majority of literature still subscribes to the technological imperative, although studies using the emergent perspective (considering both technological and organisational imperative) are on the rise. In terms of logical structure, although the majority of studies still employ variance-based theorising, process-based theorising is also in use. As far as levels of analysis are concerned, although the majority of studies still subscribe to a single level of analysis (organisational or individual), the number of multi-level studies is also on a rise. *This study views ES-mediated change as a multi-level process that is the result of interaction between technological imperative and organisational actions.* This section also reviews the empirical evidence associated with ES change management activities and notes that ES change management is deeply entwined with the implementation process and should be given consideration throughout the implementation. It is also noted that change management is closely associated with top management support and is primarily executed via training and communication.

Although most vendors and consultants present their ES as a one-stop solution for all kinds of organisations, Howcroft et al (2004) note that despite the espoused benefits and the continued popularity of ES, effectively utilising an ES in diverse organisations is not as straightforward as vendors and consultants claim it to be. Therefore, they stress the need for a context-aware perspective on ES that attends to the design, implementation, use and evaluation of ES at multiple levels (individual, groups, organisations, and society) and across varying contexts. Currie (2008) also notes that a deep understanding of public sector IT can only be achieved by placing the IT artefact within the broader context of the implementation by focussing on the socio-political and inter-organisational level. Therefore, the next section reviews the literature on ES in public service organisation (PSO) context.

2.6 Enterprise Systems in Public Service Organisations

The panel discussion (Zmud et al, 2004) at the International Conference on Information Systems 2004 discussed an important issue of implementing IS in the public service organisations (PSOs). Although there were slight differences of opinion on how to approach the issue, there was unanimity in accepting that the public sector had become a major economic force and had emerged as a major player in influencing the IT industry. This assertion is even more so in present times when the private sector is still struggling to recover from the economic recession and the investment by PSOs is still vital to support economic recovery. Consequently, PSOs have become an important clientele for ES vendors (Centre for Digital Government, 2016; Panorama Consulting, 2016).

However, consideration of the public service context remains largely ignored in the extant ES literature. Out of total 230 empirical papers from the review basket, only 29 studies (12.61%) are conducted in the PSO context and 4 papers (1.74%) include both PSOs and non-PSOs. PSO studies primarily include studies conducted in universities (Alvarez, 2008; Chae & Poole, 2005; Dong et al, 2009; Gallagher et al, 2012; Lyytinen & Newman, 2015), and health services (Ayal & Seidmann, 2009; Davis & Hikmet, 2008; Karuppan & Karuppan, 2008; Soh & Sia, 2004; Teoh et al, 2012; Tong et al, 2015). However, most of the studies treat the case organisation as a generic organisation and generalise the findings across PSOs and non-PSOs. In contrast, *this section focuses only on those papers which specifically pay attention to the public service context*. For this purpose, papers are drawn from outside the review basket. Among the studies, more than 50% of papers employ a case study approach. Other methods include surveys and content analysis. In terms of organisation type, other than health services and universities, studies are conducted on provincial governments (Anwar & Mohsin, 2011; Kumar et al, 2002; Spano et al, 2009; Wagner & Antonoucci, 2004, 2009; Watson et al, 2003), defence organisations (Blick et al, 2000; Gulledge & Simon, 2005), R&D organisation (Berente et al, 2010; Berente & Yoo, 2012), e-Government (Raymond et al, 2006), e-Procurement (Williams & Hardy, 2005), and state-controlled bank (Kaniadakis, 2012).

This section follows the logical flow of earlier sections in order to allow for comparisons. Subsection 2.6.1 discusses the applicability of the ES artefact in the PSO context. Subsections 2.6.2 to 2.6.5 discuss ES studies in PSOs that relate respectively to adoption, acquisition, implementation, and use and maintenance phase. Subsection 2.6.6 explores the research on ES-mediated organisation change in PSOs. Finally, subsection 2.6.7 summarises the discussion on ES in PSOs.

2.6.1 Applicability of ES Artefact in PSO Context

Contrasting views exist on the applicability of the ES artefact in the PSO context. At one end, Blick et al (2000) argue that since ES are primarily designed for private sector organisations, there remains a significant gap between the public sector business processes and the functionality offered by an ES. They note that since PSOs are usually required to follow some unique processes that are mandated by law, they cannot undertake significant BPR of their business processes. At the other end, Gulledge & Sommer (2003) assert that there is nothing special about the management of public organisations that precludes them from modern management practices and the use of ES. They note that although the performance measures and incentive structure may be different in the public sector, underlying business processes are usually similar. In this regard, this study takes a cue from Pollock & Cornford (2004) who maintain that although universities widely engage in the same activities as other types of organisations (e.g. Accounting, HR), they may still be considered as a bit different from others.

2.6.2 ES Adoption in PSOs

Based on a survey of Portuguese organisations, Alves & Matos (2011, 2013) report that public organisations share the same motivations for ES adoption as their private sector counterparts. These justifications include motivations related to information and system integration, business process improvements, and time-specific motivations (Y2K problem, Euro introduction), among others. Based on the analysis of the ‘success stories’ promoted by ES vendors with regards to ES adoption in the e-Government context, Raymond et al (2006) echo similar observations. Their analysis concludes that while that some government organisations adopt an ES primarily to integrate their information systems, others seek improved process operations or are driven by their strategy. Similarly, based on vendor narratives of 180 case studies, Poba-Nzaou et al (2014) classify the motivations underlying ES adoption in healthcare organisations. They find similar categories of technological motivations (IT integration, IT infrastructure), operational motivations and strategic motivations. However, they note that orientation of healthcare organisations may also differ in terms of being managerial or clinical. While healthcare organisations with the managerial orientation tend to adopt ES in order to boost their efficiency, those with the clinical orientation tend to adopt ES to improve their effectiveness in terms of service delivery. In a sense, the clinical orientation relates back to the concept of public value (Bozeman, 2007; Moore, 1995) identified in Section 1.3.

2.6.3 ES Acquisition in PSOs

In their case study of ES acquisition in a university setting, Pollock & Williams (2007) note that the public organisations need to follow strict public procurement regulations and these organisations typically have well-established, time-consuming and highly regulated processes for system procurement. Public agencies need to maintain the requirement for transparency (e.g. public tender) and the emphasis on value for money (e.g. awarding the contract to lowest bidder). They also report that procurement teams in PSOs tend to include representatives from across the organisations. Based on a case study of four provincial Canadian government organisations, Anwar & Mohsin (2011) also report that public organisations do not enjoy as much autonomy as private entities in deciding on large projects. Decision making at various stages is usually bureaucratic and results in delays in the project. They report that wider political context also plays a greater role in acquisition decisions. Government's service priorities, accountability to ministries, responsibilities toward society, and existing administrative processes are some of the key reasons why initiating an ES project can be challenging in a PSO. Sometimes the ES market context may also affect the content of the acquisition decisions. For example, in his case study of a state-funded Greek bank, Kaniadakis (2012) reports that the consortium getting the ES contract had a monopoly on the projects in the public sector and they had a good relationship with the Greek government, making the award of the contract to them almost inevitable.

2.6.4 ES Implementation in PSOs

Echoing the observations made for ES research in general, ES research in PSOs is concentrated around the implementation phase and around the identification of critical success factors. Many survey-based studies (Chang et al, 2000; Crisostomo, 2008a, 2008b; Kumar et al, 2002; Watson et al, 2003; Wainwright & Shaw, 2013) report various CSFs associated with the ES implementation in PSOs. The majority of the studies report a combination of CSFs that are common to ES studies in non-PSOs but also include other contextual factors specific to PSOs. Since common factors have already been discussed earlier, this subsection focuses on the contextual factors.

2.6.4.1 External Political Environment

While their private sector counterparts work in relatively stable external political environment, decisions related to ES implementations in PSOs may be driven by external political context that may not be relevant to the actual operations of the organisation (Sommer, 2011, Kaniadakis 2012; Wainwright & Shaw, 2013) and may fall prey to short-term orientation (Raymond et al, 2006). Instead of following a techno-managerial prescription, implementation decisions may be geared towards ensuring that there are no negative political repercussions resulting from the implementation. Wagner & Antonucci (2004, 2009) also note the impact of complex political context and fragmented power among multiple stakeholders (McAdam & Donaghy, 1999) having an impact on ES implementation in PSOs. In addition, there may be a frequent change in the leadership resulting in changing priorities. This provides a narrow window of opportunity and little incentive for political appointees thereby creating a big challenge to ensure consistent top management support and commitment (Sommer, 2011; Wagner & Antonucci, 2009). Another associated aspect is demand for public accountability of PSOs. Unlike private sector organisations, organisations in the public sector have higher demands and expectations of public accountability (Bozeman, 1987; Rainey, 2014). This puts additional pressure on the public sector organisations implementing ES. In such a case, as Berente et al (2010) report, PSO employees may engage in demonstrative compliance that is geared towards satisfying the demand for control by exhibiting public compliance but making a little direct contribution to the execution of work-related tasks.

2.6.4.2 Internal Organisation Environment

Since the leadership of the organisation may be dependent on political conditions, and since there is a higher demand for public accountability, PSOs usually follow consensus driven decision making (Sommer, 2011, Wagner & Antonucci, 2009) involving representation from different departments. This results in distributed or no leadership and slow decision making for the implementation project. The bureaucratic culture of PSOs often requires the communication and decisions via ‘proper channel’, resulting in even smallest changes being approved by the top management after an arduous change control process (Anwar & Mohsin, 2011; Kaniadakis, 2012). Another significant difference from the private sector is the importance of middle managers. The mainstream ES implementation literature remains relatively silent on the role of middle managers during the implementation (Sommer, 2006) and usually assigns them the role of passive implementers. However, middle managers can spearhead much of the organisation’s resistance to the implementation. As seasoned middle managers may have in-depth knowledge of rule books, bureaucratic procedures and existing power structures in PSOs, they may put forth many procedural obstacles to impede the process of ES implementation (Sommer, 2011). At the same time, relatively stable job profiles of civil servants may make the internal political environment hostile to the ES initiative (Bannister, 2001).

This issue is compounded by the prevalence of multiple institutional logics in the organisation. ES case studies conducted in universities (e.g. Pollock & Williams, 2007; Wagner et al, 2010) often note the clash between managerial and academic logics. Similarly, Currie & Giah (2007) and Poba-Nzaou et al (2014) also report existence of business/managerial logic and clinical logic in healthcare organisations. Based on a case study of ES implementation in NASA, Berente & Yoo (2012) find four competing institutional logics in operation. While an ES usually supports managerial logic in PSOs, it is often at odds with other institutional logics. In such a case, organisations usually form a loose coupling with the system in order to satisfy both the logics (Berente & Yoo, 2012; Wagner et al, 2010). This may involve bypassing the system or the use of parallel systems for certain tasks.

2.6.4.3 Business Process Aspects

Although some business processes might be the same across public and private sector organisations (e.g. Finance and Accounting), the majority of the processes are not exactly alike. Blick et al (2000) stress on the issue of gap closure in terms of managing process fit but also acknowledge that there may be some unique process requirements for public sector organisations due to the law of the land. In such a case, it might be difficult to ensure process fit while implementing an ES in a PSO. Thomas & Jajodia (2004) find that the majority of ES implementations in the public sector require additional time during the analysis and design phase to bridge the gap between the business processes embedded in the ES and those followed in the organisation. Business processes in the software are generally customised to suit the local requirements of the PSOs (Spano et al, 2009; Williams & Hardy, 2005). However, as Sammon & Adam (2010) show via a case study of two Irish PSOs, if an existing process is considered to be optimal and simply automated, this may create problems for implementation in the long run.

When implementing an ES in PSOs, there may be many entities involved. As an external partner, there may be a hardware supplier, software supplier and implementation consultants. Anwar & Mohsin (2011) report that the vendor may play a leading role (e.g.

system development, customisation, integration etc.) in ES implementations in the PSO context and the project team may only be involved in a supporting role (e.g. testing). From within the organisation, the specific process may involve multiple departments (e.g. procurement, finance, and operations for a public service delivery). Coupled with the consensus style of decision-making and distributed leadership, this makes it more difficult to coordinate among different departments/agencies and settle the issue of process ownership (Watson et al 2003, Wagner & Antonucci 2009). This issue may be particularly important when one is dealing with inter-organisation systems such as shared services or e-Procurement.

2.6.4.4 Technical Infrastructure and Legacy Systems

Watson et al (2003) observe that implementing ES in any organisation involves maintaining standard (and state of the art) IT infrastructure throughout the organisation. Quite often public sector organisations have systems that are technically, structurally, and geographically diverse (Bannister, 2011). Currie et al (2009) share similar observations about the information systems within the health service context. Also, public sector organisations may also be less than willing to do away with their legacy system (Blick et al 2000). In such a case, poor data quality of legacy systems and interfacing issues may create bottlenecks for the implementation (Watson et al 2003).

2.6.4.5 Implementation Methodology and Team

Thomas & Jajodia (2004) report that many PSOs try to use the system development life cycle (SDLC) consisting of analysis, design, coding, and testing to support the ES implementation. They may spend months (even years) to come up with detailed documentation of their requirements without taking into considerations the capabilities of the ES. This not only delays the implementation process but also introduces a constraint on the implementation since the details cannot be changed in developing circumstances, or the change requires lengthy change control procedures. New approaches such as agile or lean implementation provide distinct advantages in terms of increased flexibility for change and adaptation but may be at odds with a rules-driven bureaucratic culture of the PSOs.

Wagner & Antonucci (2011) report that while small teams (3-5 members per module) may be preferred in ES implementation in the private sector, the size of the implementation team in PSOs is higher in order to accommodate representation from associated departments. Also, while it is considered a standard practice to assign the domain expert in the project team for the implementation, managers in PSOs often hesitate in assigning their best person for the implementation (Thomas & Jajodia, 2004). Instead, they may assign a newcomer with IT skills who may have little domain knowledge. One more issue that may act as a hindrance to getting the best personnel for the implementation project is the incentive structure which is generally fixed in the public sector, usually with very little scope for performance-based rewards, thereby limiting the scope of innovation (Blick et al, 2000; Sommer 2011) and providing motivations to employees.

2.6.4.6. Resource Management

Based on a case study of a healthcare organisation, Teoh et al (2012) report resource constraint as a crucial factor for ES implementation. They note resource constraints such as lack of sufficient financial resources to fund all the desired applications, lack of internal technical expertise who can commit to full-time technical development, lack of floor space at the existing premises for extensions and expansions, the resistance of senior doctors, and low familiarity of ground level staff with advanced ICT. Based on their analysis, they suggest eight resource management activities spread throughout the ES lifecycle.

2.6.4.7 Knowledge Management

Based on a Delphi survey with the agencies of Australian provincial government, Chang et al (2000) report knowledge management as the most important issue for ES implementation in PSOs. Allen et al (2002) also note that knowledge sharing with the implementation partner is an important issue for ES implementations in the public sector. This is due to that fact that by virtue of their ‘publicness’, public sector organisations may not wish to share their sensitive data with their ‘corporate’ implementation partners.

This subsection discussed the context-specific factor associated with ES implementation phase in PSOs. The next subsection moves to ES use and maintenance in public organisations.

2.6.5 Use and Maintenance

Based on a survey of ten Canadian provincial government organisation, Kumar et al (2002) report three major strategies for promoting user acceptance – training and counselling, improving user awareness, and improvement in systems. Watson et al (2003) report problems such as huge numbers of users, last minute system upgrades and improper training plans (e.g. training an employee who was due to retire in a subsequent month) as some of the problems associated with training ES users in a PSO. Kumar et al (2002) note training difficulties such as insufficient budget, logistical problems, lack of computer savvy users, and getting the right people as trainers in PSOs. For improving user awareness, they report methods such as demonstrations, communication, and user guidelines being used by Canadian PSOs. Improvement in the system based on user feedback is also adopted as a strategy to promote user acceptance.

2.6.6 ES-mediated Organisation Change in PSOs

Some of the reviewed PSOs studies focus on the organisation change outcomes associated with ES. Based on a case study of two public and two private organisations, Sammon & Adam (2010) report the level of fit between ES applications and the organisations' business processes as the most significant outcome of the ES implementation. Based on a Delphi study of twenty-three Australian PSOs with a live SAP R/3 system, Sedera et al (2002) report system level outcomes (system functions, accuracy, reliability, integration, and customisation), organisation level outcomes (increase in organisational costs, and productivity) and individual levels outcomes (learning difficulties, user satisfaction). However, they also note the difficulty in performing a cost-benefit analysis in a PSO context. Based on a case study of ES implementation in an Italian regional government, Spano et al (2009) find that although the implementation had an impact on internal decision-making processes, it did not have a significant impact on the business processes. The main reason for this was the lack of BPR and existence of heavy customisation of ES. In the healthcare context, Ayal & Seidmann (2009) underscore the importance of using both tangible outcomes (e.g. turnaround time, or financial benefits) and intangible outcomes (e.g. staff and patient satisfaction) when evaluating ES outcomes.

As noted in Section 2.5, the aspect of ES-mediated organisation change needs to be understood at multiple levels (Avgerou, 2001; Collins, 1999; Howcroft et al, 2004; Markus & Robey, 1988). In this regard, Bannister (2001) and McDonagh (2016) discuss change related aspects at multiple levels with regards to the implementation of enterprise-wide IT systems in Irish PSOs. At the *macro/institutional* level, PSOs are marked by risk aversion and dominance of political authority (Bannister, 2001; Kaniadakis, 2012) engaging in the rhetoric of transformational change with help of IT, but not being able to translate that into practice (McDonagh, 2016). Due to the short-termism caused by the political context, IT investments in PSOs are generally viewed as an investment in technical systems, solutions, and infrastructure as distinct from investment in the strategic change initiative. McDonagh (2016) further argues that such institutional deficits have an equally powerful binding effect which results in IT-enabled change initiatives becoming highly techno-centric at an early stage and ultimately resulting in failure. The case of the Public Services Broker (McDonagh, 2004) and Health Services (Sammon & Adam, 2010) in Ireland are prime examples here. Even if such systems survive, these systems tend to be fragmented and result in the creation of silos or stovepipes (Bannister, 2001; Sommer, 2006, 2011) and prove to be difficult to integrate with an enterprise-wide system.

At an *organisational level*, McDonagh (2016) observes that the enterprise IT projects are marked by an untested belief that effective programme and project management are key to delivering promised outcomes mediated with such change initiatives. Here we see a recurring pattern in PSOs where the project steering committee, the project management team, and the project manager are all tilted in the direction of the technical artefact to be deployed. A highly formal and procedural approach to change is often adopted (Kaniadakis, 2012; Sammon & Adam, 2010) in the mistaken belief that the dominance of a highly technical approach to the implementation will somehow deliver much-promised value. However, often that is not the case and ES related investments in PSOs often result in huge loss of public money (McDonagh, 2004; C&AG, 2007, 2008; Sammon & Adam, 2010).

McDonagh (2016) notes that managerial groups are usually constrained by both the prevailing institutional and organisational logics of their external and internal context. This often results in executive management favouring a view that focuses solely on the promised economic outcomes, senior functional management favouring a view that focuses on enhancing efficiency and IS unit favouring a view that focuses mostly on the technical dimensions. In a public service context, usually none of these groups naturally embrace a coordinated and integrated view of IT-enabled change. In this regard, the role of executive and senior management is especially important, since an IS manager may find it difficult to influence the strategic IS decisions, which are more usually influenced by those in middle-level management positions (Bannister, 2001). In the Irish public service context, Bannister (2001) also blames interdepartmental rivalries (at both political and administrative levels) for the disintegrated state of many public sector information systems. Often, this results in an IS structure where separate systems are independently developed for specific purposes but do not talk to each other. This may occur across different PSOs, or even across different units within the same PSO.

Very few empirical studies pay attention to the multi-level context when researching ES in PSOs. Kaniadakis (2012) present ES implementation in a state-controlled bank as an Agora of techno-organisational change operating within a broad socio-economic context.

Based on their case study in a university setting, Pollock & Cornford (2004) show that the customisation decisions for an ES implementation are often distributed across levels. First, ES throws up so many demands for changes that implementation decisions cannot be properly discussed in the steering committee. Consequently, such decisions are often pushed down to technical teams and then onto the system itself. In other words, change often occurs through a process of default rather than being a deliberate choice at some level. Second, the burden of resolving the conflict between ES and working practices is then passed onto the users. This often results in the creation of workarounds as users attempt to reconcile the organisation's idiosyncratic practices with the generic practices embodied within ES. Third, even if sometimes ES are customised to accommodate certain practices, this increasingly happens at the level of the sector. A university's specific needs would be incorporated by the ES vendor only if these needs happen to be common to other clients.

2.6.7 Section Summary

This section reviews the literature associated with ES in PSOs. It notes that ES adoption motivations in PSOs are same as those of their private sector counterparts. PSOs seek similar technical, operational, and strategic benefits from their ES adoption. However, evidence suggests that ES acquisition phase in the PSOs are marked by high level of political influence and a commitment to procurement procedures, which sometimes causes delay and may result in a system selection mostly based on the lowest bid. Similar to the mainstream ES literature, the implementation research in PSOs is also focussed towards the identification of CSFs. While many traditional CSFs are also applicable to ES implementation in PSOs, there exist contextual CSFs such as external political context, change-resistant organisation culture, unique business processes, outdated and diverse legacy systems, resource constraints, and knowledge management issues. In use and maintenance, PSOs face problems such as a large number of staff members, low IT awareness of its staff, and inadequate training infrastructure. The last subsection discusses institutional, organisational, and group level influences of ES-mediated organisation change in PSOs. The next section presents a research agenda based on the literature review presented in earlier sections.

2.7 Developing a Research Agenda

Based on the review conducted and research gaps identified, this section develops the research agenda for this study. Figure 2.1 presents the research gaps and associated implications for the research agenda. The research agenda is covered in subsections

2.7.1 to 2.7.4. Section 2.7.5 presents the research question and the research model.

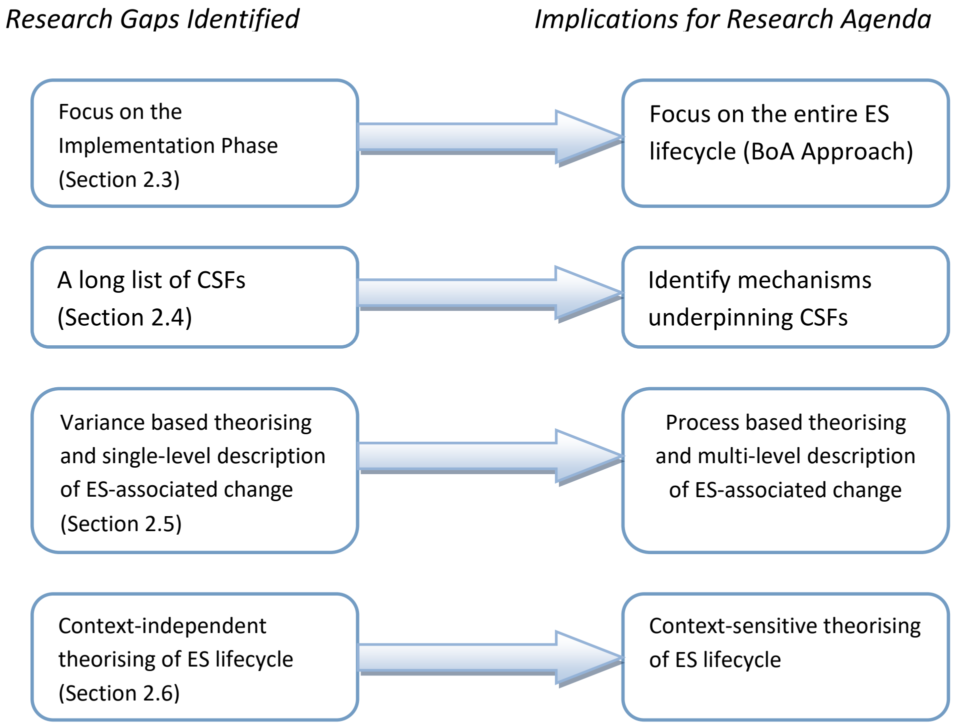


Figure 2.1 Research Gaps and Research Agenda

2.7.1 Moving Beyond the Implementation Phase

Section 2.3 notes that extant ES research is primarily concentrated towards the implementation phase. Although the implementation phase provides an opportunity to understand the interplay between technology affordance and managerial intentions, because of their limited timeframe such studies result in a partial understanding of the ES phenomena. This is due to a tendency of downplaying the influences from other phases or earlier instance of the lifecycle. To counter this tendency, Pollock & Williams (2009) and Williams & Pollock (2012) suggest a Biography of Artefact (BoA) approach to study the ES design and development process. The BoA approach goes beyond the study of technology at a single locale or moment in time, and rather, attempts to follow it through space and time. In this regard, they identify three levels to track the evolution and shaping of the ES – following the biography of an implemented artefact, following the biography of a vendor software system, or, following the biography of the technological field. *This study seeks to move beyond the implementation phase and intends to follow the ES lifecycle in an organisation.* This also allows for 'search for patterns' (Langley & Tsoukas, 2010; Langley et al, 2013; Pettigrew, 1997, 2012) across different instances of the ES lifecycle.

2.7.2 Moving Beyond the Listing of Critical Success Factors

Section 2.4 notes the prevalence of CSF studies in the ES domain and overuse of the term to referring to different variables from the same management area, resulting in a long list of factors. This not only complicates the matter for practitioners, it also results in a situation among researchers where we know too little about too many factors (Martin & Huq, 2007). It is also noted that by and large CSF studies present a static picture of the implementation and ignore the change in nature or importance of typical factors across the ES lifecycle (Shaul & Tauber, 2013). To counter these limitations, McDonagh (2016) suggests moving beyond surface-level pathologies and tracing underlying mechanisms driving these factors across ES lifecycle. This requires tracing the events and outcomes of a technology over time (Baptista et al, 2010; Pettigrew, 1997, 2012). Therefore, *this study seeks to move beyond the list of CSFs and intends to trace the factors through ES lifecycle* and in the process, *seeks to uncover underlying mechanisms.* Instead of being determined by antecedent static conditions (i.e. CSFs) the consequences of the implementation process are conceived as being indeterminate in a mechanism-based analysis, which allows for a potential explanation of a greater variety of outcomes. In this way, rather than providing them with a long list of CSFs, identification of key mechanisms may also prove useful to practitioners.

2.7.3 Outlining the Emergent and Multi-level Nature of ES-mediated Change

Section 2.5 notes that research on IS-mediated organisation change (Markus & Robey, 1988) in general, and ES-mediated organisation change, in particular, is underpinned by a technological imperative, employs variance-based theorising, and generally follows the change at a single level of analysis (usually, organisational or individual). However, it is argued that IS-mediated organisation change usually unfolds in a broader context at multiple levels (Avgerou, 2001; Currie, 2009) and is often a product of both technological imperative and organisational actions (Nandhkumar et al, 2005). In terms of management of change, section 2.5 also identifies the need to undertake change management activity throughout the ES lifecycle, and not just towards the end of the implementation (McDonagh, 2016). Therefore, this research intends to undertake research that incorporates *emergent perspective* (interplay of technological and organisational imperative), focusses on the *process of change* throughout the ES lifecycle, and attends to the outcomes at *multiple levels*.

2.7.4 Exploring the Contextual Nature of ES Lifecycle

Finally, literature review notes that the theorising in mainstream ES literature remains context-independent in the sense that it treats PSOs as just another organisational setting and implicitly assumes that the factors identified for the private organisations are also applicable to the PSO context. However, Section 2.6 notes that implementation context of PSOs also plays a big role in determining the influences and outcomes of the implementation processes. As Howcroft et al (2004) note, the ES implementation process and outcomes are not the same for all types of organisations and there is a need for a context-sensitive perspective (Avgerou, 2001; Currie, 2009) when undertaking ES studies. Therefore, apart from focussing on aspects that are generally associated with ES implementation, this study also intends to pay adequate attention to the *public service context* and seeks to examine the impact of PSO context on the ES lifecycle.

2.7.5 Research Question and Research Model

Based on the literature review and research agenda developed earlier, the research question framed for this study is as below:

What are the key factors and underlying mechanisms that underpin the enterprise systems lifecycle in Irish public service organisations?

The research question builds on the extant literature on factor studies but also seeks to uncover underlying mechanisms that underpin these factors. The focus on lifecycle reflects in the research question as opposed to the dominant focus on the implementation phase. The focus on mechanism also underpins the multi-level and processual nature of the ES lifecycle. Finally, the context is also captured in the research question by focussing on Irish Public Service Organisations.

Capturing all the elements mentioned earlier, research model for the study is depicted as in Figure 2.2. Since the study subscribes to the process-based perspective for ES lifecycle, research models includes *Phase 1* to *Phase n* that cover ES lifecycle. Based on the discussion in Section 2.3, the phases might be – Adoption, Acquisition, Implementation, Use and Maintenance, Evolution, and Retirement (Esteves & Pastor, 1999, 2001). However, the analysis does not try to force-fit the data to the above mentioned phases and considers the phases as they unfolded in the case organisation. First column of the research model includes *Mechanism 1* to *Mechanism m* that underpin the ES lifecycle phases. Each mechanism may belong to a single level or could be a multi-level mechanism. The precise number and level of mechanisms is determined based on the analysis of case data. Finally, each cell within the research model (from the third column to the last column, and second row to the last row) includes a number of factors that are a manifestation of the underlying mechanisms. It may be noted here that the list of CSFs does not remain static and keeps changing from cell to cell.

Mechanism	*Dominant Level*	*Phase 1*	*Phase 2*	*Phase 3*	...	*Phase n*
Mechanism 1	Single or multi-level	CSFs	CSFs	CSFs	...	CSFs
Mechanism 2	Single or multi-level	CSFs	CSFs	CSFs	...	CSFs
: :	: :	: :	: :	: :	: :	: :
Mechanism m	Single or multi-level	CSFs	CSFs	CSFs	...	CSFs

Figure 2.2 Research Model for the Study

2.8 Conclusion

This chapter presents a comprehensive and systematic review of the ES literature primarily drawn from the IS domain. It notes the historical evolution of ES from MRP to ERP and its application in e-Business. It also discusses the design and development of ES packages and notes that by and large, the embedded best practices reflect the techno-managerial assumptions of its designers who conceive the process of organising as a series of procedural steps. It is also noted that in most cases, these assumptions do not represent all the diverse stakeholders and represent the dominant perspective. Since such assumptions are usually drawn from the limited number of organisations with whom the package designers could interact with, quite often the features offered by the ES package need to be customised to suit the needs of the implementing organisation.

Based on a systematic review of ES research in the leading journals for the period 2000-15, it is noted that majority of the research in the ES domain is concentrated towards the implementation phase. Although it also notes the research on other phases, there remains a relative lack of research on ES lifecycle in its entirety. It is also noted that within the implementation research, the majority of research is geared towards the identification of critical success factors. CSF research is conducted in order to assist the practitioner by outlining key areas, but at times it goes too far and focusses on critical ‘variables’ rather than ‘areas’ of action. It is noted that the implementation research needs to embrace a process-based perspective and pay attention to processes and factors operating at multiple levels to uncover underlying mechanisms.

A significant part of ES research relates to ES-mediated organisation change. A major part of this research employs variance based conception, gives preference to technological imperative and confines itself to a single level of analysis. In contrast, recent empirical evidence suggests that ES-mediated organisation change unfolds through a continuous process, involves the interplay of technology affordance and organisational actions, and is associated with the outcomes at multiple levels within and beyond the organisation. It is also identified that organisation change is so deeply entwined with the ES lifecycle that the change management activities need to be undertaken throughout the implementation phase and not just towards the end of the implementation.

Finally, the literature associated with ES implementation in PSOs is also reviewed in order to pay attention to the research context. It is noted that although many of the CSFs identified in the mainstream ES literature are also applicable in the PSO context, the institutional setting of PSOs brings with it some factors unique to the PSOs. Some notable contextual factors are external political considerations, public accountability, resource constraints, and highly regulated and procedure oriented business processes. Even in terms of change management, PSOs throw unique challenges due to their risk-averse culture and due to existence of a relatively inflexible incentive system. At the technological level, it is also noted that PSOs often have diverse and disconnected systems that prohibit organisation-wide integration.

Based on the literature review, a research agenda is developed that stresses the need to move beyond the implementation phase and to cover the complete ES lifecycle, to move beyond the static listing of CSFs to follow their evolution and the identification of underlying mechanisms, the need to trace the processual and emergent nature of change at multiple levels, and the need to pay adequate attention to the implementation context. Based on the research agenda, the research question identified for this study is: *“What are the key factors and underlying mechanisms that underpin the enterprise systems lifecycle in Irish public service organisations?”* The next chapter outlines the underlying research philosophy and the methodology employed to frame and answer this research question.

CHAPTER 3
RESEARCH METHODOLOGY

“A way of seeing is also a way of not seeing.”

- Kenneth Burke (1897-1993), American Literary Theorist

3.1 Introduction

This chapter presents the research methodology that guides this study. The research methodology is influenced both by the research agenda noted in Chapter 2 and the philosophical assumptions of the researcher. Section 3.2 outlines the ontological assumptions on the nature of organisations and those on the role of technology in organisations. Thereafter, the philosophy of critical realism is discussed in Section 3.3 which provides the epistemological basis to this study. Based on the ontological and epistemological assumptions, section 3.4 outlines the theoretical framework for data collection and analysis and assesses the framework against the research agenda developed in Chapter 2. Thereafter, section 3.5 outlines the case research strategy and its relevance to the research question and the research philosophy. Section 3.6 provides the details of the application of research methodology in practice. Finally, section 3.7 concludes the chapter.

3.2 Ontological Assumptions

The word ‘ontology’ is derived from the Greek word ‘ontos’ (being) and ‘logos’ (theory or knowledge). Essentially, it deals with the essence of phenomena and the nature of their existence (Johnson & Duberley, 2000). An ontological question, therefore will be - “*What is the form and nature of reality and, therefore what is there that can be known about it?”* (Guba and Lincoln, 1994, p.108) In answering this question, this section outlines the ontological assumptions underlying this study. At the very least, IS theory development should draw on theoretical perspectives that provide ontological assumptions regarding human action and the relationship between technology and organisation (Avgerou, 2013). Therefore, subsection 3.2.1 discusses the ontological assumptions on the nature of organisations and the process of organising. Thereafter, subsection 3.2.2 discusses the ontological assumptions on the role of the technology in organisations.

3.2.1 Process Ontology of Organisations

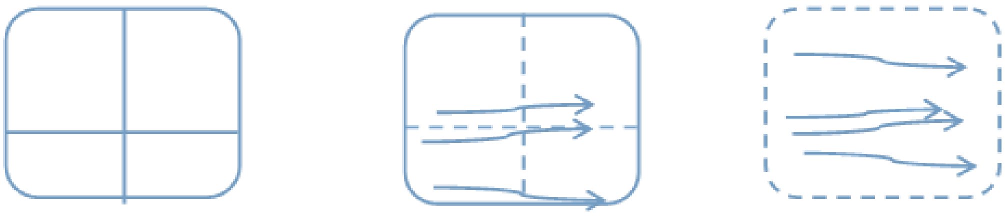
In contrast to the portrayal of organisations as static entities, this research subscribes to the process ontology of organisations. The etymological roots of the word 'process' date back to at least from fourteenth century French, from the word *proces*; meaning journey and directly from Latin, from the past participle stem of procedure - go forward (Hernes, 2008). The essence we can take from its etymological roots is that the process denotes some movement in time. However, how to study this movement in time has been approached in diverse ways. In his highly influential article, Van de Ven (1992) observes three different connotations of the term process. While all three interpretations conceive process as a sequence in some way, there are certain differences among them. The following paragraphs discuss different understandings of the process and define the term as used in this study.

In the first interpretation, Mohr (1982) defines the term process as a sequence of *probabilistic* events. Here, the term process is used in contrast with the variance approach. It is stressed that while variance theory deals with variables only, a process theory deals with discrete states and events. Used in this sense, the process is conceived as a mechanism which changes the value of the dependent variable(s) depending upon the value(s) of the independent variable(s) fed into it, though not with certainty but *with a certain probability* (Mohr, 1982, p. 51). That is why Mohr (1982, p. 55) stresses that if it is a true process model, same input will be capable of leading to more than one outcome. One example of this approach can be found in Mackenzie (2000) where he suggests different process frameworks in the form of Y = F (C) where Y is the set of outcomes, C is the set of considerations (or variables) and F is the network linking considerations with each other and with the outcomes. This interpretation of process is essentially on the line of variance theory which attempts to capture the dynamics by incorporating a set of variables/outcomes instead of using single-valued variables/outcomes. In this manner, there may be some explanation offered, but as Van de Ven & Huber (1990) note, such process explanations typically entail highly restrictive and unrealistic assumptions about the order and sequence in which events unfold in organisations. Secondly, by compressing the reality into a set of quantitative variables, this approach leaves aside the rich details which could be captured by the qualitative approaches.

The second interpretation of the term process defines it as a sequence of *predetermined* events. It is understood as a category of concepts or variables that refers to the actions of individuals or organisations (Van de Ven, 1992). Garvin (1998) refers to this kind of processes as 'work processes'. These processes involve sequences of linked interdependent activities that together transform inputs into outputs. These work processes have beginning and end with the boundaries that can be defined with reasonable precision and minimal overlap. This conception of process is heavily used in the ES literature via the term 'business process'. Examples of this kind of usage include processes such as production processes, order fulfilment processes, and supply chain processes. Used in this sense, a process is essentially conceived as a sequence of activities which produces some determined outcome. The movements like Total Quality Management (TQM) or Business Process Reengineering (BPR) rely on this conception of process for organisational improvement. However, this conception of process explains *what* happens to the outcome if something happens or does not happen in an intermediate stage, but does not explain *how* the transition takes place. In this study, wherever applicable, the term 'business process' has been used to signify this interpretation of process.

Although Weick (1979) did not use the term 'process' per se, his shift from the term 'organisation' to 'organising' underscores the third interpretation of the term process as a *sequence of events that unfold over time*. Essentially, this definition of process takes a historical and developmental perspective and focuses on the sequences of incidents, activities, and stages that unfold over the duration of a central subject's existence (Van de Ven, 1992). This subject may be an organisation, an entity or an individual. In this conception, a process is often equated with a flow or progression. In essence, this interpretation of process is what amounts to 'capturing reality in-flight' (Pettigrew, 1985, 1987, 1997) or 'as-it-happens' (Dawson, 2003a, 2003b, 2012). This study subscribes to this third interpretation of the term process in the context of organisations.

Figure 3.1 represents three different ontological views of the organisations. Figure 3.1(a) represents organisations as a static entity consisting of clear structures. The *weak process view* represented in Figure 3.1(b) treats processes as flows occurring *within* the confines of organisation goals and structures (Tsoukas & Chia, 2002; Chia & Langley, 2004; Hernes, 2008). According to this view, although organisation shapes and is shaped by ongoing processes, it has its own existence apart from processes in terms of actors, rules, routines and structure. Processes can be studied with a weak processual view by focusing on how things change over time (Bizzi & Langley, 2012; Pettigrew, 1997). Alternatively, the s*trong process view* represented in Figure 3.2(c) treats organisation as constituted *by* processes (Tsoukas & Chia, 2002; Chia & Langley, 2004; Hernes, 2008). It assumes organisation as being constantly in flux and always in the state of becoming. In strong processual view, organisational phenomena are not treated as entities but as enactments. The adoption of strong process ontology requires a focus on how continuous and non-deterministic flow of activities reconstitute relatively stable phenomena such as organisation routines or structures (Bizzi & Langley, 2012). Some scholars (e.g. Sminia & Rond, 2012; Paroutis & Pettigrew, 2007) equate the strong process view with the practice lens (Orlikowski, 2007, 2008; Whittington, 2003, 2007) that focuses on the praxis of the practitioners engaged in executing and updating their practices.



(a) Static View of Organisations (*b)* Weak Process View *(c)* Strong Process/Practice View

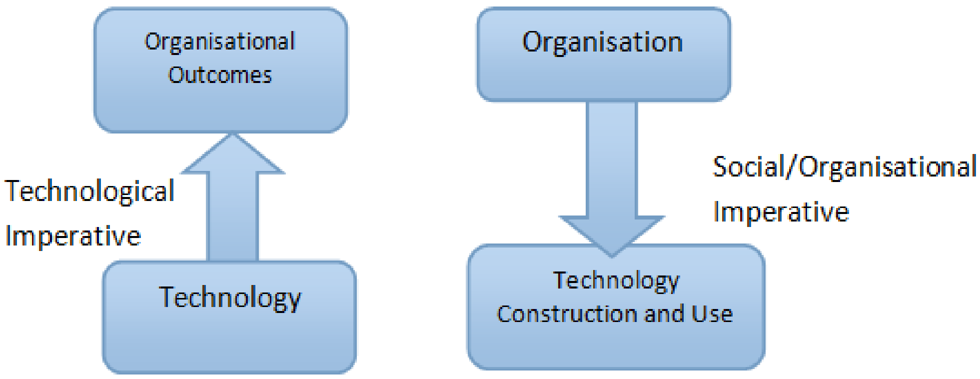
Figure 3.1 Different Ontological Views of Organisations

Bizzi & Langley (2012) note that although the strong perspective is intellectually attractive, it poses pragmatic challenges for researchers since it is assumed that the phenomenon they are studying is constantly in flux. Caldwell (2006) also finds this understanding of process and time ontologically sound but epistemologically vacuous. Taking to its extreme, research based upon strong process ontology will lose its generality since everything will be unique in terms of its context, time and processes. Perhaps that is why while emphasising change and temporal evolution, most scholars engaged in processual research tend to lean towards weak process ontology in order to answer empirical questions (Bizzi & Langley, 2012; Hernes, 2008; Pettigrew 2012; Sminia, 2009). Chia and Langley (2004) also observe that weak processual perspective tends to be pragmatic, empirically grounded, and analytical in orientation. They acknowledge that while the strong perspective enables us to appreciate the *sui generis* nature of the process, the weak perspective helps us more in empirical research. By differentiating between organisation and process, it allows us to focus on the object of change, giving us an anchor around which we can study the process of change. Therefore based on the above considerations, *this study adopts a weak perspective of the process*.

Like the different ontologies of organisation, the role of technology in organisations has been treated differently by scholars. The next subsection outlines and clarifies the ontological position on technology as adopted in this study.

3.2.2 Ontological Assumptions of Technology in Organisations

Scholars (Barley, 1986; Markus & Robey, 1988; Orlikowski, 1992) observe that traditionally there are two contrasting views of technology in organisations (Figure 3.2). In the *technological deterministic view* of technology, technology is considered as a given that has an impact on organisations. Technology is considered as a rigid black box and is immune to manipulation from outside. Organisations are considered to be driven by technological imperatives. Scholars adopting this view study the impact of technology on organisation features such as organisation structure, social relations, skilling/deskilling, managerial control (Barley, 1986; Hall, 2002). Much of the organisation and IS research reflect this orientation (Markus & Robey, 1988; Barley, 1986; Orlikowski & Scott, 2008). In contrast, the *social deterministic view* of technology puts forward an interpretive view of technology which considers technology being open for modification. In this view, technology construction and uses are shaped by social/organisational imperatives (Howcroft et al, 2004a; Walsham, 1993).



(a) Technological Determinism (b) Social Determinism

Figure 3.2 Two Contrasting Views of Technology

However, it is argued here that technology deterministic and social deterministic views have one aspect common in that both ignore the actual features of the technology in use (Orlikowski, 1992). The deterministic view ignores it by treating it as a Black-Box; the interpretive view ignores it by giving social processes primacy and treating technology as completely amenable to modification by social processes. As Avgerou and McGrath (2007) note, all technological activities are ensconced in a social setting, and none of the social processes surrounding IS are devoid of a notion of rationality. Outlining a departure from the two views outlined above, the third view of technology puts social processes and technology on equal footing. There are two major schools in this view – Sociotechnical Systems (STS) school, and Sociomaterial Practice school – which are discussed in the following paragraphs.

Though there were some earlier attempts to provide attention to the technological aspects of organising (e.g. Leavitt, 1964), the STS approach was perhaps the first one to provide explicit attention to the question of technology in organisations. The STS approach views organisation as consisting of two subsystems – the technical subsystem and the social subsystem. While the technical subsystem includes the processes, task and technology needed to transform input to outputs; the social subsystem is concerned with people, relationships, reward systems and authority structure (Bostrom & Heinen, 1977a, 1977b). The STS approach considers technical and social systems as independent and correlative and looks for their joint optimisation. As Trist (1981:24) puts it:

> *"The technical and social systems are independent of each other in the sense that the former follows the laws of natural sciences while the latter follows the laws of the human sciences and is a purposeful system. Yet they are correlative in that one requires the other for the transformation of an input into an output".*

As shown in Figure 3.3 (a), this conception of technology and social being distinct is at the heart of the STS approach which argues for the joint optimisation of these systems. Used in this form, the STS approach is more suitable to explain organisations as systems (Leonardi, 2012).

(a) STS Perspective (b) Sociomaterial Perspective

Figure 3.3 The Social and the Technical/Material

As an alternative conception shown in Figure 3.3 (b), the sociomaterial practice school challenges this separation and advances the view that there is an inherent inseparability/entwinement among the social and the material (Orlikowski & Scott, 2008; Cecez-Kecmanovic et al, 2014). Scholars of sociomateriality often define it as an assemblage (Orlikowski & Scott, 2008; Orlikowski & Iacono, 2001, Cecez-Kecmanovic et al, 2014). This conception rejects the social and material divide and the IS phenomena are understood to be hybrid assemblages (Orlikowski & Iacono, 2001) of the social and the material. Such socio-material configuration/assemblage is understood as a constitutive entanglement that presumes *neither independent nor interdependent* entities. Instead, all entities (whether social or technological, human or material) are considered inseparable. Researchers following the tenets of sociomateriality do not talk about the materiality of technology *per se*, but about the materiality of composite assemblages of technology, people, work, and organising in ongoing intra-action (Cecez-Kecmanovic et al, 2014). Sociomaterial studies shift researchers' attention from issues defined by the social and the material to the questions about these assemblages, how they move, and how they produce sociomaterial outcomes. In this perspective, the social and the material both have agency, but this agency is not known in advance and is only revealed during its practice.

However, Mutch (2013) argues that although the rejection of social-material dualism is attractive from a philosophical standpoint, it is difficult to use the ideas of the sociomaterial practice school to engage with the empirical world. Leonardi (2013) observes that actors in the real world do not perceive the material and the social as interpenetrated entities. Faulkner & Runde (2012) also note the problem in operationalising the empirical constructs based on the thesis of the interpenetration of the material and the social as required by the tenants of sociomateriality. It is difficult for studies based upon such conception to say anything about the process of organising specifically because it focuses on *how* certain actions are performed in practice and ignores the question *why* certain actions occur (Leonardi, 2013), a similar problem which Caldwell (2006) finds in the strong processual view. It is also argued that the application of the sociomaterial practice perspective neglects the broader context in which the practices are situated (Mutch, 2013; Winter et al, 2014).

While Leonardi (2013) calls for a critical realist conception of sociomateriality, IS scholars (Mutch, 2013; Robey et al, 2013; Winter et al, 2014) argue for the merits of reviving the STS approach. They stress that privileging either the social or the technical is not inherent in the STS approach and that STS approach remains capable of including both the social and the technical in explaining organisational stability and change. Consideration of the social and the technical as separate entities allows the researcher to identify how the social and the technical interact to become the sociotechnical and what implications this has for the process of organising. Therefore, in line with the weak process ontology adopted for organisations, *this research subscribes to the ontology of the social and the technical as envisaged in the STS perspective*.

This section outlined the ontological assumptions about the nature of organisations and the role of technology. The next section discusses the philosophy of critical realism which provides the epistemological foundation for this research.

3.3 Epistemological Foundation: Critical Realism

Epistemology may be defined as a set of assumptions about the nature of knowledge and knowledge claims. The epistemological questions will be – "*what is the nature of the relationship between the inquirer and what can be known?*" (Guba and Lincoln, 1994, p.108). To answer this question, this research subscribes to the philosophy of critical realism which is discussed in this section. Subsection 3.3.1 discusses the basic tenets of critical realism. Subsection 3.3.2 establishes its relevance to the ontological assumptions of this research.

3.3.1 Basic Tenets of Critical Realism

The philosophy of critical realism (CR) was developed by Bhaskar (1975) initially for natural sciences and then was extended to social sciences (Bhaskar, 1989). The CR philosophy is *realist* in the sense that it assumes that social and natural reality exists independently of our cognitive structures. For CR, an outside reality exists whether or not human beings can actually gain cognitive access to it (Johnson & Duberley, 2000). This may be a concrete reality (e.g. atmospheric pressure) or an abstract reality (e.g. social pressure), but it exists irrespective of our understanding of it (Maxwell, 2012). However, unlike naive realist ontology of positivism (that reality exists and is completely apprehendable), critical realists acknowledge that it is imperfectly apprehendable due to basically flawed human intellectual capacities and fundamentally intractable nature of phenomena (Burrell & Morgan, 1979). It is considered *critical* since it asserts that claims about reality are to be accepted with the assumption that there are significant limitations of objectivity of our knowledge. This position defends CR against both classical positivism that would reduce the world to that in which everything can be empirically observed and measured, and the various forms of constructivism that would reduce the world to our human knowledge of it (Maxwell, 2012; Mingers, 2004a, 2004b; Mingers et al, 2013).

As shown in Figure 3.4, CR stratifies reality into three nested domains (Bhaskar, 1975, 1989; Collier, 1994; Sayer, 2000, 2010). The domain of the *real* is conceived to independently exist and includes the entities, the structures and the causal powers inherent to them as they independently exist. The structure may be defined as *"a set of internally related elements whose causal powers are emergent from those of their constituents"* (Sayer, 2000: 14). The causal power of structures in referred to as a mechanism in CR. While the structure may sometimes be observable (e.g. the bureaucratic structure), the existence of the mechanisms is usually inferred by the events they produce. The domain of the *actual* is considered a subset of the real and includes the events that occur due to the enactment of the causal powers of structures and entities. These events may or may not be observed by humans. Finally, the domain of the *empirical* is understood to be a subset of the actual and it consists of our experiences via measurement or perception.

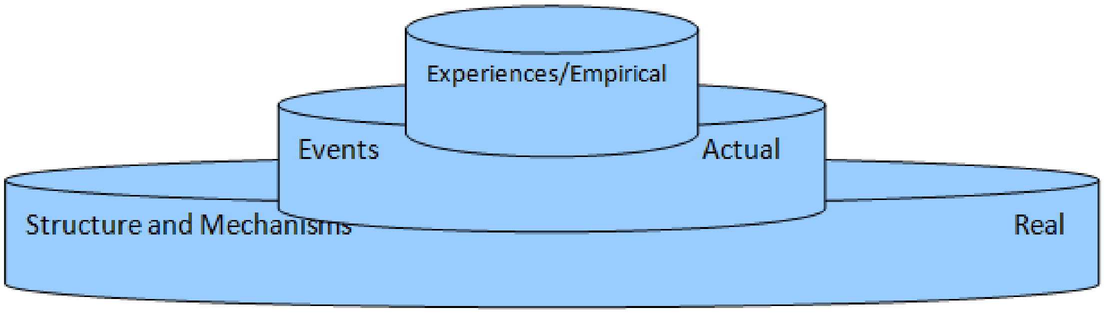


Figure 3.4: Domains of Reality in Critical Realism

The purpose of a critical realist study is to explain a given set of events by uncovering the hypothesised existence of mechanisms which, if they existed and were enacted, could have produced these events (Bhaskar 1975, 1989). In other words, an event will be created by the presence, absence or interaction among certain mechanisms. A CR researcher's goal is to identify the mechanisms that emerge from the components of a physical and social structure to produce the events of interest (Sayer, 2000, 2010). However, each event is not only dependent on the causal powers available within a social structure, but also on the continuously changing contextual conditions and the evolving properties of components within the structure (Wynn & Williams, 2012). The picture of the real is thus one of a complex interaction between dynamic, open, stratified systems, where particular structures give rise to certain generative mechanisms (Mingers et al, 2013). The interaction of these generative mechanisms, where one often counterbalances another, causes the presence or absence of actual events. Therefore, a causal explanation in CR will account for a set of existing and enacted mechanisms, along with the impact of any contextual factors and relevant conditions that generated the outcome being studied.

It may be noted here that the concept of social mechanisms in organisation theory (Coleman, 1964) pre-dates and parallels (Hedström & Swedberg, 1998) the concept of generative mechanism in CR (McGrath, 2013). Similar to critical realism, social mechanisms also became popular in the first decade of the twenty-first century (Anderson et al, 2006; Campbell, 2002; Davis, 2006; Davis & Marquis, 2005) when researchers argued that a focus on mechanisms enables one to move beyond individual variables and their linkages to consider the bigger picture of action in its entirety (Anderson et al, 2006). Social mechanisms are about *“the wheelwork or agency by which an effect is produced. In this way, mechanisms do not merely address what happened but also how it happened”* (Hernes, 1998, p. 74). Within the IS domain, Avgerou (2013) and McGrath (2013) also argue for consideration of social mechanisms in order to explain IS-related phenomena. In this study the term ‘mechanism’ is used avoiding any preference for the prefix ‘generative’ or ‘social’.

Since information systems deal with technology and people, a CR based approach has a strong appeal for IS researchers (Dobson, 2001). Irrespective of the method used, Mingers (2004a, 2004b) and Mingers et al (2013) stress that critical realism is appropriate for IS research since it recognises the existence of a variety of objects of knowledge such as material, conceptual, social, and psychological (Maxwell, 2012). Wynn & Williams (2012) argue that theorists and researchers applying methodological approaches consistent with critical realist paradigm are positioned to provide more detailed causal explanations of a given set of phenomena or events in terms of both the actors’ interpretations and the structures and mechanisms that interact to produce the outcomes in question.

Table 3.1: Epistemological Perspective in IS/ES Research

	IS Research			ES Research	
	Orlikowski & Baroudi (1991)	*Chen & Hirschheim (2004)*	*Present Study[16]*	*Dong et al (2002)*	*Present Study[17]*
Research Period Covered	1983 - 1988	1991 - 2001	2001-2015	1998-2001	2000-2015
Positivist: Theoretically Grounded	72.9%	81%	72.4%	15.91%	50.43%
Positivist: Descriptive	23.9%	-	12.7%	79.55%	25.65%
Interpretive	3.2%	19%	11.3%	2.275	20.43%
Critical	0	0	0.3%	2.27%	2.61%
Critical Realist	0	0	3.1%	0	0.87%

As shown in Table 3.1, both IS and ES research were primarily divided between the positivist and the interpretive epistemology until the end of last century, with the majority of empirical work following the positivist assumptions. The major difference between IS and ES research at the time was that the majority of ES research was descriptive. This is

[16] Based on empirical papers published in *MIS Quarterly* and *Journal of Association of Information Systems* during 2001-2015.
[17] Based on ES related empirical papers published in leading 21 IS journals for the period 2000-2015, as noted in Chapter 2.

understandable since the ES implementation was a relatively new phenomenon at the time. With the advent of the new century, empirical work following interpretive assumptions also started to make its mark in IS and ES research, as evident from Table 3.1. Around the same time, scholars (Dobson, 2001; Mingers, 2004a, 2004b) called for the adoption of critical realist philosophy in the IS domain. As shown in the table this call is taken up by IS researchers in recent years and a number of studies (e.g. Allen et al, 2013; Dobson et al, 2013; Strong et al, 2014; Volkoff & Strong, 2013, Williams & Karahanna, 2013) are conducted using the CR philosophy. Unfortunately, the trend was not followed enthusiastically in the ES literature and only two ES studies from the review basket were found to be subscribing to the CR philosophy. Therefore, there remains a gap in the ES literature in terms of conducting critical realist studies.

3.3.2 Relevance to the Ontological Assumptions

Ackroyd (2012) observes that a study based on the tenets of realism conceives organisations and other social phenomena in terms of the processes that comprise them, and accepts that the research procedures must take account of the processual nature of organisations. He further observes that the formative processes which define a typical sequence of events are a typical explanation in a realist study. It may be noted here that while an observed process as a sequence of events is at the level of the 'empirical', formative processes are at the level of the 'real'. Hence it is the latter, or what Van de Ven & Poole (1992, 1995) call the process motor, which should be taken as the generative mechanism and not the former. Within the processual approach, Sminia (2009) equates Pettigrew's contextualism with the philosophy of critical realism. For example, Pettigrew (1997) stresses that processual analysis involves a quest to find the underlying mechanisms which shape the patterns and outcomes of the observed processes. In a processual analysis, the researcher's repetitive questioning about 'how' embodies this constant search for underlying mechanisms which drive the processes (Pettigrew, 2012).

Pettigrew (1997) and Dawson (2003a, 2003b) argue that the processual approach to inquiry involves both induction and deduction (what critical realists call retroduction) which draws both from our existing theoretical knowledge and the empirical data. A purely inductive approach might seem to do justice to the contextual nature of a process but will most likely result in 'data asphyxiation' (Pettigrew, 1990). Some amount of deduction is believed to help in guiding the researcher through the research without posing too much of a preconceived understanding on the particular course of events (Sminia, 2009). Dawson (2003b: p. 2) particularly stresses that a processual perspective is an inductive-deductive approach which, whilst drawing on our existing body of knowledge in the formulation of research questions and the clarification of concepts, is also data-driven in allowing new insights and conceptual developments to emerge during the collection and analysis of data.

Context, which is considered an inseparable part of a process-based explanation (Pettigrew, 1985, 1987, 1997, 2012; Dawson 1994, 1997, 2003a, 2003b), forms an crucial aspect of the CR philosophy. CR fundamentally accepts that social scientists primarily deal with complex and open social systems and enactment of causal mechanism(s) is subject to contextual conditions (Sayer, 2000, 2010; Wynn & Williams, 2012). A CR based study essentially specifies the mechanisms along with the external conditions in which these mechanisms may be operating (Zachariadis et.al. 2013).

The tenets of CR are also consistent with the STS approach outlined in Section 3.2. Ackroyd & Fleetwood (2000) observe that what prevents critical realists from assuming that the world is merely socially constructed or is concept determined, is a commitment to materialism. For realists, there is always some material substance beneath the concept-dependent nature of social reality (Sayer, 2010). Since CR accepts the existence of different types of objects, it helps in adequately explaining IS phenomena (Maxwell, 2012; Mingers et al, 2013). Social structure and culture are said to be inscribed within the components of IS (Allen et al, 2013) in a way that may help sustain these structural and cultural relations through organisation change (Mutch, 2010). Therefore, a CR based explanation presents a complex and dynamic interaction between the social and the technical. The next section presents the research framework by integrating the processual approach with the STS perspective.

3.4 Research Framework for Data Collection and Analysis

This section discusses the research framework developed based on the ontological and epistemological assumptions presented earlier. Subsection 3.4.1 outlines the research framework which is developed by integrating processual approach with the STS perspective. Subsection 3.4.2 discusses the alignment of research framework with the research agenda developed in Chapter 2.

3.4.1 Integrating Processual Approach with the STS Perspective

The research framework used in this study combines the insights from the process research and the STS approach to guide the data collection and analysis for this study. Within the processual school, perhaps the most influential analytical framework is Pettigrew's context-content-process-outcome (Pettigrew, 1985, 1987, 1992, 1997, 2012). It consists of the following:

Context: For Pettigrew (1997), if the process is a stream of analysis, context is the terrain through which the process flows. It includes the factors that are external and internal to the process (Avgerou, 2001; Caffrey & McDonagh, 2014). External context includes the economic, social, political, and sector environment in which a firm is located, whereas internal context includes subunit level factors such as the structural, cultural and political environment where the process is being observed. It may be noted here that Pettigrew (1985, 1987) stresses that the idea of 'context' is different from the idea of 'environment' propagated by contingency theories in the sense that context is not considered as a fixed backdrop for the change. Rather than allowing or constraining the choice and manoeuvre, context is conceived to be involved in the production of action. Therefore, it is not a matter of context *or* action; rather it is about context *and* action (Pettigrew, 1985, 2012). The context itself is seen as an interactive process rather than a static backdrop of change.

Closely linked to the concept of context is the concept of ***levels***. For Pettigrew (1990), a contextualist analysis of change draws on phenomena at vertical and horizontal levels of analysis and the interconnections between those levels through time. The vertical level refers to the interdependence between higher or lower levels of analysis based upon the phenomenon to be explained; for example, the impact of a changing socio-economic context on features of intra-organisational processes and interest-group behaviour. The horizontal level refers to the sequential interconnectedness among phenomena in historical, present, and the future time. Indeed, studying processes across a number of levels of analysis, which Pettigrew (1997) and Pettigrew et al (2001) refer as *embeddedness*, is one of the guiding assumptions of processual research.

Content: It is related to the substance, scale and scope of change (Pettigrew, 1992, 1997; Pettigrew et al, 2001). In other words, it focuses on the 'what' of change (Caffrey & McDonagh, 2014). However, content does not exist in isolation. For Pettigrew, the content of any strategic change is ultimately a product of a legitimisation process shaped by gross changes in the outer context of the firm and by political and cultural considerations inside the firm, though often expressed in rational/analytical terms (Pettigrew, 1985, 2012).

Process: A process could be defined as a sequence of individual and collective events, actions, and activities unfolding over time in context (Pettigrew, 1997). Essentially, it focuses on the 'how' of change (Caffrey & McDonagh, 2014). Pettigrew (1985, 2012) offers a political and cultural view of the process where the central issues are about the legitimisation and de-legitimisation of ideas. Furthermore, he notes that there is a multiplicity of processes and which processes to choose or leave, would depend upon the allowable complexity of the research (Pettigrew, 1997).

Outcome: Outcome may be defined as an intermediate or a final effect on the process (Pettigrew, 2012). Outcomes include tangible outcomes such as financial and efficiency measures as well as intangible outcomes such as the perception of the eventual success or failure. The explanation of outcomes can be linked to different levels of the external and internal context (Caffrey & McDonagh, 2014). Pettigrew (1992, 1997, 2012) argues quite strongly that consideration of outcome should be incorporated in a processual analysis. He recommends process and outcome studies where there is an explicit attempt is made to explain the determinants of outcome variation in context and process terms.

Extant ES literature often subscribes to a static and monolithic view of ES outcome in terms of success or failure, reflected in the research tradition of critical success/failure factors. However, it is argued here that ES outcomes are multi-dimensional (Markus & Tanis, 2000; Berg, 2001), dynamic (Grenci & Hull, 2004), may not be immediately discernible (Wagner et al, 2010; Berente et al, 2008), and may depend upon the vantage point of the evaluators (Hall, 2002; Scott & Wagner, 2003). Additionally, the ES initiatives are often executed in conjunction with other organisational exercises (e.g. BPR, CRM, or SCM). In such a case, determining the outcome of individual initiatives becomes not only problematic (Hall, 2002) but also results in a 'tunnel vision' (Currie, 1999) of the change initiative. Therefore, this study moves beyond a one-dimensional construct of success and failure and defines ES outcomes as an intermediate or a final effect on the process (Pettigrew, 2012). As discussed in Section 1.3, the outcome in the public service context may include the concept of public value (Moore, 1995; Bozeman, 2007). While there are different ways of 'measuring' the public value, this study makes no explicit attempt to 'measure' the public value of the ES outcomes. Wherever mentioned, the concept of public value is used as the participants understood it.

Pettigrew's framework of context-content-process-outcome has been extensively used to study the process of change (e.g. Kaniadakis, 2012; Leavy, 1991; Lyytinen et al, 2009; Staehr et al, 2012; Walsham, 1993; Walsham & Sahay, 1999; Williams & Hardy, 2005) and is adopted in this study. However, one question that Pettigrew's framework does not categorically answer is how many levels to consider in the study. He notes that the precise choices about how many levels of context to bring into the study are likely to be shaped by the content of the research problem, the research questions driving the study, the availability of relevant data sets, and the ambitions and resources of the researchers engaged in the research process (Pettigrew, 1997; Pettigrew et al, 2001). This is where the STS approach might be useful when studying technology in organisations. Trist (1981: 11) notes that an STS based study should be carried out at three broad levels - from micro to macro - each of which is interrelated (Trist, 1981: 11).

Primary Work-system - are the systems which carry out a specific set of activities in an identifiable and bounded subsystem of an organisation such as a department or a service unit. It may consist of a group of personnel plus the relevant equipment and other resources.

Whole Organisation Systems - could be a plant, a workplace, or a public agency. These systems persist by maintaining a steady state with their environment.

Macrosocial Systems - include systems in communities, industrial sectors, and institutions operating at the overall level of a society.

Trist (1981) further argues that socio-technical phenomena are contextual as well as organisational. Processes operating at the macrosocial level change values and expectations at the organisation systems level, which in turn can change the properties of primary work-system. Conversely, changes in technology may restructure the organisation and in turn, may help in shaping values and expectations at the macrosocial level. Therefore, this study incorporates the three STS levels within Pettigrew's processual framework. By embedding the STS levels within the process inquiry, the research framework allows to contextualise the IT artefact (Currie, 2009; Currie & Swanson, 2009) and to track the events and outcomes of a technology over time (Baptista et al, 2010). Based on the framework, this study attempts to explore the contextual factors at different levels and follows the events and outcomes over time in order to identify underlying mechanisms. Table 3.2 presents the working definitions associated with the research framework.

Table 3.2: Working Definitions for the Research Framework

Macrosocial Level	Communities, industrial sectors, and institutions operating at the overall level of a society (Trist, 1981).
Organisation Level	A sociotechnical system consisting of social and technical elements intertwined in a complex web of mutual causality (Trist, 1981), defined by a formal organisational boundary (Winter et al, 2014).
Work-system Level	Systems which carry out a specific set of activities in an identifiable and bounded subsystem of an organisation such as a department or a service unit and consist of a group of personnel plus the relevant equipment and other resources (Trist, 1981).
Context	A nested arrangement of structures and processes where the subjective interpretations of actors perceiving, learning, and remembering help shape process. (Pettigrew, 1997)
Content	Substance, scale and scope of change (based on Pettigrew, 1992, 1997; Pettigrew et al, 2001)
Process	The sequence of individual and collective events unfolding over time in context. (Pettigrew, 1997)
Outcome	An intermediate or a final effect on the process (Pettigrew, 2012)

3.4.2 Alignment with the Research Agenda

This subsection discusses the alignment of the research framework with the research agenda developed in Chapter 2. The first requirement of the research agenda is *moving beyond the implementation phase* and conducting a study on entire ES lifecycle. Application of processual approach allows the study to move beyond a single implementation study and allows it to capture the ES lifecycle as it unfolded in the research setting. The second requirement of the research agenda is *moving beyond a static listing of CSFs*. While processual approach allows tracing the factors through time, critical realist conception of ES lifecycle drives the researcher towards the identification of underlying mechanisms (Sayer, 2010; McGrath, 2013). The processual framework of Pettigrew (1987, 1997, 2012) also supports the search for patterns across processes in order to identify underlying mechanisms. The third requirement for research agenda is outlining the *emergent and multi-level nature* of ES-mediated change. The STS approach, in particular, speaks to this requirement. By focussing the analysis on the technical and social subsystems, it brings out the emergent nature (Markus & Robey, 1988) of the IS-mediated change. Its consideration of three levels – work-system, organisational, and macrosocial – supports in explaining the multi-level nature of the ES lifecycle. The final requirement of the research agenda is exploring the *contextual nature of ES Lifecycle* in the PSO context. The research framework for this study explicitly incorporates contextual approach of Pettigrew (1985, 1987) that focusses on the internal and external context of change. The next section outlines the case research study.

3.5 Case Research Strategy

Yin (2013: p. 16-17) provides a twofold definition of case research strategy in terms of its *scope* and *features*:

1. A case study is an empirical inquiry that
   a) investigates a contemporary phenomenon (the ‘case’) in depth and within its real world context, especially when
   b) the boundaries between the phenomenon and context may not be clearly evident.
2. A case study inquiry
   a) copes with the technically distinctive situation in which there will be many more variables of interest than data points, and one result
   b) relies on multiple sources of evidence, with data needing to converge on a triangulating fashion, and as another result
   c) benefits from the prior development of theoretical propositions to guide data collection and analysis.

This twofold definition - covering the scope and features of a case study - shows how case study research covers the logic of design, the data collection techniques, and specific approaches to data analysis.

Subsection 3.5.1 justifies the choice of case research strategy for conducting this study. Subsection 3.5.2 outlines the requirements and guidelines for conducting a case study with the critical realist epistemology. Subsections 3.5.3 and 3.5.4 discuss the methods for data collection and analysis respectively. Finally, subsection 3.5.5 discusses ways to ensure the quality of research within the critical realist paradigm.

3.5.1 Choice of Case Research

Yin (2013) provides following three criteria for opting for a case research strategy - type of research question, the degree of control on behavioural events, and focus on contemporary events. A case research in considered appropriate when:

1. the research question is of ‘how’ or ‘why’ type,
2. the researcher has no control over behavioural events, and
3. the research focuses on contemporary events, as against ‘completely’ historical events.

Although the research question[18] for this research is a ‘what’ type question, ‘how’ is embedded in the search for mechanisms (Hernes, 1998). Also, since the constructs for tentative answers to *what* question (such as top management support, change management program) mostly involve qualitative components, it favours for the selection of case research strategy. Secondly, the researcher has no control over events associated with the case. Finally, since part of the phenomena under study is contemporary, case research is favoured as opposed to historical methods. In line with the processual approach, case research strategy enables a phenomenon to be studied over a period of time in context (Farquhar, 2012; George & Bennett, 2005).

Table 3.3 Prevalent Research Methods in IS/ES Research

	IS Research			ES Research	
	Orlikowski & Baroudi (1991)	*Chen & Hirschheim (2004)*	*Present Study[19]*	*Dong et al (2002)*	*Present Study[20]*
Research Period Covered	1983 - 1988	1991 - 2001	2001-2015	1998-2001	2000-2015
Action Research	0.6%	3%	2.4%	-	0.43%
Archival Data Analysis	-	-	18.3%	-	3.04%
Case Study	13.5%	36%	19.9%	20.45%	43.91%
Experiment	29.7%	20%	18.5%	-	0.43%
Mixed Method	3.2%	-	8.4%	-	4.78%
Survey	49.1%	41%	29.1%	13.64%	34.78%
Others	3.8%	-	3.4%	-	13%

Table 3.3 presents the prevalence of different research methods in the IS and the ES research. It may be noted that the throughout the years, the case study method remains the second-most popular method after the survey method in the IS research. Moreover, the case research is a primary research strategy in ES research throughout the years. Case research is the recommended method in process inquiry as well. Indeed, the case study of ICT by Pettigrew (1985) is considered a milestone in process inquiry. Similarly, in the CR tradition, case research strategy is the most preferred method to study the events in organisations (Ackroyd & Fleetwood, 2000; Easton, 2010; Mingers, 2004a, 2004b; Wynn & Williams, 2012; Tsang, 2014) to uncover underlying mechanisms.

[18] What are the key factors and underlying mechanisms that influence the enterprise systems lifecycle in Irish public service organisations?
[19] Based on papers published in MIS Quarterly and Journal of Association of Information Systems during 2001-2015.
[20] Based on ES related empirical papers published in leading 21 IS journals for the period 2000-2015, as noted in Chapter 2.

Pettigrew (1997) outlines three important requirements for case research in processual analysis. First, the researcher should 'search for patterns' in the process and there should be an attempt to compare the shape, character and incidence of this pattern across cases. Second, there should be a quest to find the 'underlying mechanisms' which shape any patterns in the observed processes. The third analytical factor of a processual case study is that inductive pattern recognition should go hand in hand with deduction. Dawson (1997) reminds us that one critical element of processual study centres on building a longitudinal element into the research design. Pettigrew et al (2001) also assert that the only way to reveal the relationship between multiple levels of context in the interaction field is to have a time series sufficiently long to show how firm, sector and economic levels of context interact to influence the change processes. Bizzi & Langley (2012) and Langley et al (2013) underscore the importance of longitudinal data to observe how processes unfold over time. Therefore, this study adopts a longitudinal perspective within the case inquiry.

Different recommendations exist in the process literature for the ideal number of cases. Eisenhardt (1989) and Van de Ven (1992) suggest multiple cases for pattern identification and empirical generalisation. Pettigrew (1992, 1997) and Pettigrew et al (2001) prescribe a matched pair of cases such as cases with similar context but dissimilar outcomes or cases with dissimilar context but similar outcomes. However, Dawson (2003a, 2003b) warns us that the researcher should not equate more case studies with higher-level data and the focus should be on finding rich details. The aim of a case study is not to make predictions about a sample population but to explore a phenomenon in depth (Farquhar, 2012; Yin, 2013; Tsang, 2014). Langley (1999) stresses that the number of cases should be driven by the nature of research question. If the research question aims to provide a holistic understanding of specific events and processes, even one detailed case is deemed sufficient. Similarly, Yin (2013) also suggests adopting a single-case design if the nature of the inquiry is longitudinal. George & Bennett (2005: p. 21) note that a single longitudinal case study may help in examining the operation of causal mechanisms. Single case design allows the researcher to look for many intervening factors and inductively observe any unexpected aspects of the operation of a particular causal mechanism, or to identify the contextual conditions that activate the causal mechanism.

Since this research aims to identify key mechanisms in order to provide a holistic understanding by conducting a longitudinal case study of the ES lifecycle in a public service organisation, a *longitudinal single-case design* is adopted based on the arguments presented above. The next subsection discusses the guidelines for conducting a critical realist case study.

3.5.2 Conducting a Critical Realist Case Study

Easton (2010) argues that CR not only substantiates case research as a research strategy but also provides helpful implications for both theoretical development and research process. Wynn & Williams (2012) also stress that in order to uncover the causal mechanisms and contextual factors, case study research is well-suited for conducting a critical realist study. This is because case research strategy enables researchers to develop detailed context-sensitive causal explanations of specific phenomena. Finally, Tsang (2014) stresses that the case research strategy augurs well with the critical realist view that closure conditions are rarely achievable in the social sciences. Wynn & Williams (2012) propose following five principles for conducting a critical realist case study.

1. Explication of Events

First, a researcher should identify and abstract the events being studied as a foundation for understanding what really happened in the underlying phenomena. Developing a detailed, explicit sequence of events enables subsequent structural and causal analysis. In other words, the events do not form part of the theory but act as tools by which the researcher can develop theories. Thus, by identifying and explicating the events, the foundation is established for identifying the elements of structure and context from which these events emerge, as well as the mechanisms that were enacted accordingly.

2. Explication of Structure and Context

Once the events are identified, the researcher should identify components of the social and the physical structure along with the contextual environment. These relationships should be critically re-described from actor's viewpoint into theoretical perspective. Describing causal tendencies that generate events is central to CR. To understand the source of these tendencies the researcher needs to identify the components of the structure, variations in contextual influences and other potentially activated mechanisms that interact to produce the complex causal chain leading to the phenomena of interest.

3. Retroduction

As a next step, the researcher should identify and elaborate on powers/tendencies of structure that may have interacted to generate explicated events. Retroduction is likely to occur in an iterative manner during data collection and analysis involving corroborating interviews, high-order coding and, process tracing. It is also likely to identify many potential mechanisms at different levels interacting in different ways to produce events being analysed. The objective is to identify the most complete and logically compelling explanation of the observed events given the specific conditions of the contextual environment.

4. Empirical Corroboration

When working on the explanation, a researcher should ensure that proposed mechanisms have causal power and that they have better explanatory power than alternatives. Empirically, CR researchers seek to corroborate the extent to which the causal explanations hold within the context studied (Sayer, 2010) by using the full spectrum of data describing the social structures, conditions, agency, and events. It may also be appropriate to evaluate the explanatory potential of the proposed mechanism based on how actors' perspectives change over time by refining the description of the mechanism based on longitudinal data.

5. Triangulation & Multi-methods

Finally, during the course of case research, a researcher should employ multiple approaches to support causal analysis based on a variety of data types and sources, analytical methods and theories. Yin (2013) also suggests the same for executing a rich case study. The next subsection further elaborates on this point.

3.5.3 Collecting Data in Case Research

Langley (1999) mentions four properties of process data: (1) they deal with the sequence of events, (2) they often involve multiple levels and units of analysis, (3) their temporal embeddedness often varies in terms of precision, and (4) despite the primary focus on events, process data tend to be eclectic. Langley et al (2013) remind us that in process inquiry, the researcher has to be careful that data collection is truly multi-method (i.e. paying equal attention to all sources of evidence) and not primarily uni-method (i.e. semi-structured interview with a little bit of backup from other methods). Following Yin (2013, p. 106), Table 3.4 presents sources of evidence normally used in case research, along with their respective strengths and weaknesses. For a rich case study, Yin (2013, p. 118) suggests multiple sources of evidence. Triangulation through multiple methods and multiple sources is considered a hallmark of a good case study. Use of multiple methods and multiple sources of evidence is also stressed for the correct explication of events in a critical realist study (Mingers et al, 2013; Wynn & Williams, 2012; Zachariadis et al, 2013). Proponents of process inquiry (Pettigrew, 1990, 1992, 1997; Dawson, 1994, 1997) also recommend multi-method data collection, especially focussing on data across levels and over time. Consequently, this case has attempted to use all the data collection methods outlined in the table, except participant observation.

Table 3.4: Sources of Evidence for Case Research

Source of Evidence	**Strength**	**Weakness**
Documentation	Stable: can be reviewed repeatedly Unobtrusive: not just created as a result of the study Specific: can contain exact names, references and details of an event. Broad: can cover a long span of time, many events and many settings.	Retrievability: can be difficult to find Biased Selectivity: if collection is incomplete Reporting Bias: reflects (unknown) bias of any given document's author Access: may be deliberately withheld
Archival Records	[Same as those for Documentation] Precise and usually quantitative	[Same as those for Documentation] Accessibility due to privacy reasons
Interviews	Targeted: focuses directly on case study topics Insightful: provides explanation as well as personal views (e.g. Perceptions, attitudes, and meanings)	Bias due to poorly articulated questions Response bias Inaccuracies due to poor recall Reflexivity: interviewee gives what interviewer wants to hear.
Direct Observations	Immediacy: covers action in real time Contextual: can cover the case's context	Time-consuming Selectivity: broad coverage difficult without a team of observers Reflexivity: actors may proceed differently because they are being observed. Cost: hours needed by a human observer.
Participant-Observation	[same as those for direct observation] Insightful into interpersonal behaviour and motives	[same as those for direct observation] Bias due to participant-observer's manipulation of events
Physical Artefacts	Insightful into cultural features Insightful into technical operations	Selectivity Availability

3.5.4 Conducting Processual Analysis

Pettigrew (1997) offers five guiding assumptions for conducting a processual analysis which are also reflected when Pettigrew et al (2001) outline key challenges for research on organisation change. These assumptions are outlined in the following paragraphs.

1. *Embeddedness:* The events are embedded in their outer and inner context. There are different processes operating at different levels as well as there are multiple processes operating at the same level. Consequently, the source of change is often asymmetry between the contexts and entwinement of the processes operating at different levels. Therefore, it is suggested that any study of change should be conducted across different levels of analysis.
2. *Temporal Inter-connectedness*: Understanding the sequence of events over time is a crucial requirement for a process scholar. Antecedent contextual conditions have an impact on the process unfolding at present, and process unfolding presently will affect the future outcomes. As Dawson (2003b, p 10) puts it, *"the process of change is continuously influenced by the interplay and conflict between historical reconstructions, current contextual conditions, and future expectations"*.
3. *The role of Context and Action*: Pettigrew (1997) reminds us that context is not just a stimulus environment but a nested arrangement of structures and processes where the actions of the actors help shape the process and in turn actor's actions are also shaped by unfolding processes. Thus, he argues that organisational processes are both constrained by features of the context (such as organisation culture or availability of resources) and also shape the contexts by, for example, preserving or altering power relations. Therefore, it is not about the supremacy of the context *or* action. Rather it is about the context *and* action (Pettigrew 1985, 1987, 1997, 2012) mutually interacting in creating an outcome.
4. *Holistic Explanation of Processes*: In the processual analysis, the researcher looks for a holistic explanation of processes rather merely providing a linear narrative. This is where a processual case study differs from case histories. Secondly, the explanation should not be limited to patterns recognition but should also look for underlying mechanisms which drive those patterns. This holistic explanation requires data over a length of time and across levels and involves both induction and deduction (Pettigrew, 1997).
5. *The Linkage with Outcomes*: Pettigrew (1997) argues that the ambition of a process scholar should not just be about the recognition of patterns or explaining the mechanism; ultimately s/he should be able to link the analysis to the outcomes of the process under investigation. Pettigrew (2012) identifies that one of the major limitations of much of the process research has been the failure to conduct empirical studies which link changes in context and process to outcomes. However, he also reminds us that since all outcome variables are contestable, the researcher has to be extremely clear about the choice and rationale for outcome under investigation.

Moving further, Langley (1999) describes seven different strategies (which could be used in isolation or in combination) to analyse the process data. These are:

1. *Narrative* – This strategy involves the construction of a detailed story from the raw data. The researchers who use this strategy avoid excessive data reduction and try to present as completely as possible the different viewpoints on the process studied. The generalisability comes from the detailed description of the process.
2. *Quantification* – It is just opposite of the narrative strategy. In this approach, researchers start with in-depth process data and then systematically list and code qualitative events as per predetermined protocol. Thereby, they reduce the mess of data into quantitative time series which then could be analysed using statistical methods.
3. *Alternative templates* – In this strategy, researchers analyse the same set of events with different theoretical perspectives and then assess to what extent each theory explain the process. It is assumed that taken together, all these explanations provide a complete and comprehensive picture of the process.
4. *Grounded theory* – Originally developed by Glaser and Strauss (1967), grounded theory is a systematic approach for inductive theorising. Although different variants of grounded theory methodology evolved after it was originally proposed, it is essentially a set of structured steps to develop categories and concepts from raw data after successive cycles of refinement.
5. *Visual mapping* – This strategy represents process data in the form of visuals and then derives patterns from the visual. Langley (1999) stresses that visual graphical representations allow for the simultaneous representations of a large number of dimensions and they can easily be used to show precedence, parallel processes and the passage of time.
6. *Temporal bracketing* – In this strategy, events are divided into successive adjacent time periods which allows examination of how actions of one period lead to changes in the context that will affect action in the subsequent period. It also permits the constitution of comparative units for analysis for the process.
7. *Synthetic* – In this strategy, the original process data are transformed from stories composed of ‘events’ to ‘variables’ that synthesise their critical components. These variables are then used to predict the outcome. This strategy is close to Mohr’s (1982) concept of process analysis which is interested more in coming up with accurate prediction than providing a holistic explanation.

This study uses a combination of temporal bracketing, narrative and a grounded theory *type* coding for analysis. More details about the analysis are provided in Section 3.6.

As discussed earlier, critical realists try to arrive at underlying mechanisms through *retroductive logic*. Researchers are likely to engage in retroductive inference iteratively during the stages of data collection, coding, and analysis (Tsang, 2014). This is a combination of both *inductive logic* (where you start from empirical data and then arrive at a conclusion, mostly followed in constructivism) and *deductive logic* (where you start from theoretical premises and then check with empirical data if the conclusions are correct, mostly followed in positivism). It is more iterative and creative in nature; the researcher moves back and forth between the data and explanation and across the levels of the empirical, the actual and the real. As Johnson & Duberley (2000) note, retroduction moves from a description of a phenomenon to a description of a mechanism and structure which either produces the given phenomenon or is a condition for it. Through an iterative process, a researcher improves the understanding of those mechanisms (Volkof & Strong, 2013). This also fits well with what Yin (2013, p. 147) calls the strategy of explanation building for analysing case study evidence which involves series of iterations to achieve theoretical coherence and greater explanation.

3.5.5 Ensuring Research Quality

Scholars from different epistemological perspectives use different terms to denote the criteria to ensure the research quality. Yin (2013, p. 45-49) discusses four criteria which may be understood as being primarily applicable to positivist case studies – construct validity, internal validity, external validity, and reliability. Lincoln & Guba (1985) propose four criteria to ensure the quality of interpretive case studies – credibility, transferability, dependability, and confirmability. Essentially, both sets of criteria are in the form of checks applied on the *methods* of data collection and analysis to ensure the quality of the research. However, the realist approach to validity pertains not to the method, but to the accounts and conclusions reached by using a particular method in a particular context for a particular purpose (Maxwell, 1992, Porter, 2007). A realist approach to validity is seen not in relation to the procedures, but in the relationship of an explanation to those things that it is intended to be an account of. Therefore, this study relies on the four criteria proposed by Maxwell (2012, p. 127-148) for CR based studies.

1. Descriptive Validity

Descriptive validity relates to the factual accuracy of the description of the research. It involves ensuring that the study reports the activities without referring to any theory. Therefore, the description is based on data on which inter-subjective agreement could in principle be achieved. The focus here is on describing the events rather than attributing any cause to them. As Wolcott (2009, p. 27) notes - *"description provides the foundation upon which qualitative research rests."*

2. Interpretive Validity

The issue of interpretive validity arises when the researcher moves from the description to the interpretation of actor's perspectives. Maxwell (2012) notes that, since mental phenomena cannot be directly observed, the act of interpretation relies on the meanings expressed by the participants. In this sense, ensuring interpretive validity involves possibly including all the different perspectives expressed by the participants, even if they are divergent (Miles et al, 2013). Here, care should be taken in representing participants' interpretation, rather than bringing in researcher's own interpretation *without* acknowledging it.

3. Theoretical Validity

Theoretical validity goes beyond description and interpretation and explicitly addresses the theoretical perspectives that the researcher brings to the study. The theory may refer to physical events or mental construction, but theoretical validity primarily refers to an account's function as an *explanation*, apart from a description or an interpretation. Ensuring theoretical validity requires that the theoretical concepts and their relationships expressed in the study bear a consensus within the community concerned with the research.

4. Generalisability

Generalisability in case research does not take the form of statistical generalisation from the sample to the population but takes the form of theoretical propositions that could be used to explain another set of events outside the case (Yin, 2013; Farquhar, 2012; Tsang, 2014). In this context, Maxwell (1992, 2012) stresses that compared to external generalisability, internal generalisability is more important for the qualitative researchers in the sense that the findings should be generalisable within the case to persons or events that were not directly observed or interviewed.

Section 3.6 outlines how these four criteria were ensured when applying the research methodology in practice.

3.6 Applying the Research Methodology

This section outlines the application of the research methodology as it unfolded. As shown in Figure 3.5, it consists of five phases. In each phase, certain measures were taken to ensure the different types of validity discussed earlier. The first phase was case selection and negotiating access. The second phase was the collection of primary and secondary data. This required ensuring internal generalisability and interpretive validity in order to appropriately understand the participants' perspectives. Once data collection was completed, a case narrative was written based on the evidence collected. This required ensuring descriptive validity in order to comprehensively present the sequence of events without any effort to any theorising or value-judgements. The next phase was coding and analysis of the collected data. Finally, the last phase was explanation building in the form of a theoretical framework. It may be noted that last two phases were iterative in nature and informed each other in order to ensure theoretical validity and to increase theoretical generalisability. Details of each phase are provided in the following subsections.

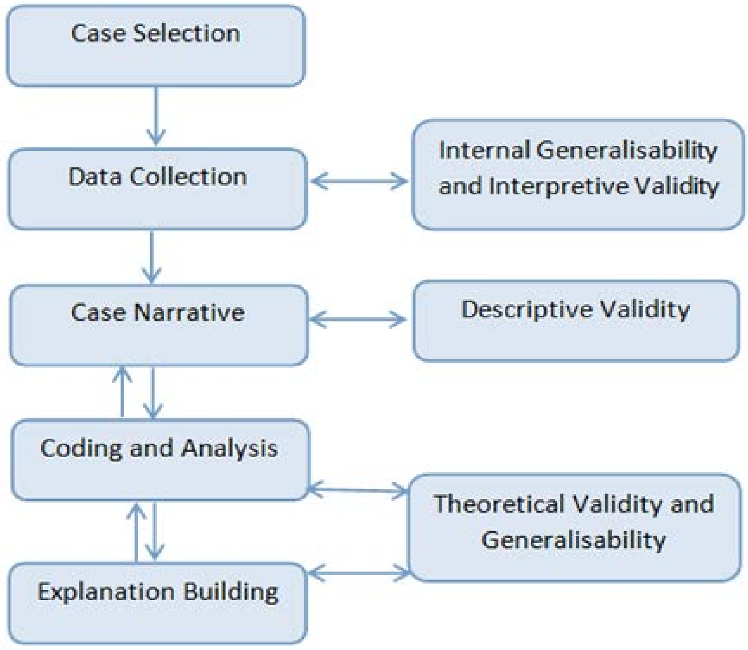


Figure 3.5: Application of Research Methodology

3.6.1 Selecting the Case

As shown in Figure 3.6, the case selection was executed in three stages. In the first stage, the case selection criteria were determined in relation to the research question. In the second stage, candidate cases satisfying the criteria were contacted. The final case was selected based on mutual agreement with the case organisation and was based on the suitability of the case to answer the research question.

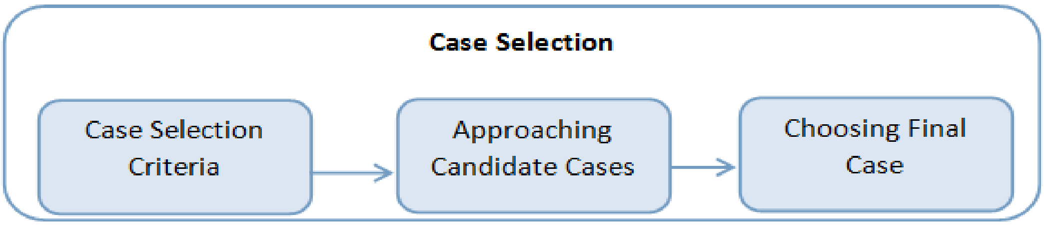


Figure 3.6: Stages of Case Selection Phase

In light of the research question posed, the following were the **case selection criteria** for this research:

1. The case study organisation must be a public service organisation.
2. The organisation should be historically and presently engaged in ES implementation. This criterion allows for both retrospective and real-time data collection.
3. The implementation should be formally planned with a clearly defined scope, project plan, responsibilities and outcomes.
4. The technical and business documentation associated with the implementation process should be available.
5. The organisation must be ready to share information associated with the implementation process and participants must be willing to be interviewed.

Subsequently, to **approach the cases**, communication was initiated with potential case sites fulfilling the above-mentioned criteria in January 2015. After a series of communication over e-mails and exploratory engagements with three different public service organisations, there was a meeting of minds with the Irish Blood Transfusion Services (IBTS). Upon advice from the Chief Executive of IBTS, the researcher met with the project sponsor and the project manager of the latest ES initiative in Feb 2015. The meeting was used to understand the project status and to explain the research objectives. It was understood that since the year 2000, IBTS engaged in three different ES implementation exercises coupled with some improvement projects. IBTS implemented a system called Progesa during 2000-2003. Thereafter, it engaged in implementing a web-based version of Progesa called eProgesa which was abandoned in 2007. Finally, for the period 2013-16, IBTS was implementing a product suite to integrate its blood operations with other activities of the organisation. It was agreed that the objective and the timing of the research would be mutually beneficial, resulting in the **selection** of IBTS as the case study organisation.

3.6.2 Collecting the Data

As shown in Figure 3.7, the data collection phase for the case was executed in three steps. Data collection started with the secondary data collection from outside and within IBTS. Subsequently, it moved to primary data collection mainly via in-depth qualitative interviews. Finally, there was follow-up data collection mainly for the triangulation purpose.

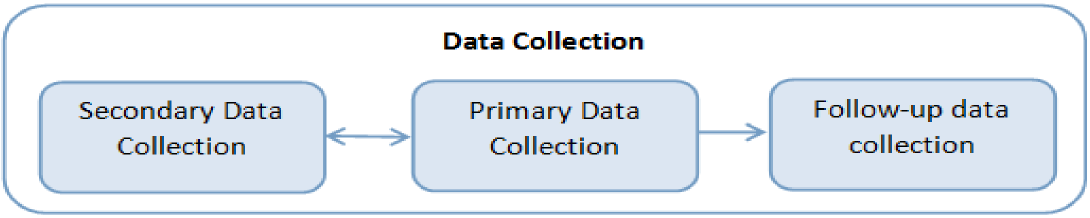


Figure 3.7: Stages of Data Collection Phase

In the first stage, **secondary data** associated with the ES lifecycle in IBTS was collected from and outside IBTS. After the first meeting in February 2015, the researcher prepared a case protocol (Appendix-2) which was shared and agreed with the project sponsor and the project manager during first part of March 2015. At the end of March, the researcher met with the project manager to have an overall view of the project and to collect the associated documentation. During April-June 2015, apart from the documentation provided by IBTS, the documentary evidence associated with IBTS (related to ES initiative as well as contextual factors) was also collected from other sources. This involved both documentation made publicly available by IBTS (e.g. Annual Reports, Board meeting minutes and strategic plans) as well as the archival data from other public agencies (e.g. reports from Comptroller and Auditor General of Ireland, debates of Committee of Public Accounts and reports by various commissions). Appendix-3 lists the secondary data collected for this research. Analysis of the documents served three purposes. First, it enabled the researcher to arrive at a chronology of events. Second, it guided the researcher towards the identification of key actors who would be interview participants. Finally, it sensitised the researcher towards certain aspects around which interview questions could be framed. Overall, the secondary data analysis provided a scaffolding to the primary data collection, which was the second stage of data collection phase.

The **primary data collection** strategy mainly consisted of in-depth qualitative interviews with the participants who were identified based on the secondary documents. To ensure *internal generalisation*, the participants included participants from IBTS management, implementation team, and IBTS user groups. Furthermore, participants were also asked during the interviews if they would like to recommend any key actor to be interviewed. Interviews were conducted during July-December 2015 in IBTS premises. At the beginning of primary data collection, an e-mail was sent by the IBTS Chief Executive to the identified participants informing them about the research. Thereafter, it was the responsibility of the researcher to individually contact the participants and to schedule the interview. Once the interviews were scheduled, a day before the interview the researcher sent the participants an e-mail in a standard template (Appendix-4) informing them about the purpose of the research and nature of the interview. The e-mail also included an ethical statement (Appendix-5) stressing the voluntary nature of the interview and rights of the participants. The participants were provided with a printed copy of the ethical statement before the start of the interview.

For conducting the interviews, the responsive interviewing model suggested by Rubin & Rubin (2012) was used. In responsive interviewing, the researcher generally starts with an open-ended question and devises additional questions depending on the emerging details. In executing this model interviewees were first asked about their background, experience, responsibilities in IBTS and then subsequent questions were formed based on their response. Following the responsive interview technique, each interview was customised based on what the individual interviewees were expected to know. For instance, the participants from the Finance division were asked about the interface of their system with the core module rather than specific implementation details of the core module. In this way, responsive interviewing emphasised searching for context and richness while accepting the complexity and ambiguity of real life. To ensure *interpretive validity*, the researcher's focus was on understanding the meanings expressed by the participants rather than imposing his own world-view on them.

Table 3.5 presents the interview participant's profile. To increase internal generalisation, care was taken to balance the affiliation in terms of top management team, IT team and user groups. In total, 24 interviews were conducted with 25 participants (one interview had two participants) which amounted to total 1,312 minutes averaging 54.6 minutes per interview. All but three interviews were recorded and transcribed verbatim by the researcher. For the three interviews for which recording was not permitted, detailed notes were taken and the interview was transcribed on the same day based on the notes and memory. Fortunately, at the same time, the major module of the ES suite was being implemented which enabled corroboration of the participant's responses to ongoing events.

Table 3.5 Interview Participants' Profile

Participant's Primary Affiliation	**No. of Participants Interviewed**
Top Management Team	6
IT Team (including Project Manager and Superusers)	8
User Groups	11
TOTAL	25

The final stage of data collection was **follow-up data collection** which was conducted post go-live of the core module of ES suite. This involved repeat interviews with three key actors (Project Sponsor, Project Manager, and IT Manager) and meetings with the users of the system in three hospitals to represent the views of ultimate end-users of the product. The follow-up interviews with the key actors focussed on the clarification of emerging themes during the earlier stage and explored the participants' evaluation of the new system. The follow-up meetings with the hospital users focussed on assessing the impact of change on their systems.

3.6.3 Writing Case Narrative

As shown in Figure 3.8, this phase consisted of two main stages as recommended by Wynn & Williams (2012) for a critical realist case study - explication of events, and explication of structure and context. Once all of the data was collected, a descriptive case narrative was written describing the events, structure and context. The narrative was in the form of process tracing (George & Bennett, 2005, p. 210) which was highly specific to the case and did not make any explicit use of the theory. Essentially, the narrative focussed on providing 'pure' description (Walcott, 2009, p. 27-29) trying to present the events as they unfolded without any efforts to analyse so that richness of the case is not compromised. This also helped in ensuring the *descriptive validity* of the narrative.

The strategy of temporal bracketing was used in the case narrative (Langley, 1999). For this purpose, the key events at all three levels (macrosocial, organisation, and work-system) were identified across the timeline (2000-15). Subsequently, the event-sequence and the interconnections were narrated in detail based on the primary and secondary data. Following STS perspective, there was an effort of focus on both the social and the technical aspects of the exercise. This helped in presenting a holistic picture of the ES initiatives in IBTS. The case narrative is presented in Chapter-4.

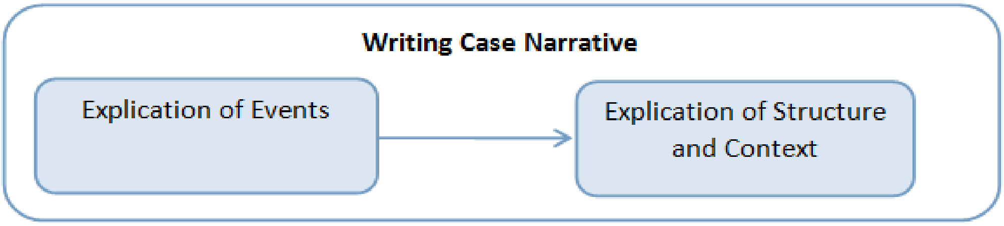


Figure 3.8: Writing Case Narrative

3.6.4 Coding and Analysis / Explanation Building

As shown in Figure 3.9, this study followed a three-stage process (Farquahar, 2012; Miles et al, 2013; Saldaña, 2013) for coding and analysis. It started with the first-order coding based on the data and corresponded to the *inductive* phase of the analysis. Second-order coding started with the first-order codes and corresponded to the *deductive* phase of the analysis since many second-order codes were drawn from the CSF literature. The final stage focussed on the identification of underlying mechanisms and theory development. The coding software used for this purpose was *QDA Miner Lite*. As indicated in Figure 3.9, being part of an abductive analysis, the coding procedure was not unidirectional and these codes were subject to revision, merger or deletion based on the emerging understanding of the researcher about the constructs (Miles et al, 2013; Saldaña, 2013). The final coding tree is included in Appendix-6.

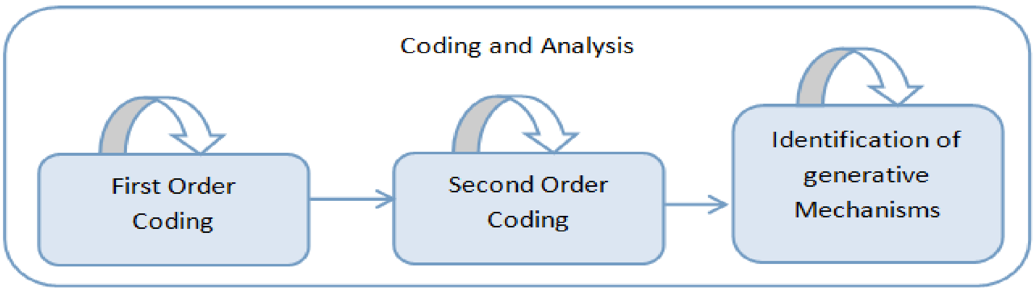
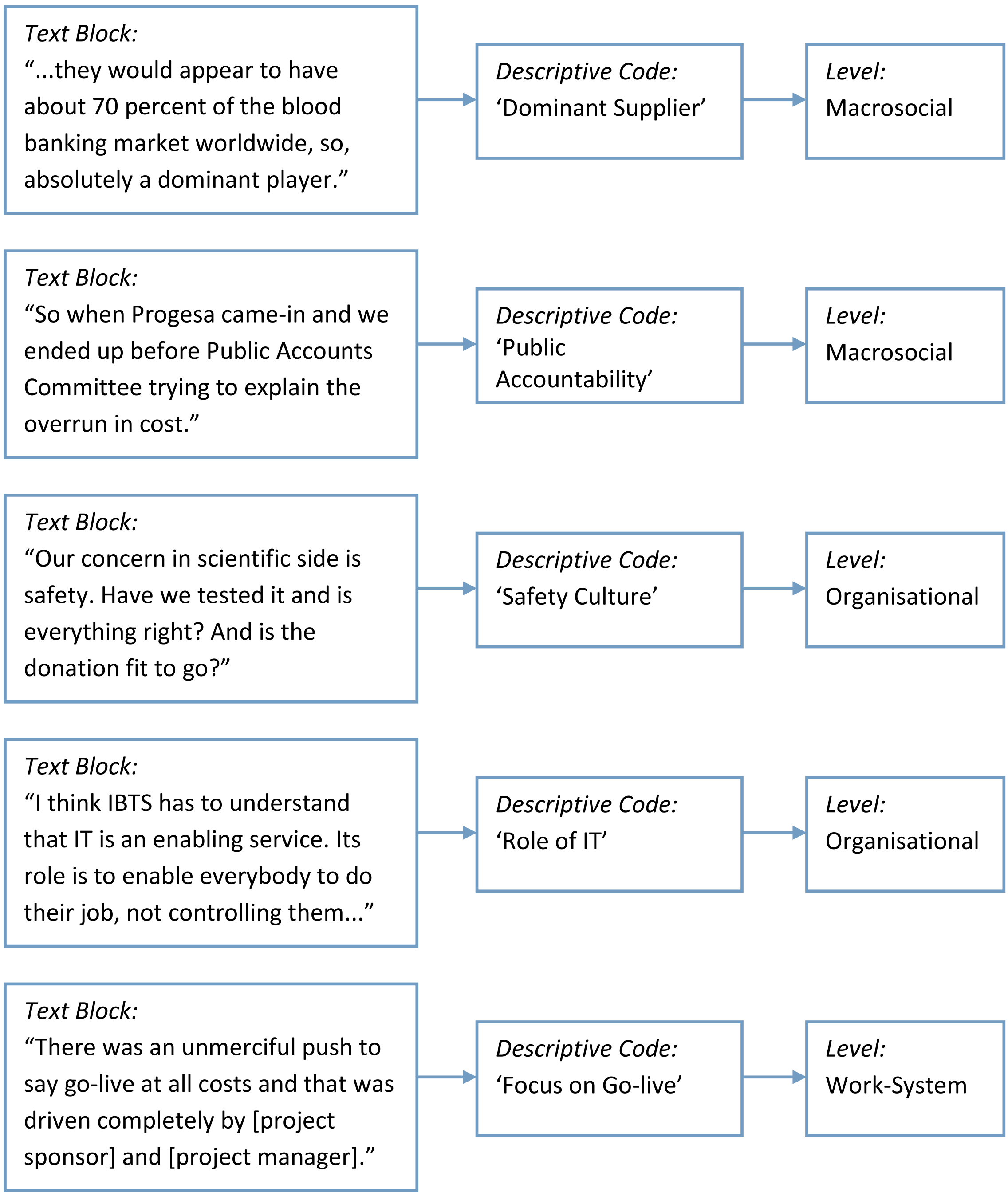


Figure 3.9: Stages of Coding and Analysis Phase

The coding process started with the **first-order coding** in which codes were assigned directly to the chunk of data. As suggested by Miles et al (2013), this chunk of data was of varying lengths depending on the richness of the data and its context. All the interview transcripts and relevant secondary data were coded in this stage. First-order coding made use of three types of coding described in Saldaña (2013) – descriptive coding, process coding, and nested coding. While *descriptive coding* summarised the chunk of text in a word or short phrase – usually a noun, *process coding* used gerunds ("-ing" words) to emphasise action. Care was taken to remain true to the data and not to force any specific choice. Once a block of text was assigned a code, the *nested coding* process was used to preserve the contextual and multilevel nature of the data. Here, all the descriptive and process codes were assigned to one of the levels as recommended in STS framework (discussed in Section 3.4.1) – macrosocial, organisation, or the work-system level. The level of the code was determined by the entities/events being discussed in the text and how they aligned with the definitions provided by Trist (1981). Figure 3.10 depicts two examples from each level to depict the first-order coding process.



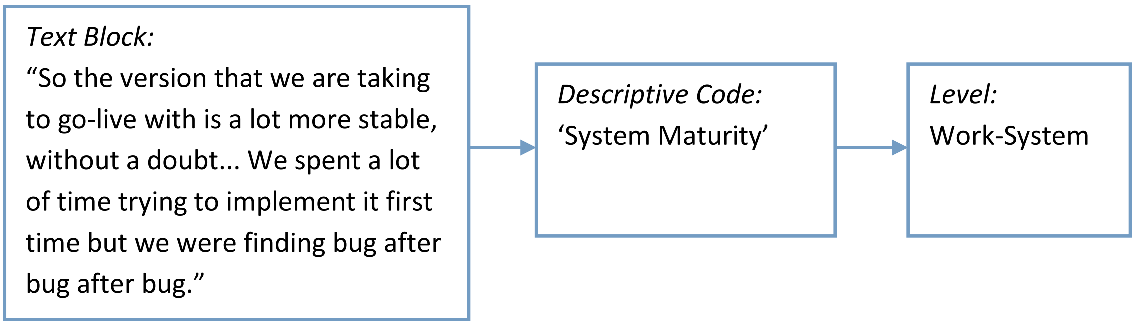


Figure 3.10 First-Order Coding and Assigning STS Levels

Figure 3.11 presents a screenshot of the software during the first-order coding process. This process resulted in total 153 codes across three levels. These codes are outlined in the second column of the coding tree (Appendix-6) with their associated STS level in the first column.

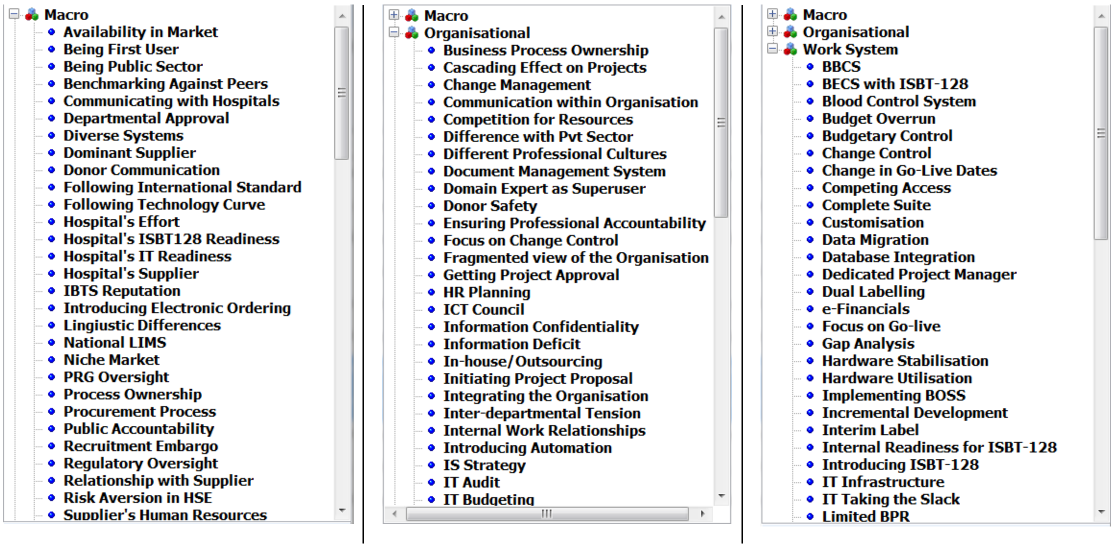
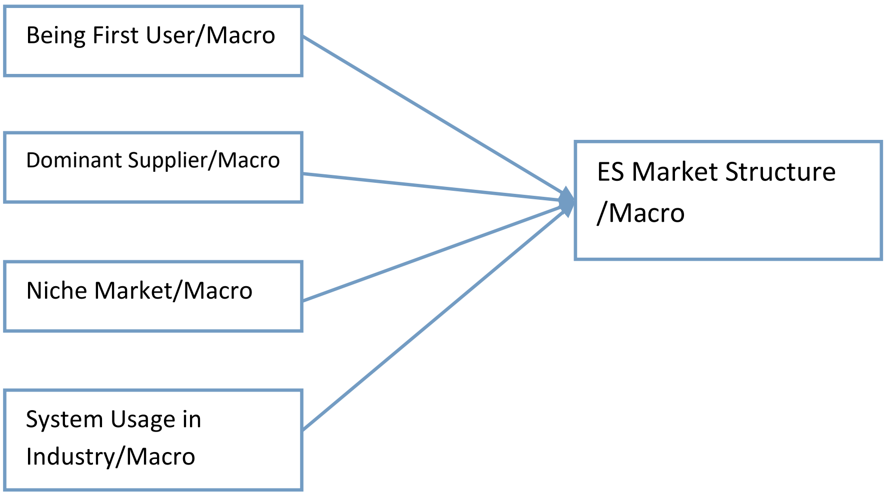


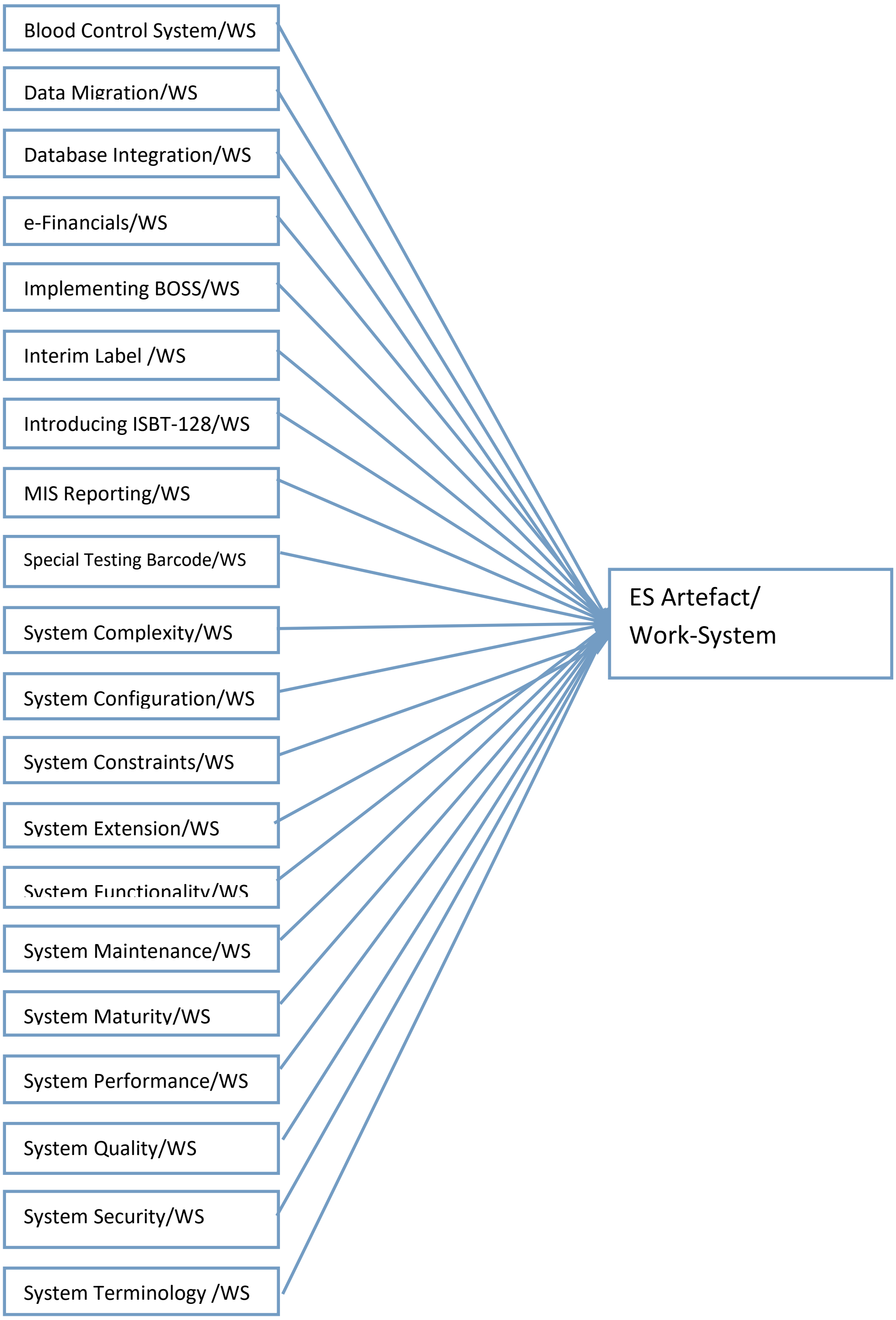
Figure 3.11 First-Order Coding Screenshot

Once all the data was coded in the form of first-order codes, the next step was the **second-order coding** in which first order codes were grouped based on their similarity. During this whole exercise, the level of the original codes was maintained, thereby assigning levels to second-order codes as well. Second order codes resulted in 29 codes across three levels. While the nomenclature of the second-order codes was determined based on the underlying first-order codes, *in most cases the second-order codes reflected the critical success factors* discussed in Chapter 2. Figure 3.12 depicts the second-order coding process using an example from each level.



(a) An Example of Second-order Coding at Macro Level

(b) An Example of Second-order Coding at Organisational Level

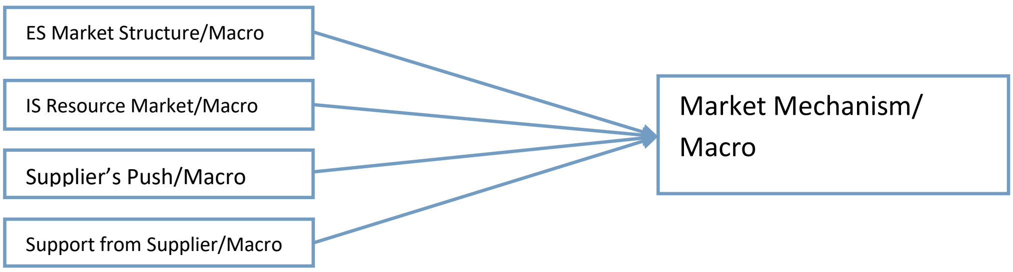


(c) An Example of Second-order Coding at Work-System Level

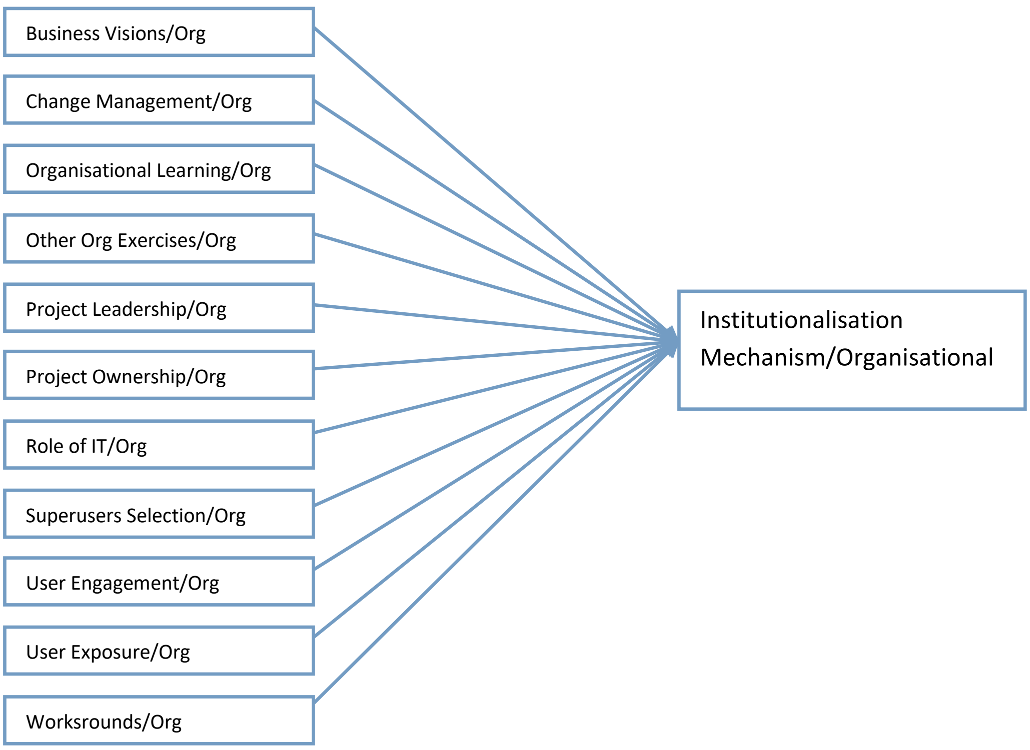
Figure 3.12 Second-order Coding Examples

The second-order codes are included in the third column of the coding tree (Appendix-6) with the corresponding first order codes in the first column. At this stage, case narrative and transcripts were again analysed to 'search for patterns' (Pettigrew, 1997, 2012) in order to associate second order codes with specific phase(s). The phases were found to be mirroring ES lifecycle framework by Esteves & Pastor (1999, 2001). Appendix-7 presents the second order codes as they relate to specific phase and associated evidence in the form of quotations.

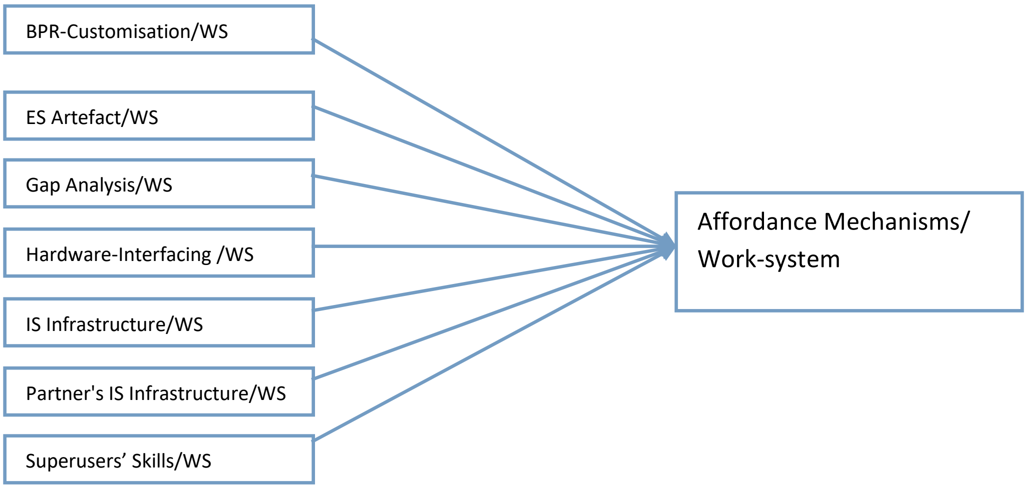
Finally, the last stage of the analysis and coding was the **identification of underlying mechanisms** operating across the phases of the ES lifecycle. Again, this was not a straightforward process but rather a dialectic process of abductive reasoning involving method and creativity (Klag & Langley, 2013). In practice, this involved looking for commonality among the second order codes within and across levels, going back to the literature in search of mechanisms that could explain this commonality, and developing an explanation of events under consideration. Many candidate mechanisms were considered before finally arriving at four underlying mechanisms that form the building blocks of the theoretical framework presented in Chapter 5. Figure 3.13 shows the key mechanisms identified and associated second order codes with corresponding levels.



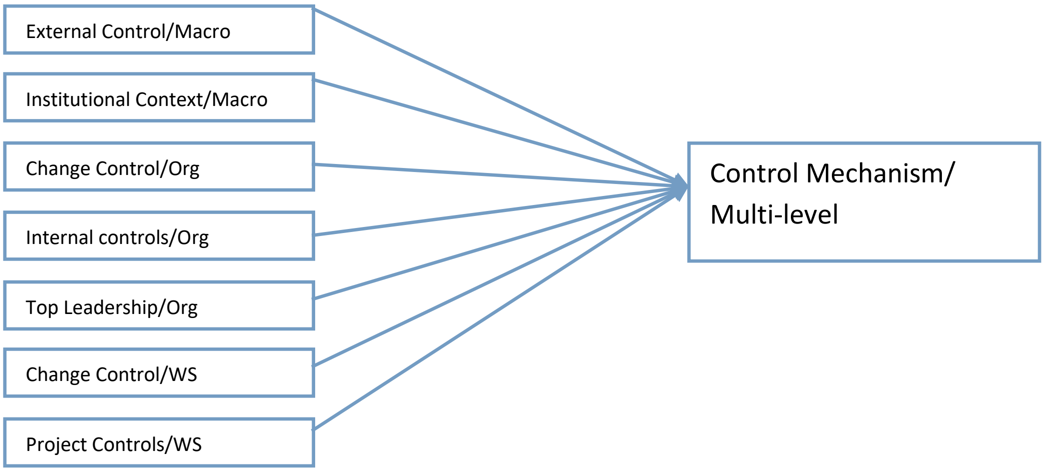
(a) Macro level Mechanism from second-order Codes



(b) Organisational level Mechanism from second-order codes



(c) Work-System level Mechanism from second-order codes



(d) Multi-level Mechanism from second-order codes

Figure 3.13 Identification of Underlying Mechanisms

Once the underlying mechanisms were identified with a level of reasonable certainty, the last phase involved the development of an explanatory framework.

3.6.5 Explanation Building

The final phase of the analysis was 'explanation building' (Yin, 2013: p. 147-150) or what George & Bennett (2005) call 'analytical process tracing'. This involved converting the codes and the descriptive narrative into an analytical causal explanation presented in explicit theoretical form. The goal here was to build an explanation of the events on 'how' or 'why' something happened. As noted in Yin (2013: p. 149), this phase involved a series of iterations and revisions to achieve greater explanation and theoretical coherence. The objective was to identify the most complete and logically compelling explanation of the observed events given the specific conditions of the contextual environment (Wynn & Williams, 2012). Care was taken to ensure *theoretical validity and (theoretical) generalisation* when developing and explaining the theoretical framework. This meant ensuring that the constructs are logically consistent, are based on the empirical evidence, and are generally supported by the literature. Chapter 5 presents the theoretical framework developed through this process.

3.7 Conclusion

This chapter outlines the research methodology adopted for this study. Section 3.2 presents the process ontology of organisations and technology. Section 3.3 presents critical realism as an epistemological foundation of this study and justifies its relevance to the ontological position outlined earlier. Consistent with the research agenda outlined in Chapter 2, critical realism is found well suited for the identification of key mechanisms. Subsequently, in Section 3.4, research framework is presented combining the process and STS frameworks and its alignment with the research agenda is outlined. Section 3.5 outlines the case research strategy and justifies the adoption of case research based on the research question and the research framework. Guidelines related to conducting a critical realist case study and executing a processual analysis are also discussed in this section. Section 3.6 presents the application of research strategy as it unfolded in this study, with worked out examples from the coding process. The next chapter presents the case narrative of the ES lifecycle in IBTS.

CHAPTER 4
CASE NARRATIVE

“A good story cannot be devised; it has to be distilled.”
- Raymond Chandler (1888-1959), British-American Novelist

4.1 Introduction

The purpose of this study is to explore the key factors and underlying mechanisms that influence Enterprise Systems (ES) lifecycle in Irish Public Service Organisations (PSOs). Chapter 2 outlines that extant studies are concentrated towards the implementation phase, do not move beyond the listing of factors and that ES lifecycle is still an under-researched area in the PSO context. Subsequently, Chapter 2 argues for the need for an approach to inquiry that captures the ES lifecycle and identifies key mechanisms underpinning the ES lifecycle. Chapter 3 outlines the relevance of Case Research Strategy within a Critical Realist philosophy to fulfil this need. As noted in Chapter 3, the case site chosen for the study was the Irish Blood Transfusion Services (IBTS). This chapter presents the case narrative for the duration 2000-15 based on the primary and secondary data. Following a processual logic, it focuses on the sequence of events unfoldingng a context. For presentation and analytical purpose, the narrative is divided into five parts. Section 4.2 presents the case site context and focuses on the historical, institutional, organisational, and technological context of IBTS before the year 2000. Using the technique of temporal bracketing (Langley, 1999), Section 4.3 to 4.6 present events unfolding in four distinct periods in the history of IBTS. Section 4.3 covers major events from 2000 to 2003 and describes the first attempt of integration by IBTS. Section 4.4 covers major events from the year 2004 to 2007 when IBTS engaged in an unsuccessful attempt of technology change. Section 4.5 captures major events from the year 2008 to 2011 when IBTS was operating in somewhat troubled environment. The last period covered in this study is from the year 2012 to 2015 in Section 4.6 when IBTS attempted greater integration by implementing a product suite around its core processes. Although the events are presented as occurring in distinct periods for analytical and presentation purpose, it is understood here that underlying processes causing those events may be continuous in nature. Section 4.7 presents a summary timeline of the events discussed in the Sections 4.3 to 4.6. Finally, Section 4.8 concludes the chapter.

A note on referencing *- This Chapter is written based on the events as reported by the respondents (referred to as R1, R2, R3 and so on) and as covered by the secondary* *documents, in particular, IBTS Board Minutes, IBTS Annual Reports, Reports from Comptroller and Auditor General*[21] *(C&AG), and debates of the Committee of Public Accounts*[22] *(CPA), referenced at appropriate places. Responses given by IBTS representative in the CPA debate have been taken as the official position of IBTS and have not been attributed to any respondent.*

4.2 Case Site Context

Blood transfusion is considered an essential and inseparable part of modern health care systems. Much of modern surgical and medicinal practice cannot be conducted without the availability of a safe and consistent blood supply. However, compared to the pharmaceutical production, blood operations are different in the sense that they use people as a source of supply. Therefore, it is essential that blood operations are safe and efficient, both for the donors and for the patients. In Ireland, it is the responsibility of the IBTS to ensure safe and consistent blood supply to hospitals all over Ireland. This section presents the historical, institutional, organisational, and technological context of IBTS before the year 2000.

4.2.1 Historical Context

Before World War II, when a patient required a transfusion in Ireland, donors had to go to the hospital where the patient was for a direct transfusion. These donors were known as 'donors on the hoof'. The hospitals managed blood donations themselves. In 1948, the Minister for Health established the National Blood Transfusion Association in Ireland. This was born from the work carried out by the St. John Ambulance Brigade of Ireland in setting up an 'on call' blood donor panel to serve the hospitals in the Dublin area. Thereafter, it took around 17 years for the Blood Transfusion Service Board (BTSB) to come into existence by the Blood Transfusion Service Board (Establishment) Order, 1965. In 1975 the Cork Blood Transfusion Service was absorbed in the BTSB. The Limerick Blood Transfusion Service was included in the BTSB in 1991.

With the support of the Department of Health (DoH)[23], a major management consultancy

[21] The Comptroller and Auditor General (C&AG) is the constitutional officer responsible for audit of public bodies in Ireland.
[22] Committee of Public Accounts (CPA) is a standing Committee of Dáil Éireann, the lower house of the Irish Parliament. It is responsible for examining C&AG reports on Departmental expenditure and certain other accounts.
[23] For the period 1997-2011, the Department of Health was known as Department of Health and Children. However, for consistency purpose it has been referred as Department of Health, or simply 'the Department' throughout the text.

exercise was undertaken in the mid-1990s to review all aspects of BTSB's operations. Based on the exercise, the BTSB adopted a reorganisation plan in 1996, which was accepted by Government and endorsed in the Finlay tribunal of inquiry report[24] which called for the early implementation of the plan. The plan envisaged significant investment in extra staff, new buildings, new equipment and enhanced operational systems. The plan called upon a wide range of measures which included steps such as the strengthening of the finance function, and the development and upgrading of the BTSB's IT system. Finally at the dawn of new millennium, along with other organisational changes, the name of the organisation was changed to the Irish Blood Transfusion Service (IBTS) in the year 2000, the name by which it is still known by.

The functions of IBTS[25] are set out in Statutory Instrument No. 78 of 1965 and Statutory Instrument no 209 of 1988 which are as follows (IBTS, 2016):

1. Organise and administer a blood transfusion service including the processing or the supply of blood derivatives or other blood products, and also including blood group and other tests in relation to specimens of blood received by the Board.
2. To make available blood and blood products.
3. To make available equipment or reagents suitable for use in relation to the service.
4. To make such charges (if any) as the Board thinks fit, for the services referred to above and, where the Minister gives any direction in relation to such charges, to comply with such direction.
5. To furnish advice, information and assistance in relation to any aspect of the service to the Minister, any health authority or any hospital authority.
6. To make any necessary provision for publicity in relation to the service.
7. To organise, provide, assist or encourage research and the training and teaching of persons in matters relating to blood transfusion and preparation of blood products.
8. To cooperate with other bodies with analogous scientific functions.
9. To organise and administer a service for obtaining and assessing reports of unexpected or undesirable effects of transfusion of blood or blood components made available by the Board.

The functions cited above still form the basis of IBTS present day operations. However, apart from these functions, IBTS operations are also affected by the institutional context in which it operates. This is the focus of next subsection.

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[24] Finlay report was prepared by Finlay commission that was constituted by Government of Ireland on October 1996 to inquire into the issue of Hepatitis-C infection and role of IBTS in this regard.

[25] For consistency purpose, the organisation is referred to as IBTS in this study even if some of the events before the year 2000 are referred to.

4.2.2 Institutional Context

IBTS comes under the aegis of the Department of Health in Ireland. The role of the Department of Health is to provide strategic leadership for the health service and to ensure that Government policies are translated into actions and implemented effectively. The Department also supports the Minister and Ministers of State in their implementation of Government policy and in discharging their governmental, parliamentary and Departmental duties (DoH, 2016). The responsibilities of the Department include advising the government on the strategic development of the health system including policy and legislation, evaluating the performance of the health and social services, and working with other sectors to enhance people's health and well-being.

Under its aegis, apart from IBTS, Department of Health has the following non-commercial state agencies (DoH, 2016): Nursing and Midwifery Board of Ireland, Dental Council, Food Safety Authority of Ireland, Food Safety Promotions Board - Safe food, Health and Social Care Professionals Council, Health Information and Quality Authority, Health Insurance Authority, Health Research Board, Health Products Regulatory Authority, Medical Council, Mental Health Commission, National Cancer Registry Board, National Paediatric Hospital Development Board, National Treatment Purchase Fund, Opticians Board, Pharmaceutical Society of Ireland, and Pre-Hospital Emergency Care Council.

However, not all agencies are directly connected to each other in terms of their work. Figure 4.1 shows the relationships of agencies related to blood operations in Ireland. IBTS collects the blood from the donors. It processes the blood and supplies blood products to hospitals/hospital blood banks as and when requested. Operations of the hospitals are overseen by the Health Service Executive (HSE). Since blood and blood products are regulated by the Health Products Regulatory Authority (HPRA, 2016) in Ireland, the entire supply chain of the blood operations must conform to the standards prescribed by the HPRA.

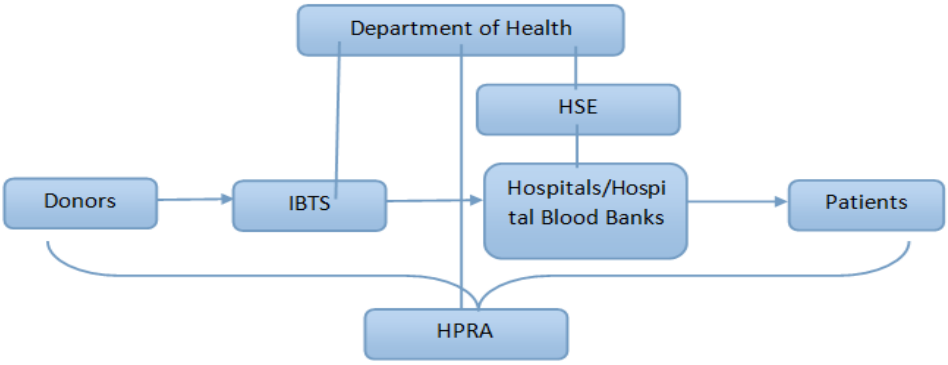

Figure 4.1: Blood Operations in Ireland

The HSE provides all of Ireland's public health services in hospitals and communities across the country. The HSE is a large organisation of over 100,000 people, whose job is to run all of the public health services in Ireland (HSE, 2016). Although all the Hospitals in Ireland fall under the aegis of HSE, following the publication of two reports in May 2013 (*The Establishment of Hospital Groups as a Transition to Independent Hospital Trusts,* and *The Framework for Development – Securing the Future of Smaller Hospitals*), the hospitals are now grouped in seven hospital groups (DoH, 2016) each with their own governance and management. As conceived by the Department, the establishment of hospital groups is potentially a key enabler for the reorganisation of services across the hospitals, with associated benefits in terms of providing care in the most appropriate setting and delivering a safe quality service. In this sense, the HSE and IBTS have a more indirect relationship with the hospitals acting as mediators.

Unlike the HSE, the HPRA has a more direct impact on IBTS's operations. The role of the HPRA is to protect and enhance public and animal health by regulating medicines, medical devices and other health products (HPRA, 2016). Formerly known as the Irish Medicines Board (IMB), it was renamed as the Health Products Regulatory Authority in July 2014 to reflect its broader remit and regulatory functions which have expanded over a number of years to include human medicines, veterinary medicines, clinical trials, medical devices, controlled drugs, blood and blood components, tissues and cells, cosmetic products, the protection of animals used for scientific purposes, and organs intended for transplantation. Of these, IBTS processes blood and blood components, and tissue and cells. Therefore, all of IBTS's operations and practices must conform to the standards set out by the HPRA.

Thus, IBTS operates within a highly regulated environment that is similar to the pharmaceutical industry. A safe transfusion service is assured by close collaboration between IBTS and clinicians in managing the aspects of the transfusion process for which they are responsible. Only blood which is donated by appropriately selected donors and is tested for transfusion transmissible infectious agents can be issued for transfusion (IBTS Strategic Plan 2010-2012). Having outlined the external institutional context of IBTS, next subsection deals with the organisational context of IBTS.

4.2.3 Organisational Context

Though IBTS comes under the aegis of Department of Health for administrative purpose, it is constituted as a self-financed public service body. Finlay report (1997) notes that although in theory IBTS was intended to be self-financing but in fact and in practice it requires the sanction of the Department of Health in fixing the prices of its services and products. It also requires the financial subvention from the Department for major capital investment in premises, equipment or major staff changes. Matters such as the introduction of new systems of screening or viral inactivation, acquisition of significant new equipment, or recruitment of new staff require the prior sanction of the Department. Therefore, even though IBTS is financially self-sufficient in the sense that it does not require voted money from the Irish Parliament, it still has to seek agreement from the Department of Health for major decisions.

From 1995 on, a major reorganisation and expansion of IBTS took place. It came up with a development plan for the period 1996-1999. The plan took account of the recommendations made by a 1994 expert group set up by the Minister for Health, and also the report of a consultancy firm. Finlay report (1997) also recommended speedy implementation of IBTS development plan for the period 1996-1999. It stressed, in particular, the provisions of a new site, buildings and equipment for the Dublin unit of IBTS preferably located in close proximity to a teaching hospital. It also recommended appropriate renewal of the premises and equipment in the Cork unit. Under the new development plan, the consultant medical staff of IBTS was to be substantially enlarged. Under the new plan, IBTS had to execute restructuring within the organisation in order to improve the communication between and within the administrative side.

Therefore, essentially IBTS was in flux in the late 1990s. As the C&AG notes in CPA (2003), not only IBTS had to improve its business processes in response to the concerns about the blood supply in terms of the absolute need to ensure the quality of products and components; at the same time, it had to cope-up with the fallout from the tribunals and inquiries. Consequently, it put a strain on the organisation while going about the day to day business of managing the service. It also led to a high attrition rate among senior management in the service. The strain on the organisation also manifested itself in shortcomings in financial and project management as identified in the C&AG audit of 2003.

Apart from the administrative concerns, a major concern for IBTS at the time was managing public perception related to unintended and largely undetected Hepatitis-C infection of its blood products and its spread in the population that came to the fore in the early 1990s. IBTS conveyed to the Department of Health and to the public at large in February 1994 about the events that had occurred and the risk that persons who could be infected with Hepatitis-C. IBTS organised a series of meetings and advertised throughout the country for the discussion of the effects of Hepatitis-C. Broad publicity was given to such meetings and information was provided to the women who attended them. It also followed with a nation-wide screening program that involved screening, testing and further testing and counselling of over 60,000 women. Joint appointments between hospitals and IBTS were also initiated to improve the relationship between IBTS and the research and clinical branches of medicine. At the same time, IBTS also had to assist with Finlay commission which was given responsibility to inquire into the issue of the Hepatitis-C infection and role of IBTS in this regard. The next subsection moves to the technological context of IBTS around the same time.

4.2.4 Technological Context

In the late 1990s, IBTS operated with a blood management system named Blood Bank Control System (BBCS). BBCS operated in both Dublin and Cork centres but these systems worked in isolation without any connectivity between the two. These were two separate 'boxes' as the superusers called them. These boxes were separate in two ways. First, they were not connected via any network. Second, because of the differences in business processes (e.g. type of testing carried out) across Dublin and Cork, these two boxes were very different in terms of their databases structure and business process logic. Essentially, these were two different systems in two different centres but with same system name and same overarching organisation. On the ground, it meant that a donor could register in both the regions (Dublin and Cork) and could potentially donate in the other region even if he was screened out in one region. This also meant IBTS did not have any direct mechanisms to compare or collate data from both the systems to gain meaningful insights. It is no surprise, therefore, that the need for an overhaul of IBTS's IT systems was stressed in the reorganisation plan of 1996.

However, a major technological issue looming large at the time was the year 2000 problem or the Y2K problem as the global IT industry used to call this. It resulted from the practice of truncating a four-digit year to two digits, e.g. using 80 for 1980 in the year field of the program/databases. This made the year 2000 indistinguishable from 1900. Specifically, it involved two sets of problems in IT systems. First, the practice of representing the year with two digits became problematic with logical errors arising upon rollover from '99' to '00'. Without corrective action, systems would break down when the ascending numbering assumption suddenly became invalid. Second, some programmers had misunderstood the Gregorian rule that determines whether years that are exactly divisible by 100 are not leap years, and assumed the year 2000 would not be a leap year.

However, years divisible by 100 are not leap years, except for years that are divisible by 400. Thus the year 2000 was a leap year. Therefore, globally organisations were working to fix the Y2K problem and upgrading their systems. IBTS was no exception either.

IBTS approached the Department of Health in 1998 with the concern that its BBCS was not Y2K compliant and there was no assurance that it could be made so. It was identified that urgent action was required to ensure the continuity of operations from January 1st, 2000. Otherwise, there would be a serious threat to the blood supply with the potential impact on patient care. Subsequently, the Department of Health agreed to IBTS's proposals for a major IT programme involving the Progesa project. Facing the twin challenges of the Y2K problem and an IT infrastructure upgrade, IBTS started its journey towards its first ES implementation. It was envisaged that the new system called Progesa would be Y2K compatible and would replicate industry's best practices in the management of blood banking activities and in related data processing activities. The project started around 1998 and was due to implement fully by late 1999 at a cost of €4.26 million. However, the project did not complete and was estimated to be over-budget by around €5 million, making the final estimate €9.04 million, double of the initial estimates (C&AG, 2002). The events associated with Progesa implementation are explored in the next section.

4.3 First Wave of Integration (2000 - 2003)

Apart from existing as two separate boxes, BBCS had rather limited functionality. It only managed the donor records. It did not cover any process at the clinic or in the laboratories. Progesa envisaged linking the donation clinic with the donor records and with all of the testing and processing laboratories. Progesa project was reportedly designed to increase security in relation to donor information from procurement to transfusion by ensuring that the donor information is integrated at laboratories and additional security measures are applied at issue stage. Other motivations included improving the donor recruitment and creating a national database of blood donations. It was envisaged that the implementation of the Progesa system would enable a donor's record to be accessed at any mobile clinic throughout the country contributing towards donor screening, thereby providing a further safety enhancement to the blood supply by using laptops at the clinic location.

The Progesa project was managed by a project manager using a number of key skilled operators (known as superusers) who were instrumental in testing and adapting the system to suit the operational processes of IBTS. It may be noted here that neither the project manager nor the superusers were from an IT background. They were the domain experts but they worked in close proximity to the IT Manager. IT unit was responsible for ensuring that the IT network was of the required standards and that all of the technological requirements were in place for the system. This structure was put in place to ensure that any obstacles along the critical path were identified at the earliest opportunity and measures were taken to resolve them (CPA, 2003). The project was overseen by a coordinating committee which has membership in the acting Chief Executive (CE), National Medical Director, Project Manager, Regional Director, Chief Scientific Officer, National Donor Services Manager, National Quality Assurance Manager and other heads of function in the Cork and Dublin Centres. Separate project groups operated in Dublin and Cork centre. Each group oversaw the implementation of the project in their centre and addressed implementation difficulties as they arose.

However, there were a set of events, both inside and outside IBTS, which created hurdles during the implementation. During 1999 and 2000, IBTS was moving its headquarters and processing and testing facilities in Dublin from Pelican House to James Street. This decision was taken in line with the recommendation of the Finlay tribunal report (1997) that IBTS's Dublin centre should be on the site of a teaching hospital. This movement also created problems in terms of designing, testing and validating the system. Network costs were underestimated at the start of the project. The addition of new collection centres and a donor clinic and the relocation to the new headquarters at St James Hospital also contributed to the network costs (C&AG, 2002). Due to delay in the project, it was necessary to make the existing system (BBCS) Y2K compliant in 1999 at a cost of around €4 million. Ensuring Y2K compliance of all systems within the organisation involved considerable staff time. Validation of the existing system due to regulatory requirements became necessary at a cost of €283,024.

During the same period, services of IT experts came at a premium price because of the Y2K situation, which resulted in higher cost of acquiring suitable resource persons from the market. Consequently, IBTS's expenses for human resources were considerably higher (CPA, 2003). Considerable staff changes took place throughout the project implementation phase particularly in the IT area which necessitated the employment of consultancy staff to fill vacancies (C&AG, 2002). IBTS had decided to follow good manufacturing practice in the implementation of Progesa. However, the level of expertise on good manufacturing practice available within the organisation and with the supervisory bodies at the project outset was low (C&AG, 2002). In addition, it was difficult to predict at the commencement stage what good manufacturing practice requirements would materialise over the project term. Consequently, it was necessary to engage additional contractors to ensure compliance with the best practice.

IBTS notes in CPA debates (2003) that IT resources recruited during the duration of the project possessed IT skills rather than blood bank skills. On the other hand, system superusers were domain experts with almost no IT knowledge. It was a huge learning curve for both sets of people. This also considerably delayed the project as IT resources required to get domain knowledge before working on the system and superusers needed to understand the technology. There was also a high staff turnover at senior management level before and during the project. IBTS had fifth chief executive officer since 1996 and it had three IT managers since 1998. It also had a second quality assurance manager since the start of the project. Turnover of very senior positions within the organisation created problems in managing continuity and stability of the project in terms of project management and the delivery of services.

Apart from Progesa implementation, IBTS senior management had many issues to pay attention to. IBTS was in the news consistently over the past eight years or so for the reasons ranging from the Hepatitis-C scandal to the disputes over the location of blood-related services (C&AG in CPA, 2003). IBTS senior management had to handle the responsibilities for both internal operations and for managing external factors. They had to respond to the concerns about the blood supply in regard to the quality of products and components. At the same time, they were also coping with the fallout from tribunals and inquiries. This put a strain on the organisation while going about the day to day business of managing the service. It also led to a high attrition rate among senior management in the service.

Another major issue was the underestimation of costs at the beginning of the project, particularly with regard to hardware. There was a lack of appropriate expertise within the organisation to understand the hardware requirements of such a major system in a pharmaceutical grade operation. In March 2000, a database locking[26] problem emerged during testing. It was noted that a situation could arise where one person could issue a product and another person could quarantine the same product simultaneously. It was considered crucially important to address the locking problem. This was also emphasised by the regulator (HPRA) as a necessary task to be undertaken. Checking of all aspects of

[26] Database locking is a standard feature of database systems which ensures that record can not be simultaneously accessed by another user for update when one user is updating it. This is done to avoid data inconsistency.

the system involved testing, retesting, validation and documenting each issue over a period of six months. To make the matter more complex, in the beginning, the supplier attributed the problem to the procedures and parameterisation followed by IBTS rather than acknowledging a fault with its system, subsequently resulting in IBTS staff spending more time in the validation of the system.

The market position of the supplier also made it difficult for IBTS to get adequate supplier attention. The supplier of Progesa system was a world leader in blood bank software and provided service to blood banks worldwide. At the time, the Progesa system was being used in New Zealand, Canada, Singapore, New York, Australia, Finland, the Netherlands, Scotland and Belgium. The involvement of the supplier in providing support to other sites resulted in delays in obtaining assistance for IBTS at the time (C&AG, 2002). Finally, in July 2000, the supplier acknowledged the existence of a problem with respect to the design of its system and promised the correction in the new version release. The task of identifying a resolution to the problem resulted in significant delays in 2000 but a solution was achieved in January 2001 (C&AG, 2002). Overall, this process took 9 months and cost €500,000. IBTS board considered the possibility of legal action against supplier but decided against it since it would have taken enormous time in French (the supplier’s country of origin) justice system and would have resulted in supplier taking off all the support from the system (CPA, 2003). This was a situation that IBTS wanted to avoid.

During the implementation, while there was an expectation that assistance could be obtained from other countries with similar systems, this did not materialise due to the differences in production methods (C&AG, 2002). IBTS’s IT manager was in contact with the Scottish National Blood Transfusion Service that had implemented Progesa in Scotland, requesting assistance with documentation to speed up the implementation process. However, when IBTS went into the project details, it discovered that the Scottish system operated differently and the system had to be parameterised differently for each service. While Scotland parameterised its system in a certain way, IBTS had to parameterise it to suit its needs. The documentation provided by Scottish service was therefore not of great use and IBTS had to come up with its own documentation from scratch (CPA, 2003). Even within IBTS due to historical reasons, there were differences in some business processes across Dublin and Cork. These differences persisted even during the Progesa implementation. Consequently, in terms of certain business processes, these systems were still two different systems, but they shared a common database in the implementation of Progesa.

Industrial relations problems arising (in an unrelated area) in 2001 also affected the implementation of the system (C&AG, 2002). In March 2002, Acting CE informed the IBTS board that IBTS had sought an early meeting with the unions to outline the options that it faced in regard to the Progesa system. In February 2003, the board had an understanding that the implementation of the Progesa system was being used as a lever in pay negotiation. These industrial relation problems also resulted in delaying the project implementation. Even when the industrial relation problem was resolved, there was another problem related to staff. During training on the new system, a considerable problem identified by the superusers was a lack of digital literacy among most of the staff members who had started work in the pre-digital age. Consequently, superusers had to train the staff for using computers as well as for using the Progesa system.

The Progesa project finally rolled out during early 2003 with an estimated cost of €9.3 million (C&AG, 2008). IBTS used an incremental approach in going live with the system. First, it introduced the patient module, and then it went ahead with the core module. The system first went live in Cork and Limerick centres on 18th March 2003, and in all other centres including Dublin on 8th May 2003. It helped IBTS in identifying any issues with the system in the smaller centres (Cork and Limerick) before going live in Dublin which is the biggest centre. The BBCS system ceased to operate and system was only used for the look-back purpose only. The board of IBTS approved a one-off settlement with team leaders and other staff members regarding the implementation (IBTS Board Minutes, 2003). After the go-live, a user group was established to look at Progesa issues in all centres. The group comprised of users from all relevant sections of IBTS. A work list was developed over the span of the meetings and all issues were resolved with the exception of management information required from the system (IBTS Annual Report, 2003). IBTS planned to address the requirement in 2004, with the possibility of the development of a data warehouse project.

Another parallel development with Progesa implementation was the introduction of laboratory automates in IBTS laboratories. Automate is a software that executes a laboratory test and saves/transfers the result of the test. During 2003, interfacing of many automates with Progesa was validated and implemented. Now Progesa could store results from many automates avoiding any manual data entry. However, due to the ever-changing requirements on Progesa from various business elements, IBTS also identified the need to evaluate the later versions of software to see the fit with the organisation and to put in place a plan to implement that version. How did IBTS go ahead with the task of need identification and subsequent implementation, is the topic of the next section.

4.4 Attempting technology change (2004 - 2007)

This Section presents the sequence of events associated with the period 2004 to 2007 when IBTS engaged in a technology change exercise by moving from a flat-file based Progesa system to a relational database based eProgesa system. The event sequence is presented in the form of three subsections on the events associated with the exercise. Subsection 4.4.1 outlines major events in 2004 that were associated with initiating technology change. However, after initiating the project, IBTS consistently faced numerous roadblocks for the next two years (2005-06) which are outlined in subsection 4.4.2. Finally, these roadblocks forced IBTS to stop the project in 2007, which is covered in subsection 4.4.3.

4.4.1 Initiating Technology Change (2004)

C&AG (2008) in his special report notes that the implemented version (4.4d/e) of Progesa was a 'non-final' one as installing all the requirements of IBTS would have destabilised the system. In May 2004, IBTS decided to move from Progesa to a new system called eProgesa developed by the same supplier. A project definition for the implementation of eProgesa was drawn up in May 2004. The report explained the rationale for moving from Progesa to eProgesa. The project definition document was written by IBTS IT unit outlining the various options available to IBTS at the time and also dealt with various requirements for the implementation of eProgesa in IBTS. It also gave justifications for moving to eProgesa, which are noted in the following paragraphs (C&AG, 2008; CPA, 2008).

1. Hardware Obsolescence

Because of the length of time taken to implement Progesa, IBTS found itself in a situation where the hardware on which it was operating had reached the end of its life and needed to be replaced. Consequently, hardware support agreements could become exceptionally expensive or even unavailable. Therefore, it was felt that there was an urgent need to manage this risk. IBTS contended that the biggest risk at the time was to do nothing and to remain on the implemented version of hardware and software. IBTS identified a need to move from its installed version of Progesa for improved functionality. Irrespective of the solution that was opted (whether from the same supplier or from other suppliers), it would have required an investment in hardware (CPA, 2008). Therefore, for IBTS it made good economic sense to upgrade the current blood bank control system at the same time.

2. Underlying Software Technology

Progesa was a system that operated on a flat-file structure. In a flat-file structure, the data is kept in the form of different files corresponding to each table. The same information may be put in different files but the files are not connected with each other. This increases the risk of data inconsistency as the user may not be sure if the data has been updated at all the relevant places. This was the major reason beneath the database locking problem noted in earlier section. Similarly, pulling data from different flat files to prepare a report is considered a very tedious and time-consuming process. Consequently, Progesa provided only basic reports which were of no practical use for the management. IBTS reckoned that an upgrade to a different version of Progesa instead of implementing eProgesa would give improved functionality but would retain the same flat-file structure putting constraints similar to those being experienced at the time. To overcome the limitations of the flat-file system, most of the database service providers switched to the relational database structure in which data is stored in the form of database tables which are connected with each other by common fields. The underlying system architecture of relational database makes it impossible to input/update inconsistent data. The eProgesa system was designed on a relational database system called Oracle, which was in line with IBTS's software policy of using Oracle database for its systems (CPA, 2008), and therefore looked promising at the time.

3. Data Recovery Ability

Another related aspect was the ability of data recovery in case of any outage of the system. Due to its flat-file structure, Progesa only allowed the system to be returned to the previous day's backup with the loss of all products processed in the intervening period. In contrast, eProgesa offered the facility to fully recover data from a systems failure right up to the point of failure (C&AG, 2008). It may be noted here that this feature is not specific to eProgesa software and it is a feature of all relational database systems like Oracle.

4. Generation of Management Report

One important feature of modern database systems is the ability to run user queries and to generate periodic management reports. Again, due to its flat-file structure, Progesa did not have this ability and did not provide useful management reports. The eProgesa system claimed to offer current and reliable data which would allow users to run reports and analyse trend (C&AG, 2008).

5. Strategic Advantage

The eProgesa system promised additional functionality which would allow for a more efficient blood transfusion service. Since at the time eProgesa was not implemented elsewhere, IBTS anticipated that implementing eProgesa would allow it to become a 'world leader' in blood transfusion technology (C&AG, 2008; CPA, 2008).

When it came to choosing suppliers, MAK System (the supplier of Progesa) was their preferred supplier due to many reasons (CPA, 2008; C&AG, 2008). First, MAK System was (and still remains at the time of writing) the dominant supplier of blood bank information systems to transfusion services across the world. The Progesa system was in operation in Europe, USA, Canada, Australia, New Zealand and Asia at the time. Second, when IBTS initially purchased Progesa, it followed a full tendering process and there was only one supplier other than MAK that was shortlisted for consideration. IBTS reports (CPA, 2008) that the other company that was shortlisted in 1998 for the first version of Progesa still did not progress beyond the US and did not have an integrated system. They had two different software packages to manage - the donor side and the production side; whereas IBTS was looking for an integrated system to manage its entire blood operations. After product evaluation, IBTS found that the product offered by the MAK system was suitable for the purpose. Third, senior IBTS staff regularly attended conferences and scientific meetings where suppliers of all major systems and equipment for use in blood transfusion services exhibit their products. IBTS staff also attended the biannual meeting organised by the association of the national blood services in Europe. They found no evidence at either of these fora that an appropriate alternative system to Progesa had come to market.

Due to the reasons cited above, IBTS concluded that it was a reasonable course of action not to go through a formal tendering process when the decision was taken to upgrade to eProgesa (CPA, 2008). They also cite a benchmarking exercise conducted by another European blood service examining all possible systems and still deciding to purchase eProgesa. Based on this rationale, the project definition document prepared by IBTS in May 2004 set out the cost of computer hardware, software and licensing expenses at €1.8 million. The total estimated cost of the project, including staff costs and training, amounted to €3.13 million (C&AG, 2008). Work for the eProgesa project started in the fourth quarter of 2004. An Executive Steering Group (ESG) was established to set and monitor project strategy, assess and manage progress, make timely decisions on project related issues, and to take other IBTS projects into account and indicate to the project team where conflicts might arise (C&AG, 2008). In October 2004, MAK sent an official proposal for the eProgesa project to IBTS which was accepted by the ESG. A test box of eProgesa software was set up with Progesa data installed in December (IBTS Annual Report, 2004).

At the same time, IBTS also undertook many upgrades to its existing system (IBTS Annual Report, 2004). A number of automate interfaces were developed in 2004 whereby results from various laboratories testing equipment are passed to Progesa. A new grouping instrument was commissioned at Cork centre which required the development of scripts to integrate the results into Progesa. IBTS IT unit also developed a Haemovigilance system since no other system in the market could fulfil their requirements. A fully developed and validated system by IT was delivered to the users towards the end of 2004. The first project methodology set for the organisation was also developed in 2004. This document was supposed to form the basis of all future project developments in IBTS. The methodology-set was a subset of the PRINCE2 [27] methodologies and was used for the project definition document for the eProgesa project as well. All of these developments were apart from IBTS regular IT activities which included maintenance and support of the Progesa system, upgrading network infrastructure, e-mail service implementation, virus detection and protection, and PC maintenance and support.

Another development which was somewhat related to IT was the introduction of risk registers in IBTS. Following a number of workshops facilitated by an outside consultant in late 2004, a formal risk register was approved by the Business Review Group of IBTS. The risk register identified strategic, clinical, financial and operational risks to the organisation and included the controls and actions necessary to minimise the impact on the organisation in the event of the risk occurring. IT risks were dealt within operational risks. Risk register was to be reviewed and updated regularly by the Business Review Group to ensure that the identified risks and controls are adequately dealt with and that new and emerging risks are identified and controlling measures are put in place (IBTS Annual Report, 2005).

4.4.2 Facing the Roadblocks (2005-06)

From the beginning, eProgesa project faced a series of roadblocks (C&AG, 2008). The supplier, following a visit to IBTS in January 2005, highlighted certain gaps in IBTS

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[27] PRINCE2 is a process based methodology and the Project Management standard for public projects in Ireland and in the UK. It is a best practice framework for running a successful project and can be tailored to the needs of any project or organisation of any type or scale.

requirements as set out in the project definition document prepared in May 2004. There were issues relating to the ability of users to run reports from the system. Internally, multiple issues were also being raised by IBTS superusers who were testing the system. It was agreed that the supplier would address these issues and have them resolved by the time the system hardware was supplied. In April 2005, IT application manager (who was also the project manager for eProgesa) resigned from IBTS (IBTS Board Minutes, 2005) and the IT manager was made the project manager. Project timelines were drawn up and a go-live date was set for 28 October 2005 (CPA, 2008). In April 2005, IBTS also hosted the International MAK Users conference. It was attended by 55 delegates from 15 different blood bank establishments throughout the world who used Progesa for their blood bank operations. IBTS also gave a presentation of its eProgesa implementation. This was reported to be very well received by those in attendance and IBTS was reportedly seen as a respected leader within the group (IBTS Annual Reports, 2005).

However, development of a tool to manage the configuration of eProgesa proved much more complex than the supplier had anticipated. From May 2005, the system showed a continuous stream of issues and bugs which were difficult to resolve. Afterwards, two further go-live dates were missed due to issues and bugs not being resolved. It proved extremely difficult to resolve the issues despite constant telephone conferences, letters to the supplier, and visits to supplier's headquarters in Paris by IBTS and return visits by supplier's personnel to Dublin (CPA, 2008). During Dec 2005, IBTS decided that it would continue its interaction in regard to eProgesa implementation with other sites. In June 2006, IBTS board was informed that Singapore blood bank had gone live with eProgesa. Subsequently, arrangements were made to send the IT/Project Manager to visit Singapore to learn from their experience (IBTS Board Minutes, 2006). A meeting was also planned with the supplier to discuss the implementation timelines.

Despite all these developments, the ESG had become very concerned that no definite go-live date could be identified and requested the IT manager to develop an options appraisal document setting out the options available to the organisation (CPA, 2008). The ESG examined the following options in September 2006 (C&AG, 2008): to continue with the implementation of eProgesa, to migrate the current version of Progesa to new hardware and upgrade later to a different version, or to upgrade to Progesa 4.4g directly on the new hardware. The ESG examined the options and decided, primarily due to the lack of viable long-term alternatives, that IBTS should proceed with the implementation of eProgesa. However, it was also agreed that investment should be made on the maintenance of the servers as they were critical to the continued operation of the existing system.

Nevertheless, the project continued to face difficulties after that decision and IBTS was constantly looking for effective fixes for the difficulties that were being reported by the superusers.

It is important to note at this point that IBTS was at a relatively advanced stage of eProgesa implementation among all the countries and the difficulties IBTS was experiencing in dealing with the software were closely being monitored by blood transfusion services in other countries (IBTS Board Minutes, 2006). In a sense, it was the first time the supplier was *really cutting* its *teeth in the open market* (R3). In December 2006, a patch was received from the supplier to deal with outstanding bugs. Although there were more than 100 outstanding bugs, the patch offered by the supplier only dealt with just 20 bugs (IBTS Board Minutes, 2006). Subsequently, the patch was rejected. In its 2006 annual report, IBTS reckoned that the implementation of eProgesa was problematic and its continuation was in doubt. It noted that a decision would be required on the fate of project unless a definitive go-live date could be agreed early in 2007.

Despite the roadblocks mentioned earlier, IBTS was active on other matters related to Information and Communication Technologies (ICT). In its strategic plan for the period 2005-09, IBTS envisaged embracing technological change. This included automation and strategic use of ICT. IBTS planned increased automation within laboratory services and automating certain collections of platelets and red cells over the next three to five years. This was planned in order to reduce the time taken to process donations and to eliminate many of the manual processes which were in place then. It also planned the strategic use of ICT to undertake a change in its business operations. The strategic plan outlined three strategic actions and performance indicators to use ICT as an enabling tool. The first strategic action was to integrate ICT into business planning and implementation. This required all project managers ensuring that ICT was included at very early stages in the process. The second strategic action was ICT becoming a partner in the achievement of a more effective and efficient blood transfusion service. For this purpose, ICT had to sign service level agreements with all Departments within IBTS. The third strategic action was the development of a strategy for integration of ICT in planning and execution of operations of IBTS and this was to be done following consultation with relevant stakeholders.

Apart from upgrading the software/hardware and migrating the database in the eProgesa project, IBTS was also looking for merging the donor and patient file systems that existed separately in Dublin and Cork at the time (CPA, 2008). IBTS cosidered this important to have all their blood-related data in a single database. This merger on the existing Progesa system was successfully completed in August 2005. During 2005, it also became apparent to IBTS that there was a pressing need to find a solution to the amount of documentation generated from the various systems within IBTS. An external consultant was contracted to gather the user requirements for such systems and a detailed users requirement specification (URS) document was agreed and signed off in 2005 for an Electronic Document Management System.

The year 2005 also saw some major changes to IBTS IT infrastructure with the migration of the core systems to new operating systems. It was moved from the obsolete NT4 system to relatively new Windows 2003 and XP systems. This move allowed the introduction of new versions of general applications and enhanced IBTS's ability to improve existing services and to introduce new ones to the organisation. The data communications lines between the different IBTS offices that allowed for use of systems such as Progesa, CORE (the HR\Payroll system) and email were also upgraded at the same time. With the introduction of new IT equipment in IBTS and the hardware to support the new eProgesa system, there was a requirement to improve both power supply protection system and the air handling system. The UPS which provided battery-powered backup in the event of a power supply failure was increased in capacity to accommodate the new systems. In the same year, IBTS also introduced new virus protection software to protect the organisation from virus and malware attacks.

4.4.3 Swallowing the Bitter Pill (2007)

A particular constraint posed limitations on IBTS capability to modify or work with the software. As informed by the project members, the supplier did not share underlying database structure with them citing competitive reasons. Consequently, IBTS superusers could not cross-reference vital data. The information was spread across 1,000 tables with the column and table names written in French. Many of the columns were not used and there was no cross reference between them. As one of the superusers told, eProgesa was like a black-box for them. IBTS superusers could only validate input and output and did not have access to what was written within the software.

In January 2007, the project had 127 outstanding bugs and in February 2007, it had 52 outstanding bugs, which again increased to 75 in March. Most of the bugs were the responsibility of the supplier (IBTS Board Minutes, 2007). The ESG met to discuss the project in March 2007. IT/project manager reported that the system was unstable and the superusers had lost confidence in it. A fix to one area of operation was causing problems in unrelated areas. This indicated that the patch was not being tested properly before being shipped to IBTS. The response from the supplier was inconsistent and IBTS could no longer rely upon it. The performance of the system at Singapore blood bank was found to be slow and at an unacceptable level for IBTS. The project never got below 30 issues or bugs outstanding despite extensive testing and follow-up. Also, IBTS and the supplier had constant disagreements on the number of issues and bugs outstanding and whose responsibility it was to fix them (CPA, 2008).

Consequently, in March 2007, the ESG decided to suspend the eProgesa project and not return to it until the system was implemented in other countries. IBTS decided to stabilise the existing Progesa system to ensure continued service delivery to its blood operations (C&AG, 2008; CPA, 2008). Up to the end of April 2007, the sum of €1,887,625 was spent on the eProgesa project. Costs associated with hardware, software and licensing amounted to €1,252,804 while IBTS staff costs and professional services totalled €634,821. IBTS wrote off €729,000 attributable to the eProgesa project in 2006. It noted in its accounts for that year that no value was obtained for this expenditure. Pending the final outcome of the project, it recorded the remaining €1,158,625 as an asset in progress in its annual accounts. This represented an investment of €500,000 in software licenses with most of the balance of the expenditure having been incurred on hardware (C&AG, 2008). Similar to its earlier instance, IBTS did not enter into a negotiation or legal battle with the supplier for a refund of the money it wrote off, citing costly and delayed justice delivery system in France. This loss of public money invited bad press and an audit by C&AG. Apart from the review by C&AG, IBTS also commissioned an external review of the project and KPMG was appointed to undertake this review.

However, even after the project suspension, all was not lost for IBTS. The existing hardware on which Progesa system was running was also towards the end of its life. In April 2007, the CE informed IBTS board that the immediate priority was to stabilise the running version of Progesa on new hardware as hardware provider did not guarantee service on the existing servers (IBTS Board Minutes, 2007). Although the technical specifications of the hardware were greater than what was required for Progesa, it provided the benefits of greater performance and resilience. Since IBTS could not find any credible alternative to Progesa/eProgesa in the market, it was stuck with the same supplier for Progesa stabilisation to new hardware. Although the decision was taken in April 2007, the supplier was rather slow in responding and IBTS received a proposal for the stabilisation project in July 2007 (IBTS Board Minutes, 2007). At the same time, KPMG also commenced the review of the eProgesa project. Stabilisation project finally commenced in the fourth quarter of 2007 and was expected to complete by March/April 2008.

IBTS utilised the hardware purchased for eProgesa in other operational areas (CPA, 2008). During 2007, IBTS implemented a stand-alone Electronic Document Management System (EDMS) to assist in the processing of supplier invoices (IBTS Annual Report, 2008). Towards the end of 2007, IBTS also initiated implementation of a query tool named Blood Operations Support Software, or BOSS (IBTS Annual Report, 2007). BOSS was developed by the New York Blood Centre (NYBC) and could generate customised reports from the Progesa database. The need for such a query tool was stressed by the Director of Operations who identified the limitations with Progesa in terms of the absence of availability of MIS reports. After joining IBTS in 2005, he was instrumental in studying the supply and demand patterns of blood products and focussed on the rationalisation of duty roasters for donor collection. These two steps served as a cost saving exercise for IBTS. Interestingly, at the same time IBTS IT unit also suggested the in-house development of a data warehousing tool. However, IBTS decided to go for an external solution. Two tenders were run during 2007 resulting in the contract being awarded to NYBC. It was envisaged that both of these tools (EDMS and BOSS) would help in improving control and undertaking continuous improvements in business operation within IBTS.

It may be incorrect to think that IBTS was alone in Ireland in regard to facing problems related to its ICT projects. In its 2008 review report, apart from the eProgesa project, C&AG also reviewed ICT projects of Science Foundation Ireland, and Beaumont Hospital, both being cases of loss of public money in ICT investments with low/no value generation. In 2005, HSE halted its ES implementation project named Personnel, Payroll and Related Systems (PPARS) which incurred the exchequer €131m till August 2005, and a C&AG review was conducted for the project. More recently, Public Service Broker, an ambitious project to integrate all services of central and local government in Ireland, was closed down by the Government of Ireland in the first half of 2008 after expenses of more than €37m. The situation also reflects in the following comment from a member of the Committee of Public Accounts (2008): "*How does it happen that virtually every public body, whether it is a Department, State agency or whatever, that comes before this committee has a problem with IT? It seems to be universal, right throughout the entire system. I do not know whether we will ever get it right.*"

Indeed, in its review of e-Governance projects in Ireland, C&AG (2007) reports that approximate 16% of such projects did not progress or abandoned, and 31% were partly implemented. The report also notes that at the end of 2005, there were 161 such projects across all government Department and agencies, with an estimated cost of €420m. This investment was partly fuelled by the Celtic Tiger era of Irish economy which was marked by rapid economic growth. From 1995 to 2007, the Irish economy grew averaging 6 percent a year. Perhaps that is why Irish government approved so many ICT projects in its Departments and agencies. However, noting the frequent problems with the ICT projects within many Department and agencies, Department of Finance came up with a circular on arrangements for ICT expenditure in the civil and public service in 2009 which was subsequently updated in 2011. These circulars provided guidelines on issues such as project approvals, governance structures, project management, project reporting, and accountability management for ICT projects in the public service. It is under these changed and constrained environment IBTS continued its ICT journey which is the focus of the next Section.

4.5 Managing in Turbulent Environment (2008 - 2011)

As outlined in the previous section, the eProgesa project ended on a bad note and also dented the public image of IBTS. This section presents event sequence for the period 2008 to 2011 when IBTS focussed on changing its organisation structure and on re-focussing its ICT strategy. This section is divided into two subsections. Subsection 4.5.1 provides an outline of IBTS attempts on stabilising amid chaos. Subsection 4.5.2 provides details of events that took place when IBTS focussed on formulating a plan for the next change and started gathering support for the change.

4.5.1 Stabilising amid Chaos (2008-2009)

C&AG conducted a review of the eProgesa project in the first half of 2008. In its review, although C&AG agreed with the rationale provided for commencing the project and appreciated IBTS for its risk mitigation steps, in the report the following factors were attributed to the project failure (C&AG, 2008):

1. Requirements of IBTS were inadequately specified in the project definition and these gaps led to implementation problems with the project.
2. There was a lack of a long-term strategic plan for IT in IBTS.
3. There was an absence of a formal signed contract to define the scope of the project.
4. There was a lack of clarity on the roles and responsibilities of each of the parties to

the arrangement.

5. The use of a hardware platform on which the software was not validated.
6. There was a lack of formal process for the management of changes in scope, delivery times and other requirements.

On the positive side, the review noted some positive features of the management of the project. It noted that there was reasonable budgetary control over the project and the business case for the development was documented at the outset. It lauded the stringent quality standards and validation enforced by IBTS. The review also credited IBTS for taking a tough decision on suspending the project in order to cut its losses and rethink the project.

The eProgesa review commissioned by IBTS and conducted by KPMG made four key recommendations on IT strategy and planning, IS environment and supporting technology, avoiding dependence on a single supplier, and in regard to project management (CPA, 2008). Although IBTS dealt with IT under the pillar of technology and research in its strategic plan for 2005-2009, it did not have a specific IT strategy. Responding to the findings and recommendations, IBTS constituted an ICT council in the first part of 2008. It was chaired by the Chief Executive and had Head of IT as one of its members. The mandate of the ICT council was to review the skills mix and structure of the IT unit, identifying IBTS's future ICT requirements, and to develop an ICT strategy for IBTS. Risk register of IBTS, which was in existence since 2004, was divided into Organisational, Clinical and IT risk registers. The responsibility of reviewing and updating the IT Risk register rested with the ICT Council.

In the later part of 2008, IBTS also commissioned a study by an outside expert to suggest steps to maximise the business value from ICT. The study involved engagement with key business units of IBTS to assess what they expected from ICT, how they planned to maximise the value of ICT investments, and facilitating them in co-creating and co-owning the ICT strategy. The final deliverable for the study was a high-level blueprint for ICT-enabled change that responded to the key themes emerging from the engagement process. The study was scheduled to complete in Oct 2009 and the statement of ICT strategy was to be presented to the IBTS Board.

However, these changes were minor as compared to what was happening outside IBTS at the macroeconomic level. In 2008, as a result of a crash in real estate market in Ireland and due to the global downturn, economic activity dropped sharply and the country entered into a recession for the first time in more than a decade. Annual growth rate of

Ireland's GDP was record low (*minus* 8%) in the fourth quarter of 2008. Consequently, Irish government tightened its purse for its Department and agencies. This was evident, when the Chief Executive noted the following in IBTS annual report (2008, p. 8): "*The global economic downturn and the effect that is having on the Irish economy will have a significant impact on IBTS and we will be required to become more efficient and deliver greater value for money to the health system. This will be against the backdrop of fifteen years of substantial investment by successive Governments in the blood transfusion service which makes the transformation to working with less resources much more difficult.*"

In this backdrop, IBTS recognised that the business processes followed in its donation clinics and laboratories needed to be reviewed to make them more efficient in the new resource-constrained environment. IBTS felt that it needed an overhaul of its business processes and management structure. This recognition was also partly due to the release of 'Framework for Corporate & Financial Governance for agencies funded by the Department of Health & Children' in 2006. This was addressed in two ways. First was the review and revision of its management structure. The second was the commencement of a training and development programme (IBTS Annual Report, 2008). The revised management structure was launched in October 2008 following consultation with the key stakeholders. An Executive Management Team (EMT) was established and designated the senior decision-making body in IBTS. The EMT consisted of Chief Executive of IBTS and directors of Operations, Quality & Compliance, Human Resources, Finance, and Medical & Scientific Director. Simultaneously, IBTS also undertook a major training and development initiative covering clinic supervisory staff, middle management and senior management. The training and development initiative named 'Quantum Leap - Transformation through Learning', commenced in September 2008 and was scheduled to finish in September 2009 (CPA, 2008). IBTS expected that the skills and knowledge gained from the programme would be tested over the coming years when IBTS would have to operate within an environment of much-constrained resources.

Amid all the flux, the BOSS implementation that kick-started in Dec 2007 was also underway. It may also be recalled from Section 4.4 that BOSS was an independent query tool developed by NYBC to generate reports from Progesa. Unlike eProgesa, its leadership remained with the domain experts rather than with the IT unit. However, BOSS implementation was not bereft of problems either. In the beginning of the project, IT unit warned of competing priorities since Progesa stabilisation was also underway at the same time. In February 2008 though, a problem of a different kind emerged.

Due to project requirements, IBTS exported a selection of log files from Progesa to NYBC in an encrypted CD. The CD was handed over to NYBC personnel in Ireland during a visit to IBTS in Dec 2007. The log files in the CD contained the transaction files from Progesa for the period 2nd July 2007 to 11th October 2007 when 171,324 donor records and 3,294 patient blood group records were updated (IBTS Statement, 2008). Although the CD was kept in a physically secure environment at NYBC, the log files were copied in a laptop that was stolen from an NYBC employee in New York on 7th February 2008. This incident raised huge concerns about the privacy of donor and patient records and sent IBTS into the fire-fighting mode. IBTS notified the Data Protection Commissioner of Ireland on 11th February who conducted an investigation on the incident. After an investigation, the commissioner concluded that the encryption in place on the laptop was sufficient to ensure that there was only the remotest of possibilities of access taking place to the personal data in question. The investigation also concluded that even in such an eventuality of accessing the contents, the personal data in question did not contain any sensitive information in relation to any of the identifiable persons (DPC, 2008). Nevertheless, IBTS issued letters to all the affected donors on Feb 22nd and also wrote to the hospitals on March 7th. IBTS also considered its status as a data controller or data processor under the relevant Acts, with a view to develop a policy on the issue. By April 2008, a secure remote access was put in place for NYBC (IBTS Board Minutes, 2008).

Considering the environment in which BOSS was being implemented, it had to compete for resources with other projects running simultaneously. These included Progesa stabilisation, Electronic Quality Management System, log file archive, database backup, encryption policy, and e-Financials upgrade. It also struggled for attention from IBTS top management who were busy in EMT formation, preparing ICT Strategy, managing Cork Centre re-structure and Quantum Leap program. On top of that, reporting requirements of IBTS were different from those designed by NYBC in BOSS. Therefore, it required significant redesign for its optimal use in IBTS. At the end, all the reports IBTS implemented (more than 100) were custom-built during the project, rather than using the standard reports provided by the software.

The project structure for BOSS consisted of a steering group, sponsor, project manager, business analyst, SQL Developer, and the user groups. While the steering committee provided overall direction from the top, the user groups were expected to provide input for the report. Although the steering committee seemed to understand operational implications of BOSS before reports got delivered, the user groups were slow to select reports to be generated using BOSS. Eventually, the project manager and sponsor selected the reports to be implemented in BOSS. Once the reports were ready, users' lack of experience of validation test scripts and execution also created hurdles in the project.

In the later part of 2008, IBTS engaged in an interim audit of BOSS with its external audit partner. The report, submitted in November 2008 concluded that the system of internal controls surrounding the BOSS project was satisfactory but the project management approach at organisation level required further development. In particular, the audit lauded the senior management in providing a commitment to BOSS at project initiation in terms of providing resources and the appointment of a project manager. However, it expressed some concerns over the absence of a formal project management methodology, irregular updates of project risk register, incomplete functional requirements, and absence of a formal go-live and training plan. IBTS top management agreed to implement most of the audit recommendations.

Finally, the project got completed towards the end of 2009. At the lessons-learnt session in Dec 2009, it was concluded that appointing a project manager made a positive contribution to the project and added business knowledge value. However, it was also identified that BOSS remained an enterprise-wide system without an enterprise-wide ownership. Perhaps due to this lack of ownership, the project manager took too many responsibilities and in the process, the timeline creep was not understood, grasped, or owned. IBTS identified the need of full scoping in advance of setting timeline to maintain the trade-off among cost, content and timeline. During the BOSS implementation, costs were explicitly controlled and content became pre-eminent, but timelines were implicitly relegated to least priority. Consequently, the project was completed in Q4 of 2009, a year after the scheduled completion date of September 2008.

Apart from the completion of the BOSS project, by the end of 2009, based on the report from external expert and deliberation by IBTS board, IBTS had its ICT strategy in place as part of the overall IBTS strategy that consisted of six broad themes (IBTS Strategic Plan 2010-2012):

1. To provide a sustainable and safe blood supply and services that will meet all safety and compliance standards;
2. Maintain international best practice;
3. The provision of appropriate Patient Services that meet the needs of patients and clinicians;
4. Adapting to the changing business environment;
5. Relationships and Alliances; and
6. Reconfiguration of Services.

While developing its strategic plan, IBTS was aware of the changing business environment. It recognised that due to the changed economic circumstances, there would be significant pressure on it to reduce the price charged to the customers for the products it offers. To accomplish this, IBTS looked for significant cost savings through improved productivity and greater efficiency. The strategic plan conceived ICT as an integral component of adapting to changing business environment and stressed on restructuring and refocusing of the ICT function. It envisaged using ICT to deliver better quality business information, to improve the business processes, to develop closer links with the stakeholders, and to provide more dynamic interaction within and outside the organisation. Specifically, the focus of ICT over the lifetime of the plan (2010-12) was to:

1. Embed a strategic approach to the management of ICT resources and capabilities throughout the organisation;
2. Embed a collaborative approach to ICT-enabled change, including a system of continuous evaluations of all major ICT-enabled change programmes and projects;
3. Upgrade the blood bank system;
4. Create of an integrated over-arching management information system; and
5. Review, streamline and consolidate ICT operations and exploit opportunities for outsourcing aspects that could be more efficiently and cost-effectively carried out by external parties.

IBTS envisaged ICT as an enabler for its change agenda. For delivering ICT-enabled change, the report from the external expert strongly recommended the establishment of Office of the Chief Information Officer (CIO) and appointment of a CIO following international best practices. Irish public service also, in general, recognised the importance of CIO role and an Office of the Government CIO (OGCIO) was established in July 2013 for leading the implementation of Public Service ICT strategy.

However, although Head of the IT unit had direct access to the Chief Executive of IBTS, the position of CIO was never created within IBTS. IBTS board considered it for a while but it was concluded that the salary structure offered by IBTS may not attract suitable candidates. Consequently, contrary to the recommendations of external expert and intent in the strategic plan, IT did not get any ‘formal’ representation in the EMT of IBTS and the situation stayed the same at the time of writing the case. Instead, the most ‘immediate’ item of the ICT agenda of IBTS at the time was upgrading the blood bank system (IBTS Strategic Plan 2010-2012, p. 25). However, before embarking on that initiative, IBTS engaged in another change related to its product labelling.

4.5.2 Steering in Troubled Waters (2010-11)

In the blood transfusion industry, it is important to be able to trace the blood (and blood products) from the donor to the recipient. This is ensured by labelling each bag with a unique identifier and putting some additional (usually, testing related) information on the label. IBTS used seven-digit Codabar codes for this purpose. Codabar is a specific technology which may be used anywhere (e.g. blood banks, courier service, libraries etc.) irrespective of the context. Each organisation is free to decide upon the exact format of the seven digits in the Codabar code. Therefore, interoperability of Codabar codes is not possible unless explicitly planned. IBTS used Codabar system of labelling which was also shared with the hospitals so that they could also read and use the label correctly. Figure 4.2 shows an example of Codabar labels used in IBTS.

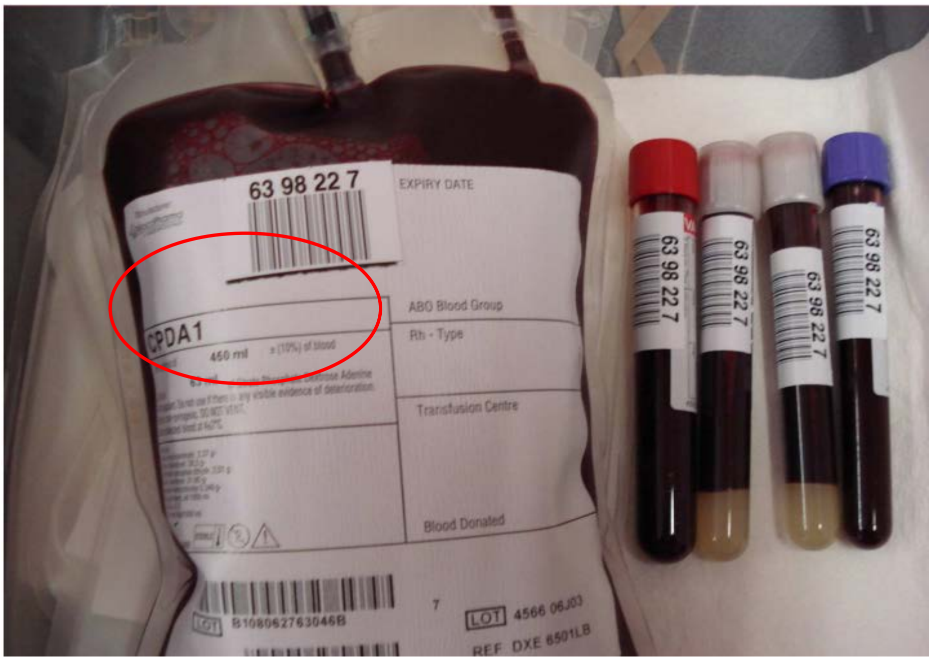

Figure 4.2: Codabar Labels used in IBTS

(Source: IBTS, 2010)

In contrast to the bespoke Codabar system, ISBT-128 is a global standard for the identification, labelling, and information transfer of medical products of human origin (including blood, cells, tissues, human milk, and organ products) across international borders and disparate healthcare systems. It was developed in 1994 by the International Society of Blood Transfusion (ISBT). One year later, the International Council for Commonality in Blood Banking Automation (ICCBBA) was established in 1995 and was given the responsibility for the management of ISBT-128. Version 1.0 of the ISBT-128

Standard Technical Specification was first published in 1997 and was intended to replace Codabar-based standards with a more secure bar code symbology using 14 digits.

IBTS board had considered the possibility of introducing ISBT-128 earlier in 2007 as well but decided against it since existing Progesa system was not compatible with ISBT-128 (IBTS Board Minutes, 2007). However, problems related to the Codabar system also started to surface in the next couple of years. Since the Codabar system has only 7 digits, it was inevitable that in few years, all the permutations will be exhausted and the code will repeat itself. When this happened and hospitals tried to import the repeating code into their systems, it either did not allow the code to be entered, or it overwrote the old data. In the first case, it meant delays in the transfusion to the patient. In the second case, it meant the loss of traceability. Neither of the cases was acceptable to the hospitals and IBTS.

Up until now, IBTS used two workarounds to resolve this problem. Internally, it had modified Progesa to include the year information to distinguish same Codabar codes from two different years. Externally, it made sure manually that the same Codabar code is never sent to the same hospitals twice. To develop a long-term solution to this problem, ISBT introduced a dual label for the donation identification number field in 2010. As shown in Figure 4.3, IBTS printed labels with the Codabar format on top and its corresponding ISBT-128 code below it. For hospitals, this meant that they were free to use either format depending on their capability. IBTS conducted a one-day training session with the hospitals in May 2010 and went live with the dual labelling in June 2010. This resolved hospitals' immediate concerns related to label duplication.

Figure 4.3: Dual Label with Codabar and ISBT-128 Codes
(Source: ISBT, 2010)

Coming back to its strategic agenda, in July 2010 the Chief Executive reported to IBTS board that software for the blood banking system required to be upgraded. He noted that the Progesa software was towards the end of its operational life and could not be used for long. The supplier for Progesa had also indicated that they would support the existing version of Progesa only around 2014 or so. Consequently, IBTS either needed an upgrade of the existing system or a replacement of the existing system. It was noted that the implementation time for any new blood bank system would be two to three years. The board agreed to the new project but IBTS also needed concurrence from the Department of Health. As mentioned at the end of Section 4.4, after noting consistent problems with ICT projects across Irish public service, Department of Finance had issued guidelines on ICT expenditure in 2009 and revised those in 2011. This made it mandatory for PSOs in Ireland to undertake ICT project above a certain cost with the concurrence of their parent Department (Department of Health in the case of IBTS) and/or the Department of Finance. In the second half of 2010, IBTS submitted the project proposal to the Department of Health. However, the main difficulty for IBTS was not because of the cost of the project or because of the problems encountered in the eProgesa project. It was due to some other factor unrelated to the project.

In the wake of the economic recession that started in 2008, the Irish government introduced a pension levy for Irish public service. Effectively, it was a pay-cut applied to the salary of civil servants that would be invested in pension funds to disburse pensions when they retire. There was a lack of clarity on IBTS's position since it already had its own pension fund. Nevertheless, IBTS started collecting the levy from its employees but decided not to transfer the money into Department's account until the matter was sorted out. In response to that, in Dec 2010, the Department decided to veto all IT projects of IBTS pending the payments of the money collected for the pension levy. In Jan 2011, the Department relented and approved the Bone Marrow database project. Again, this was perhaps due to the factor that IBTS needed to implement this project to join European Marrow Donor Information System, an international computer network of stem cells donor registries. However, the future of the new blood bank software was still in limbo since a similar argument could not be raised for its implementation. Subsequently, the Department continued to veto the proposal of its implementation unless IBTS deposited the collected pension levy.

The logjam continued during the first half of 2011 when IBTS tried to convince the Department of decoupling the pension and IT issues and Department kept vetoing the implementation pending the payments of pension levy (IBTS Board Minutes, 2011).

Ultimately, IBTS stressed that the timelines on support for existing hardware and software were finite and it would take some time to procure new hardware and to implement new software. IBTS argued that this posed a huge risk to the blood supply system if the existing system went down at some point in time. Therefore, despite Departmental veto, IBTS went ahead with publishing a Request to Participate (RtP) to progress the project. It added an additional clause in the RtP document which would allow IBTS to cancel or not to proceed with the tender, in case the Department continued to veto the project. However, IBTS did not need to use this clause since the Department of Health approved the project in May 2011. RtP was published by June 2011. IBTS looked for a more integrated system covering its Blood/Tissue bank operations in the RtP. The supplier was responsible for supply, installation, configuration, acceptance testing, data migration, integration including interaction with third party vendors, delivery of all interface requirements with associated costs, delivery of the entire training programme, implementation, and providing on-going support on a 24x7x365 basis.

Along with the approval, the Department of Health recommended the establishment of the Peer Review Group (PRG) for the project and suggested its composition. The peer review process was implemented on foot of a Government of Ireland decision in Oct 2005. The process is applicable to major ICT projects being run by Government Departments and State Agencies and organisations under the aegis of Departments and Agencies. A peer review is an independent, structured review of a programme or a project carried out at key decision points by a team of experienced people, external to the Sponsoring Organisation, i.e. the Department/Agency in charge of the project. Reviews are carried out at key decision points of a project including the business case, the preparation of the tender requirements and subsequent tender evaluation exercise, the proposed contract, project initiation, key milestones in the project cycle, and project completion. However, it may be noted that the peer review process does not override the ultimate decision making and the concomitant accountability arrangements of the sanctioning authority and/or sponsoring organisation (GoI, 2010).

Nevertheless, not all IT projects are subject to peer review. In deciding whether an ICT project should be submitted to the peer review process, the sponsoring Organisation should take the following factors into consideration (GoI, 2010):

Estimated cost – projects with an estimated cost of €5 million or more must be submitted to peer review;

Risk – projects with a significant element of risk due to their scope, timescale, technology approach; priority within an organisation; and the capacity of an organisation to take it on board;

Impact – projects which propose large-scale changes to work practices or staffing issues or have significant programme or policy implications;

Regulatory framework – projects with significant legal compliance outcomes; and

Dependency – projects with cross-organisational or multi-organisational interfacing or dependency elements.

It may be noted here that IBTS is not funded through Voted monies and therefore need not form a PRG by law. Nevertheless, IBTS complied with the recommendation of the Department and accordingly formed a PRG for its blood bank project in Q3 of 2011. PRG had one member from the Department of Health, one member from the HSE, and one outside expert. In the meantime, IBTS had also received responses (4 in number) to the RtP. In the Q4 of 2011, IBTS prepared a User Requirement Specification (URS) document and a draft contract to go with the URS. These documents were approved by PRG and a tender for the project was published before Christmas of 2011. As envisaged in the RtP, the tender document also sought integration of entire blood and tissue operations within IBTS. Specifically, it sought functionality related to donor services, donor vigilance, nursing / medical, component processing, hospital services, quality control, laboratory testing, medical virology management, patient management, tissue banking, Haemovigilance, and MIS reporting.

There were some relevant developments around 2010-2011 both externally and internally. Externally, in early 2010, MAK Systems, the supplier of Progesa and eProgesa system, bought BOSS reporting system from NYBC. At the same time, IBTS had also renewed the contract with NYBC for BOSS support which was valid till 2014. Internally, IBTS undertook the development of a web-based Electronic Ordering System (EOS) to receive online orders from the hospitals, thereby intending to replace the manual, telephone-based ordering process. The push for the development came from the HPRA audit when they noted a large number of customer complaints. These complaints were related to delay in the delivery of the product or the delivery of the wrong product. The regulator identified this as a serious deficiency and asked IBTS to look for a solution. EOS envisaged to replace the manual order receipt in both the Dispatch and Issue laboratory areas and to further strengthen the relationship between Processing and Hospitals Services departments. EOS was meant to provide an improved and more efficient link to the hospitals by greatly reducing the errors caused by misunderstanding in the verbal communication. It was also expected that EOS would provide an improvement in the quality of service and provide a more efficient service.

The project was conceived by the hospital services unit within IBTS and a member of an IT unit worked on developing the solution. Although the head of the IT unit expressed concerns about the security aspects of such a system, system development continued for EOS nevertheless. IBTS followed the design of "*the system developed by the English Blood Service in this regard*" (R1). By May 2011, the pilot testing of the system with a nearby hospital was completed and modifications were done in the software based on the feedback received from the pilot test site. The system was planned to go-live in all the hospitals by September 2011. However, the plan hit a roadblock due to the difficulty in contacting the relevant IT personnel in smaller hospitals. Consequently, the project was live only in three hospitals by the scheduled deadline. To put the number in context, IBTS deals with around fifty hospitals across Ireland. Another issue that IBTS identified was that the private hospitals were not on the government VPN and this required upgrading of the firewall if they had to connect to EOS. IBTS worked to resolve the issues and finally by March 2012 EOS was live in every hospital. Apart from hospital service, it was seen as a positive development by the Quality department within IBTS in terms of improving service quality to IBTS customers (i.e. Hospitals). However, the new integration project was on a different scale and required significant effort from IBTS. This is covered in the next section.

4.6 Second Wave of Integration (2012 - 2015)

The new integration project was on a much wider scale compared to the first wave of integration that IBTS undertook during 2000-03. While Progesa covered only the blood bank operations for IBTS, the new project intended to cover patient transfusion information, incident tracking, and tissue, cord blood and stem cells operations apart from covering the core blood bank operations. This section covers the events for the period between 2012 and 2015 and is divided into three subsections. Subsection 4.6.1 focuses on the events from 2012-13 when IBTS performed the groundwork for the integration. Next, subsection 4.6.2 describes the events in 2014 when two smaller modules were rolled out but IBTS identified critical problems in implementing a change of its blood labelling system. Subsection 4.6.3 outlines the events during 2015 when the core module eProgesa was rolled out after facing problems associated with the change of labelling system.

4.6.1 Setting the Stage (2012-13)

The closing date for the tender was January 2012 which was subsequently extended to February 2012. IBTS received only two responses – one from its existing supplier, another from a supplier from the UK. The existing supplier offered a suite of applications on top of eProgesa. The other supplier primarily supplied software for blood bank operations only. In its strategy map (2013-16), IBTS envisaged using IT to streamline its business processes and using information for timely decision making. This required integrating all business operations and generation of regular reports. Therefore, although IBTS had apprehensions due to existing supplier's business practices, after tender evaluation it chose to go with the same supplier. The tender was reviewed by PRG and awarded to the supplier in April 2012. Contract negotiation and signing were over by July 2012 and the project was kicked off in September 2012.

The project, named Blood Establishment Computer System (BECS), apart from the establishment of IT infrastructure, had 5 major elements – eProgesa, eRiskline, eTraceline, Tissue Chord and Stem Cells (TCS) module, and BOSS interfacing. ***eProgesa*** was now a mature software application which was marketed by the company as the successor of Progesa. Unlike Progesa which was a client-server based system[28], eProgesa was a web-based system[29]. In terms of database architecture, unlike Progesa which was a flat-file system, eProgesa was based on relational database architecture offering more security and a range of possibilities for reporting. However, like Progesa it covered only blood bank operations. ***eTraceline*** was designed for blood bank reference lab and clinical services. eTraceline functionality permitted the tracking of patient transfusion requests from the time the order is placed, including sample verification steps, to the final patient to whom the blood is transfused. It provided an interface with eProgesa to allow for electronic stock movement, automatic quarantine in the event of a donation recall and tracking of components from the donor to the patient through automatic updating of eProgesa with the transfusion details from eTraceline. ***eRiskline*** was a user configurable risk management system that could be used to record and track all adverse incidents/events or nonconformities that occur within a blood service. eRiskline provided functionalities such as incident reporting management, investigation management, risk management, and providing statistics. ***TCS*** was a user configurable web software solution dedicated to the management of Tissue, Cord Blood and Stem Cells activities. TCS

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[28] In a client-server based system, an application is installed on the machine (known as the client) that needs to use the service. This application then connects to the machine (known as the Server) providing the service. This limits the usage of the system.

[29] A web-based service can be accessed from any system using log-in credentials and does not require installation of any additional software, thereby providing flexibility in terms of system use.

provided functionalities such as tissue/cord blood/stem cells donor record, mother-baby link for cord donation, user defined screens and processes per product, interface with laboratory results, medical release, and recipient management. Finally, ***BOSS interface*** was to provide continuity from Progesa to eProgesa in terms of reports that were prepared by IBTS for its use.

Perhaps due to earlier experience and observations made in C&AG reports and CPA debates, IBTS formed an elaborate governance structure for managing BECS as shown in Figure 4.4. From supplier side also, a similar structure was in place where they had one member in the Project Steering Group (PSG) and had their own project manager and individual resource persons for the work-streams. The reader may notice that there is no mention of ICT council in this governance structure. This is due to the fact that ICT council ceased to exist in 2012. The main reason cited for it was that the ICT council was getting engaged in minor details of ICT and had lost its strategic focus (R2, R5). An example of this was found in the IT risk registers that contained 90 risk items across 24 risk categories. The Chief Executive of IBTS disbanded the ICT council during 2012 and review of IT risk register was now the responsibility of the Chief Executive and the IT manager. Nevertheless, following paragraphs outline the constitution and responsibilities of difference governance units on IBTS side.

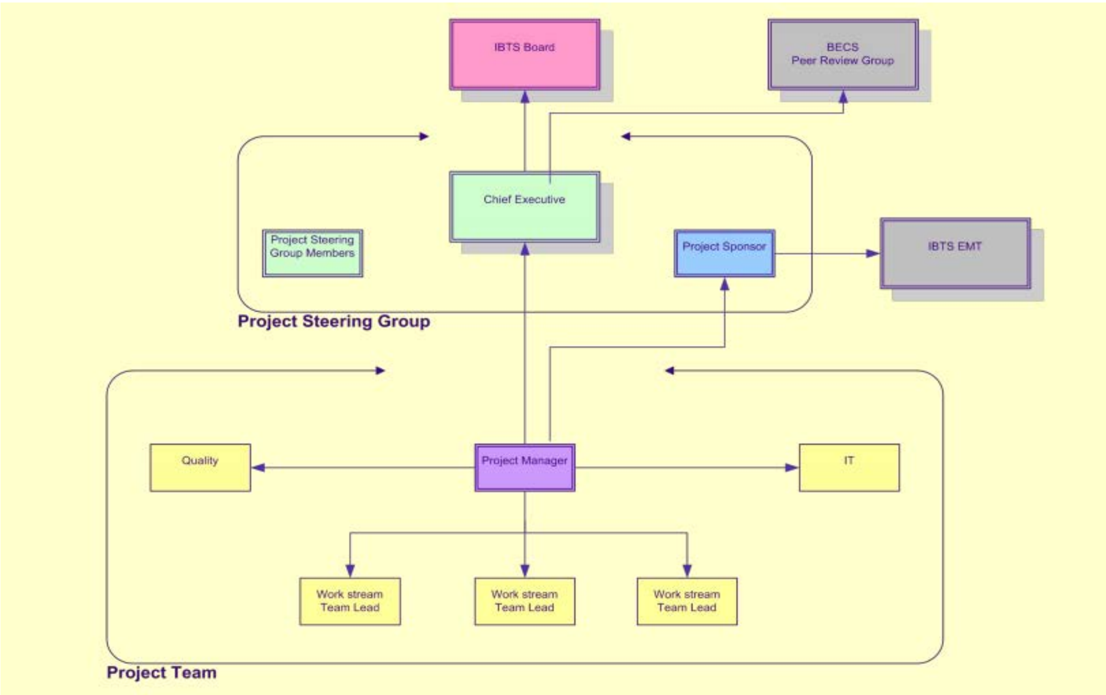

Figure 4.4: Governance Structure for BECS Project

(Source: BECS Project Documents)

Peer Review Group (PRG) - As mentioned earlier, Department of Health had asked IBTS to form a PRG for the BECS project. The PRG had one member from the Department of Health, one member from the HSE, and one external expert. PRG's function was to provide external project governance oversight on the BECS project to ensure that IBTS is conducting the project in accordance with the best practice for Public Sector large project implementation. The project sponsor had to report at the end of each PRG stage to the PRG group.

Project Steering Group (PSG) - The steering group was formed by taking 4 members from the EMT (refer section 4.5.1) and one high-level representative from the supplier. The Chief Executive of IBTS chaired the PSG. The following were the core functions of the project steering group:

1. To ensure that a project manager is appointed;
2. To provide overall direction and guidance to the project;
3. To commit the necessary resources to carry out the project;
4. To ensure the project delivers its objectives and benefits;
5. Ongoing validation of the business benefits;
6. To resolve escalated issues and problems;
7. Termination of the project when the project is complete or when the business benefits are deemed to be no longer viable; and
8. To Accept and approve the End Project Report.

Project Sponsor - Director of Operations assumed the role of BECS project sponsor. His roles and responsibilities included the following:

1. Single point of contact with the project manager for the day-to-day management of the interests of IBTS;
2. Ongoing management on behalf of the organisation to ensure that the desired project objectives are delivered;
3. Coordinating and fostering teamwork;
4. Managing the project manager's performance of delegated responsibility;
5. Establishing formal reporting arrangements on project progress;
6. Defining criteria for control and management of the project;
7. Assisting the project manager in the resolution of problems;
8. Receiving and reviewing detailed reports on the project from the project manager;
9. Ensuring the project manager receives departmental decisions on time;
10. Establishing with the project manager a common approach to major issues that arise; and

11. Establishing a mechanism to ensure regular dialogue with supplier to promote problem-solving, team working, and risk sharing

Project Manager - An external contractor, who had wide experience of working as validation manager with different IBTS units, was appointed Project Manager for BECS. Following were the roles and responsibilities of the project manager:

1. Reporting through agreed reporting lines on project progress through reports and stage assessments;
2. Liaison with appointed project assurance roles to assure the overall direction and integrity of the project;
3. Adopting technical and quality strategy;
4. Identifying and obtaining any support and advice required for the management, planning and control of the project;
5. Managing project administration;
6. Conducting end project evaluation to assess how well the project was managed;
7. Preparing a Lessons Learned report; and
8. Preparing any follow-on action recommendations as required.

Project Work Streams - The project was divided into different work-stream according to the business processes and the functionality of the software. IT infrastructure, eRiskline, eTraceline, TCS, and BOSS interfacing - each were individual work streams. Due to the complexity of the eProgesa module, it was further divided into seven work-streams - donor services, nursing/medical, components/hospital services, quality control, laboratory/medical virology, HLA[30], and Finance. In most of the cases, head of the concerned department was made the work-stream lead. Each team lead was assisted by a superuser, usually taken from the same department, who had extensive knowledge of the business process and existing systems if any. Following were the responsibilities of work-stream team leads:

1. Agree on configuration specification for their respective area(s);
2. To deliver agreed on work package within identified time, cost and quality constraints;
3. Undertake defined tasks within agreed constraints of time and cost;
4. Identify and notify any issues affecting the project to the Project Manager;
5. Provide timely feedback on progress to the Project Manager;
6. Contribute to the capture of project lessons learnt; and
7. Manage their respective team.

[30] HLA later on stayed away from the project citing non-suitability of the software for its business processes.

An interesting point to note here is that apart from the project manager, all the members of the implementation were drawn from existing workforce in IBTS and they were expected to contribute to the BECS project apart from conducting their regular duties. Although IBTS cited reasons such as harnessing domain knowledge of the existing workforce, developing in-house IT capabilities, and avoiding over-reliance on the supplier, recruitment embargo by the Department of Health (along with the embargo in Irish public service in general) might also have played a big role in this. Even project manager, who was appointed on contract, was already working with IBTS as a validation manager on contract. This pattern of staffing also had implications for project costing. IBTS took a deliberate decision that the BECS resource allocation would be tracked but would not be attributed to the project. The main argument was that, with the exception of the project manager, none of the resources was hired fresh for the BECS project and neither their post were being back-filled when they moved to the project. This was unlike the eProgesa project in which staff costs were capitalised as project cost, thereby resulting in the inflated figures of loss. Nevertheless, with all the governance structure and systems in place, IBTS was ready to take the first steps into the project implementation.

During 2013, IBTS focussed on putting IT infrastructure in place for BECS and implementation of eTraceline and eRiskline. In July-August 2013, IBTS conducted the first review of a two-part review of the BECS project with external auditors. The review was focused towards governance process and noted two deficiencies related to project communication and risk management. Following a walk-through of project roles and responsibilities with the members, the review found that they were not aware of their full project specific responsibilities highlighted in the BECS Project Planning Document. The review also found that the project risk log (separate from IT risk register discussed earlier) was not being updated with the status of risk mitigation actions. It was however noted that risks were tracked via the monthly project status update report. In response, IBTS decided that project risk log was the responsibility of the project sponsor and the project manager and that it would be updated on monthly basis. At the year end, IBTS also had an IT audit in which some concerns were expressed regarding server security, access rights, system logs, resource reporting, network issues, project management methodology, change management plan, and disaster recovery plan. Most of the issues were identified as having medium risk and IBTS management asserted that mechanisms and plans were in place to address those risks. eTraceline which was due to go live in 2013 end, was deferred to Q1 of 2014 to allow for the infrastructure for backup of BECS to be upgraded and to implement IT audit recommendations regarding server security.

4.6.2 Tasting Little Successes and Facing Big Challenges (2014)

At the start of 2014, IBTS noticed that supplier invoices consistently got delayed and did not properly reflect the content and amount of work. The supplier's billing practices were also discussed in the finance committee of IBTS. IBTS sent a letter to the supplier setting out the issues that needed to be addressed. The CE of IBTS also arranged a meeting to meet the supplier in Paris for discussing IBTS concerns and for reaching an agreement regarding billing. The negotiations with the supplier on cost issue were finally concluded in June 2014 and later on agreed by the finance committee of IBTS. The eTraceline module rolled out in March 2014 and the eRiskline module rolled out in June 2014.

As IBTS proceeded with eProgesa implementation, users from the lab reported that the system performance was slower than similar functionality offered in the Progesa system. For example, during testing in July 2014, the users found that total data transmission time for the test results into the BECS system was increased to 51 minutes compared to earlier 30 minutes (R6). Users were informed by the BECS team that resolving this issue required an upgrade which was being implemented. The issue of delay primarily related to two aspects. The minor factor was that while Progesa was a single integrated system covering all major functionalities, the new architecture had different modules for specialised tasks. However, the major factor that caused this delay was the new interface between the testing equipment and the BECS software modules. As shown in Figure 4.5, earlier all the test equipment had their proprietary middleware to the Progesa system. In the new architecture, BECS module could no longer accept data directly from the middleware. As shown in Figure 4.6, the new architecture required a new component called eDMS (electronic Device Management System) or concentrator provided by the same supplier to collate all the results from middleware and then to supply the data to BECS modules. Effectively, this introduced an additional layer in the software architecture, thereby causing much delay. Although BECS team was not happy with this and IBTS contacted the supplier on this issue, but they were informed by the supplier that this was the only option available to them.

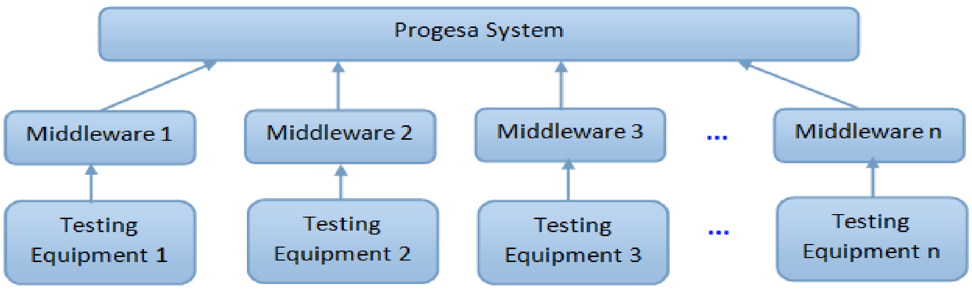

Figure 4.5: Progesa Interface for Testing Equipment

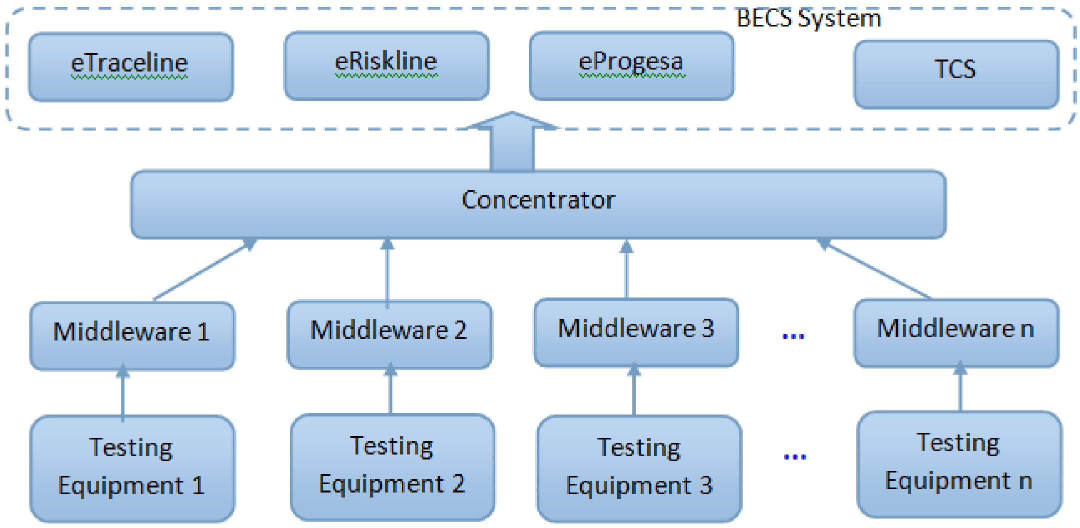

Figure 4.6: BECS Interface for Testing Equipment

A similar issue was observed with the BOSS reporting system which was originally designed to work with the Progesa system. Now, the application interface had to be upgraded to work with the BECS system, in particular with the eProgesa module. IBTS contacted the supplier to resolve both of these issues, but the main focus was now on the implementation of the eProgesa system. While eRiskline and eTraceline module were relatively smaller modules, the eProgesa module was the backbone of the BECS system covering the core blood operations. Perhaps, that is why as mentioned in the subsection 4.6.1, eProgesa was further divided into seven work-streams - donor services, nursing/medical, components/hospital services, quality control, laboratory/medical virology, HLA, and Finance.

Along with the eProgesa implementation, IBTS also decided to introduce full-face ISBT-128 labelling system. As noted in Section 4.5, ISBT had earlier introduced a dual labelling system incorporating Codabar and ISBT-128 labels in 2010 to avoid duplication of numbers in the donor identification number field in Codabar labels. However, identification or labelling of biological products is only one aspect of ISBT-128. ISBT-128 encodes information about biological products in a manner that allows the information to be transferred from one computer system to another in a way that is unambiguous and accurate (ICCBBA, 2016). ISBT-128 specifies:

1. A donation numbering system that ensures globally unique identification;
2. The information to be transferred, using internationally agreed reference tables;
3. An international product reference database;
4. The data structures in which this information is placed;
5. A bar coding system for transfer of the information on the product label;

6. A standard layout for the product label; and
7. A standard reference for use in electronic messaging.

ISBT-128 blood labelling system is endorsed by the Red Cross, European Blood Alliance and United Kingdom National Health Service. The system has been implemented in blood banks in Canada, Denmark, Finland, Norway, Switzerland, and United States of America, among others. A sample ISBT-128 full face label is shown in Figure 4.7.

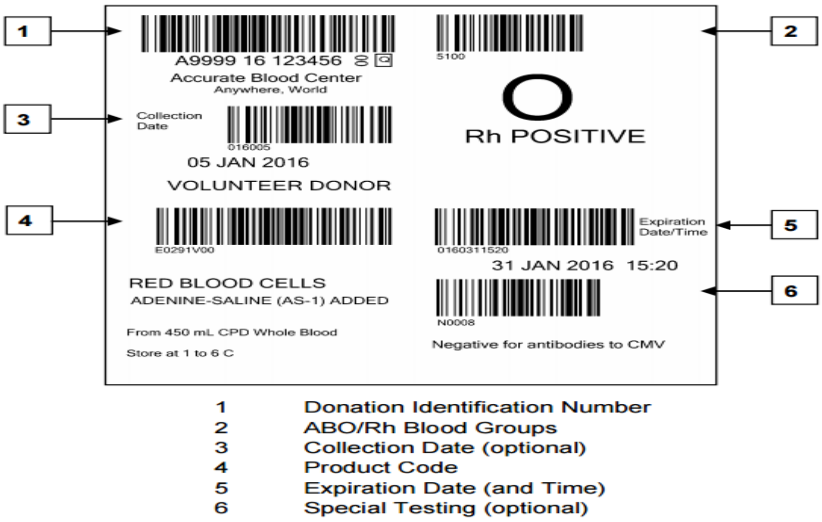

Figure 4.7: Sample ISBT-128 Label

(Source: ICCBBA, 2016)

Since IBTS was anyway engaging in system change from Progesa to eProgesa, it decided to go for full face implementation of ISBT-128 which was long overdue. Since the implementation of ISBT-128 had repercussions for the hospitals, the responsibility of managing the change was given to the Components and Hospital Services work-stream of eProgesa. In March 2014, the Components and Hospital Service, along with the IT unit within IBTS organised a workshop with the hospitals informing them about the proposed change in the labelling system. In the workshop, the hospitals were informed about the data structure being used, possible impact on their systems, and supporting documentation provided by ICCBBA. IBTS informed the hospitals that eProgesa (along with ISBT-128) would be live in Q4 of 2014.

However, IBTS soon realised that this was not going to an easy task. Data related to the blood transfusion products is usually managed by Laboratory Information Management Systems (LIMS)[31] in hospitals. By June 2014, it was noted that different hospitals had

[31] A LIMS is a software that stores, processes and manages data from different stages of patient healthcare. It usually covers (but not limited to) the functions related to patient check-in, test request, test result entry and outpatient status.

different LIMS provided by different vendors. Even for LIMS provided by the same vendor, different hospitals were on different versions of the software. Notwithstanding that, it was the responsibility of individual hospitals to make their LIMS compatible with ISBT-128. At the same time, issues related to BOSS interface and concentrator performance remained largely unresolved. Consequently, in Nov 2014, IBTS changed the proposed go-live date for eProgesa to April 2015.

Towards the end of 2014, IBTS also engaged in the second review of the BECS project. The audit focused on performing a high-level review of the status of the BECS project implementation. The review assessed the level of assurance for the project relating to the suitability of arrangements, controls, testing and project target against the requirements set by the organisation. The review also assessed the status of the project against potential risks relating to the expectations of the organisation, project planning, budgeting and management. It also examined the strength of governance surrounding the BECS project in addition to reviewing the management of the project specific risks. Detailed design configuration decisions and issues related to business engagement, change management and business transformation were out of scope for the review.

The review noted that a project plan was in place to monitor the progress of the BECS project and it was updated on a periodic basis as required by the project. The review also identified that a detailed risk log was in place which records all key risks associated with the project. IBTS formally assessed these risks on an ongoing basis through project meetings. It also noted that a well-defined development process was in place incorporating an appropriate approval process. A controlled testing plan was also in place to manage development changes which included unit-testing, stress-testing and user acceptance testing. In addition to this, a deviation log was also used to highlight any deviations to the development of the BECS project. This log monitored each deviation from the implementation plan.

It was noted in the review that monthly steering meetings took place to monitor the progress of the BECS project. However, the audit found that the frequency of the PRG meetings was not maintained in 2014, resulting in a decrease in external oversight of the project at different stages of the project. It was opined that this could lead to certain risks not being fully identified and could negatively impact the BECS project due to the lack of comprehensive guidance. The review recommended that the PRG reinstates the quarterly reviews to provide formal guidance to the project team and project steering committee as per the PRG terms of reference. Subsequently, a discussion was held with PRG and PRG identified budget overrun as a major issue if the system did not go live as planned for April 2015.

4.6.3 What's in a Name? - Dealing with ISBT-128 (2015)

After the go-live of eRiskline and eTraceline, IBTS shifted its attention to eProgesa, BOSS and the concentrator. As far as eProgesa is concerned, by and large, it followed the same business process flow as in Progesa with two changes. The first change was the introduction of a label called Work-in-Progress (WIP). This allowed IBTS to generate WIP label for the sample with incomplete test results. This was to facilitate the existing practices within IBTS. However, the other major change was the introduction of ISBT-128 labels and it had repercussion outside IBTS as well. In IBTS board meeting in February 2015, it was acknowledged that although the concentrator was progressing well, there were issues with BOSS and ISBT-128 labelling. In mid-April, it was noted that some of the middleware was not compatible with the ISBT-128 and resolving this would require workarounds. The go-live date for eProgesa was moved to June 1st. However, resolving these issues and further testing the solutions took some more time and go-live was once again re-scheduled to end of June. By mid-June, testing was completed and project team felt that the system was on course to go-live. However, this feeling was very short-lived.

As noted in the previous subsection, IBTS had informed the hospitals in March 2014 about the full-face implementation of the IBTS-128 labelling system. At the time, the presentation was mostly indicative and generic since IBTS had yet to implement the specific configurations and product codes. For the time being, the hospitals were directed towards the ICCBBA website for further information. Afterwards, there was no communication from IBTS to the hospitals for a long time in this regard. When IBTS's CE wrote to the hospitals in May 2015 informing them about the go-live of eProgesa in June 2015 and noting that the go-live would mandate the use of ISBT-128 labelling system, it caught many hospitals by surprise. This was primarily due to the reason that IBTS did not communicate with them regarding the labelling issue after the workshop in March 2014. While the BECS project team was "*happily developing the labels and doing everything that* they *needed to do, it had somehow forgotten about the hospitals"* (R23). Consequently, many hospitals did not initiate the process of IBTS 128 implementation at all in the anticipation that ISBT-128 project "*may not take off*" (R3).

Notwithstanding the relative lack of communication from IBTS, "*hospitals themselves expected to be in a very different place in relation to their ability to read ISBT-128*" (R1) into their LIMS. At the time, each hospital in Ireland had (and they still have at the time of writing) independent relationship with their LIMS supplier. There were a number of suppliers associated with a number of hospitals. Even with the same supplier, different hospitals were on different versions of the LIMS. Consequently, there was no uniformity of LIMS across different hospitals. This was on top of the fact that different hospitals had different capability and capacity to implement and use IT in their business processes. For example, while St. James Hospital in Dublin had already implemented ISBT-128 even before the BECS project started, other hospitals only tried to do so after ISBT communicated its intention to introduce ISBT-128 along with BECS.

With an intention to avoid this discrepancy and to bring all the hospitals at the same platform, HSE announced a National LIMS (named MedLIS) implementation and awarded the contract to a supplier in October 2015. The project is scheduled to complete in the year 2019. Interestingly, none of the existing suppliers of the hospitals got the contract. Subsequently, existing suppliers lost interest in maintaining and supporting the existing LIMS in the hospitals. Therefore, even though the hospitals would have tried to get their LIMS ready for ISBT-128, they probably did not receive enough support from their supplier. For example, a good number of the hospitals were waiting for a patch from a particular LIMS supplier which did not arrive on time. Those few hospitals which had initiated it, their LIMS supplier required specific configurations chosen by IBTS and a set of product codes with sample labels to develop and validate the system. When such hospitals contacted IBTS with queries, IBTS responded with information but it was more ad-hoc and haphazard in nature. In a sense, IBTS was "*chaotically firing things out at them"* (R4).

Upon receiving the communication about June go-live, most of the Hospitals wrote back to IBTS expressing their inability to move to the new labelling system. IBTS stressed that it intends to go-live with the new system anyway but moved the go-live date to June end in order to give the hospitals some more time. However, this was insufficient for the hospitals and subsequently, the hospitals informed the HSE noting that they wouldn't be able to switch to the new labelling system. When the HSE contacted IBTS about it, IBTS maintained that it was hospitals' responsibility to ensure that their systems are compatible with the ISBT-128 labels and they were told in advance. Eventually, the matter reached the regulator (HPRA) since hospital's inability to read ISBT labels would have resulted in disruption of the supply of blood to the patients. The HPRA called a meeting with the HSE and IBTS. Finally, IBTS relented and made a last minute decision to postpone the go-live by three months. Since many hospitals were not able to implement ISBT-128 even with the extended timeline, as a compromise it was also decided that the ISBT-128 label would also include a Codabar code to ensure compatibility with the LIMS in all hospitals. At the end, the situation was similar to earlier labels albeit in a reversed way. Earlier dual labels had Codabar labels for all the fields and additionally had donation identification number in the ISBT-128 format. New dual labels had ISBT-128 codes for all the fields and additionally had the Codabar codes at the bottom of the new label.

Interestingly, although IBTS participants assert that they opted for dual labelling due to the inability of the hospitals to move forward with the new labelling system, they too needed both sets of labels. Since some of their machines/analysers within IBTS could not accept IBTS-128 barcode due to size limitations, IBTS was anyway converting the ISBT-128 code into a Codabar code. Due to the nature[32] of labelling in ISBT-128, this 'new' Codabar system needed 56 new product codes. Consequently, the hospitals that were staying with the Codabar system needed to input these new 56 Codabar product codes to continue working with the old labelling system. At the same time, IBTS also noted a couple of problems in its ISBT-128 implementation. The first problem related to the special testing bar code of the label. As per ICCBBA recommendations, this code is used to hold test information about blood antigens with the last part of the barcode reserved for the rare type of antigens. ISBT included all the regular antigen types plus one specific rare antigen type that it usually encountered during testing but other types of rare antigen types were ignored during the configuration. As it turned out, St. James hospital, that had already implemented ISBT-128 even before IBTS, had included other rare antigen types as well. This would have resulted in an inconsistency of information about those antigen tests. Although these issues came up during parallel runs, IBTS ignored these issues considering them irrelevant. The second problem was related to the issue of interim labels. These would be the old labels from existing stock that would still be in the system after eProgesa rollout. These labels would have created problems for those hospitals that had gone with the full-face implementation of ISBT-128. eProgesa team had to work on resolving above two issues.

After resolving the above two issues, IBTS also prepared an information pack of all possible product codes and sent it to all the hospitals in late July. As per understanding developed with the HPRA, IBTS gave the hospitals 4 weeks' time to validate their system. The information pack included both ISBT-128 full face label and Codabar labels (including 56 new product codes) for validation. Although the hospitals appreciated the information pack, most of the hospitals considered that it was too late. Finally, eProgesa went live in

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[32] For example, while radiated and irradiated blood had same product codes in the Codabar system, ISBT-128 assigns different product codes to the radiated and irradiated blood.

September 2015. After go-live, no major problems were reported by IBTS users or the hospitals perhaps due to the fact that a large number of hospitals remained with the Codabar system of labelling. IBTS annual report (2015) notes that 15 hospitals transitioned to full ISBT 128 labelling and 31 hospitals were still using the Codabar label. Nevertheless, full-face ISBT-128 implementation by IBTS has now "*given the hospitals the capacity to migrate across at their time"* (R3).

For most of the internal users, migrating to the new system was rather smooth and they did not face any major change in terms of interface and processes since BECS team had deliberately sought to replicate those from the Progesa system. Most of the users and superusers seemed happy with the variety and quality of reports available with the new system. However, there were still some complaints about the slowness of the new system. One set of complaints related to the delays associated with printing the new labels. However, it should be noted that while the earlier system was printing the label in two separate stages; new ISBT labels are being printed in a single step. The sum total of previous two steps is more than the time taken for label generation in a single step. The second set of complaints were primarily related to the delay by the concentrator in fetching and transferring results as discussed in subsection 4.6.2. At the time of the end of data collection (Dec 2015), this issue of the concentrator was still open for further discussion and negotiation with the supplier. The IT teams also had to agree with the supplier and the business on scheduling the maintenance of the system, since unlike Progesa, eProgesa requires a complete shut-down of the system for installing upgrades. Some of the system fixes were installed in early 2016 to implement some minor changes and IBTS focussed its attention on implementing TCS, the last module of the BECS project.

4.7 Summary timeline of the Events

This section presents a summary timeline of the events described in Sections 4.2-4.6. As discussed in Chapter 3, a processual inquiry not only focuses on the sequence of events occurring at the organisation level, it also captures events occurring across different levels. Table 4.1 provides a summary timelines of events over time and across levels. As defined in Chapter 3, Work-system level refers to systems (Progesa/BOSS/eProgesa) which carry out a specific set of activities in an identifiable and bounded subsystem at IBTS; organisation level refers to the activities of the IBTS (including other IT and non-IT systems); and macrosocial level refers to communities, industrial sectors, and institutions operating at the overall level of a society (Trist, 1981: 11). It is acknowledged here that the levels considered do not remain isolated and there is significant interaction across different levels. Indeed, as this case study shows, not only events at the same level affect the outcome, events occurring at one level have an impact on other levels and on the final outcome.

Table 4.1: Summary timeline of Events across Levels

time-line	Macrosocial Level	Organisation Level	Work-System Level
1998	Resolution of Y2K Problem,	IBTS Approaches the Department of Health	Progesa project is initiated
1999	High Demand of IT Experts,	Change of office premises	BBCS is made Y2K Compliant
2000	Supplier being busy in other sites		Identification and resolution of Locking problem in Progesa
2001		Dealing with the Industrial Relations Problem	Progesa configuration, validation and testing
2002	C&AG conducts a review of Progesa project		
2003	Committee of Public Accounts discusses the C&AG report and seeks explanations from IBTS		Progesa goes live Implementation and interfacing of laboratory automates with Progesa
2004	Mak initiates development of eProgesa	Q1: IBTS decides to implement eProgesa Q1-Q4: In-house Development of Haemovigilance system Q4: Introduction of IT Risk Registers	Q1-Q4: Implementation and interfacing of laboratory automates with Progesa May: Project definition developed for eProgesa implementation December: eProgesa implementation starts
2005	April: IBTS hosts International MAK Users conference	Q1-Q4: Upgrade of IT infrastructure (Software and Hardware) Dec: IBTS decides to continue interaction with other sites on eProgesa implementation	Q1: Supplier identifies some gaps in the project definition Q2-Q4: Superusers identify a range of issues with eProgesa August: Merger of donor and patient files systems on Progesa
2006	May: Singapore Blood Bank goes live with eProgesa		Q1-Q4: Identification of more issues and working on fixes Sep: IBTS decides to continue with the

			implementation
2007	July: KPMG starts review of the eProgesa Project	Implementation of Electronic Document Management System	March: IBTS decides to stop the eProgesa project and to stabilise Progesa onto the new hardware Q4: IBTS initiates the BOSS implementation; Stabilisation project for Progesa commences
2008	C&AG conducts a review of eProgesa project Committee of Public Accounts discusses the C&AG report and seeks explanations from IBTS Q3-Q4: Economic recession strikes Ireland	IBTS constitutes ICT council Oct: IBTS commissions a study by an external expert to advise on ICT strategy Oct: Revision of management structure and initiation of training and development program	Ongoing BOSS implementation
2009	Department of Finance issues circular on arrangements for ICT expenditure in the civil and public service	IBTS develops strategic plan 2010-12 and associated ICT strategy	BOSS implementation and go-live in Q4
2010	Mak buys the BOSS system from NYBC Dec: Department of Health decides to veto all IT projects of IBTS	IBTS renews the contract for BOSS maintenance with Mak May-June: IBTS introduces dual labelling for its labels for Blood Product Q3-Q4: IBTS conceives implementation of new Blood Banking software	
2011	May: Department of Health Approves the Project Q3: Peer Review Group is formed for the project Sep: EOS is deployed in three hospitals	IBTS develops Electronic Ordering System (EOS)	June: Request to participate document is published Dec: Tender for the project is published
2012	March: EOS is deployed in all the hospitals	ICT Council is Disbanded by CE;	April: Tender is awarded to Mak Systems

		Governance Structure for BECS project is established	September: BECS Project Kicks off
2013			Development of IT Infrastructure First Review of BECS project eTraceline and eRiskline implementation
2014	March: IBTS conducts one-day workshop with Hospitals regarding ISBT-128 June: Billing Process negotiated with supplier June-Dec: Problems noted regarding ISBT-128 implementation in the Hospitals		March: eTraceline goes live June: eRiskline goes live; Problems related to concentrator are noted Nov: eProgesa go-live date changed to April 2015 Q4: Second review of the BECS Project
2015	May: IBTS CE writes to the Hospitals about e-Progesa go-live and ISBT-128 implementation May-June: Hospitals move to the HSE June: HPRA intervenes and IBTS agrees to postpone the go-live date and incorporates dual labelling August: Hospitals validate their system for ISBT-128 / Add new product codes for Codabar		Q1: Consistent problems related to ISBT-128, Middleware, and BOSS interface; Q1: eProgesa go-live date moved to June 1st Q2: eProgesa go-live date moved to June end June: ISBT notes problems related to special testing bar-codes and interim labels June: ISBT further postpones the go-live date July: IBTS prepares product master files for labels and sends to the hospitals September: eProgesa goes live

4.8 Conclusion

A key requirement for a process-based study is to capture the sequence of events unfolding over time in context. The case narrative in Chapter 4 provides an in-depth longitudinal narrative of IBTS focussing on integrating its core operations during the period 2000-2015. The first section of the narrative outlines the overall context of the case study in the form of historical, institutional, organisational and technological context. The next four sections focus on the sequence of events divided into four analytical periods of 2000-2003, 2004-2007, 2008-2011, and 2012-2015, when IBTS engaged in the implementation of Progesa and two implementations of eProgesa. To develop an overall picture, Section 4.8 presents a summary timeline of the events occurring at the macrosocial, organisation, and the work-system levels. The next chapter presents the outcome of the analysis in the form of an explanatory framework that identifies key factors and underlying mechanisms underpinning the sequence of events presented in this chapter.

CHAPTER 5
TOWARDS A THEORY OF ENTERPRISE SYSTEMS LIFECYCLE

"The supreme goal of all theory is to make the irreducible basic elements as simple and as few as possible without having to surrender the adequate representation of a simple datum of experience."

- Albert Einstein (1879-1955), Theoretical Physicist

5.1 Introduction

Based on the literature review presented in Chapter 2 and research methodology presented in Chapter 3, this study seeks to answer the following research question:

What are the key factors and underlying mechanisms that underpin the Enterprise System lifecycle in Irish Public Service Organisations?

Based on the fieldwork and analysis, the previous chapter presented a case narrative outlining the sequence of events and contextual conditions of ES lifecycle in IBTS. This chapter presents the theoretical framework that answers the research question and develops an explanatory theory of the ES lifecycle in the form of key factors and underlying mechanisms. Unlike predictive theory that tries to predict the outcomes based on input conditions, explanatory theory addresses why and how observed phenomena occur, and thus, helps us to better understand the world (Avgerou, 2013). The most important feature of the explanatory theory is the focus on causal processes that bring about theorised phenomenon (Gregor, 2006; Markus & Robey, 1988). As Sutton & Staw (1995, p. 378) note - *"theory is about the connections among phenomena, a story about why acts, events, structures, and thoughts occur… the nature of causal relationships… as well as the timing of… events"*. Thus, the explanatory theoretical framework presented in this chapter notes the key factors as they emerged during the ES lifecycle in IBTS and identifies key underlying mechanisms driving these factors. Following a biography of artefact approach (Williams & Pollock, 2012), this chapter presents a biography of the ES artefact in Irish Blood Transfusion Services (IBTS), while attending to the context, process and outcomes (Pettigrew, 2012) underpinning the lifecycle. By explaining the emergence of key factors in terms of their underlying mechanisms, the theoretical framework presented in this chapter moves beyond the description and explains *how and why one thing leads to another* (Anderson et al, 2006).

Section 5.2 provides a description of the theoretical framework that emerged from the detailed analysis of the ES lifecycle in IBTS. Section 5.3 presents the empirical evidence for the theoretical framework in terms of key mechanisms and how they manifest in the form of diverse factors across each phase of ES lifecycle in IBTS. Section 5.4 discusses the theoretical framework in light of the extant literature. Thereafter, Section 5.5 assesses the framework with respect to the research agenda developed in Section 2.7. Finally, Section 5.6 concludes the chapter.

5.2 Theoretical Framework

Table 5.1 presents the explanatory theoretical framework on the ES lifecycle in the PSO context. Following temporal bracketing strategy of processual analysis (Langley, 1999), the framework is divided into five phases of the ES lifecycle (Esteves & Pastor, 1999, 2001) – *adoption, acquisition, implementation, use and maintenance,* and *evolution* – as it broadly mirrors the sequence of events observed in IBTS[33]. Adoption decision includes the set of activities conducted to determine the requirement of a new ES for the organisation. The acquisition phase includes selecting and acquiring the product that best fits the need of the organisation. This phase also includes the selection and appointment of the vendor, the implementation partner and/or the consultants. The implementation phase deals with the configuration and/or customisation of the ES package according to organisational needs. The use and maintenance phase involves continuous use of the system in the organisation and regular maintenance/upgrades whenever required. Evolution occurs when additional capabilities are included in the ES. This may include upward evolution (e.g. adding more capabilities/applications to ES) and/or outward evolution (e.g. including your supply chain partner).

Each phase of the ES lifecycle is delineated by four key mechanisms – affordance mechanism, control mechanism, institutionalisation mechanism, and market mechanism. *Affordance mechanism* is defined as action possibilities and opportunities that emerge from actors engaging with the enterprise system (Faraj & Azad, 2012). An affordance perspective recognises how an object supports a set of business processes and constraints some other business processes (Leonardi, 2011; Zamutto et al, 2007) when an organisation attempts to appropriate the technology. Thus, it includes aspects related both to the technology and the business process and primarily operates at the work-

[33] It may be noted here that the same framework is used to structure the literature review in Chapter 2.

system level. The *control mechanism* is defined as a set of activities that are conducted in a project to regulate or adjust the behaviour of the stakeholders, to motivate participants, and to ensure that their capabilities are fully applied to advance the ES initiative towards its objectives (Kirsch, 1997, 2004). The control mechanism operates at all three levels – work-system, organisational, and macrosocial level. The i*nstitutionalisation mechanism* is conceived here as a process by which a social structure attains a stable and durable state or property (Currie, 2009) that produces recognisable, repetitive patterns of interdependent actions, carried out by multiple actors within a pre-existing social context (Iannacci & Hatzaras, 2012; Feldman & Pentland, 2003). Institutionalisation[34] is generally considered to be associated with the post-implementation phase of ES lifecycle (Rajagopal, 2002; Lyytinen et al, 2009) when it becomes taken-for-granted and part of the routines and the habits of employees (Baptista et al, 2010). However, case evidence exhibits that the institutionalisation mechanism extends to other phases of ES lifecycle and primarily operated at the organisational level. Finally, the *market mechanism* is identified as product availability, market structure, buyer-supplier relationship, and the impact of these on the ES lifecycle. The market mechanism is found to be a dominant mechanism at the macrosocial level that has an impact on how ES lifecycle unfolded within IBTS. For each phase of the ES lifecycle, key factors are noted in the framework as empirical-level manifestations of underlying mechanisms. The empirical evidence for the emergence of the factors in respective phases is presented in the next section.

[34] Other terms used in the literature to denote the same phenomenon are Routinisation (Rajagopal, 2002) and Embedding (Kwon & Zmud, 1987). However, for consistency purpose, this study uses the term institutionalisation.

Table 5.1 Underlying Mechanisms and Key Factors across ES Lifecycle

Mechanism	*Dominant Level*	**Phases of ES Lifecycle**				
		Adoption	**Acquisition**	**Implementation**	**Use and Maintenance**	**Evolution**
Affordance Mechanism	*Work System*	ES Artefact	Gap Analysis	ES Artefact, Hardware/Interfacing, BPR/ Customisation, IS Infrastructure, Superusers' Skills	ES Artefact	ES artefact, (Partner) IS Infrastructure
Control Mechanism	*Multi-level*	Top Leadership	Institutional Context, Top leadership	External Controls, Internal Controls, Project Controls	Change control	Project Controls
Institutionalisation Mechanism	*Organisational*	Business vision	User Involvement, User Exposure	Project Leadership, Superusers' Selection, Project Ownership/Role of IT, User Engagement, Change Management, Other organisational exercises	Mandatory use, User Exposure, Workarounds	Project leadership, Project ownership, Integration with other systems
Market Mechanism	*Macrosocial*	Supplier's Push	ES Market Structure	Support from Supplier(s), IT Resource Market	Suppliers' Push	ES Market Structure

5.3 Empirical Evidence for the Theoretical Framework

This section presents the empirical evidence in the form of key factors and underlying mechanisms associated with each phase of the ES lifecycle. In doing so, there is a 'search for patterns' (Pettigrew, 1997; Langley, 1999) based on the empirical evidence across three instances of the ES lifecycle in IBTS. Appedix-7 includes these patterns in terms of quotations for each phase of the ES lifecycle in IBTS. Subsections 5.3.1 to 5.3.5 discuss the empirical evidence in terms of key factors emerging during each phase of the ES lifecycle (Esteves & Pastor, 1999, 2001). Within each phase, the discussion is organised around key factors that are seen as manifestations of underlying mechanisms. Subsection 5.3.6 traces some key factors during the phases of ES lifecycle. Finally, subsection 5.3.7 concludes the section by tracing key factors across the three instances of ES lifecycle.

5.3.1 Adoption

The adoption phase typically includes the decisions and activities leading up to formal project approval and funding (Kumar et al, 2002). During the adoption phase, the organisation becomes aware of the possibility of implementing an ES and evaluates it against the possibility of developing a bespoke information system to fulfil its information and reporting needs. This section presents the empirical evidence for key factors and associated outcomes that are noted for the three instances of the adoption phase in IBTS.

5.3.1.1 Affordance Mechanism

During the adoption phase, the affordance mechanism operated primarily via the **ES artefact** at the work-system level. The technical component of the affordance mechanism reflects in the constraints of an existing system or the enabling features of the new system. The social component of the affordance mechanism relates to the business process aspects afforded by the technology artefact.

The *Constraints* of existing ES Artefact act as the principle contributing factor towards increasing awareness for the ES adoption. These constraints work as motivations to move away from the old system and are used as justification to adopt the new system. During Progesa adoption phase, the existing system (BBCS - Blood Bank Control System) had limited functionality. "*The information that was put in the BBCS was quite basic*" (R21). It was a bespoke system that only *"managed the donor records (and) did not manage anything happening at the clinic (or) the laboratories"* (R2). Due to these limitations, the need for an overhaul of IBTS's IT systems was also stressed in the reorganisation plan of 1996. Y2K compliance of BBCS was also a major concern for IBTS and it had approached the Department of Health in 1998 since BBCS was not Y2K compliant and there was no assurance that it could be made so. It is interesting to note that due to delay in Progesa roll-out, BBCS was indeed made Y2K compliant at the end with additional cost and effort. One respondent recalls:

> *"Progesa was to be implemented because back then they had an old system which was called BBCS. And it wasn't Y2K compliant…. (When) I joined in 1999, then it wasn't implemented. At that stage, they were actually looking for a solution to making BBCS Y2K compliant because they knew there weren't going to hit the deadline… So, you had Progesa trying to go on one strand, but then you also had BBCS trying to get that Y2K compliant. We found the solution to that and implemented it as well. That then at least took the pressure off Progesa having to be completed."* (R5)

For eProgesa adoption, technology related justification included hardware obsolescence, limitations of the flat-file system underlying Progesa, and superior data recovery ability of eProgesa. IBTS notes in CPA (2008) - *"because of the length of time taken to implement Progesa, the IBTS was left in a situation where the hardware on which it was operating had reached the end of its life and needed to be replaced. It made good economic sense to upgrade the current blood bank control system at the same time*". The flat-file structure underlying Progesa offered limited data recovery abilities and had the risk of data inconsistency where the same data could be updated in one file and not updated in the other. The eProgesa system, due to its underlying relational database structure, offered to solve these two problems. A relational database design not only ensured data consistency across different tables, it also "*offered the facility to fully recover data from a system failure right up to the point of failure, in contrast to Progesa which only allowed the system to be returned to the previous day's backup with the loss of all products processed in the intervening period*" (C&AG, 2008). The motivations for BECS (Blood Establishment Computer System) adoption were mostly related to the constraints of the existing system. As documentary evidence suggests, the main reason for the BECS adoption was the end of the software and hardware lifecycle. In a sense, it was "*more reactive than prospective*" (R3). Therefore in all three instances, constraints of the existing system (limited functionality, Y2K problem, hardware obsolescence, end of software lifecycle) provided a reason to look for the new system.

Apart from constraints, affordance mechanism also operates via the *features* of the proposed ES Artefact. This included IBTS's motivation associated with improving its business processes. The most important of these motivations was business process integration across IBTS. In the first instance, the existing system BBCS did not offer business process integration. It "*had the separate box in Cork and a separate box in Dublin (with) no link between them*" (R20). Progesa offered the opportunity to integrate its donor information from procurement to transfusion following industry's best practices and to build a national database of blood banking system in Ireland. Progesa system promised to link "*the donation clinic with the donor record and with all of the testing and processing technologies*" (R2).

Within a year after Progesa roll-out in 2003, IBTS decided to adopt eProgesa developed by the same supplier. Since Progesa had already integrated IBTS blood operations, adoption justifications for eProgesa included operational efficiency and generation of management reports. IBTS noted that existing system was inefficient at the clinics and saw the new system as *"solving a whole lot of problems that (they) had mostly at the clinic level"* (R19) via ensuring more linkages across business operations. eProgesa was also seen as removing the reporting limitation of Progesa that was *"very difficult to extract effective management information in a timely manner"* (R2). Therefore, IBTS decided to adopt eProgesa that was based on a relational database system which allows generation of management reports due to the connectivity among tables.

For BECS adoption, once again total business process integration was a major factor at the organisation level. This time IBTS was looking for integrating other business processes with its core blood operations along with improved risk management.

> *"(BECS) wasn't just the Progesa; it was the enterprise-wide system. So it covered system hardware, infrastructure system software, it covered the blood management system, which is eProgesa, included laboratory testing and distribution, covered the diagnostic system which is the patient services element of our business. It covered tissue, which is our tissue services. Also, we had a kind of our risk management system.*" (R3)

Therefore, based on all three instances of adoption it can be concluded that affordance mechanism operated through constraints and features of the <u>ES artefact</u> that were related to ES functionality, business process integration, operational improvement, and the generation of management reports made possible by new ES. The next subsection presents key factors associated with the control mechanism during the adoption phase.

5.3.1.2 Control Mechanism

Based on the case evidence, control mechanism is found to be a multi-level mechanism operating at different levels during different phases of ES lifecycle. During the adoption phase, control mechanism is found to be primarily working at the organisation level. For all three instances of the adoption phase, control mechanism operated through **top leadership** buy-in for the ES project. In all three instances, the initiative from the chief executive played an important role in selling the idea to IBTS board and in gaining their support. From IBTS board minutes, it is clear that the chief executive presented the case for the ES implementation in the IBTS board meetings and provided the justifications for the introduction of new system, resulting in the Board accepting the proposal for adoption of the new system. In all three instances, IBTS board acted as an internal control mechanism in vetting the new initiative. Support from top leadership was deemed crucial for ES adoption since *"once you get the leadership and the buy-in from the top (and) once you get the support at a senior administration level or whatever within the organisation, you can get the job done"* (R3). The next subsection presents key factors associated with the institutionalisation mechanism during the adoption phase.

5.3.1.3 Institutionalisation Mechanism

Based on the case evidence, it may be concluded that the institutionalisation mechanism mostly operates at the organisation level and if operating, embeds the ES initiative in the organisation's work practices. During the adoption phase, institutionalisation mechanism manifests itself in developing a **business vision** around the ES initiative. Avoiding *"a serious threat to the blood supply with the potential impact on patient care"* (CPA, 2003) was a major argument based on which the Department of Health agreed to the adoption of Progesa system. Another part of the adoption argument was geared towards the provision of increased donor and patient safety made possible by the new system. The safety could be ensured by donor recruitment and screening (aided by database integration) at the donation stage, tracking of blood from donation clinics to the hospitals (due to business process integration), and parameter checks (made possible by parameterisation of the system) at issue stage. It was argued that ES would contribute to the patient safety since blood operations are very much *'information-driven'* (R19) and "*traceability with blood is a very important issue. For every unit of blood donated, (IBTS) must be able to say what patient received it*" (R16). Another argument for Progesa adoption was following industry's best practices and to build a national database of blood banking system in Ireland.

In the case of eProgesa adoption, "a *project definition for the implementation of eProgesa, which included a business case, was drawn up in May 2004*" (C&AG, 2008). The business case explained the rationale for moving from Progesa to eProgesa. Apart from affordance related justifications noted earlier, the business case also noted that *"eProgesa would allow the IBTS to become a world leader in blood transfusion technology"* (C&AG, 2008). Interestingly, this justification was based on the fact that the system was completely new in the market. IBTS argued that since at the time eProgesa was not implemented elsewhere, being the first would allow IBTS to become a world leader in blood transfusion technology. This justification looks somewhat inappropriate since IBTS had (and still has) a *"monopoly in the country (and) there are no private blood banks in Ireland"* (R15) with whom IBTS would compete. IBTS is also not allowed to export its products. Perhaps the only justification, in this case, was being a reference site for other blood banks which may be noticed in the following excerpt from IBTS annual report:

> *"In April the IBTS hosted the International MAK Users conference. It was attended by 55 delegates from 15 different blood bank establishments throughout the world. We gave a demonstration of eProgesa which was very well received by all in attendance and has resulted in the IBTS being seen as a respected leader within this group."* (IBTS Annual Report, 2005)

Although adoption motivation for BECS primarily emerged from Progesa constraints, IBTS sought "*an enterprise-wide off the shelf computer system"* that could meet *"the operational needs of a twenty-first century blood, tissue and whole product distribution organisation... maximising current technology to deliver the business need*" (IBTS Internal Documents, 2011). This presents a business case for utilising the latest technology by IBTS. Therefore, in all three instances, institutionalisation mechanism operated through a <u>business vision</u> (best practices, world leader, twenty-first century organisation) that was centred on the ES initiative. The next subsection presents key factors associated with the market mechanism during the adoption phase.

5.3.1.4 Market Mechanism

Based on the empirical evidence, the market mechanism is identified as product availability, market structure, buyer-supplier relationship, and impact of these on the ES lifecycle in IBTS. For example, it has repercussions for IBTS due to the presence of a dominant supplier (MAK Systems) in a niche (Blood Bank Information Systems) market. As one respondent notes:

> *"They would appear to have about 70 percent of the blood banking market worldwide, so, absolutely a dominant player… A number of attempts have been made but very little success of blood services trying to come together to convince a software manufacturer to design something bespoke for, let's say, two or three big blood services. I know that*

SAP has been approached and have said - globally the market is too small for us to be interested. So, what happens is the niche players just stay there and continue." (R1)

Even within the Blood Bank market, IBTS is not a big customer of the Mak Systems and *"would only be like 1% of their business or 2% of their business in terms of the revenue"* (R19). Clearly, this market structure also has imperatives for IBTS in engaging with the supplier. For the adoption phase, the effect of the market mechanism reflects in the **supplier's push** for adopting the new system. While Progesa adoption was based mostly on factors associated with functional affordances, the supplier played an important role in eProgesa and BECS adoption decisions. In the case of eProgesa, although its product was in the developing stage, the supplier encouraged IBTS to adopt it. In fact, as will be discussed in the analysis of the implementation phase, the supplier used IBTS as a test site to develop and improve their product. The supplier played an even major role in BECS adoption by indicating *"that they could support the existing version of Progesa only around 2014 or so"* (IBTS Board Minutes, 2010). By indicating the end of support for Progesa, the supplier arguably forced IBTS to look for a new solution. Therefore, in all three instances, <u>supplier's push</u> was a key factor in the Adoption decisions. The next subsection discusses the outcomes of the adoption phase.

5.3.1.5 Adoption Outcomes

The outcome of the adoption phase in all three instances was the decision to introduce a new enterprise-wide system in the organisation. Based on the analysis, it may be concluded that the affordance and market mechanisms play a dominant role in determining the outcomes of the adoption phase and the control and institutionalisation mechanisms usually play an ostensive role in justifying the adoption decision. The adoption process involves writing a business case document and moving ahead with the formal acquisition process. For end users and the IT unit, it means investing their resources in writing Users Requirement Specifications (URS) document to initiate the acquisition process, which is explored in the next section.

5.3.2 Acquisition

ES acquisition phase is usually associated with understanding user requirements, package evaluation, and final selection and procurement (Howcroft & Light, 2010). During this phase, normally an implementation partner is also selected to help in the subsequent phases of the ES lifecycle (Esteves & Pastor, 1999). Factors such as price, training and maintenance terms are also negotiated in this phase. This section presents the empirical evidence for key factors and associated outcomes that are noted for the three instances of the acquisition phase in IBTS.

5.3.2.1 Affordance Mechanism

For the acquisition phase, affordances mechanism operates through the **gap analysis** between the functionality offered by the ES artefact and business process requirements of IBTS. Gap analysis and product evaluation is generally considered an important activity during the acquisition process and operates mostly at the work-system level. A key factor for Progesa acquisition was the level of integration offered by the product. The solution from the other company did not have an integrated system and "*had two different software packages to manage, the donor side and the production side"* (CPA, 2008). Progesa offered an integrated system to manage entire blood operations. For eProgesa though, C&AG (2008) notes that it was *"not clear to what extent the Board evaluated the alternatives to eProgesa and how it proposed to mitigate the risks associated with moving to a new and untried system"*. To justify eProgesa acquisition without a formal gap analysis, IBTS notes that they needed an integrated system to manage their complete blood bank operations and the rival company *"had not progressed beyond the US and had not an integrated system"* (CPA, 2008). In contrast, eProgesa offered to integrate entire blood operations of IBTS.

Tender evaluation for BECS involved technical evaluation, business fit evaluation, project methodology, and cost. Based on the available evidence, it appears that the evaluation was primarily based on the information reported by the supplier and IBTS did not have any direct means to assess the affordances associated with the product. Based on the gap analysis, *"MAK Systems came out to be clear winners because they could answer very much all the elements of it"* (R3). During BECS acquisition, IBTS decided to go for the complete suite offered by the supplier to further its goal of complete business process integration. This aspect was also driven by integrating affordances provided by the software. Although it was theoretically possible for IBTS to implement different modules for different functions, IBTS opted for *"the full integrated package"* (R1) offered by the same supplier. Otherwise, they would "*have multiple systems then trying to communicate with one another (with the) main system... still (being) provided by MAK"* (R5).

Therefore for the acquisition phase, the affordance mechanism operates through <u>gap analysis</u> in terms of basic functionality offered by the ES artefact and integration capability across different ES modules. Although it may also be noted here that the gap analysis mostly rested on the system capability as reported by the supplier and IBTS did not have a direct access to the ES artefact for evaluation purpose. The next subsection presents the factors associated with the control mechanism during the acquisition phase.

5.3.2.2 Control Mechanism

While the control mechanism operates at the organisational level for the adoption phase, for the acquisition phase it mostly operates at the macrosocial level. In particular, the **institutional context** of IBTS operates as an external control mechanism for the ES acquisition. For Progesa acquisition, IBTS first approached the Department of Health for their concurrence for the acquisition of the new system primarily based on the justifications outlined in subsection 5.3.1. These justifications were related to affordance - *"Y2K compliance"* and, institutionalisation – "*threat to blood supply with potential impact on patient care"* (CPA, 2003). After receiving agreement from the Department, IBTS went ahead with a public tender for the acquisition of a new system. It may be noted that public tendering is a key feature of the public sector procurement process in Ireland.

For eProgesa acquisition though, IBTS neither seek clearance from the Department of Health nor did it go with the full public tender process, effectively bypassing external control mechanisms. Instead, the supplier sent an official proposal for the eProgesa project which was then accepted by the executive steering group. It was a move that IBTS ended up justifying before the Committee of Public Accounts (CPA, 2008). In this case, therefore, external control mechanism played a post-facto role. However, it was the acquisition process for the BECS system that saw the full impact of external control mechanism. After taking the adoption decision, when IBTS approached the Department of Health for its concurrence, the Department vetoed not only the BECS project but also the other IT projects (IBTS Board Minutes, Dec 2010). Interestingly, as noted in Chapter 4, this veto was not directly related to the project but basically was due to external factors. As one respondent notes:

> *"Yeah, that's politics! Okay, I suppose there were two issues. We were getting at this thing, what we were getting to the decision-making points of this thing, right to the point of the crash hitting the country. So, there was whole question of how much money we are going to spend. Which were, these were very legitimate questions to ask us - 'why do you need to do this?' But then what also happened at the same time was, the government introduced one of the, the cost saving measures the government introduced was the pension levy… So, along the way the department said, they were taking out all the sticks. They said, okay unless you pay over this money, this pension levy, you can't have your computer system."* (R1)

Here one may also note the indirect influence of the global economic context. The global recession of 2008-09 forced the governments to be prudent in their spending and to impose controls on the investments by its agencies. The logjam with the department continued for few months when IBTS kept trying to convince the Department of decoupling the pension and IT issues and Department kept vetoing the implementation pending the payments of pension levy. Ultimately, IBTS took recourse to affordance and institutionalisation related arguments that were used in the adoption phase:

> *"[The CEO] eventually wrote them, says - 'That's okay. If the existing hardware falls over, and if the existing software is no longer supported, I'm sure you'll take responsibility for the impact of that on the national blood supply and the supply of that to the patient.'… They straightaway came back and said - okay go ahead."* (R1)

Partly due to bypassing of external control mechanisms during eProgesa acquisition and partly due to the prevalent practice in Irish PSOs, the Department of Health suggested constitution of Peer Review Group (PRG) as an additional external control mechanism for the BECS project. PRG process is mandatory for all the major IT projects in the Irish Public sector. However, since IBTS is not funded through Voted monies, it need not form a PRG by law. Yet, it formed a peer review group which had more *"to do with how IT projects in the public system generally were managed, and have been seen to be managed (and it was felt that) there was more awareness for the need for oversight"* (R2).

Apart from the controlling role of IBTS institutional context, in all three instances, **top leadership** of IBTS was instrumental in mediating with the institutional context of IBTS. For Progesa and BECS acquisition, it was the CE who engaged with the Department of Health through constant negotiation and gaining approval. In the case of Progesa and eProgesa, it was the CE who represented IBTS before the Comptroller & Auditor General and before the Committee of Public Accounts after the implementation failure.

Therefore, it may be concluded that the <u>institutional context</u> acts as a primary control mechanism for the acquisition phase by mandating departmental approval and public tendering process. In all three instances, the <u>top leadership</u> of IBTS mediated in working with the institutional context. The next subsection presents key factors associated with the institutionalisation mechanism during the acquisition phase.

5.3.2.3 Institutionalisation Mechanism

To ensure institutionalisation of its projects, especially in the case of BECS, IBTS took recourse to **user involvement**. The users were involved in writing the URS document for their respective functional areas.

"We set down with all the user departments, we gathered up all the requirements, we determined what was phase-1; we determined what was phase-2." (R5)

"We begin with defining user requirements. This has to be done by user themselves and it has to be based on hard scientific facts. So, it will not be like - we want this and that. It has to be like - this is the specific functionality we want and these are the rules for the particular functionally. Essentially, it is about writing down exactly what do you want." (R15)

Although the users were involved in writing the URS for the ES initiative, some users felt that they were pushed into the project. It was also expressed by some users that they were not equipped to write a detailed URS. They *"were given documents from the Welsh blood service and more or less told to copy and paste them"* (R17). It was also expressed by the respondents that *"not enough time was put in at that stage of the process"* due to time constraints on *"on top of (their) routine day"* (R16). It is interesting to note that although the users were involved in writing the URS, they were outside of *"all the negotiations that went on with MAK when they were selected"* (R6). During BECS acquisition, **users' exposure** to the system and training cost were also noted as an important factor in the acquisition decision:

"When blood services sit down and do the evaluation of a change from the existing computer systems to a new computer systems versus an upgrade, they find that the cost, the true cost of the change can sometimes by double of the quoted cost because… but there is actually massive training cost." (R1)

"There is a learning curve for staff if a new system is brought in. In our business, we have to have proven technology. We cannot put a system in that may not work." (R2)

Therefore, the acquisition phase within IBTS shows user involvement and user exposure to the system as a manifestation of the institutionalisation mechanism. However, it also reflects that these actions sometimes serve the ostensive purpose rather than serving the substantive purpose. The next subsection presents key factors associated with the market mechanism during the acquisition phase.

5.3.2.4 Market Mechanism

At the macrosocial level, apart from the institutional context, **ES market structure** also plays a big role in ES acquisition. Once IBTS got approval from the Department of Health for ES acquisition, it went with a public tender in the first and third instance. During the Progesa tendering process, there was only one supplier other than MAK Systems that was shortlisted for consideration. MAK systems remained the dominant supplier of the blood bank information systems to transfusion services across the world at the time and was subsequently awarded the contract. IBTS attributed ES market context for not going with a public tender in the second instance. IBTS noted that there was no evidence that *"an appropriate alternative system to Progesa had come to market"* and therefore, it was a *"reasonable course of action not to go through a formal tender process when the decision was taken to upgrade to eProgesa"* (CPA, 2008). IBTS surmised that if they went ahead with the public tendering process, they could end up *"obtaining another version of the system from that same company"* (CPA, 2008).

When IBTS followed the public tendering process for BECS acquisition, external market conditions did not change much from the last time in terms of solutions availability or supplier's dominance. Over the years MAK cemented its position through the acquisition of related modules (BOSS and eRiskline) from other companies. Consequently, if IBTS wanted greater business integration, they did not have much choice but to opt for the complete solution supplied by MAK. For instance, patient related information management that earlier was part of Progesa was *"going to be no longer supplied by the company"* (R16) as part of eProgesa. The patient functionality was to be covered by *"a new standalone application called eTraceline"* (R20) which was interfaced with the eProgesa module.

Therefore, the existence of a dominant supplier in a niche blood bank market means that ES market structure drives IBTS acquisition decisions, signifying the role of the market mechanism. Next subsection discusses the outcomes of the acquisition phase in the three instances.

5.3.2.5 Acquisition Outcomes

The outcome of the acquisition process in all three instances was the award of the ES contract to the supplier. In the case of Progesa and BECS acquisition, this involved writing URS, inviting tenders, evaluating bids and awarding the contract to the supplier. For eProgesa acquisition, the contract was directly awarded to the existing supplier once the proposal was submitted by the supplier. However, BECS project witnessed a significant outcome due to the institutional context. The Department of Health suggested constitution of PRG as an external control mechanism to review the BECS project from the tendering process to eventual go-live. Therefore, based on the analysis of three instances of acquisition, it may be argued that the control mechanism and the market mechanism play a major role in determining the outcome of the acquisition process. Affordance mechanism (gap analysis) and institutionalisation mechanism (user involvement/ exposure) seem to play only a justifying role for the acquisition decision. The next phase after the acquisition is the implementation phase, which is the topic of next subsection.

5.3.3 Implementation

The implementation phase primarily deals with developing the IS infrastructure and configuration and/or customisation of the ES package for organisational needs (Esteves & Pastor, 1999, 2001). This section looks for patterns in the implementation phase and focusses on the events taking place after the ES contract award until the go-live of the system. This section presents the empirical evidence for key factors and associated outcomes that are noted for three instances of the implementation phase in IBTS.

5.3.3.1 Affordance Mechanism

Affordances mechanism manifests itself through multiple factors during the implementation phase. As noted in Table 5.1, these factors include ES artefact, hardware/interfacing, BPR/customisation, IS infrastructure, and superusers' Skills. Empirical evidence for these factors is presented in the following paragraphs.

In terms of **ES artefact**, for Progesa, a major issue that emerged during implementation was the absence of database locking which resulted in parallel access. IBTS *"uncovered the locking issue in March 2000, whereby one person could issue a product while another could quarantine that product simultaneously (which) involved serious retesting of the system"* (CPA, 2003). The locking issue caused significant delays and financial cost for IBTS. The situation was worse with eProgesa. The implementation phase of eProgesa was marked by a recurrent cycle of bug identification by IBTS, bug correction by the supplier, and new bug identifications by IBTS. As respondents recall:

> *"We were getting fix which were fixing some and unfixing others that had already been fixed. So, (it) got to a point where we couldn't trust the quality control of the patch releases. So that, if we fixed a problem x, that there was no impact on our rest of the system. Whereas, what we were finding was if we fixed problem x, but we unfixed problem y which already had been fixed by previous patch. So which means that there wasn't proper control coming throughout the patches."* (R2)

> *"We used to have bug after bug, we sent bug reports to them and in some case didn't hear from them even after a month. So this was causing us significant delays. Even after the bug correction, the system was failing in the tests which it earlier cleared and we had to revalidate it all over again."* (R18)

This was primarily related to system maturity. The eProgesa system *"was too beta basically"* (R8). IBTS was the first major implementer of eProgesa (Singapore Blood Bank implemented it with limited functionality almost simultaneously with IBTS). Although during the acquisition phase, IBTS had presented being the first user as an advantage, they were in a disadvantaged position due to the inadequacies of the system. This cycle of validation-bug identification-bug correction-revalidation went on for around two years. Eventually, IBTS realised that *"the software wasn't really workable"* (R20) and abandoned the project in March 2007. In contrast, during BECS implementation, eProgesa was *"a more mature product"* (R18) and *"a lot more stable"* (R8) application. However, other modules within the BECS system were relatively new and still imposed challenges to the implementation team. While some were not intuitive (R7), others had features that IBTS did not require (R14). Based on the patterns observed in three instances, it may be concluded that the features and constraints of the ES artefact is the first factor through which affordance mechanism unfolds. A working ES artefact is the first crucial step during the implementation phase. If the ES artefact does not have required functionality, the implementation may not proceed further.

However, it is not just the software features and constraints of the ES artefact that posed implementation challenges for IBTS. Affordance mechanism also manifests itself in terms of **hardware/interfacing** issues. For Progesa implementation, IBTS noted in CPA (2003) that "*one of the major issues was the underestimation of costs at the beginning of the project, particularly with regard to hardware (and) there was a lack of appropriate expertise within the organisation to implement such a major system."* With time, IBTS developed an expertise in the area. While Progesa and BECS operated on new hardware, after implementation failure of eProgesa, existing Progesa was stabilised on the hardware purchased for eProgesa. However, many other systems, especially laboratory automates remained and had to be interfaced with the new system. In the case of Progesa, IBTS IT unit created direct interfaces one by one. BECS implementation, however, included an additional layer called concentrator/eDMS (electronic Device Management System) to collate results from the automates and then transfer the results to the core eProgesa module. The problem compounded due to the fact that the concentrator was *"a new piece of software to send all of the results across"* and *"was not working properly"* (R4). It seemed to cause a delay in the transfer process and was a cause of concern for IBTS. Users felt that they were *"relying on another function, an interface that as users in the lab (they had) no control over whatsoever"* (R16). At the time of go-live, the concentrator was working with the reduced functionality and IBTS was contemplating using other options provided by established suppliers of automates.

While middleware and interfacing proved to be a challenge during the BECS implementation, **skill and knowledge of superusers** was a key driver of the implementation phase in the IBTS. As noted in the case narrative in Chapter 4, Progesa superusers were appointed from the business units. Although they had extensive domain knowledge, they did not have much exposure to IT development. There was a relative *"lack of knowledge of IT really at the start*" (R22) and it was a huge *"learning curve"* (R18, R22) for them. For them, Progesa implementation acted as *"a kind of on-the-job training"* (R18). The same superusers engaged in the testing and validation when IBTS decided to implement eProgesa the first time. Although eProgesa implementation was eventually stopped due to consistent problems, this exposure to the eProgesa system proved to be beneficial when the eProgesa module was implemented as part of the BECS implementation. In a way, these superusers *"had a bit of an advantage because some of it wasn't brand new"* and they *"weren't looking at it necessarily for the very first time"* (R8). Prior exposure to the system *"definitely helped when (they) started it up again in 2012"* (R22). Some new superusers were also trained to work with new modules such as eTraceline, eRiskline, and TCS.

While the first two factors described here belong to the technological aspect of the affordance mechanism, the next factor relates to the business process aspect. During all three instances of the implementation, IBTS had to make decisions on whether to engage in **business process reengineering** or the **customisation** of the software. During Progesa implementation, a major problem that the implementation team faced was the differences in the business processes in some units of Dublin and Cork centres. Despite the business efficiency and best practices logic put forward during the adoption phase, there was no serious attempt at business process reengineering. Eventually, IBTS ended up *"doing it twice at the same time – once for Dublin, once for Cork and trying to put those together"* (R19). This was primarily due to the situation where *"they might have specific components in Cork that they wouldn't have in Dublin and vice versa"* (R22). IBTS reluctance to change its business processes also ruled out the possibility that they could use the experience of any other blood service. IBTS noted that it *"operated differently in some small respects when it came to processing blood (and) the system had to be parameterised differently for each service"* (CPA, 2003). While eProgesa implementation did not go beyond the testing and validation stage, eProgesa module within the BECS project remained similar in terms of the functionality and user interface. There was a *"change in underlying technology and infrastructure, but there (was) not much change from Progesa in terms of the functionality"* (R15). However, other modules required some customisation to suit IBTS business process needs. For example, it was noted by respondents that eTraceline is geared towards patients in a hospital setting, whereas IBTS wanted it to use as a service. Consequently, IBTS *"had to get a certain amount of modifications done"* (R16) for modules other than eProgesa.

However, one area where the BECS project brought about significant change, was the introduction of a new blood labelling system. One of the major outputs of a blood control system like Progesa/eProgesa is the production of a blood label that is generated based on the content and results of various tests. Based on these results, blood and blood product may be immediately classified for their intended use. As noted in Chapter-4, IBTS operated with an independently developed Codabar system of blood labelling for its blood products. The Laboratory Information Management Systems (LIMS) in the hospitals were designed to read the information from these Codabar labels. Since the Codabar system was a non-standard system, in the long run, it exhibited some limitations at the work-system label. First, since it was an 8-bit system, less information could be encoded. Second, due to the space constraints, Codabar labels were bound to repeat themselves after a certain period. IBTS had to introduce a new labelling system because they *"had reached a stage with the Codabar numbering system where every three years, (they) were starting to repeat the numbers. Therefore, the hospitals weren't able to achieve the donation number in a uniformly traceable way because they had duplicate numbers inside their system"* (R1). During BECS implementation, IBTS decided to implement a global standard of blood products labelling called ISBT-128 (ICCBBA, 1997). Since ISBT-128 labels have 14 bits, more information can be encoded in it. Due to the unique labelling system that incorporates year, there is no problem of repeat labels. Furthermore, it would enable blood labels produced by IBTS to be read by blood banks across the world and also enable it to import blood products if required. Therefore, IBTS decided to implement the new labelling system to create new affordances.

The affordance mechanism also revealed itself in the form of **IS Infrastructure** in the Hospitals. A blood product sent by the IBTS to the hospitals should be readable in the LIMS operating in the hospitals. However, as the case evidence suggests, most of the hospitals were *"not able to read the new labels"* (R13). This was both due to hardware and software affordances. First, *"the quality of scans or the scanners being used in the hospitals were not as good as"* (R5) those used in IBTS. Second, *"their LIMS systems (were not) able to read ISBT 128"* (R2) due to software feature. To complicate the matters, different hospitals were using the LIMS supplied by different suppliers. Even with the same suppliers, there were different versions of the same software operating in different hospitals. As one respondent recalls:

> *"There are 49 different hospitals. Within those 49 hospitals, there are 12 different software applications in use. Within those 12 different software applications, there are a number of different versions. It's pushing upwards 18 to 20 different systems in effect."* (R3)

In summary, during the implementation phase, the affordance mechanism manifests itself in constraints and limitations of the ES artefact, hardware/interfacing issues, superusers' skills and knowledge, business process aspects associated with BPR/customisation, and IS infrastructure in the hospitals. The next subsection presents key factors associated with the control mechanism during the implementation phase.

5.3.3.2 Control Mechanism

As noted earlier, the control mechanism is a multi-level mechanism and this characteristic is truly evident during the implementation phase. During the implementation phase, control mechanism operates at all three levels – macrosocial (external control mechanisms), organisational (internal control mechanisms), and work-system level (project control mechanism).

Although there were no explicit **external control mechanisms** applied during Progesa and eProgesa implementation phase, external control mechanisms came into operation towards the end of the implementation. For both projects, IBTS ended up justifying itself before the C&AG and the parliamentary Committee of Public Accounts. C&AG and CPA are macrosocial level control mechanisms in Irish public sector. For Progesa, IBTS needed to justify the time and cost overrun in the implementation (C&AG, 2002). For eProgesa it needed to justify the acquisition decision and implementation process since the project was abandoned and value for money was not achieved (C&AG, 2008). In both cases, there were *"loads of questions asked from the government point of view at that time as to why so much money was spent"* (R22). Perhaps, therefore, being *"very conscious of (what) had happened in the past"* (R1), when it came to BECS, IBTS adopted two external control mechanisms to help avoid a repeat of the negative outcomes experienced with Progesa and eProgesa.

Two external controls applied on the BECS project were – project audit by an external entity and constitution of a Peer Review Group (PRG). During BECS implementation, there were two audits of BECS project by external audit partners. However, a more extensive control was a regular project review by PRG that constituted experts external to the IBTS. As outlined in Chapter 4, PRG is a mandatory feature of large scale IT projects in Irish PSOs. *"A peer review group was set up and they established checkpoints for each of the different stages of the process. It included tender approval, budget re-approval, and then checkpoints throughout the process. They were sort of milestones"* (R15). It was expressed that the PRG *"did ensure that (IBTS) did retain discipline around project management and around delivering through the different stages"* (R2). At the same time, the audit report of BECS project also suggests that the frequency of the PRG meetings was not maintained throughout 2014 as outlined within the BECS PRG terms of reference.

The next level of control mechanism operates at the organisational level. This **internal control mechanism** primarily includes the constitution of the steering group. This was evidenced in all three project instances. Progesa project was *“overseen by a coordinating committee which (had) membership in the acting Chief Executive, National Medical Director, Project Manager, Regional Director, Chief Scientific Officer, National Donor Services Manager, National Quality Assurance Manager and other heads of function in the Cork and Dublin centres”* (C&AG, 2002). This committee provided project governance and internal oversight mechanism. For eProgesa, an *“Executive Steering Group (ESG) was established oversee the project*” (C&AG, 2008). ESG’s responsibilities included setting and monitoring project strategy, assessing and managing progress, making timely decisions on project related issues, taking other IBTS projects into account and indicate to the project team where conflicts might arise. As case evidence suggests, the ESG maintained a high-level oversight over the eProgesa project. When eProgesa project got into trouble during 2005-06, the ESG examined three options in September 2006 – to continue with the implementation of the project, to migrate the current version of Progesa to new hardware and upgrade later to a different version, or upgrade to Progesa 4.4g directly on new hardware (C&AG, 2008). However, due to a lack of long-term viability of other alternatives, the ESG decided that the IBTS should proceed with the implementation of eProgesa. However, when the project manager reported in March 2007 that the system was unstable and its critical users had lost confidence in it, the ESG then suspended the project and the IBTS decided to concentrate its efforts on achieving stability in the existing Progesa system. Although C&AG (2008) notes in its report that value for money was not achieved for the eProgesa project, it also commends IBTS for abandoning the project when the problems were evident.

Similar internal controls were followed for the BECS project in which there was a Project Steering Group (PSG) that had four members from the senior management team and a high-level supplier representative. PSG was chaired by the chief executive of IBTS. One important difference from earlier projects was that one senior representative from the supplier was also part of the PSG. It was felt that *“the set-up of the steering group meetings helped”* (R3) the project and ensured that the issues were *“being raised with the vendor at the highest level”* (R2). However, some users also felt that the composition of the steering group was at *“a very high level (and) they (were) far removed from what (was) happening”* (R6).

From the pattern observed in the three instances of implementation, it may be concluded that the steering group acts as an internal control mechanism and its role is especially crucial during the crisis situation, as evidenced during eProgesa implementation. Outcomes of the BECS project suggest that putting a vendor representative on the steering committee is helpful for the project. Apart from the steering committee, BECS project included additional internal control processes at the organisational level. This probably was due to the repercussions associated with earlier implementations. One internal control mechanism was including cost-control with the supplier that involved *"being very challenging and scrutinising every invoice... and linking it back to the work"* (R1) on the ground. The second internal control mechanism was a quarterly review of the BECS project by the Finance committee of IBTS. It is a sub-committee of the IBTS board and *"project manager would present at each meeting of the finance committee project update and status of the project"* (R2).

Finally, there were **project-level control** mechanisms that were applied particularly on the BECS project. These controls were primarily associated with the project structure and communication, and with thorough validation and testing. For Progesa, separate project groups operated in Dublin and Cork centres. Each group oversaw the implementation of the project in their centre and addressed implementation difficulties as they arose. During eProgesa implementation, this was remedied and the project management was integrated across Dublin and Cork. As one respondent recalls:

> *"At (Progesa) time, we wouldn't have had coordinated meetings at all. We would have been having meetings in Cork, and meetings in Dublin, but we would never have had like, Cork-Dublin meetings; whereas in eProgesa, those team meetings were Cork and Dublin. There was no question of having separate meetings for each centre. So, it was much easier, yeah."* (R22)

While all three implementation projects in IBTS followed a functional structure, the BECS project was explicitly divided into various work-streams as noted in Chapter-4. Although there were larger project meetings (usually once a month), the focus of the implementation phase was on the work-streams and work-stream meetings were more frequent (usually once a week). The majority of the respondents agreed that work-stream structure *"worked well"* for the project and IBTS had *"an implementation plan for each of the different work-streams"* (R3). Each work-stream had a *"weekly meetings with (the) project manager (and) issues were discussed weekly"* (R22).

In the case of the BECS project, IBTS seemed to limit the project communication on 'as needed' basis. Communication among the work streams was discouraged and communication to internal and external control entities was only conducted via the project manager or the project sponsor. *“They were the only two people feeding back to (the) steering (committee) and anything the people and managers said at the ground was not getting through”* (R4). The primary reason cited for this practice was prevalent organisation culture of not focussing on own work. At the same time, it is also noted that engagement with available communication channels was less than required. IBTS had project team meetings with the purpose of project-level communication. *“Engagement for that meeting only really got serious when IBTS got close to the mark”* (R3). This perhaps is also reflective of a relative lack of communication within the organisational units. Within IBTS *“the departments seem to be very focused”* (R22) and *“one business unit won't speak to another business unit”* (R5). Therefore based on the evidence, it may be concluded that the work-stream structure worked well for the project team as it allowed the team to focus on the work associated with its function. Although there was a relative lack of communication among the work-streams, it seemed to stem from the prevalent organisation culture.

The second project level control mechanism that was evident in all three instances of implementation was testing and validation of the work-system. Perhaps due to its health service context and risk aversive nature, IBTS essentially subscribes to validation view of the implementation process. Within IBTS, *“the validation process, validation lifecycle process is very closely akin to project management, especially in terms of specification, design, testing, (and) delivery”* (R3). There is *“a great emphasis on validation reports for all the software development in IBTS. All the validation reports are sent to quality (and there is) a quality manager sitting in IT, who ensures that (the) IT systems fulfil all the quality requirements”* (R15). Considering the health service context of IBTS, the level of testing and validation does not seem misplaced. Although time-consuming in itself, it was IBTS testing and validation process that revealed the locking problem in Progesa and recurrent bugs in eProgesa. Although C&AG (2008) noted in its report that value for money was not achieved during eProgesa implementation, it also commended IBTS for its ‘the exacting testing standards’ that led to the suspension of the project. For **BECS** project, IBTS followed a well laid-out testing and validation procedure. As one respondent explains:

> *“So the testing structure is, we formally qualify a system initially through an installation qualification of the test environment. What the installation qualification does is - it records the programs that we use and any configurable parameters in those programs, and we lock it. So that's our test environment. We do our functional testing on that. We call it our OQ tests. A number of deviations come up, we have an iterative process there where we correct it, fix it, retest, so that cycle goes on, a little bit more than you would like but it does. So we get that appointed that our OQ is okay and then we move on to the user acceptance testing. The user acceptance testing is more process based testing*

from the each of the different work streams; we conduct our user acceptance testing. At that point, then we have our parallel runs can take place, or parallel runs, its full system integration, as much as we can, as we have the operational capacity to do. We've modelled it, it's about a third of what a maximum load day it would be. It would be equivalent of what we would do on a Monday or Tuesday. We would run that through full system." (R3)

At the same time, some respondents were not satisfied with how the testing and validation process was executed, especially with respect to the new labels. There is some evidence in the case that there was less than adequate testing and validation of the new labels. Although every label went through OQ (operational qualification) testing, *"the next piece of user acceptance testing, for whatever reasons, it didn't get on to be tested"* (R4). This was especially true for an element called special testing barcode that was related to the testing of rare antigens. IBTS *"really only validated the system for a particular very rare antigen that (they) would routinely test for (and) ignored the rest of them"* (R22), whereas at least one hospital had developed the labelling beyond that and were able to manage all the rare antigens. This caused numerous problems towards the end of the implementation and required IBTS to test the labels thoroughly.

Therefore, it may be concluded that the control mechanism operates at all three levels during the implementation phase. At the macrosocial level, there were external control mechanisms in the form of C&AG, CPA, external audit, and PRG. At the organisational level, there were internal control mechanisms in the form of the steering committee, finance committee, and closer scrutiny of supplier invoices. Finally, at the work-system level, there were project controls such as project structure and communication control, and thorough validation and testing. Only in the case of new labels, the testing and validation mechanism did not seem to be applied thoroughly, arguably due to a lack of institutionalisation. This aspect is discussed with other institutionalisation related factors in the next subsection.

5.3.3.3 Institutionalisation Mechanism

As shown in Table 5.1, during the implementation phase institutionalisation mechanism manifested itself via the project leadership, superusers' selection, project ownership and the role of IT, user engagement, change management, and other organisational exercises. All of these factors operated at the organisational level.

One key factor that determined the institutionalisation of the project within the organisation was **project leadership**. For leading the Progesa project, the appointed project manager had a medical background and the IT unit performed a supportive role in the development and validation of the IS infrastructure. As Progesa project manager recalls:

"So, when we went for Progesa, the project was led by me… but the people on it were the head of production, the head of testing, the head of IT, and the head of quality… So, there were 4 or 5 of us who went in and looked at in the (United) States, went in and looked at it in various places and made the decision as to what we were going to do, which way we were going to go. But by the time we decided, and it was a six-month project, we were pretty familiar with how the system worked. We were also pretty familiar with how our system worked. We could see how the project was going to work and how it was going to be done. We then led the project over the next several years."

The above statement reflects the business ownership of the Progesa project. However, this wasn't the case with eProgesa implementation. Within a year of Progesa rollout in 2003, eProgesa implementation started in late 2004. Unlike Progesa, the project was led by the IT application manager and when he left in April 2005, by the IT manager. It was identified that project was practically *"run by the CEO and the Head of IT"* (R19). Consequently, eProgesa project was presumably owned by the IT unit and the business units remained aloof to the project. For the BECS project, however, Director of Operations assumed the role of the project sponsor, and a contractor who was working as validation manager with IBTS was appointed a project manager. This made the project management *"a little bit more removed from the actual technical piece"* (R8) and closer to the business in case of BECS implementation.

If we compare the pattern across the three instances, it may be concluded that keeping project leadership outside IT unit and placing it in the hands of the business contributes towards the institutionalisation of the project in the organisation. The Same case may be stated for **superusers' selection** for Progesa. The superusers chosen for Progesa project were the domain expert of their functions. These superusers *"came from the clinics or from the labs"* (R8). Although they faced initial problems transitioning to system development, their domain knowledge helped in customisation of the system for IBTS needs. As one respondent notes:

"The point of having, I suppose, a user that has the knowledge and (who) understands the process, is the... You can just come in, and you know, you understand the system rather than having to have somebody to come in and spend 3 weeks explaining what to do, and then trying to figure it out." (R7)

After Progesa rollout, most of the superusers continued as a superuser, trained other users, and developed excellent system knowledge over the years. Even the experience gained during eProgesa failure helped them during BECS implementation. Therefore, it may be concluded that although using domain experts as superusers did have some initial roadblocks in terms of their learning curve, they became an asset to IBTS once Progesa was implemented. As one respondent notes:

> *"(Superuser 1) is probably the most knowledgeable person as far as Progesa and eProgesa (are concerned). She's unbelievable. She knows everything about everything. She really does. She's fabulous. So, she trained me on eProgesa, and then went on to train other people."* (R7)

However, despite a non-IT leadership of the BECS project and inclusion of expert superusers, case evidence points to a lack of clarity surrounding **project ownership and the role of IT** unit. While business units saw it as an 'IT project', IT unit saw BECS as *"an application that (business) use and it (had) to be owned by the business"* (R5). Consequently, business ownership of the project was found be a major issue. Project members from the business side *"either weren't made by their respective managers get involved to the levels they should have been involved, or chose not to involve at the level they should have involved"* (R8). This usually resulted in IT unit taking on the responsibilities that ideally should have been with the business units. *"So, it's the people in IT (who) had to pick up the slack for those people"* (R12). IT unit was *"doing it since they (business were) not doing it"* (R18).

This aspect was particularly salient in the case of the implementation of new labelling system (ISBT-128). As noted in section 5.5, BECS work streams were divided based on the functional structure of IBTS. Consequently, there was no separate work stream for ISBT-128. Although the major responsibility for the labelling decision fell on one of the eProgesa work streams, the labelling process cuts across the functional units. A label consists of *"information coming from the grouping testing lab, it has information coming from the virology testing lab, and all of this label was now changing"* (R4). This meant that there was possibly no unit that would know the end-to-end details about the new labelling system, resulting in a relative lack of knowledge in the assigned unit, and in general lack of business process ownership for the labelling process. Due to a lack of change ownership by other units, it eventually fell on IT unit's shoulder to work with the new labels. Even towards the end, when IBTS had to send product master files for validation by hospitals, there *"was quite a bit of time spent on that by IT"* (R12) on preparing the information pack for the hospitals.

It may also be noted that the IT unit members had to concentrate on the implementation as well as to focus on the maintenance of the existing system. The project resourcing was such that *"the same people who (were) supporting the current day to day production applications (were) implementing projects"* (R8). This resulted in *"a lot of multi-tasking.*

(The superuser) would be writing the test scripts for eProgesa and then a user may call to solve a daily problem related to Progesa" (R18). Understandably this decision was made to exploit superusers' in-depth knowledge of the system, but it also increased their workload. It was also evident that IT unit was short on resourcing. The result was that resources from IT unit worked *"above and beyond (working) on evenings and on weekends"* (R18). IT resource constraint was found to be a major problem within IBTS and resulted in *"single points of dependency in many areas"* (R13), especially with the system superusers. It was also identified that it was a general problem in the public sector *"and resources have to be squeezed throughout the public sector"* (R7). Resource constraint *"had a big impact on (IBTS) in terms of implementing project because the public sector as a whole has been very restricted (and) haven't been allowed to hire staff"* (R8).

There is some evidence in the case that and IT unit probably did not receive full support from the management. *"It seems to never be okay for IT to say – 'no we don't have the time; no, we don't have the resources' (but) it does seem acceptable for the business to say - 'no, we don't have the time; we don't have the resources'"* (R8). The relative lack of top management support for the IT unit may also be understood from the fact that although after eProgesa implementation failure an external report proposed establishing an office of the CIO in 2009, and an office of the Government CIO (OGCIO) was established at the institutional level in 2013, the proposal was never accepted by IBTS top management. At the time of writing the case, although the IT manager has a direct access to the CEO, there is no 'official' IT representative at the executive management level of IBTS.

Another factor through which institutionalisation mechanism manifested itself was through **user engagement**. User engagement here refers to users' buy-in and their involvement in the project. Due to the institutionalisation of the BBCS, *user buy-in* was difficult for the Progesa system. A major focus of the project was *"trying to bring people along and there was a huge resistance to it because people were so used to the old (BBCS)"* (R22). BECS project faced a similar problem since Progesa was completely institutionalised into IBTS operations due to its use for around 12 years. *"Since the people (got) so used to Progesa, selling (BECS) to these people (became) a big challenge"* (R18).

For Progesa, it was the *user involvement* through which IBTS got its long-standing superusers. However, as the evidence suggests, users did not engage to the full extent in the BECS project partly due to their already busy schedule. Users maintained that they had *"their own work to do (and) it would not be possible for anybody to work on another* *project after these"* (R15). The blood service context also played a role here since patient focus is institutionalised in IBTS work. As one respondent notes:

> *"We've been very busy. We have been struggling to get through the day to day work which has to be done. We can't leave patients without the blood. We can't not monitor the antibody in pregnancy. So, to take on another project on top of that is the most difficult aspect of it for us at the moment."* (R16)

Yet, there is also evidence in the case that users were sometimes ignored by the IT unit during BECS implementation especially in terms of approving validation and testing associated with new labels. It was noted that IBTS was *"about to go-live on the 18th of June with critical deviations opened and not signed-off by the users"* (R4). Some users *"weren't very happy with the way parallel runs were conducted and there was no sign-off of the parallel runs as they went along"* (R6). It was also expressed that there *"should have (been) more time spent on testing protocol to make sure that the users were happy that all the critical processes had been included in the test"* (R23).

A significant part of the **change management** associated with ES implementations in IBTS was user training. User training was especially a concern during Progesa implementation due to a relative lack of digital literacy among its end users. Once Progesa was live, IBTS *"went from being completely manual to actually having laptops and computers. That was extraordinarily stressful because it was such a big change. (They) had people who did not know how to turn on a computer, suddenly sitting down trying to figure it out – F11 and F8 and all these different buttons"* (R7). *"For most of the end-users, they were using computers the very first time. So it was not just training for Progesa, but also it was their first exposure to work with computers. So the lack of computer literacy was one of the biggest challenges which (IBTS) faced in the beginning"* (R18). While eProgesa did not go beyond the testing phase, user training was not given too much attention during BECS implementation due to the fact that business processes and user screens did not change much in the BECS implementation. A limited amount of training was conducted towards the very end of the implementation. The *"training at the last minute didn't really impact because the navigation (in BECS) is so similar to the old system"* (R22).

During BECS implementation, however, IBTS faced significant troubles from its external users, the hospitals, due to inadequate change management. Inadequate change management primarily reflected in insufficient attention to the content of change and insufficient engagements with the hospitals. Based on the analysis, it is clear that there was an inadequate assessment of change from Codabar based labelling system to ISBT-

128. IBTS *“completely underestimated the impact of the change of the label”* (R1). This was *“the biggest change in the label in 20 years. The enormity of what that change was and what it meant was not understood”* (R4). Participants noted that IBTS *“hadn't fully identified the full extent and the amount of work involved in changing the label”* (R23). At the same time, there was also an inadequate assessment of hospitals’ needs due to the changeover to the new label. In its relentless focus towards go-live, BECS project management seemed to ignore the fact that the hospitals *“had to validate all these labels in the hospitals”* and that it *“had to provide them with materials to validate their systems”* (R23). This insufficient attention to the content of change reflected in the later realisation by IBTS respondents that “*there was a mistake made in terms of the BECS project and the label issue.(IBTS) had work stream for donor services, for testing, for hospital services, for all (functions but) didn't have specific work stream for the label”* (R2). Towards the end of BECS implementation phase, there was an acknowledgement regarding the labelling piece that IBTS *“should have resourced it way more”* and clubbing it with BECS was like executing *“two major projects”* (R22) at the same time.

Case evidence also suggests that there was inadequate engagement with the hospitals on the change of labels. As noted in Chapter 4, IBTS organised a meeting with hospital’s representative and their LIMS supplier in March 2014, where they were informed about the change in the labelling system and were given broad overview of the ISBT-128 label. With this, hospitals were informed of the proposed go-live being in the fourth Quarter of 2014. After that BECS project team *“merrily went about (their) business working on eProgesa. While (they) were happily developing the labels and doing everything that (they) needed to do, it was somehow forgotten about the hospitals, especially for the communication with the hospitals”* (R22). During the implementation period, there was virtually no contact with the hospitals regarding the new labelling system, even when eProgesa got delayed.

The lack of change communication was also noted during the follow-up interviews with the hospitals. Hospital participants[35] recall that IBTS “*conducted a workshop in the beginning and then there was nothing”*. It was suggested that IBTS *“should have conducted another workshop closer to the final rollout (since) most of the people who participated in the workshop had forgotten the stuff”* (H3). Interestingly, another reason that hospitals seemed to disregard the (limited) communication from IBTS was *“that ISBT-128 been talked about for so long, there was a little bit of – ‘that’s never going to happen’”* (R3). The talk of the new labelling system and not following it up, in a sense was institutionalised

[35] Identified as H1, H2, and H3.

within the hospitals. Therefore, when IBTS contacted the hospitals in May 2015 informing them that the go-live of the eProgesa system would take place in June, most of the hospitals were caught by surprise. *“A lot of it came through, at short notice to the hospitals and put the hospitals under enormous stress”* (R3). Subsequently, most of the hospitals expressed inability to move to new labels. Those few hospitals that were in the process of label change, asked for sample product codes for validation. As noted earlier, IBTS did not seem to envisage this requirement. In the beginning *“IBTS only gave general guidelines (and) sent a web link that provides the meaning of the codes rather than specific product codes which they were using”* (H2). When the hospitals asked for specific information, IBTS responded by sending the labels that were still in testing and were not fully validated (since IBTS itself was finalising and testing the labels). In a sense IBTS was *“chaotically firing things out at them”* (R4) in *“a really rushed manner"* (R22).

Since these labels were prepared in haste, they created confusion among the hospitals around precise ISBT-128 configuration. A respondent from one hospital recalls:

> *“...in some cases some information was wrong, few little things here and there. For example, a label has a bar code and an eye readable information underneath. We read the bar-code through the software and then it was not matching with the description underneath. We thought there is something wrong with the coding. When we contacted them, we were told the description was just a sample and it did not correspond to the bar code. So, there was clearly a lack of quality check at their end. I wonder how did they perform their own validation. They needed to be clear about the examples they were providing.”* (H3)

As noted in Chapter 4, at this point Hospitals moved to the regulator (HPRA) and made IBTS reconsider its decision to go-live in June 2015. After rescheduling the go-live to September 2015, IBTS worked on preparing an extensive and accurate information pack for the hospitals. The hospitals seemed satisfied with the quality of information packs that were eventually provided, but this was after a huge breakdown of communication. Towards the end, though, IBTS did realise its inadequate attention to communication and support to the hospitals and noted that the *“communications with the hospitals could have (been) a lot better”* (R3). It is now realised that IBTS needs to *“find a better way of communicating with the hospitals on significant change”* and needs to develop *“means of getting into the hospital system in a timely manner, at the right level and making sure (that) there are no issues with it”* (R2).

Finally, **other organisational exercises** also seem to have an impact on the implementation. During Progesa implementation, two other organisational exercises took management’s attention and resources away from the implementation. The first exercise was the movement of IBTS headquarters at a new location. In 1999 and 2000 the IBTS was moving its headquarters and processing and testing facilities in Dublin from Pelican House to James's Street. *"Considerable resources were devoted to the implementation of a number of IT projects, i.e., a new payroll system, financial control system, and a blood bank control system, to the establishment of a decentralised collection centre in Carlow and to the move to the headquarters in James's Street"* (CPA, 2003). The second event was an industrial relations problem arising in 2001 that *"prevented the implementation of the system as the Labour Court became involved in dealing with re-grading claims"* (C&AG, 2002). Both issues required considerable resources and high level of involvement from the senior management, resulting in relatively less attention given to the Progesa project. Interestingly, same industrial relations issue that took senior management's attention away from the project gave more time for training. During Progesa implementation, the project team had a *"lot more time to bring people along"* (R22) than they had during BECS implementation. During BECS project also, there was an organisation exercise in which component laboratory in Cork was moved to Dublin to create a 'single site processing' for components that coincided with the implementation phase of BECS. Incidentally, this helped the implementation team as *"the emphasis was then very much totally on Dublin"* (R22), they did not have to worry about the components lab in Cork.

Based on the analysis, it may be concluded that the institutionalisation mechanism manifests itself in the factors that both support and imped the process of implementation. It was noted that keeping project leadership outside the IT unit and appointing system superusers from the domain experts worked in favour of the project. However, project ownership and the role of IT was a contested issue and generally resulted in IT unit taking the slack for the business. User engagement was found to be difficult to achieve and also somewhat ignored by the implementation team. However, users' prior exposure to the system (and lack of BPR) helped with the institutionalisation of the new system. However, change management associated with the new labelling system remained elusive and hampered the institutionalisation of the new label within the hospitals. Finally, other organisational exercises had a positive or negative impact on the implementation depending on the context. The next subsection presents key factors associated with the market mechanism during the implementation phase.

5.3.3.4 Market Mechanism

Similar to the adoption and acquisition phases, market mechanism primarily operates through the supplier during the implementation phase. A major challenge for IBTS in all three implementations was getting timely and appropriate **support from the supplier**. IBTS respondents consistently maintained that the supplier was difficult to deal with. As noted earlier, the supplier tends to have an upper hand in its relationship with IBTS due to its dominant position in the blood bank information system market and due to IBTS's relatively low share in its business. It also certainly helped the supplier that its corporate office is situated in another country (France) where IBTS would not like to engage in legal processing.

For Progesa, getting supplier's support was especially difficult since it was taking place during the Y2K years and the supplier was busy providing support to other clients. For a certain period, the supplier even *"refused to accept that there was a problem with the software"* (CPA, 2003) and insisted that the problem was in IBTS procedures. Although later on the supplier acknowledged the existence of a problem with the design of the software, it charged heavily to resolve the problem. In the eProgesa implementation, although the supplier worked with IBTS to solve the problems, the support was often not timely and definitely not comprehensive. The support was not timely in the sense that if IBTS project members identified a bug, they would report it to the supplier and sometimes *"would find it quite difficult to get response back from them (requiring) to send an issue again, or it will take a while to get an answer to the issue"* (R21). The support was not comprehensive in the sense that *"even after the bug correction, the system was failing the tests which it earlier cleared and (IBTS) had to revalidate it all over again"* (R18). Apart from the supplier's dominant position in the market, the market mechanism also manifested itself through the fact that eProgesa was not in use elsewhere and therefore was not a mature application. IBTS was essentially *"being treated as guinea pigs"* (R18) and by continuously identifying the bugs in the software, IBTS in a sense *"cleaned up an awful lot"* (R20) for the supplier.

During BECS implementation, the supplier forced IBTS to implement its brand new interface (eDMS/concentrator) which connected eProgesa with the laboratory automates. The supplier informed IBTS that it would not provide a *"direct link to eProgesa from the automates (and) that (IBTS) had to send the results to a new application called eDMS"* (R20). Despite the fact that the interface was *"a new piece of software"* (R4) and was not in use elsewhere, IBTS had to accept this requirement. As noted earlier, it posed more challenges for the implementation team and IBTS was considering other options post go-live of eProgesa module within BECS. During the BECS project, some of the problems also originated from the supplier's internal organisational aspects. For instance, a *"key personnel from the supplier changed during the course of the project (and) there was a* *long... learning curve for another person who replaced him"* (R2). For a particular module within BECS, *"there has been at least three different personnel changes as (the) lead contact"* (R14).

For the labelling part of BECS, the market mechanism also operated through **hospitals' suppliers**. As the case evidence suggests, the level of IT expertise in the hospitals is not very high and they are mostly dependent on their suppliers for software maintenance and upgrades. Also, different hospitals are dependent on different suppliers for their LIMS. Ireland's Health Service Executive (HSE) that oversees hospitals' operations was, in fact, aware of the situation and was looking for the implementation of a National level LIMS system. When the BECS project was underway, HSE awarded the contract for National LIMS (called, MedLIS) and an Electronic Blood Tracking System (called BloodTrack) (eHealth Ireland, 2015). Interestingly, *"none of the current suppliers won the tenders. So, they had no incentives to invest or to maintain or to upgrade their systems"* (R19). Even the supplier that tried to provide support, could not do so in timely fashion, resulting in validation delays by the hospitals. Therefore, *"about half the hospitals found out with six weeks to go that they couldn't go to ISBT 128, they were going to have to stay with Codabar. So, they had to reset their whole validation process themselves as well"* (R1).

Apart from the supplier support, the market mechanism also manifests itself via the **IT resources market** that constrains the availability of IT resources to IBTS. During Progesa implementation, IT resources *"came at a premium price because of the Y2K situation"* and IBTS had *"three IT managers since 1998"* (CPA, 2003). Towards the end of BECS implementation, a Database Administrator left the organisation since "he felt undervalued" (R18) and *"got to know that in the industry he could get higher salary compared to what he was getting"* (R13) in the IBTS. Also due to the public sector context, IBTS cannot offer higher salaries to match market standards. Apparently, it was one of the primary reasons for not appointing a CIO in IBTS and can be argued to be a potential reason for the lack of IT support in hospitals.

Therefore, during the implementation phase, market mechanism primarily operates through suppliers by determining the level of <u>support from the supplier</u> – both the supplier to IBTS and the LIMS suppliers to the hospitals. Apart from the suppliers, the market mechanism also determines the <u>availability of IT resources</u> to IBTS and to the hospitals. Next subsection discusses the outcomes associated with the implementation phase.

5.3.3.5 Implementation Outcomes

For Progesa and BECS, the major outcome of the implementation process was the go-live of the system although with major delays. Due to delays in Progesa going live, existing *“blood bank control system (BBCS) had to be Y2K compliant in 1999”* (CPA, 2003), resulting in additional expenses which were also added to Progesa budget. Consequently, when the Progesa system went live in 2003, it had serious time and budget overrun, resulting in the C&AG audit and IBTS ended up defending itself before the Committee of Public Accounts. IBTS admitted before CPA (2003) that despite the supplier being responsible for the locking problem, it decided not to go to the court to recover the money. Here, two aspects related to the supplier are crucial. First, the supplier’s corporate headquarters is in France and French justice system is notorious for inordinate delays. Second, IBTS had the apprehension that if it went ahead with a lawsuit, the supplier would withdraw all support for the system. Here one notes the impact of a dominant supplier in a niche market.

On the positive side though, the blood operation of IBTS was now covered by a single system and its superusers had extensive knowledge of Progesa operations, who continued as superusers and trained the users. As one respondent recalls:

> *“It actually, it was tough, it was hard, and it took longer but that was okay, you know, because when it was done, when eventually we went live, we had stayed live. It was, you know, it was a successful project. It made us spend… a little bit more money… (and) certainly took a lot longer in time. But at the end, it was done. The whole place was integrated across one system. We might have done a better job of it, it might have been, you know, you might have got rid of a lot of other processes along the way, but when it was done, it was done. So, it was a very big project done at a very difficult time, and yeah, it's, it was good.”* (R19)

For eProgesa implementation, a major outcome was the abandonment of the project. Since the project was abandoned, IBTS had to write-off the amount spent on the project. Once again due to the reasons mentioned earlier (French justice system and Progesa maintenance issues), IBTS did not file any lawsuit for the recovery of its money from the supplier. Similar to the earlier instance, this resulted in IBTS justifying itself in C&AG audit (2008) and before CPA (2008). For the project members, work stress was a major outcome of the implementation process with no satisfaction about the system outcome. As they recall:

> *“In a single sentence, it was incredibly stressful. I still remember those horrible times… We used to have bug after bug, we sent bug reports to them and in some case didn't hear from them even after a month. So this was causing us significant delays. Even after the bug correction, the system was failing in the tests which it earlier cleared and*

we had to revalidate it all over again. And all of this fell on our shoulders. We were working overtime. We'll stay late in the office. We even used to come on the weekends." (R18)

On the positive side, the existing version of Progesa was stabilised on the new hardware and worked for years to come. Another associated outcome of the failed eProgesa implementation was evident during BECS implementation when prior exposure to eProgesa helped the superusers in working with BECS. eProgesa module of BECS went live just a couple of months before the end of data collection in Dec 2015. Therefore, long-term outcomes of BECS remains to be seen. However, during the BECS project, there were certainly some intermediate outcomes and these outcomes were mostly mediated by existing resource constraints in IBTS. One outcome at work-system level was that implementation team had frequent work overloads and work related stress. Project team member worked *"weekends a lot, and extremely long hours during the week"* (R12) and they felt being *"under pressure to get things done at a certain time and to get documents signed off"* (R21). At the organisation level, the resource allocation to BECS meant that other project had to wait for BECS go-live. Once BECS was delayed, other projects had to wait longer as it was *"the only show in town"* (R18).

As far as ISBT-128 labelling is concerned, one major outcome was that the new labels were dual labels. *"Because some of the hospitals weren't capable of reading the ISBT-128 elemental labels, (IBTS) provided the current Codabar as a hybrid at the bottom of it"* (R3). IBTS annual report (2015) notes that 15 hospitals transitioned to full ISBT 128 labelling and 31 hospitals were still using the Codabar label. At the organisation level, the way the implementation process unfolded, "*it caused serious problems with relationships internally and (that with) the hospitals"* (R3). At the end, however, it was expressed that the dual labels have given the hospitals capacity to move to ISBT-128 in the future whenever they are ready. When eProgesa module of BECS rolled out, most of the IBTS respondents were glad that although it had huge time overrun and was slightly over-budget, it eventually went live without any significant problems.

Therefore, it is evident that all the four mechanisms (affordance, control, institutionalisation, and market mechanism) drove the outcomes of the implementation phase. It also reflects in the emergence of a higher number of factors compared to other phases and observation of a number of outcomes at different levels. The next subsection discusses key factors and associated outcomes with the use and maintenance phase.

5.3.4 Use and Maintenance

The use and maintenance phase involves continuous use of the system in the organisation and regular maintenance/upgrades whenever required (Esteves & Pastor, 1999, 2001). Since the first implementation of eProgesa was stopped, it required longer use and maintenance of Progesa. Therefore, most of the discussion in this section pertains to Progesa use and maintenance. Some discussion on BECS use and maintenance is included based on how the participants envisaged it.

5.3.4.1 Affordance Mechanism

Similar to earlier sections, Affordance mechanism primarily operates through features and constraints of the **ES artefact** during the use and maintenance phase. This includes the ES software and the hardware on which the artefact runs. Due to eProgesa failure, Progesa required extended maintenance and this necessitated the changeover of hardware for Progesa during 2007-08. Therefore, after eProgesa failure IBTS *"priority was to stabilise the current version of Progesa on new hardware"* (IBTS Board Minutes, 2007). Subsequently, *"the hardware acquired (for eProgesa was) used to replace Progesa hardware. (Although) the technical specification of the hardware (was) greater than is required for Progesa but (it had) the benefits of greater performance and resilience"* (C&AG, 2006). IBTS utilised the new hardware and software licences in other operational areas (e.g. e-Financials system in the finance domain) as well.

The underlying features of the ES artefact also impose a certain way of ES maintenance and upgrade. System superusers note that while it was possible to introduce parameter changes in Progesa 'on the fly', BECS application architecture requires that the system needed to be shut-down for maintenance and upgrades. IBTS need *"to stop the application services, stop database services and (other) things to implement changes"* (R8). This requires determining the maintenance schedule for the application suite in close coordination with other modules and with the users. Most of the implementation team members saw this as an opportunity to systematise the maintenance schedule.

> *"So, it just means that you would tell people - we will be doing our changes on a certain day. Like, if you have change, I would say to say - 'well, the next scheduled parameter change is such a date; so, it will be done then.' So, you can kind of tell people more or less when it will be done. You know, that's a difference really I think in making parameter changes than that with Progesa."* (R21)

With the new system, IBTS successfully conducted a system maintenance exercise in the early part of 2016 but a decision was still needed *"to be made regarding the semester* *patch for eProgesa before the end of the year"* (IBTS Board Minutes, 2016). Therefore, it may be concluded here that the ES artefact played a key role during the use and maintenance phase via the features and constraints of the system. The next subsection presents key factors associated with the control mechanism during the use and maintenance phase.

5.3.4.2 Control Mechanism

For the use and maintenance phase, control mechanisms mostly operate at the work-system level. Control mechanism during this phase manifest in strict **change control** and validation procedures at the work-system level. Within IBTS, any maintenance and upgrade activity requires a high level of change control procedures and associated documentation. For some, *"there (is) an insane amount of change control and very high level of validation (surpassing) the level of validations and quality control (in the pharmaceutical industry)"* (R18). Within IBTS, *"it can be quite difficult to get a change. There is an awful lot of paperwork. There is a validation procedure and a lot of paperwork even for the smallest change on a system"* (R16). Although the users realise that such level of change control and validation procedures are *"required for the safety of the patients"* (R18), for them it is also *"frustrating the length of time that it takes to actually to get (simple modifications) done"* (R24). There is also a feeling that same standard of validation is applied for all the processes irrespective of their criticality, resulting in delays even for non-critical processes. For example:

> *"As a manager, if you are looking at (operational) trends and you are looking at stuff, there is a variance that is acceptable within it. If you are looking at 200,000 donors and how they act year on year. If there is a slight inaccuracy in the report, it's relative year on year. So, it doesn't really materially impact on what the decision you are going to actually make"* (R24).

Even though there is some recognition in the organisation on this aspect, still the organisation focusses on strict quality and validation standards:

> *"...it is not like that we enforce a single standard for every product. But what we do is that we have tried for the standardisation of the culture in quality. For a good quality management system, there has to have a commonality. We have developed that culture. For example, we are among the only four blood banks in the world that operate in the clean room environment for the blood. Though it is not a necessity in the blood directives, but we still do so since we have to operate in the clear room environment for some other products"* (R15).

In other words, the control mechanism seems to be prominent within IBTS in the form of strict change controls. The next subsection presents key factors associated with ES institutionalisation in IBTS.

5.3.4.3 Institutionalisation Mechanism

For the use and maintenance phase, institutionalisation mechanism manifests in the form of **mandatory use** of the new system, creation of **workarounds** and **user exposure** to the system. A common feature of system use in IBTS is that it does not allow two parallel systems (with possibly the exception of labels) to operate for the same business process. With the rollout of the Progesa system, BBCS ceased to operate in 2003 and it was only *'used for look-back'* (IBTS Annual Report, 2003) old records. The same strategy was envisaged for eProgesa go-live within BECS:

> *"We'll leave Progesa running; we'll do the data migration process. Then we've qualification process and set up processes, but we would expect to be moving over to eProgesa at 4 o'clock the following day. So, Progesa will be gone, eProgesa will be up. We can't afford, we can't do a parallel implementation."* (R3)

Subsequently, when the eProgesa module within the BECS project went live in September 2015, Progesa ceased to operate. Therefore, due to mandatory use of the system by the organisation, end user did not have much scope of deciding which system to use. As noted in earlier section, although few performance issues were noted for some of the BECS modules, users were still supposed to use the same system with the implementation team focussing on performance improvement. Therefore, mandatory use of the new system contributed towards quick institutionalisation of the system.

IBTS harnessed **user exposure** with Progesa to ensure user acceptance for the BECS system. eProgesa within BECS is *"only an upgrade (of) what (IBTS) have already (and) there is little change"* (R6) in terms of user screens and navigation. Since Progesa application and usage of computers were highly institutionalised in the organisation, training the staff on the new system was easier. *"Every single member of staff that (superusers) trained, they're familiar with the computer; they're familiar with the keyboard; they're familiar with navigating around the screen"* (R17) prompting the quick institutionalisation of the new system. At the time of the end of data collection, apart from some performance issues related to interfacing, there were no serious complaints about system usage in the organisation.

In the long term, the institutionalisation mechanism manifests in various **workarounds** surrounding the system use. Despite the mandatory use of the system and high level of change control, Progesa required quite a few workarounds to suit the needs of the organisation. For example, since Progesa reporting capabilities were limited, many users opted to export Progesa data in Excel to generate required reports. Other workarounds were related to the Codabar labelling system. As noted in earlier subsection, Codabar numbers used to repeat after few years. One workaround was that IBTS manually *“stopped sending repeat numbers to particular hospitals”* (R2), thereby ensuring that the same Codabar label was not sent to the same hospital twice. Similarly, since existing e-financial system in IBTS could not work with repeatable Codabar codes, the finance division introduced an internal finance code to uniquely identify the product sent to the hospital. Before ISBT-128 implementation, the finance division *“had two coding systems going on… the operations code and… the finance code”* (R10) in order to uniquely identify a product sent to the hospitals. This was required to ensure correct billing to the hospitals.

The introduction of dual labelling system in 2010 that included ISBT-128 code for donation identification number instead of implementing full-face ISBT system can be also seen as a workaround to avoid duplication in Codabar codes. This was perhaps necessitated by the deep institutionalisation of Codabar labels in the hospitals and IBTS. Interestingly, when ISBT-128 full-face label was introduced along with BECS, IBTS still had to introduce workarounds for the machines that could not work with the new labelling system. They *“had to put it in an additional step now to convert the ISBT-128 donation numbers into Codabar numbers, so that (they) could enter the sample reference numbers… into the testing equipment”* (R23). In fact, the provision of Codabar labels with ISBT-128 full face label itself amounts to providing a workaround to the hospitals that could not move to the new labelling system.

Therefore, while <u>mandatory use</u> and the creation of <u>workarounds</u> facilitated the institutionalisation of Progesa, prior <u>user exposure</u> to the system helped in the quick institutionalisation of eProgesa within the BECS project. The next subsection presents the factors associated with the market mechanism during the use and maintenance phase.

5.3.4.4 Market Mechanism

During the use and maintenance phase for Progesa, market mechanism primarily operated through **suppliers’ push**. First, it was hardware supplier (HP) in 2007 who noted that they *“won't guarantee service on the existing servers”* (IBTS Board Minutes, 2007). As noted in Chapter 4, eProgesa implementation was stopped in 2007 and Progesa was stabilised on the new hardware purchased for eProgesa. Thereafter around 2010, MAK Systems (Progesa supplier) *“indicated that they (would) support the current version of Progesa until at least 2014”* (IBTS Board Minutes, 2010) without giving a definitive date. As noted in section 5.3.1, this prompted IBTS towards BECS adoption in due time. Therefore, it may be concluded that <u>suppliers’ push</u> in the form of end of system support during the use and maintenance phase, paved the way for Adoption in the ES lifecycle.The next subsection discusses the outcomes of the use and maintenance phase.

5.3.4.5 Use and Maintenance Outcomes

Due to eProgesa implementation failure, Progesa had extended use and maintenance phase, requiring major hardware change during 2007-08. The primary outcome of Progesa use and maintenance phase was the institutionalisation of the system in the organisation through regular maintenance and upgrades, and occasionally via workarounds if the system did not meet user requirements. This also had an impact on the BECS implementation. Progesa became so institutionalised into IBTS's blood operations that users did not feel the need for a new system even after a decade. Within IBTS, users were *"more comfortable with the (Progesa) system (and) they refused to see the benefits of the new system"* (R18). As far as BECS is concerned, in the beginning, there were some *'familiarisation issues'* but the implementation team expected that system usage will be institutionalised in the organisation with time. Therefore, based on the discussion it may be concluded that the institutionalisation mechanism was the most prominent mechanism driving the outcomes during the use and maintenance phase, with other mechanisms having a somewhat lesser impact. The next section discusses the evolution phase of Progesa lifecycle.

5.3.5 Evolution

Just as eProgesa implementation failure resulted in longer use and maintenance phase for Progesa system, it also allowed for longer evolution period for Progesa. Evolution occurs when additional capabilities are included in the ES. This section discusses how the underlying mechanisms manifested themselves in the form of key factors during Progesa evolution. As discussed in Chapter 4, the evolution phase for Progesa included implementation of a reporting software called BOSS (Blood Operations Support Software) and the introduction of Electronic Ordering System (EOS) for the hospitals. Both initiatives might be understood as implementation projects in themselves. Therefore, many factors noted for the implementation phase are also found to be relevant for the evolution phase.

5.3.5.1 Affordance Mechanism

During the evolution phase, affordances mechanism manifests itself through features and constraints of the **ES artefact** (Progesa and BOSS) and through **IS infrastructure** of the partner (Hospitals). Although IBTS cited the availability of management reports as an important factor in Progesa adoption decision, in reality, Progesa reporting functionality was barely useful and there was *"a massive deficit in information"* (R1). To ameliorate this problem, IBTS decided to purchase Blood Operations Support Software (BOSS) that could extract reports from Progesa. BOSS implementation could be seen as a microcosm of Progesa/BECS implementation. Similar to Progesa and BECS, BOSS also engaged in minimum BPR and maximum customisation of the reports.

> *"We were buying 120 (reports) - 100 that were supposedly the same as New York and twenty bespoke. That didn't work at all because they, everywhere it was different. You couldn't say - 'give me that exact report for Ireland' - because it made no sense. So they were all bespoke in a sense."* (R4)

Around 2011-12, IBTS started developing an Electronic Ordering System (EOS) to provide the hospitals with a direct and online interface with Progesa to order their product. Until this time, orders were taken manually over telephone and therefore, had ample scope for errors in noting product requirements (e.g. radiated or irradiated product). Consequently, *"there were mistakes made in orders going to hospital (and) to get rid of all of this"* (R2) IBTS decided to implement EOS. As noted in Section 4.5, IBTS engaged in in-house development of an EOS to automate the ordering process for the Hospitals. IBTS was ready with the system in September 2011, but only three hospitals could go-live with the system at the time. The major problem in this regard was associated with the hospitals'' IS infrastructure. It was noted that *"the IT support in hospitals… ranges from quite good to quite poor, because there are so many hospitals (and) that was the biggest challenge in that project"* (R2). Some hospitals have a single IT resource and "*one person taking a holiday in a small hospital can have an impact of delaying the whole system"* (R3). Due to these inadequacies of hospitals' IS infrastructure, EOS Implementation in all hospitals didn't take place until March 2012. This was 6 months after EOS was ready to be deployed by IBTS. In this way, EOS was quite similar to the ISBT-128 part of BECS. Therefore, it may be concluded that <u>ES artefact</u> (through its features and constraints) and (partner) <u>IS infrastructure</u> played a key role during the evolution phase. The next subsection presents the factors associated with the control mechanism during the evolution phase.

5.3.5.2 Control Mechanism

Control mechanism primarily operates at the work-system level during the evolution phase. There were similar levels of **project controls** during the evolution phase of

Progesa. The BOSS implementation team followed similar procedures for report development validation and testing that are reported earlier for Progesa and BECS:

> *"We did specs for every one of them and then tested them against the spec. Got them built, got them in, had a look at them, got them refined, then validated them. So, that's how we did it."* (R4)

EOS project initiation was a bit informal in the sense that *"EOS was born out of (the) director of Operations and (the) Head of processing approaching a member of IT directly"* and *"there were no controls put in place"* (R5). However, later on, project-level controls were placed and it was ensured the system was properly validated and that it was a secure system. Therefore, for both BOSS and EOS implementations, project controls played a big role during the evolution phase. The next subsection presents the factors associated with the institutionalisation mechanism during the evolution phase.

5.3.5.3 Institutionalisation Mechanism

During the evolution phase, institutionalisation mechanism manifests through **project leadership**, and a lack of **project ownership,** and **integration with other systems**. Similar to Progesa and BECS, BOSS project also had a non-IT leadership and a dedicated project manager that helped IBTS in exploiting organisational knowledge. Operations director was the project sponsor and there was a dedicated Project Manager. *"Typically, most of the projects in the organisation (used to be) managed by somebody who is in an area and they run the project as well, that in their area. This was the first time (that IBTS had appointed)… a dedicated project manager and that was crucial to getting BOSS over the line"* (R1). Like the BECS project, the BOSS project also faced the issue of business ownership where they needed to determine *"who was the owner within IBTS of the report" and to ensure that "they were responsible for it"* (R4). Like Progesa and BECS, BOSS project also went over-budget and over-time but eventually rolled out towards the end of 2009. At the lesson learnt session for BOSS in Dec 2009, it was identified that while appointing a full-time project manager contributed to the project in a positive way, the project manager took on too many responsibilities due to lack of business process ownership within IBTS. Like BOSS, EOS also exhibits non-IT project leadership but it also indicates inter-departmental tensions between the operations unit and the IT unit in regard to project ownership.

When Progesa was being implemented, the testing laboratories were also engaged in introducing testing automates to automatically record the results. Progesa evolution also involved developing interfaces primarily with laboratory automates. When Progesa went live in 2003, at least two interfaces were developed at the same time to transfer results automatically from various laboratory testing equipment to Progesa system. Over the years, most of the laboratory automates were interfaced with the Progesa software. At the same time, Progesa was also interfaced with the e-Financial system that managed financial accounting within the IBTS. Integration with other systems helped in long-term institutionalisation of Progesa in IBTS.

Therefore, it may be concluded that the project leadership outside the IT unit, a relative lack of project ownership, and integration with other systems within IBTS played a crucial role during the evolution phase. The next subsection presents the factors associated with the market mechanism during the evolution phase.

5.3.5.4 Market Mechanism

While market mechanism seemed to constrain IBTS choices in other phases, **ES market structure** favoured the Progesa evolution within IBTS. Market mechanism played a major role in BOSS adoption by Progesa. Interestingly, BOSS was not developed by the MAK Systems, but by the New York Blood Centre (NYBC), a for-profit blood bank in the United States. It might be argued that BOSS implementation was perhaps conceived only because it was available on the market. The case evidence does not show any serious attempt of in-house development of the reporting tool for Progesa before BOSS came into the picture, thus establishing the importance of market mechanism. When integrating its existing systems with Progesa, IBTS did not seem to face any major problems either. This might be primarily due to the fact that providers of automates and e-Financial software are fairly established in the market. Market positions of system providers played a supporting role here since interfaces were available to export the results to other systems (automates to Progesa) or to take the output from other systems to process transactions (Progesa to e-Financials). Therefore, the case provides the evidence that the ES market structure has an impact on the evolution phase via the level of standardisation and support available. The next subsection discusses the outcomes of the evolution phase.

5.3.5.5 Evolution Outcomes

Based on the analysis, it may be concluded that three major outcomes of Progesa evolution phases were – more integration with other systems within IBTS, enhancement of MIS reporting capabilities through BOSS implementation, and integrating the hospitals in the supply chain by introducing EOS. Interfacing with other systems in IBTS probably helped Progesa to become more institutionalised in organisation’s operations. However, the same aspect posed challenges during BECS implementation since the supplier mandated the use of its interfacing software on top of existing interfaces. BOSS implementation reflects the organisation's intention to extract more useful management information and report from the system. Over the years, BOSS reports have become an inseparable part of IBTS operations and it is considered as a *"very advantageous system to give (IBTS) very good information"* (R2). It was expressed that many units *"wouldn't really be able to function without"* (R4) the BOSS reports. Another major outcome of the evolution phase was integrating the hospitals with Progesa via EOS. Although IBTS initially faced problems due to inadequate IS infrastructure and insufficient support in the hospitals, the system is now in use by all the hospitals transacting with IBTS. Therefore, based on the discussion, it may be concluded that all four mechanisms drove the outcomes during the evolution phase, albeit to a lesser extent compared to the implementation phase. The next subsection takes an overall view by tracing key factors during ES lifecycle in IBTS.

5.3.6 Tracing key factors during ES Lifecycle

This subsection traces key factors *during* different phases of the ES lifecycle in IBTS. Figure 5.1 exhibits the relative importance of the factors that played a key role across most of the phases. A key observation is that the majority of factors emerged during the implementation phase. This implies that within the ES lifecycle, implementation remains the most challenging phase since it involves the interaction of all four mechanisms resulting in the emergence of a large number of factors. This also explains ES researchers' focus on the implementation phase since this phase presents numerous challenges for the organisations.

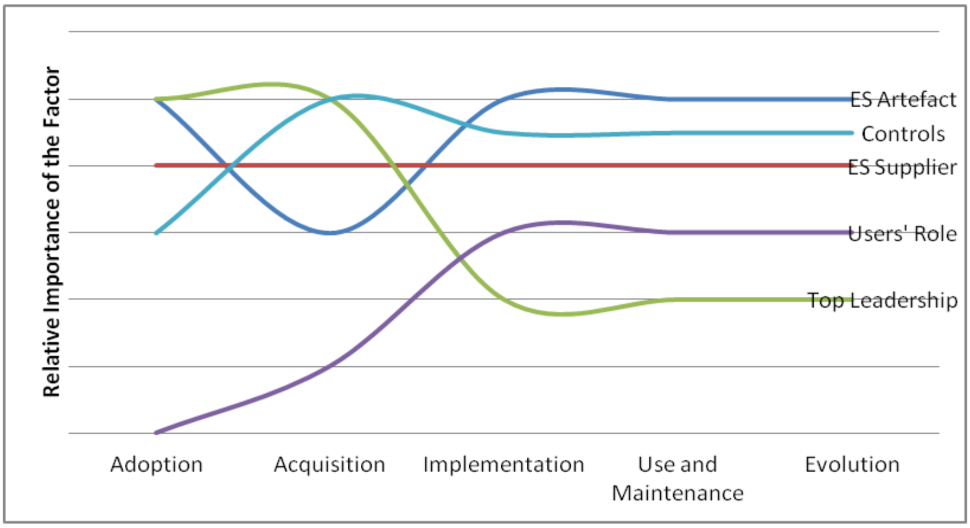

Figure 5.1 Relative Importance of Key Factors during the ES Lifecycle

Affordance mechanism and **ES artefact** played an important role in all phases with the possible exception of the acquisition phase. ES artefact played a major role during the adoption phase via constraining limitations of the existing system and enabling features of the new system, resulting in the adoption of the new system. During the acquisition phase, ES artefact arguably played a secondary role in gap analysis since IBTS did not have a direct access to the features of ES artefact. It was in the implementation phase, however, when affordance mechanism was most prominent not just through the ES artefact but also in the form of hardware/interfacing issues, business process aspects, IS infrastructure, and through superusers' skills associated with the ES. During the use and maintenance phase, architectural features of the ES enabled or constrained certain way of maintenance and upgrades. Finally, evolution phase is marked not only by the ES artefact (Progesa) but also by the features of the proposed enhancements (BOSS/EOS) and IS infrastructure in the hospitals.

Similar to the ES artefact, the **supplier** also played a major role during all the phases of the ES lifecycle in IBTS, especially due to the fact that the supplier is a dominant player in a niche market. It was supplier's push during Progesa use and maintenance phase that prompted BECS adoption and acquisition by IBTS. Support from the supplier was found to be very crucial during the implementation phase where IBTS implementation team relied on the supplier to correct the bugs in their product and to provide the customisation/configuration support. A major part of Progesa delay can be attributed to lack of supplier's support. Interestingly, suppliers of hospital LIMS also played a crucial role during BECS implementation since they were supposed to provide support (which many of them didn't) to their respective hospitals in reading ISBT-128 labels to their LIMS. During the evolution phase, the role of Progesa supplier was partially undermined by the development of the BOSS system by an outside entity, but the supplier, later on, ensured its market monopoly by acquiring the system from its developers.

Empirical evidence from the case indicates that nature of the **top leadership** support changes during different phases of the ES lifecycle. While top leadership of IBTS acted as an internal control mechanism during the adoption phase, it mediated with the institutional context during the acquisition phase. Implementation phase was mainly marked by resource allocation and tacit support to the implementation team. In the post-implementation phase of Progesa and eProgesa when the concerns were raised by the C&AG (2002, 2008) and the matter was discussed in the CPA (2003, 2008), top leadership once again represented IBTS in mediating with the external context. During the use and maintenance and evolution phase, the role of top leadership was again primarily tacit and mainly as an internal control mechanism.

Like top leadership support, nature of the **user** involvement also changed across different phases of the ES lifecycle in IBTS. While adoption phase was marked by user involvement in writing URS, they were found to be ill-equipped for the task due to their busy schedule and inability to see beyond their current practices. This limited involvement also appears partially demonstrative since the users were *"more or less told to copy and paste"* the URS from another blood service. Due to the prevalence of market and external control mechanisms during the acquisition phase, users did not have much influence. They were partially involved during the implementation phase, but their role was primarily associated with testing the ES artefact with respect to the URS. During the post-implementation, the role of users mainly confined to using the system and reporting bugs, if any.

Perhaps due to the health service and PSO context, **control** mechanism was also found to be important throughout the ES lifecycle. However, the nature of the controls varied in different phases of the ES lifecycle. During the adoption phase, it was mainly internal control via the top leadership in terms of how the adoption decision is presented to the IBTS board. In the acquisition phase, however, it was external control by the department that had an impact on the acquisition process. During the implementation phase, both external and internal controls were operational respectively via the PRG and project-level controls. During the use and maintenance, and evolution phase internal control were primarily seen to be in operation.

While the present section discussed key factors *during* different phases of the ES lifecycle, the next section takes a long-term perspective and discusses the factors *across* three instances of the ES lifecycle.

5.3.7 Tracing the factors across three instances of ES Lifecycle

Since the case evidence captures three instances of the ES lifecycle, it also offers the opportunity to observe the change in the relative importance of certain factors across three instances. Figure 4.2 exhibits the relative importance of selected factor across three instances of the ES lifecycle. It may be noted here that the factors included here are only those factors for which changes were noted across three instances of ES lifecycle.

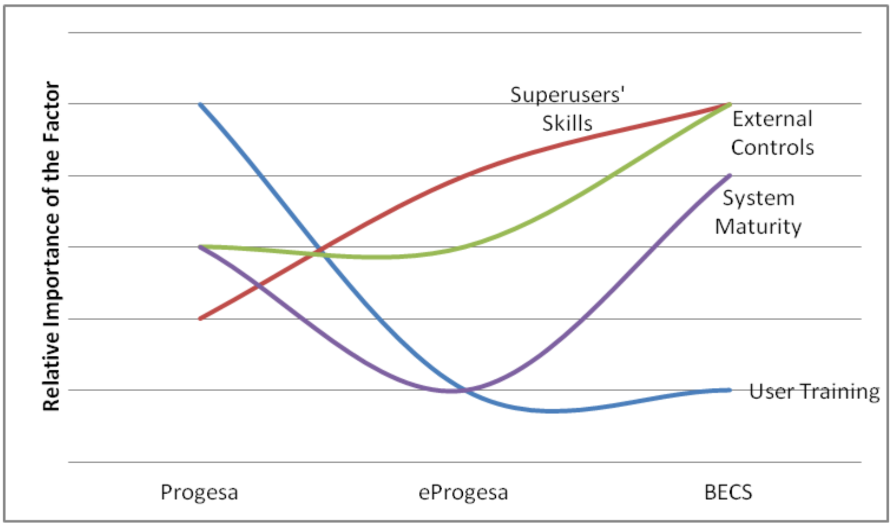

Figure 5.2 Key Factors across three instances of ES lifecycle

At the macrosocial and organisational level, one may notice the different levels of external and internal controls on three projects. The internal control for Progesa and eProgesa was primarily in the form of project level controls. The external control on Progesa and eProgesa was minimal during the implementation of the project and it came into operation only after the implementation phase. For the first two instances, the external control from the institutional context of IBTS was imposed only when the concerns emerged in the form of 'value for money' (C&AG, 2002, 2008). As discussed in Chapter 4, perhaps due to the concerns raised for first two instances, and the wider concern for e-Government projects in the Irish public sector (C&AG, 2007), BECS project incorporated various internal and external controls from the beginning. While the external control was in the form of PRG review, the internal control was in the form of steering group, finance committee, and project-level controls.

Other three factors that witnessed substantial change during the three instances of the ES lifecycle in IBTS primarily worked at the work-system level. During the three instances, there were different levels of **superusers' skills**. When superusers were selected during the Progesa project, most of them had very little IT skills and no prior knowledge of Progesa. As noted in Section 5.3.3, it was a learning curve for the superusers during the Progesa project. During the eProgesa implementation however, superusers attained more skills by conducting extensive testing of the eProgesa system. Later during the BECS implementation, superusers' skills were a key supportive factor due to their extensive experience and expertise on the system.

Like superusers, the end users of the system had very low IT skills when Progesa was implemented. Therefore, when conducting **user training**, the superusers had to train the end users both for general IT skills as well as for using Progesa. Therefore the relative importance of user training was higher during Progesa implementation. The user training aspect of eProgesa was not materialised due to the abandonment of the project during the implementation phase. Finally, when BECS was being implemented, end users had extensive experience of general IT usage as well as that of Progesa application. Since the user interface was kept the same in the BECS implementation, user training was given a low priority. As noted in Section 5.3.4, limited amount of training did not cause any problems in the use of the new system.

Finally, three instances of the ES lifecycle in Progesa also witnessed differing levels of **system maturity** that had an impact on the implementation outcomes. When Progesa was being implemented, it was a moderately mature system. Consequently, barring the data locking problem discussed in Sections 4.3 and 5.3.3, Progesa implementation did not face any system related major issue. In contrast, at the second instance, eProgesa was a completely new system and consistently posed problem to superusers during the implementation and testing. The system maturity of the eProgesa system was so low that the project had to be abandoned. During the BECS project, however, although the other modules (eTraceline, eRiskline, TCS, EDMS) were not so mature, the core module (eProgesa) was a mature application and the superusers did not face any significant problems in implementing it.

This section presented the empirical evidence supporting the explanatory framework presented in Section 5.2. In particular, the evidence not only captures the emergence of key factors and mechanisms in different phases of the ES lifecycle, it also traces the factors and mechanisms across the three instances of the ES lifecycle. The next section compares the explanatory framework against extant literature.

5.4 Comparing the Framework against Extant Literature

This section discusses the explanatory theoretical framework in the light of extant literature. The discussion is organised around the four key mechanisms that are identified in earlier sections – affordance, control, institutionalisation, and market mechanism. However, due to the ES literature's primary focus on critical success factors, most of the links to the literature are in the form of key factors. Subsections 5.4.1 to 5.4.4 discuss the findings associated with four key mechanisms – affordance, control, institutionalisation, and market mechanism. Subsection 5.4.5 concludes the section by focussing on the interaction and dynamics of the four key mechanisms.

5.4.1 Affordance Mechanism

Of the four mechanisms identified in the theoretical framework, perhaps affordance mechanism is the most popular mechanism in the IS literature in recent years. Originally introduced by a psychologist named Gibson (1986), an affordance perspective recognises how an object supports a set of specific usage of the object and constraints some other usage (Leonardi, 2011; Zamutto et al, 2007). Furthermore, an affordance perspective does not only refer to features and constraints of the technology but also relates to the capability of the actor to appropriate the technology artefact (Faraj & Azad, 2012). Affordance is often realised via the enactment of several mutuality relations between the technology artefact and the actor. Bloomfield et al (2010) emphasise that the affordances of the technological object and the action capabilities of human agents should not be viewed as a given but emerging as situated, and indeed as ongoing accomplishments. In the ES context, this translates to the features of both the technology and to the nature of the business processes. Based on the empirical evidence, four distinct affordances were identified pertaining to ES lifecycle in IBTS – basic affordance, integrating affordance, interfacing affordance, and reporting affordance. Table 5.2 provides a definition of the four affordances as used in this study. These four affordances had a differential impact during different phases of the ES lifecycle.

Table 5.2 Types of Affordances Identified in the Study

Affordance	Definition
Basic Affordance	Being able to run the software on the given hardware in order to record and save the information (based on Volkoff & Strong, 2013).
Integrating Affordance	Being able to capture the business process through a single system where the output of one stage acts as input to the next stage (based on Volkoff & Strong, 2013).
Interfacing Affordance	The possibility of interfacing the ES with other systems in the organisation (Gulledge, 2006) in order to promote widespread usage of the system.
Reporting Affordance	Being able to generate reports on performance trends that may help the management in making business decisions.

Progesa adoption was initiated because then-existing BBCS could stop providing even the *basic affordances* due to the Y2K problem. Progesa also offered to provide *integrating affordance* for IBTS blood operations over Dublin and Cork office, something which BBCS could not provide. However, as noted in Chapter 4, earlier version of Progesa lacked some basic affordances in the form of maintaining data consistency that caused delays during the implementation phase. Once implemented, although Progesa could provide basic and integrating affordances, it had very limited reporting affordances due to its flat-file structure. eProgesa was adopted primarily due to its reported capability of generating management reports (reporting affordances) and its superior recovery features (basic affordance). Due to relative immaturity of the product, eProgesa was so bereft of even the basic affordance that the implementation did not go beyond the testing stage. This puts basic affordances as a 'necessary but not sufficient mechanism' (Mohr, 1982 p. 36). In other words, availability of basic affordances is necessary to continue the implementation but it is not a sufficient condition for implementation success. The availability of basic affordances but the absence of desired affordances (Ignatiadis & Nandhkumar, 2009) may drive the ES evolution phase. As reported in Chapter 4, Progesa had an absence of reporting affordances. Therefore, when eProgesa implementation was stopped, IBTS purchased and implemented BOSS to actualise reporting affordances from Progesa.

Similar to Progesa adoption, BECS adoption was also initiated because Progesa could stop providing even the basic affordances due to hardware and software constraints. During BECS implementation, eProgesa module turned out to be more mature than its earlier version and did not pose any major problem associated with the basic affordances. However, other modules were relatively new and still posed problems associated with the basic affordances. The second type of affordance that IBTS was seeking with BECS implementation is integrating affordance. BECS provided additional integrating affordance by incorporating modules associated with risk management, patient safety, and tissue operation. As noted in earlier section, the *interfacing affordance* provided by different modules of the product suite was one of the reasons for IBTS to go with the BECS complete suite since it was easier to interface modules provided by the same supplier. However, constraints of using supplier-provided middleware/interface (called concentrator/eDMS) for interfacing with existing automates created more problems for the implementation team, thus limiting the interfacing affordance. Finally, the fourth type of affordance that IBTS was seeking from BECS was *reporting affordance*. BECS included the reporting affordance that allows IBTS to produce customised reports using a utility called iReports. Thus, the findings support the observation (Nandhakumar et al, 2005) that in the context of ES implementation, the affordance of the ES either may accommodate managers' intentions enabling them to realise their goals or may resist the progress forcing them to revise their plans and goals.

Key factors emerging due to affordance mechanism support the findings by ES scholars that technical and business process related justifications act as adoption motivation. Findings from the study echo the adoption motivations found in the literature such as – limitations of existing IS (Alves & Matos, 2011, 2013; Kumar et al, 2002; Oliver & Romm, 2002), business integration (Alves & Matos, 2011, 2013; Oliver & Romm, 2002; Laukkanen et al, 2007; Raymond et al, 2006; Poba-Nzaou et al, 2014), and improvements in operational efficiency (Adam & O'doharty, 2000; Alves & Matos, 2011, 2013; Kumar et al, 2002; Laukkanen et al, 2007). The Y2K issue noted for Progesa also reflects in the adoption motivations of Canadian PSOs studied in Kumar et al (2002, 2003) at the dawn of the new millennium.

As noted in Chapter 2, ES acquisition literature tends to develop extensive ES evaluation criteria based on detailed variables and complex mathematical models (e.g. Cebeci, 2009; Gürbüz et al, 2012; Karsak & Özogul, 2009; Yazgan et al, 2009). Although the analysis partially supports the prescription of techno-managerial literature that organisations evaluate the ES based on the technical and business criteria (Gürbüz et al, 2012; Kilic et al 2014; Kilic et al 2015), it rather strongly supports the assertion (Entwistle & Light, 2008; Pollock & Williams, 2007) that it is usually difficult to evaluate the functionality of ES artefact without actually implementing it. This makes the gap analysis and evaluation process dependent on the reported (as opposed to actual) affordances by the supplier and renders it less than rational. The analysis also supports the finding by Kauffman & Tsai (2009) that in recent years firms have moved toward a unified procurement strategy for ES solutions, as IBTS did for BECS acquisition. However, the efficacy of this strategy is debatable based on the outcomes.

Emerging due to the affordance mechanism, features and constraints of the ES Artefact, IS infrastructure, and issues related to legacy System and interfacing were the primary challenges during the implementation phase in IBTS, supporting the findings of extant literature (Amid et al, 2012; Soja, 2008; Umble & Umble, 2002; Wright & Wright, 2002) that identifies technical difficulties as one of the important challenges. In particular, the analysis brings out the importance of middleware and interfacing in system integration (Gulledge, 2006) with the legacy systems. As Finnegan & Hamid (2009, p. 58) observe – "*the heritage of legacy systems continues to determine major technical integration approaches... given the context of complexity and variance within the medical field".* The findings of this study also support the observation that health sector tends to be a 'follower' in adopting ICT (Currie, 2009a) that also reflects in low product maturity of the Progesa, eProgesa (at first instance), and interfacing module (eDMS/Concentrator). The state of IS infrastructure among the hospitals supports the findings by Currie & Seddon (2014) that Irish health sector tends to be relatively slow in adopting ICT due to due to a more conservative and cautious approach towards eHealth. This could be understood from the fact that while the National Blood Services in England and Norway adopted ISBT-128 at the dawn of the new millennium (Doughty & Flanagan, 1996; Aandahl et al, 2007), in Ireland it started only around 2013.

At the same time, IBTS's reluctance to conduct business process reengineering resulted in more customisation of the software. This supports the findings that many organisations try to avoid BPR (Liang & Xue, 2004) and replicate their existing business processes on the new ES (Adam & O'doharty, 2000; Jones et al, 2006) by customising the ES. This is especially true in the context of niche organisations (Beijsterveld & Groenendaal, 2015; Liang & Xue, 2004; Olsen & Sætre, 2007) or public sector organisations (Blick et al, 2000; Spano et al, 2009; Williams & Hardy, 2005) due to their unique business processes. Such organisations choose to customise the software since implementing an ES as-it-is may create deeper level business process misalignments (Sia & Soh, 2007; Strong & Volkoff, 2010) and may not fulfil their operational needs. Interestingly, nature of the business process also seems to play a role here since IBTS did not report any major problems associated with e-Financials implementation and update. This supports the findings of Santamaria-Sanchez et al (2010) that implementing business support modules (e.g. Accounting and Finance, Human Resource Management) is less challenging compared to the implementation of value-chain modules in an organisation. More importantly, this also substantiates the assertion that due to their widespread heterogeneous, autonomous and distributed nature, information needs of healthcare IS cannot be fulfilled by a monolithic ES (Currie et al, 2009; Wainwright & Waring, 2000).

Affordance mechanism was also found to be influencing the way maintenance and upgrades were conducted (Khoo & Robey, 2007) through the features and constraints of the system. It also had an impact on managing users when upgrading the software (Khoo et al, 2011a, 2011b). While for Progesa maintenance, superusers need not worry about the planning and scheduling, BECS architecture required careful planning and scheduling for maintenance and upgrades. The evolution phase of Progesa in IBTS supports the assertion that information infrastructure constantly evolve and are always a work in progress (Edwards et al, 2009). Progesa evolution started after the go-live and continued till BECS implementation started. In this evolution, Progesa work-system served as an installed base (Grisot et al, 2014) upon which other systems could be interfaced, modified, or added. Supporting the observation by Ciborra (1998), this evolution occurred through the accumulation of various unutilised ES resources (e.g. Progesa data) that were later utilised through recombination with other systems (e.g. BOSS). BOSS and EOS provide instances of innovation associated with the ES infrastructure in which new modules were added to facilitate managerial decision-making (Grisot et al, 2014), and customers were included in the business process (Shaw, 2000; Karimi et al, 2009) respectively. Analysis of EOS and ISBT-128 implementation also support the findings that digital infrastructure of the supply chain partner plays an important role in supply chain integration with the ES (Koh et al, 2011; Karimi et al, 2009). In the healthcare context, this becomes even more important since it has been noted that the level of IT maturity varies considerably in the health sector (Currie, 2009a; Mark, 2009; Wainwright & Waring, 2000). For instance, while St. James Hospital Dublin (a teaching hospital) was at the forefront of implementing EOS and ISBT-128, other hospitals struggled in terms of their IS infrastructure and support. Provision of dual labelling affordances in ISBT-128 project supports the observation by Eason (2009) that there is a need to combine planned and organic approaches to change when introducing a new information system in healthcare organisations.

Thus, affordance mechanism emerges as a key underlying mechanism underpinning the case events. However, as other non-technology related mechanisms also interact with the affordances during an IT-mediated change process (Volkoff & Strong, 2013), an explanatory framework should include other non-technology-related mechanisms. These non-technology mechanisms are covered in the following subsections.

5.4.2 Control Mechanism

As noted in Section 5.2, control mechanism is defined as a mechanism that is imposed on the project to regulate or adjust the behaviour of the stakeholders, to motivate participants, and to ensure that their capabilities are fully applied to advance the ES initiative towards its objectives (Kirsch, 1997, 2004). Case analysis notes the use of formal control methods but a relative absence of informal control methods (Wiener et al, 2016) during ES lifecycle in IBTS. Formal control methods include input control (e.g. resource allocation), behaviour control (e.g. regular status meetings, monthly and weekly reports, mandated project methodology), and outcome control (e.g. functional specifications, defined project milestones, defined target implementation dates). However, informal control methods – namely clan control (e.g. socialisation, ceremonies and rituals), and self-control (e.g. work autonomy) were found to be missing in IBTS context. This supports the findings by Vlasic & Yetton (2004) and Mao et al (2008) that organisation in low uncertainty environment usually exercise formal controls, in contrast to the prevalence of informal controls in organisations with high uncertainty environment.

Supporting the findings of Soh et al (2011), ES lifecycle in IBTS exhibits multi-level nature of control, noting both control *over* the project and *within* the project (Wiener et al, 2016), exerted by multiple entities. Table 5.3 outlines the form of controls at the three STS levels considered in this study. At the macrosocial level, control was exerted by the Department of Health, C&AG, CPA, and PRG. The existence of additional external control mechanisms was found to be a product of the public service context (Bozeman, 1987; Rainey, 2014) that demands higher levels of public accountability. At the organisation level, control was in the form of project audit by external partner and financial control by the finance committee. Finally, at the work-system level, control was exerted by project leadership in the form of project and work-group meetings, validation and testing. The existence of stringent control mechanisms at the work system level was found to be a product of the health service context (Currie & Giah, 2007; Poba-Nzaou et al, 2014) that focuses on the patient safety. In general, case evidence supports the findings the formal control is associated with positive project outcomes (Keil et al, 2013; Maruping et al, 2009; Tiwana & Keil, 2009). Progesa and BECS project clearly had more formal control and eventually went live with the system, whereas eProgesa project mainly relied on informal control within the IT unit and eventually had to be abandoned. Similarly, formal controls were initially side-lined for the ISBT-128 component within the BECS project and it proved to be Achilles heel for the BECS project.

Table 5.3 Controls at the three STS Levels

Control Level (Trist, 1981)	**Form of Control**
Macrosocial	Control through the institutional context (Bozeman, 1987; Howcroft & Light, 2010; Pollock & Williams, 2007)
Organisational	Formal control (Wiener et al, 2016) through audits and financial oversight
Work-system	Project level controls through project leadership and regular meetings, and extensive validation and testing procedures (Keil et al, 2013; Maruping et al, 2009; Tiwana & Keil, 2009)

It should not be concluded, however, that more controls always contribute towards ES project success. As noted in Section 5.3, many IBTS users expressed dissatisfaction with the high level of control mechanism even for non-core operations. The issue of change communication was perhaps ignored due to the fact that implementation team members were usually busy in fulfilling the documentary requirements associated with external, internal, and project level controls. As Currie (2008) notes, elaborate governance structure existing in the health service context sometimes fail to address the softer aspects of change management, particularly those around the user engagement.

At the same time, case findings also support the findings by Berente et al (2010) in that apart from functional control, ES projects may also embody elements of demonstrative control which do not support project efficiency but rather serve to advance the appearance of a neatly organised project. Unlike functional control that is exercised for corrective purposes and is intended to make the ES implementation more efficient or effective, demonstrative control focuses on the public display of compliance. For instance, although during the acquisition phase it was almost certain that MAK Systems would get the contract, public tendering was necessary for the acquisition due to the public service context of IBTS. The same case may also be stated for BOSS acquisition. Since NYBC developed the BOSS system, it was expected that it would get the contract. Still, IBTS needed to go through a formal tendering process for BOSS acquisition. The constitution of PRG during BECS project may also be considered as a demonstrative control since a project audit conducted at a later stage of the project noted less than expected frequency of PRG meetings.

The findings from the case also highlight the dynamic nature of control mechanism (Kirsch, 2004; Susilo et al, 2007) that can be noted in different types of controls in operation during different phases of the ES lifecycle. In all three instances, top leadership acted as an internal control mechanism in initiating the adoption, a pattern also noted by Kumar et al (2002, 2003) for Canadian PSOs. During latter phases, institutional context (Howcroft & Light, 2010; Pollock & Williams, 2007) acted as an external control mechanism and top leadership was instrumental in mediating with external control mechanisms, supporting the findings in extant ES literature (Liang et al, 2007; Martin & Huq, 2007). The approval process in particular shows the politically contested and negotiated nature of the acquisition phase, supporting the findings by Anwar & Mohsin (2011) that decision making in public organisations at various stages is usually bureaucratic and results in delays in the project (e.g. BECS acquisition phase lasted around a year).

During the implementation phase, the steering committee was found to be an effective governance and oversight mechanism for an ES project (Somers & Nelson, 2004; Gosain et al, 2005; Murphy et al, 2017). Case evidence also suggests that including the vendor in the steering committee might help in resolution implementation problems at somewhat early stages. The structure of the steering committee supports the assertion that decision making in PSOs is usually consensus driven and involves representatives from multiple departments (Sommer, 2011, Wagner & Antonucci, 2009). At the project level, strict testing, validation and change control processes in IBTS resulted in even the smallest changes being approved through an arduous change control process (Anwar & Mohsin, 2011) which arguably is a product of its health service context. Perhaps due to same reasons, IBTS employed a similar level of change control procedures during Progesa use and maintenance phase. Furthermore, evolution phase of Progesa (BOSS/EOS) are also marked by project level control similar to the implementation phase in terms of rigorous validation and testing. This is arguably due to health and public service context of IBTS that in general forces strict change control procedures in order to avoid any negative political repercussions (Anwar & Mohsin, 2011; Currie, 2008; Kaniadakis, 2012).

However, there are two findings associated with the control mechanism that either go against the received wisdom or are under-reported in the extant literature. The first set of findings relates to the role of top leadership. Unlike the observations made by Sommer (2011) and Wagner & Antonucci (2009) that there may be a frequent change of leadership in PSOs, the top leadership of IBTS remained same throughout the years. This may be due to a difference in the country and institutional context. Whereas PSO appointees are usually political and change with the change in government in the USA, in Ireland PSO appointments are usually independent of the government. Furthermore, questioning the assumptions of consistent top management support in the extant literature, this study supports the recent findings that the level and type of the top leadership support changes with the ES lifecycle (Elbanna, 2013; Boonstra, 2013). Whereas the role of top leadership was found to be crucial and active during the adoption and more so during the acquisition phase, during the implementation phase it was found to be rather passive, mostly related to resource allocation (Dong et al, 2009) in the beginning of the implementation and providing tacit support to the implementation team afterwards. Towards the end of the implementation, however, the top leadership actively mediated with the external context (Liang et al, 2007) in order to justify IBTS decisions.

The second finding relates to project communication as a behavioural control mechanism (Kirsch, 1997) during BECS implementation. While received wisdom is that ‘open and honest communication’ is crucial for ES success (Aladwani, 2001; Finny, 2011; Huq et al, 2006; Sarker & Lee, 2003; Sedmark, 2006), findings from the case study suggest that sometimes selective and slightly ambiguous communication may also work well for the project. It is clear from the case evidence that at least within the organisation, project communication was neither open nor honest. Case evidence suggests that there was no established formal channel for communication among the work stream and superusers tended to *"to work in isolation"* (R7). Overall project meetings were usually confined to status reporting of respective work-streams. Communication within the work-streams was also not beyond the project deliverables and avoided communication regarding overall project. In one instance where project leadership of BECS was aware that the go-live date would be postponed, project team members were informed about it only at the very end *"to keep the pressure on and the focus on and getting the work done*" (R2). This pattern of communication questions the commandment of openness in organisation communication (Eisenberg & Witten, 1987) and illustrates a case where ambiguity was used as a strategy in organisation communication (Eisenberg, 1984) to facilitate the implementation.

The case study exhibits that due to their situational requirements or prevailing organisation culture, project leadership may adopt communicative strategies which do not always minimise ambiguity but are nonetheless effective. As far as upward communication is concerned, project manager and project sponsor were the only voice communicating with the top leadership, IBTS board and other control mechanisms in place. There is some evidence of selective reporting in which top leadership and other control entities were not aware of the exact nature and level of project challenges and there was *"a mismatch between what was being reported at senior level... and what was actually the reality on the ground"* (R8). However, this is not a specific phenomenon to IBTS. Based on a survey of 561 IS project managers, Iacovou et al (2009) also report the phenomena of selective reporting by project managers, mostly fuelled by their optimistic bias towards the project completion. This bias, however, erred on the wrong side due to the relative lack of project institutionalisation in IBTS. This aspect is discussed in the next subsection.

5.4.3 Institutionalisation Mechanism

As noted in Section 5.2, institutionalisation mechanism is conceived here as a process by which a social structure attains a stable and durable state or property (Currie, 2009) that produces recognisable, repetitive patterns of interdependent actions, carried out by multiple actors within a pre-existing social context (Iannacci & Hatzaras, 2012; Feldman & Pentland, 2003). Institutionalisation is generally assumed to be influential during the post-implementation phase of the ES lifecycle (Rajagopal, 2002) and assumed to be always beneficial to the organisation. However, case evidence suggests that the institutionalisation mechanism is applicable to entire ES lifecycle.

During the Adoption phase, institutionalisation mechanism manifested itself in the form of business vision proposed by IBTS. The patient safety and strategic positioning argument used by IBTS for ES adoption indicates the existence of both clinical institutional logic and managerial institutional logic in healthcare organisations (Currie & Giah, 2007; Poba-Nzaou et al, 2014). Similar findings are reported in Salge et al (2015) who find that senior managers engage in IS adoption not only to find a solution to performance shortfalls (affordance mechanism) but also to signal conformity with their core business vision (institutionalisation mechanism). However, a more important finding from the case study is that some of the espoused justifications by IBTS (e.g. best practices, twenty-first century organisation) mostly served the demonstrative purpose (Berente et al, 2010) and were subsequently not realised during implementation. While the Progesa system did not have any meaningful reporting capability, strategic advantages from being the first user of the eProgesa system never got realised due to the abandonment of the implementation. In this regard, Oliver & Romm (2002) note that public organisations often engage in justifying their ES adoption by alluding to what they call 'technical rationality'. They note that compliance with both accepted and emerging norms of technical rationality (e.g. following best practices, using the state-of-the-art system) becomes a way of obtaining legitimacy but never gets institutionalised in the organisation. During the acquisition phase, system institutionalisation was used both as justification (e.g. users' exposure to Progesa) and as a means (e.g. user involvement in writing URS) to further the goal of the implementation.

For the implementation phase, the analysis supports the recommendation that project management and leadership should remain outside the IT unit (Adam & O'doharty, 2000; Berg, 2001; British Computer Society, 2006). Keeping the project leadership with the business might help in ensuring the business fit and in institutionalising the implementation process within the organisation. When the IT unit was heading eProgesa implementation, the implementation was found to be more techno-centric (Akkermans & van Helden, 2002; Berg, 2001; McDonagh, 2016) and eventually was found not fit for the business. On the other hand, selection of domain experts as superusers worked for IBTS in the long run because the superusers gained significant experience in the process of implementing Progesa and validating eProgesa. In this way, it supports the findings (Rothenberger et al, 2010; Sammon & Adam, 2010) that a multi-skilled team having experience in both organisational processes and IT is crucial for the ES implementation. These superusers later played a major role in Progesa institutionalisation by transferring their knowledge to user groups (Haines & Goodhue, 2003; Volkoff et al, 2004). Interestingly, eProgesa implementation failure also allowed the superusers to gather immense product knowledge that helped them during BECS implementation. This mirrors the concept of intelligent failure by Sitkin (1992) where he argues that small planned failures may enhance organisational learning when operating in uncertain environments. Although eProgesa implementation failure certainly can neither be termed intelligent nor planned, it gave IBTS superusers the knowledge that helped in implementing BECS. Similar findings are reported in the ES literature (Chen et al, 2009; Scott & Vessey, 2000) where an organisation used the learning from earlier failures to make the next implementation successful.

While IBTS followed a modular project structure based on functional lines, it was noted that the functional and linear project structure was inadequate to manage the ES project that transcended pre-defined boundaries (Elbanna, 2010). A function-based structure created problems in determining business process ownership (Al-Mashari & Al-Mudimigh, 2003; Watson et al, 2003; Wagner & Antonucci, 2009) with lack of ownership eventuality causing IT unit to take over the implementation, especially the labelling part of it. This resulted in work overload for the implementation team members, especially those belonging to the IT unit. This supports recent findings by Khoo et al (2011b) IS staff tend to bear additional burden since they have to negotiate with the vendor as well as to work with the users in implementing the changes, notwithstanding the learning curve that they themselves need to follow.

At the same time, domain experts were also busy and stressed out due to multiple responsibilities. Consequently, it hampered the institutionalisation of the implementation process within the user groups, for whom their "*core work took priority*" (R14) and the project work got *"pushed back"* (R24). Therefore, during the implementation phase, there was a conflict between the clinical and managerial institutional logics (Currie & Giah, 2007; Poba-Nzaou et al, 2014) in which participants gave priority to clinical work over project task completion. For IT team as well, it was the dual role of supporting Progesa and implementing BECS. Therefore, it may be argued here that a relative lack of project institutionalisation hampered the implementation process within IBTS.

Interestingly, institutionalisation mechanism also influenced how project time was conceived by the project members. Active participants in the implementation process seemed to ignore the implementation delays by focussing on the last scheduled go-live date, whereas other users highlighted implementation delays with the first go-live date in mind and reckoned four different go-live dates since the beginning of the project. This finding supports the existence of multiple perceptions of the implementation time (Scott & Wagner, 2003) in an ES project. On the lines of Sawyer & Southwick (2002), this study notes two particular conceptions of time in the implementation context. In particular, it was noted that the implementation team members subscribed to a non-linear social conception of the project time and adjusted their perception of available time as per the latest go-live date. Consequently, this group of respondents attributed the majority of the delay to lack of readiness from the hospitals, arguing that the system was ready for the scheduled go-live in June, ignoring the fact that it was the third go-live date that was missed. On the other hand, respondents belonging to the user groups subscribed to the clocked and linear conception of time and referred to the original plans in determining the project delays.

The multi-level outcomes of the implementation process exhibit the multi-dimensional and dynamic nature of ES outcomes (Markus & Tanis, 2000; Grenci & Hull, 2004) and those associated with health information systems (Berg, 2001; Heeks, 2006). At the same time, the analysis also brings out the importance of the implementation context in the evaluation of the implementation outcomes. Despite the delays, both Progesa and BECS implementation were deemed successful by the organisation. Progesa implementation *"took longer but that was okay... when eventually (it) went live, (it) stayed live... it was a successful project"* (R19). Similarly, BECS was also deemed successful since *"all the systems are working (without) any significant... instance that would have jeopardised patient safety or product quality"* (R3). This brings out the importance of public sector context in determining the implementation outcome as the creation of public value (Moore, 1995; Bozeman, 2007) rather than being based on scheduled time and budget. However, it should be noted here that the notion of public value was invoked by the participants as they understood and public value was not 'measured' in the study. This also brings out the importance of health service context where the institutional logic of patient safety (Currie & Giah, 2007; Poba-Nzaou et al, 2014) was paramount in evaluating the outcome of the implementation instead of project management logic of on-time and within-budget completion.

Another important finding associated with the ISBT-128 implementation is the importance of change communication (Aladwani, 2001; Finny, 2011; Huq et al, 2006; Sedmark, 2006) during an ES-mediated organisation change. Research conducted at the organisation level frequently posits organisation change as a communication problem (Lewis & Siebold, 1998) and stresses focussing both on the content and process of change (Goodman & Truss, 2004). The issue of change communication becomes especially important if there are uncertainties associated with the change (Allen et al, 2007; Bordia et al, 2004). Interpersonal communication assumes special significance in the health service context where person-to-person contact is more institutionalised (Avison & Young, 2007). However, despite uncertainties about precise ISBT-128 configurations and the requirements for extensive communication, IBTS seemed to ignore project communication with the hospitals. A selective communication strategy that seemed to work for BECS implementation within IBTS, did not work with the labelling change that requirement involvement from the hospitals and their suppliers. Minimal communication with the hospitals also goes against the advice by Kemp & Low (2008) that if there is too much gap between different stages of the implementation, frequent communication is required to assure the stakeholders that the change is still being implemented. As the case evidence suggests, infrequency of change communication hampered ISBT-128 institutionalisation in the hospitals.

As reported in extant literature (Bagchi et al, 2003; Baptista et al, 2010; Ignatiadis & Nandhkumar, 2009; Iannacci & Hatzaras, 2012; Rajagopal, 2002), institutionalisation mechanism was the most prominent mechanism during the use and maintenance phase. During this phase, an ES may be considered to be institutionalised in the organisation when users accept the system, flaws are corrected, and use of ES is considered a standard practice in the organisation (Baptista et al, 2010; Rajagopal, 2002). The findings from the case suggest that if the use of ES is made mandatory with no option of using the parallel system, it is institutionalised quickly in organisation practices. Such mandates are deemed to be necessary for the organisation due to the fact that an ES project is expensive in terms of both hardware and software and it is imperative for the organisation to make it a success (Bagchi et al, 2003). During BECS implementation, the user interface was kept similar to that in Progesa to facilitate quick institutionalisation, in line with the findings of Technology Acceptance Model (Davis, 1989) based theories that ease of use facilitates user acceptance and institutionalisation.

Workarounds played a major role for institutionalisation during the use and maintenance phase, a frequent finding in the ES literature (Bagchi et al, 2003; Ignatiadis & Nandhkumar, 2009). These workarounds could be for supporting the legacy processes (Wagner et al, 2010), to resolve the ES-organisation misfits (Beijsterveld & Groenendaal, 2015; Malaurent & Avison, 2016). In the case of Progesa, these workarounds included the use of Excel for certain reporting requirements, dual labels in 2010, and parallel codes in the finance division. Since Progesa evolution involved the implementation of BOSS and EOS, the factors discussed for the implementation phase are also by and large applicable here. BOSS and EOS both were institutionalised by the business leadership of the project with IT unit playing a supporting role. Reflecting the ‘stovepipe’ mentality of public sector organisations (Bannister, 2001; Sommer, 2011), business process ownership was also an issue with BOSS. Finally, Progesa integration with laboratory automates and e-Financials system contributed towards institutionalisation of the ES infrastructure during the evolution phase (Hedfridsson & Bygstad, 2013; Grisot et al, 2014) making the organisation completely dependent on the system. One respondent from IBTS notes:

> *"We have now got, we have dependency on 3 systems - we have BOSS, we have, this is only just but this isn't all our systems but we have BOSS, we have eProgesa/Progesa, we have the electronic ordering system, in that side, not to mention eFinancials which is the system to get the payments out."* (R4)

Some findings associated with the institutionalisation mechanism merit special attention since they either go against the received wisdom or remain under-reported in the extant literature. First such finding relates to the 'dark side of institutionalisation' (Baptista et al, 2010) in the sense that the technology artefact becomes so entwined with the organisation that it becomes invisible to its users sometimes giving them a false sense of security. This makes it difficult for the users to think beyond the existing system. Progesa became so institutionalised within IBTS that user buy-in was somewhat difficult for the BECS adoption. One responded recalls the users saying *"what's wrong with the current system? Why do we have to do this testing?"* (R9). As one respondent from the IT team notes: *"they don't see it because it's working fine... the day it breaks, then they come knocking on our door"* (R5). This is in line with the observation by Silva & Backhouse (1997, p. 390) that *"institutionalised information systems are noticed only when they break down."* The same case may also be stated for the Codabar labelling system that was institutionalised in the IBTS and the hospitals for around twenty years, making it difficult to get the user buy-in for ISBT-128 implementation. Most of the hospitals were happy with the earlier dual label workaround of 2010 and did not want to move to ISBT-128 full face labelling. Due to this level of institutionalisation, BECS project had to include Codabar label with ISBT-128 full face label. Interestingly, English Blood Service had to go with dual labelling way back in 1996 (Doughty & Flanagan, 1996) due to same reasons. Recourse to dual labelling system in Ireland after almost two decades also signifies a relative lack of eHealth readiness in the Irish health sector (Currie & Seddon, 2014).

Another dark side of the institutionalisation mechanism relates to selective organisational learning across ES lifecycle in IBTS. Organisation learning and knowledge management are considered a crucial factor in ES implementations (Ke & Wei, 2008; Markus et al, 2000; Lee & Lee, 2000; Nwankpa & Roumani, 2014), especially for a niche organisation (Liang & Xue, 2004). Although participants from IBTS frequently spoke about 'lessons learnt' during the interviews (e.g. *"I think there (is) a big lesson to be learnt there on how* *we deal with hospitals going forward for implementation of the project"* - R3), there was no evidence of any formal lessons-learnt session with the exception of BOSS. Interestingly, even lesson learnt during BOSS about determining the business process ownership was not kept in mind when implementing the ISBT-128 labelling within the BECS project. Similarly, although IBTS seemed to have a fair idea about the status of IS infrastructure in the hospitals due to EOS implementation, this experience was never considered when planning the labelling piece within BECS. The planning and management of ISBT-128 labelling project clearly show a lack of institutionalisation of organisation learning in IBTS. As one respondent sums it up - *"We never do that. We do all these projects; we review the projects; we see why we have overruns; we see why we have problems... but we have never (learnt)"* (R24). Although there seems to be some learning in terms of application of additional control mechanisms, the case study provides evidence there is a relative lack of learning associated with the institutionalisation mechanism. This relative lack of organisation learning exhibits a learning myopia (Levinthal & March, 1993) in IBTS that is partly fuelled by the institutionalisation of providing post-hoc rationalisation (Weick, 1995) of past failures to external control authorities (C&AG, 2002; C&AG, 2008; CPA, 2003; CPA, 2008; DPC, 2008).

The second finding that goes against the received wisdom relates to the user engagement during the implementation. Whereas extant literature treats user engagement as a *sine qua non* for implementation success, the findings from the case study show that user engagement did not play a crucial role during the implementation phase. When the users were involved in writing users requirements specifications (URS), many of them did not have an adequate idea of what they should expect from the new system and found it difficult to see beyond their current practices (Wagner & Newell, 2007). Due to their lack of exposure to the new system and limited technical knowledge of the ES artefact, they failed to anticipate how things could be done differently if they were to receive new tools to enable more integration across the business. Even if they could do that, there would not be any impact on the acquisition decision since it was already decided to implement the complete suite offered by the supplier. In that sense, user engagement was mostly demonstrative in nature (Berente et al, 2010) and mostly in the form of 'pseudo participation' (Wagner & Newell, 2007).

There is also some evidence that even genuine attempts made by the users to engage in the implementation in a significant way fell short because they were usually busy with their day to day 'core' responsibilities which were given more importance (Wagner & Piccoli, 2007; Currie & Giah, 2007; Poba-Nzaou et al, 2014) than the 'outside' project work.

Certain user groups did not participate in the implementation until their domain and work practices were directly affected (Wagner & Newell, 2007). At the same time, the user community was also a bit marginalised (Lyytinen & Newman, 2015) by the senior management and the implementation team in order to successfully implement BECS. Although there were opportunities for users to express their views and system requirements, in reality, most of their requests were dismissed during the implementation process in order to enforce a technical-managerial view of the organisation (Willis & Chaisson, 2007).

The third finding that goes against the received wisdom relates to user training. Extant literature stresses on intensive and regular user training (Amoako-Gyampah & Salam, 2004; Klaus et al, 2010; Liu et al, 2011; Somers & Nelson, 2004; Sumner, 2000) for successful ES institutionalisation in the organisation. As noted in Section 5.3.7, this was indeed true for IBTS during the Progesa implementation when the system was being used for the first time and the majority of the workforce did not have an adequate level of digital literacy. In contrast, user exposure played a major role during BECS project for which IBTS engaged in minimal training, and still did not face any issues in system use by its end-users. This underscores the importance of users' prior exposure to the software and mimic the findings of Koh et al (2009) who report that the domain-specific ES can be implemented and operated effectively with a limited investment in formal training, primarily due to system design (user interface remained same from Progesa to eProgesa), experience of users (extensive experience on Progesa), and system support (mainly by the superusers). Perhaps due to these factors, IBTS did not report any problems associated with BECS institutionalisation after go-live. This supports the importance of existing social capital (Chou et al, 2014; Sykes et al, 2014; Sykes, 2015) in system institutionalisation.

A final finding that is almost absent from the extant literature is that chance events happening in internal and external context inadvertently have an impact on the implementation. While public service literature acknowledges the importance of chance events in the broader context (Pollitt & Bouckaert, 2004; Rhodes & Boyle, 2012), mainstream ES literature tends to ignore this aspect. However, the findings from the case study bring out the importance of chance events in external and internal context. Chance events in the external context included global recession of 2008 resulting in the tightening of the purse for IBTS. Similarly, chance events that coincided with the implementation included movement of offices and industrial relations problem occurrence during Progesa implementation and single site processing project during BECS implementation. Both sets of problems resulted in unintended consequences (e.g. implementation delays, work overload, more time for training) due to unowned processes (Mackay & Chia, 2013) powered by chance events.

Table 5.4 Institutionalisation Mechanism during ES lifecycle

Factor supporting project institutionalisation	**Factors impeding project institutionalisation**
- Project management and leadership outside the IT unit (Adam & O'doharty, 2000; Berg, 2001; British Computer Society, 2006) - Multi-skilled team involving domain and IT experts (Rothenberger et al, 2010; Sammon & Adam, 2010) - Workarounds (Bagchi et al, 2003; Ignatiadis & Nandhkumar, 2009) - ES integration with other systems (Hedfridsson & Bygstad, 2013; Grisot et al, 2014)	- Functional and linear project structure (Elbanna, 2010) - Lack of project ownership (Al-Mashari & Al-Mudimigh, 2003; Watson et al, 2003; Wagner & Antonucci, 2009) and work overload on IT experts (Khoo et al, 2011b) - Lack of change communication (Aladwani, 2001; Finny, 2011; Huq et al, 2006; Sedmark, 2006) - User engagement being demonstrative and ostensive in nature (Berente et al, 2010; Wagner & Newell, 2007) - Users being busy in their core responsibilities (Wagner & Piccoli, 2007; Currie & Giah, 2007)
Bright Side of institutionalisation - Project support via the logic of patient safety and strategic positioning (Currie & Giah, 2007; Poba-Nzaou et al, 2014; Salge et al, 2015) - Notion of public value to determined project outcome (Moore, 1995; Bozeman, 2007) - ES entwining with organisational work (Bagchi et al, 2003; Ignatiadis & Nandhkumar, 2009; Iannacci & Hatzaras, 2012; Rajagopal, 2002) - Limited need for formal user training (Koh et al, 2009)	**Dark Side of institutionalisation** - Lack of user buy-in for the new system (Baptista et al, 2010; Silva & Backhouse, 1997) - Learning myopia (Levinthal & March, 1993) and the institutionalisation of providing post-hoc rationalisation (Weick, 1995)

To conclude the discussion on the institutionalisation mechanism, Table 5.4 presents the key findings and their association with the existing literature. As one can see, there are mixed findings with respect to the institutionalisation mechanism. First cell of the table note a set of factors that support the project institutionalisation that in turn has a positive influence on the ES lifecycle. At the same time, the table also notes a set of factors that impede the project institutionalisation. While there is a bright side of institutionalisation, especially during the post-implementation phase, in the long run it also presents a 'dark side'. This aspect is noted in the second row of Table 5.4. The next subsection discusses the market mechanism in the light of extant literature.

5.4.4 Market Mechanism

Although the market mechanism is a widely used *generic* term in economics, within the context of this study market mechanism is identified as product availability, market structure, supplier-client relationship, and impact of these on the ES lifecycle. The role of market mechanism remains relatively under-explored in the extant ES literature with a focus on standard ES market[36] which is oligopolistic in nature. In contrast, blood bank ES market is relatively monopolistic (or at best, a partial duopoly) market and hence offers unique challenges to the client organisations such as IBTS. The manifestation of the market mechanism during the ES lifecycle in IBTS was dependent on many characteristics of the ES market which are noted in Table 5.5 and are discussed below.

Table 5.5 Key Characteristics and Impact of ES Market

	Characteristic	**Impact**
1.	ES market is information asymmetric (Cho et al, 2013).	Insufficient information for the client when conducting gap analysis (Entwistle & Light, 2008; Pollock & Williams, 2007).
2.	ES sales are combination of the product and the service (Cho et al, 2013; Chellappa et al, 2010).	Customer is dependent upon the service from the supplier to utilise the ES.
3.	ES artefact is always a work-in-progress Gosain, 2004; Pollock & Cornford, 2004).	ES supplier may promise features that are still in development.
4.	Blood bank ES market is largely monopolistic.	Organisations are largely dependent on a single supplier (Olsen & Sætre, 2007; Pollock & Cornford, 2004) and the supplier has no incentive in investing in product quality (Cho et al, 2013).
5.	Human resources with relevant skill-set are in high demand and in limited supply.	Organisations run the risk of losing its key resources (Amid et al, 2012; Barker & Frolick, 2003; Garg & Garg, 2013; Soja, 2008; Teoh et al, 2012).

A unique characteristic of the ES market is that it is inherently information asymmetric (Stiglitz, 2002) in the sense that while the supplier has complete information about the product, the client organisation does not have sufficient information to evaluate the product (Cho et al, 2013). Although the client may visit reference site and seek demonstration from the supplier, it is usually difficult to evaluate the functionality of ES artefact without actually implementing it (Entwistle & Light, 2008; Pollock & Williams, 2007). In such a situation, the relative use of the product in the industry becomes a proxy for the software quality. This is what seemed to drive IBTS adoption and acquisition decision in favour of MAK Systems. When IBTS decided to adopt Progesa, *"it was in New*

[36] Standard ES market here refers to the ES market that supplier standard components (e.g. Finance, CRM, Production etc.) across many industries. This market include vendors such as SAP, Oracle, or BAAN.

Zealand, it was in Australia, it was in Scotland, it was in several places in the US, it was in France, it was in Netherland, it was in Finland and one or two other places as well" (R19). The public tendering process also meant the IBTS was dependent only upon the responses received for the published tender, which reflected the structure of blood bank ES market.

A second unique characteristic of the ES market is that ES sales involve a combination of product and services associated with it and the customer usually needs to purchase both to generate value from its ES investment (Cho et al, 2013; Chellappa et al, 2010). Over the complete ES lifecycle, the cost of services (e.g. customisation, maintenance, and enhancement) outweighs the product (ES artefact) costs by a huge margin. MAK Systems definitely seemed to use this strategy as noted in the following quote: *"the style of the supplier is such that he bids, he tenders in a way that has a fair chunk of time and materials in it, and he underestimates the number of days needed, and time and materials and delivery of that to make more money"* (R1). Therefore, being the dominant supplier and being the cheapest supplier meant that IBTS had no other option than to award the contract to the same supplier during the acquisition phase.

A third unique characteristic of the ES market is that ES artefact is always a work-in-progress (Gosain, 2004; Pollock & Cornford, 2004). Since implementation process sometimes takes years to complete, the supplier may exaggerate the software capabilities to make a sale in the anticipation that it would develop the product in due time (Cho et al, 2013). This seems to be the case in all three instances. As noted in subsection 5.4.1, Progesa did not offer reporting affordances to IBTS as promised. The eProgesa system did not even have basic affordances to be executed without error. Finally, concentrator/eDMS that was pushed as an interface with the automates, did not have the expected level of performance. However, once the customers have signed the contract and have put substantial organisational and financial resources into the process of implementation, they become reluctant to shift allegiance and in turn may become locked into a vendor's product development trajectory (Markus & Tanis, 2000). To paraphrase Howcroft & Light (2010, p.142), *technological legacies and histories shape the decisions for future*. In such a case of being tied to a supplier, the client becomes active in the user group and engages with the supplier in an attempt to influence their plans for product enhancement (Markus & Tanis, 2000; Howcroft & Light, 2010). This observation is especially true for IBTS involvement with MAK user group during eProgesa implementation.

A commissioned project review of the eProgesa project conducted by KPMG warned against dependency on a single supplier, a situation that organisations are usually recommended to avoid (Currie, 1998; Currie & Willcocks, 1998). Indeed, IBTS respondents informally maintained that they would have preferred an alternative, indicating a lack of trust (Gefen, 2004) based on their previous experience. However, IBTS had little choice due to relatively monopolistic Blood Bank ES market with MAK Systems being the dominant supplier. As reported by the participants, other suppliers are relatively small suppliers and their products apparently do not offer all the features. Thus monopoly market structure of the niche market (Olsen & Sætre, 2007; Pollock & Cornford, 2004) constrained the choices available to IBTS. This is reflected in supplier's push for adoption of the new system (Khoo & Robey, 2007; Khoo et al, 2011b) by signalling the end of support for the existing system. To ensure the balance of power, IBTS opted for a multi-stage contract in the BECS project, supporting the findings (Currie & Willcocks, 2009; Wu et al, 2013) that multi-stage contract tends to be favourable for the client as it reduces the risk and allows the client to realise higher value from the system.

To break the monopoly of MAK systems, some blood services *"tried to get SAP interested but (the market) is too small (and) there are just not enough numbers for them... there is not a lot of money in selling systems to blood transfusion service*" (R19). As Chellappa et al (2010) show, standard ES vendors such as SAP prefer to compete in the crowded (oligopolistic) market since their commitments to the crowded market can mitigate concerns about compatibility between the components purchased from several suppliers. In the context of health services, Currie (2008) also notes that very few IT vendors possess the appropriate capabilities and skills to fully appreciate, understand, and mediate with institutional context of the health sector. While some IT service providers provide health information systems, blood banks play very little role in larger healthcare IT market with the majority of solutions being developed for the direct healthcare providers such as hospitals (Anyanwu et al, 2003; Finnegan & Hamid, 2009; Raghupathi & Tan, 2002). This market structure provides MAK Systems with the opportunity to maintain its monopoly in the blood bank market. MAK Systems cemented its monopoly by purchasing BOSS from NYBC in 2010, and other modules (eTraceline, eRiskline) from different small suppliers afterwards, supporting the findings that IT service providers often use acquisitions and mergers as a business strategy for market growth (Currie, 2000; Chellappa et al, 2010). For the client organisation, unified procurement strategy (Kauffman & Tsai, 2009) also becomes more attractive by avoiding complications associated with integrating diverse modules, as evident in the acquisition of BECS complete suite by IBTS.

The market mechanism also explains the relatively poor quality of the ES artefact (such as, locking problem in Progesa, product immaturity of eProgesa, and poor performance of the concentrator) uncovered by IBTS. As Cho et al (2013) argue, the cost of improving the quality of the ES artefact is a sunk design cost for the supplier that does not directly affect the demand for the ES. Coupled with the monopolistic market, the supplier did not have many benefits from investing in software quality upfront. Indeed, the supplier seemed to rely on the market mechanism to improve the software by bug identification by the implementing organisations which, in the case of eProgesa, included IBTS.

During the implementation phase, technical problems were sometimes compounded by inconsistent and delayed support from the supplier, supporting the findings about the importance of supplier engagement (Chang, 2006; Pozzebon & Pinsonneault, 2005; Somers & Nelson, 2004), especially in the PSO context (Anwar & Mohsin, 2011). This was clearly due to IBTS's dependence on a monopoly supplier in a niche market. On the other hand, market structure of laboratory automates and finance related ES ensured that IBTS will have interfacing affordance from suppliers of existing Automates and e-Financial system. Since these suppliers are established players in the market, they were aware of interfacing needs of different organisations. Perhaps due to this reason when the new interface mandated during BECS implementation did not perform well, IBTS mulled going back to the interface provided by the leading automate supplier. Interestingly, market mechanism influenced BECS implementation in more than one way. As noted in Section 4.6, Ireland's Health Service Executive (HSE) awarded the contract for National LIMS (called, MedLIS) and an Electronic Blood Tracking System (called BloodTrack) in 2015 (eHealth Ireland, 2015). Since none of the existing LIMS suppliers got the contract, it drastically reduced the support and uptake for ISBT-128 in the hospitals.

Evolution phase of Progesa exhibits decentralised nature of digital infrastructure evolution (Ciborra, 2000). Although MAK system did not engage in the development of a reporting tool for Progesa, BOSS reporting tool was developed by NYBC. Upon this, MAK again centralised the solution by acquiring the BOSS system from NYBC. The dominance of MAK also ensured that it could dictate upgrades (Khoo & Robey, 2007) or adoption of a new product suite by phasing out of the support for the old system. Raymond & Uwizeyemungu (2007) report a similar situation of market dependence where small suppliers find themselves adopting a specific ES due to their commercial dependence on the buyer who happens to use that specific ES.

Finally, the market mechanism also indirectly affected IBTS at regular intervals in terms of availability of skilled human resources. Since IBTS is bound by public sector recruitment rules (Thomas & Jajodia, 2004), it cannot afford the compensation level prevalent in the software market. This was evident in employee turnover during the implementation of Progesa and the resignation of the Database Administrator during BECS implementation. This supports the findings from the ES literature that identifies human resource constraints as one of the major risk factors for ES implementation (Amid et al, 2012; Barker & Frolick, 2003; Garg & Garg, 2013; Soja, 2008; Teoh et al, 2012).

Articulation and explanation of mechanisms and their tracing through time remains rather underdeveloped in the extant literature. Even when they are discussed, they are often discussed in isolation and in a static way. Therefore processual account of the four mechanisms (affordance, control, institutionalisation, and market mechanism) across the ES lifecycle remains a novel contribution of this study. In order to further deepen the understanding of the mechanism-based account, the next section discusses interaction among the four mechanisms across the phases of the ES lifecycle in IBTS and across the three instances of ES lifecycle.

5.4.5 Interaction among Mechanisms

Apart from theorising about mechanisms, the philosophy of critical realism provides a powerful concept of emergence (Elder-Vass, 2005; Sayer, 2010) that acknowledges that different mechanisms may interact with each other to provide a causal effect which is more than the sum of the effects generated by each mechanism in isolation. This subsection discusses how the four key mechanisms interacted with each other during different phases of the ES lifecycle in IBTS. Figure 4.3 presents an indicative representation of the interaction among mechanisms across the phases of ES lifecycle.

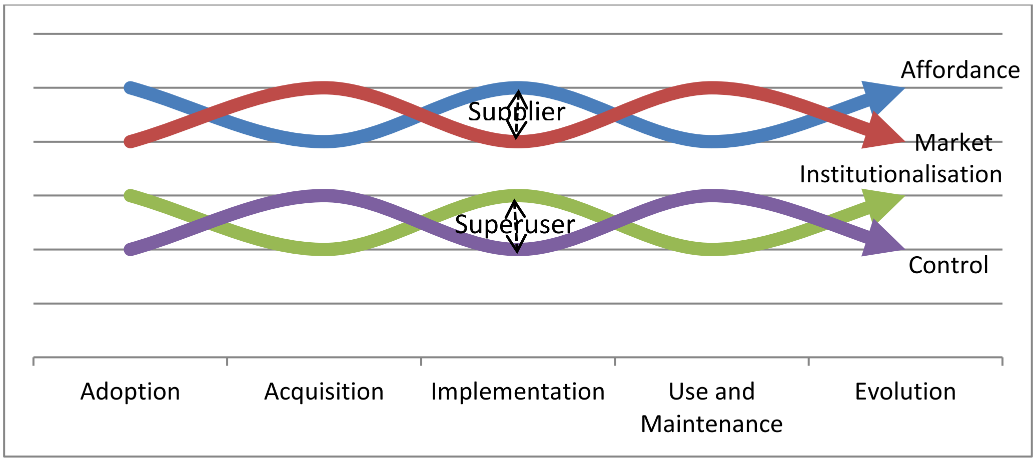

Figure 5.3 Interaction among Mechanisms across ES Lifecycle

For the majority of the ES lifecycle, the affordance mechanism and the market mechanism interacted with each other through supplier behaviour. Since the supplier enjoyed a dominant position in the market, it dictated what affordance its software would provide and usually did not pay much attention to the quality of its software (Cho et al, 2013), as evident in Progesa locking problem, eProgesa at first instance, and eDMS/concentrator. When the supplier decided not to support Progesa beyond a certain period, for IBTS it meant that Progesa would not provide the affordances it provided so far. This prompted IBTS to adopt BECS in due time. During the acquisition phase, information asymmetry of the ES market (Cho et al, 2013; Stiglitz, 2002) ensured that IBTS would not have access to ES artefact's affordances for evaluation purpose, thereby resulting in a less than rational gap analysis. The information asymmetry resulted in eProgesa acquisition which was immature software not being able to provide even the basic affordances. In addition, during Progesa implementation, ES market structure and Y2K situation resulted in a delay of supplier support even though Progesa clearly lacked the basic affordance of error-free transactions. During BECS implementation, a new interface was accepted due to supplier's push, but later on, it created problems associated with integrating affordances.

Similarly, control mechanism and institutionalisation mechanism seemed to interact with each other throughout the ES lifecycle, although control mechanism prevailed most of the times due to public/health service context of IBTS. During the adoption phase, top leadership agreement was found to be crucial and business vision only followed later. During the acquisition phase, users were involved in creating URS documents so that *"their expectations... are locked down"* (R3), thereby using URS as an expectation control method. BECS implementation, in particular, demonstrates control mechanism operating over institutionalisation mechanism. For example, although there were steps taken to institutionalise the implementation process (e.g. non-IT project leadership, user engagement), the focus was more on external, internal, and project level controls. IBTS focus was *"more on change control rather than (on) change management"* (R18). When change management is mentioned within IBTS, the prevailing view is – *"it's a documented change, it's a change to a process or procedure"* (R5). As noted earlier, the creation of workarounds (institutionalisation mechanism) during use and maintenance phase was also marked by a focus on change control (control mechanism).

Interestingly, superusers seemed to play a mediating role between the institutionalisation mechanism and the affordance mechanism. After Progesa implementation, superusers helped in the institutionalisation of the system by providing training and support to the end-users. This is in line with the reported role of superusers in system institutionalisation via training (Haines & Goodhue, 2003; Volkoff et al, 2004). Superusers' skills and knowledge gained during extended use and maintenance phase of Progesa and during the failed implementation of eProgesa resulted in enhanced system knowledge and enabling affordances for IBTS during BECS implementation. Institutionalisation and affordance mechanisms also seemed to play a mutually reinforcing role in the ES lifecycle within IBTS. Integrating affordances and workaround related affordances resulted in extensive institutionalisation of Progesa system within IBTS. This institutionalisation in turn also had an impact on the affordance mechanism during BECS implementation via minimum BPR and high level of customisation, which in turn supported BECS institutionalisation due to minimal changes in the user interface.

Empirical evidence suggests that all four underlying mechanisms interacted with each other during the implementation phase. This explains the emergence of a higher number of key factors during the implementation phase. A health service context probably exacerbated the implementation problems since IBTS faced significant resource and operational constraints (Currie et al, 2009; Teoh et al, 2012) in dealing with a large number of factors emerging due to interaction among the mechanisms identified. Moreover, affordance, control, and market mechanisms seemed to be more prominent than institutionalisation mechanism during the implementation phase. It is argued here that it is the lesser prominence of institutionalisation mechanism that resulted in implementation challenges due to a lack of project ownership and inadequate attention to change management associated with ISBT-128 labelling. More institutionalisation of the project within IBTS would have allowed control mechanisms to pick up the lack of affordance associated with the ISBT-128 labelling piece of the BECS project.

Comparing the operation of the four mechanisms across the three instances of the ES lifecycle (Figure 5.4), it may be argued that the affordance and the market mechanisms had same level of importance for all three projects. The *market* mechanism seem to have the same importance since there was no major change in the ES market structure (Olsen & Sætre, 2007; Pollock & Cornford, 2004) for the duration of the three projects. Although the range of *affordances* offered by the ES varied for the three projects, its importance remained high for all three projects. Particularly for the eProgesa project where the ES lacked even the basic affordances, the importance of the affordance mechanism was seen to be higher (Ignatiadis & Nandhkumar, 2009; Nandhkumar et al, 2005). The *institutionalisation* of the project was not too high for the Progesa and the BECS project but nevertheless it was sufficient to get the project over the line. For the eProgesa project, however, the institutionalisation of the project was almost non-existent due to the project being confined to the IT unit. Coupled the lack of affordances in eProgesa, this technological focus (Akkermans & van Helden, 2002; Berg, 2001; McDonagh, 2016) hindered the institutionalisation of the project in organisational fabric. Finally, being a public service organisation there is always certain level of *control* on IBTS, yet the impact of control mechanism was the highest during the BECS project due to institutional pressures (Anwar & Mohsin, 2011; Kumar et al, 2002).

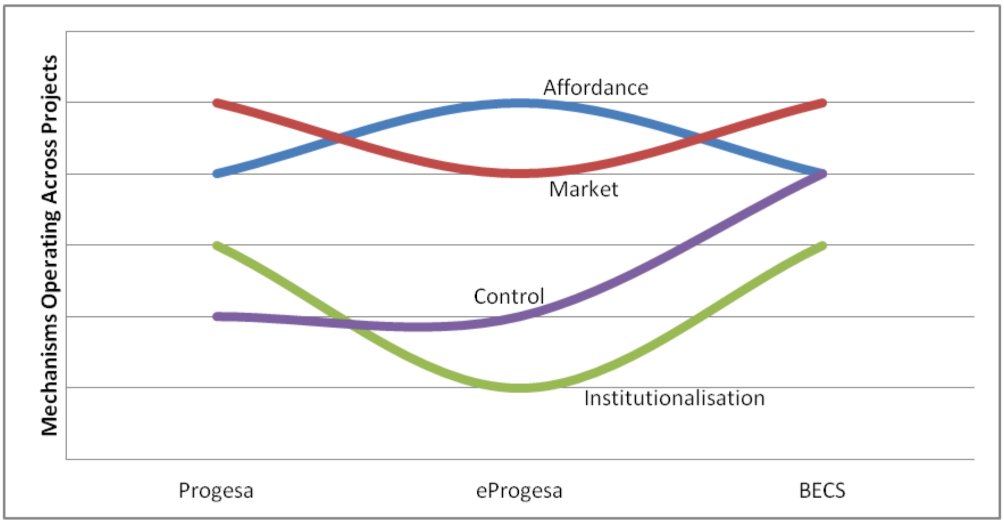

Figure 5.4 Mechanisms across three instances of ES lifecycle

Finally, from the nature of the four mechanisms, it is clear that ES lifecycle is indeed a socio-technical phenomenon (Trist, 1981) that goes beyond the organisational boundaries (Winter et al, 2014). Of the four mechanism identified in the analysis, three mechanisms (Control, Institutionalisation, and Market mechanism) clearly are social mechanisms (Anderson et al, 2006; Avgerou, 2013; Campbell, 2002; Davis, 2006; Davis & Marquis, 2005) with Affordance mechanism (Leonardi, 2011; Volfoff & Strong, 2013; Zamutto et al, 2007) representing a technological imperative. Taken together, the analysis presents the ES phenomena as a highly intricate set of co-dependent elements (Currie et al, 2009) operating in a broader institutional context. Therefore, the analysis supports the assertion that instead of taking technical and system pathways to system integration, there is a need to adopt *"a holistic systems approach with complementary organisational and social integration strategies"* (Currie et al, 2009, p. 177) in a health service context. Having discussed the theoretical framework in the light of extant literature; the next section assesses the theoretical framework against the research agenda outlined in Chapter 2.

5.5 Assessing the Theoretical Framework against the Research Agenda

This section assesses the theoretical framework against the research agenda outlined in Section 2.7 to evaluate if the research agenda is fulfilled. Subsections 5.5.1 to 5.5.4 respectively correspond to agenda items outlined in subsections 2.7.1 to 2.7.4. Subsection 5.5.5 outlines a key outcome of the study that was not envisaged initially.

5.5.1 Moving Beyond the Implementation Phase

As noted in Chapter 2, the majority of ES research is concentrated towards the implementation phase and subsection 2.7.1 marks the need to move beyond the implementation phase and to follow the ES lifecycle. The theoretical framework explains ES lifecycle in terms of five distinct phases, namely adoption, acquisition, implementation, use and maintenance, and evolution, which unfolded during Progesa, eProgesa and BECS lifecycle in IBTS. In this way, this study brings out the unique factors associated with the pre-implementation and the post-implementation phases and the changing nature of certain factors *during* different phases of the ES lifecycle. For example, while top leadership acted as an internal control mechanism during the adoption phase, it mediated with the external control during BECS acquisition and post-implementation phases of Progesa/eProgesa. Moreover, by extending the research focus to the complete lifecycle, the emergent theory provides a deeper understanding of the ES phenomena by establishing links between key factors and activities during different phases of the ES lifecycle. For example, failure to ensure business process ownership for ISBT-128 initiative in the initial phases created the problems for BECS project during later stages. Creating non-IT leadership and selecting domain experts as superusers helped in the institutionalisation of the Progesa and the BECS project in the long run. Nevertheless, the framework also justifies ES researchers' focus on the implementation phase since the implementation remains the most complex phase of the ES lifecycle.

5.5.2 Moving Beyond the Listing of Critical Success Factors

Chapter 2 notes the prevalence of CSF studies in the ES domain and a long list of factors presenting a static picture of ES lifecycle. Subsection 2.7.2, it notes the need to move beyond surface level static listing of factors and searching for underlying mechanisms (McDonagh, 2016) driving the ES lifecycle. By tracing the key mechanisms through time, the framework explains the emergence of different factors during different phases of the ES lifecycle. Emergent theory identifies four underlying mechanisms – *affordance*, *control*, *institutionalisation*, and *market* mechanism - that underpin the ES lifecycle in IBTS. The affordance mechanism primarily relates to the features of the ES artefact and how it supports or constrains the business processes followed in the organisation. The control mechanism manifests itself in various external, internal, and project level controls that have an impact on ES lifecycle in IBTS. The institutionalisation mechanism reflects to what extent ES lifecycle is embedded within the organisation. Finally, the market mechanism brings out the influence of market-level factors primarily via the supplier. Focus on the mechanisms provides a deeper understanding of the ES lifecycle by explaining how ES lifecycle unfolds due to different mechanisms operating at different levels, and thereby providing a causal reconstruction of the ES phenomena (Avegerou, 2013). Identification of underlying mechanisms helps in conceptually clarifying the ES phenomena surrounded by numerous factors at the empirical level. As Davis (2006, p.117) observes, *"at the bottom, there are a relatively small number of mechanisms that are… useful for explaining problems around organisations and organising."*

5.5.3 Outlining the Emergent and Multi-level Nature of ES-mediated Change

Since the majority of the studies on ES-mediated change either take a technological imperative or an organisational imperative, these studies do not present a complete picture (Markus & Robey, 1988) of the ES phenomenon. Therefore, this study attempts to pay equal attention to the social and the technical (Trist, 1981). Theoretical framework developed in this study outlines the emergent nature (Markus & Robey, 1988; Berg, 2001) of the ES lifecycle where technical factors (primarily via the mechanism of affordances) and social factors (via control, institutionalisation, and market mechanisms) are shown to influence the change outcomes. Especially during the implementation phase, these factors are found to be deeply entwined in determining the outcomes (e.g. cost and time overrun, work stress for implementation team members, C&AG audit) at various levels. The emergent change process is found to be socio-technical in nature (Trist, 1981), supporting the observation by Eason (2009) that changes in health systems can be understood more holistically using the STS framework.

The analysis also demonstrates the multi-level nature of the change processes with key mechanisms identified to be operating at different levels (Trist, 1981; Winter et al, 2014). While affordance mechanism primarily operates at the work-system level, institutionalisation mechanism manifests itself primarily at the organisational level and extends beyond the use and maintenance phase. Interestingly, control mechanism is found to be operating at different levels during different phases of the ES lifecycle.

However, a completely novel finding of this study is the influence of market mechanism, working at the macrosocial level, on the ES lifecycle in IBTS. ISBT-128 implementation within BECS project clearly exhibits the multi-level nature of the change processes. The case analysis shows that this project required change management at all the three levels – work-system, organisational, and macrosocial level. At the work-system level, labelling change required sharing of configuration decisions and supporting material to validate the systems in hospitals. At the organisation level, it required consistent and constant communication with the hospitals to create awareness and urgency about the implementation. Finally, the analysis also brings out the importance of change management at the macrosocial level that is needed to ensure that various initiatives do not run counter to each other, and in fact need to be synchronised with each other. As the case evidence suggests, it was primarily the lack of communication across diverse levels that caused delays in implementing the new labelling system, and to roll-out the eProgesa module within BECS.

5.5.4 Exploring the Contextual Nature of the ES Lifecycle

Following the Processual perspective (Pettigrew, 1985, 1987) this study also explores the contextual nature (Avgerou, 2001; Currie, 2009) of ES lifecycle. Although many findings of this study corroborate the findings that are based on the ES studies conducted in the private sector, it also brings out the contextual nature of the ES lifecycle. The control mechanism, in particular, is found to be an influence of the public service and the health service context (Mark, 2009). Public service context implies extensive external and internal controls compared to their private sector counterparts. External controls manifest in the form of public tendering, C&AG audit, CPA, external audit, and PRG review. Internal controls manifested in the form of oversight by steering committee and finance committee. The health sector context reveals itself in the form of extensive project controls in the form of validation, testing and strict change control, reflecting patient focus revolving around their safety. In the long run, it was found that the participants formed an overall view of the project based on the notion of 'public value' although there was no evidence in the case that the public value was explicitly measured by the organisation. Finally, the market mechanism is found to be a product of the implementation context which is marked by a dominant supplier in a niche area.

5.5.5. Exploring the factors and mechanisms across three instances of the ES lifecycle

Following a biography of artefact approach (Pollock & Williams, 2009; Williams & Pollock, 2012) this study traces the biography of the blood bank ES in IBTS. In doing so, it explains the impact of various time and locale on the ES lifecycle (Esteves & Pastor, 2001). This study not only captures the ES lifecycle, it goes one step further by tracing the key factors and their underlying mechanisms *across* three instances of the ES lifecycle in IBTS covering Progesa, eProgesa and BECS. In doing so, it uncovers the changing nature and the relative importance of some key factors across three projects. For example, as noted in Section 5.3.7, superusers' skills that were reportedly very low at the beginning of the Progesa project, consistently improved during the Progesa lifecycle and proved to be a key asset during the BECS implementation. Similarly, user training that took considerable time during the Progesa project was almost ignored during the BECS project due to experience of the users with the system. This possibly relate to the learning and maturity (of both superusers and the end users) within the organisation along the ES lifecycle. Moving beyond the implementation phase also helps in understanding the impact of one instance of ES lifecycle on the next instance of it. For example, supplier's push during the use and maintenance/evolution phase prompted for the adoption of a new version of the software. Similarly, post-implementation controls (e.g. C&AG, and CPA) of the Progesa and eProgesa projects, prompted IBTS to adopt strict external controls from the beginning of the BECS project. Tracing the factors and mechanisms *across* the three instances of ES lifecycle remains a major contribution of this study.

5.6 Conclusion

This chapter presents the findings from a case study to answer the following research question: *"What are the key factors and underlying mechanisms that underpin the Enterprise System lifecycle in Irish Public Service Organisations?"* Based on the fieldwork and subsequent analysis, Section 5.2 presents the explanatory theoretical framework. The framework identifies four underlying mechanisms – affordance, control, institutionalisation, and market mechanism – that manifest in various factors emerging across the five phases of theES lifecycle – adoption, acquisition, implementation, use and maintenance, and evolution. Section 5.3 presents the empirical evidence associated with the emergence of key factors across ES lifecycle phases in IBTS. To contextualise the findings, Section 5.4 compares the emergent framework against extant literature. Section 5.5 assesses the theoretical framework against the research agenda developed in Chapter 2 and also outlines a unique contribution of the study beyond the research agenda. The next chapter discusses the research contribution and implications of the theoretical framework presented in this chapter.

CHAPTER 6
CONCLUSION

"In science, all conclusions are provisional, subject to new evidence and better arguments."

- Michael Shermer (1954-), Science Author

6.1 Introduction

This chapter concludes the study that unfolded over time within the context of my doctoral research. Section 6.2 presents a brief review of the study and summarises different phases of the research journey, presents their association with individual chapters, and summarises the theoretical framework developed in this study. Section 6.3 discusses the contributions of this study in terms of theoretical contribution, empirical contribution, methodological contribution, and intended contributions to managerial practice. Section 6.4 discusses an emerging research theme that is not captured in the theoretical framework but nevertheless increases our understanding of the phenomenon. Section 6.5 discusses the limitations of the study. Section 6.6 discusses future research agenda. Section 6.7 concludes the chapter and the thesis by offering some personal reflections on the research journey.

6.2 A Brief Review of the Study

As noted in Chapter 1, the motivations for this study stemmed from the association of the researcher with ES projects in two Indian PSOs. From the experience, it was identified that the technical and the managerial issues are only a small part of the ES project and other factors emerging from the internal and external context play a major role in determining the outcome of the implementation process. It was also recognised that extant studies on critical success factors do not provide adequate guidelines and end up confusing practitioners due to numerous factors reported in the literature. Finally, it was also observed that extant studies do not pay adequate attention to the implementation context. This prompted an interest in pursuing a formal program of research to study ES lifecycle in the public service organisations (PSOs).

The literature review presented in Chapter 2 identified extant ES literature around five key phases of the ES lifecycle – adoption, acquisition, implementation, use and maintenance, and evolution (Esteves & Pastor, 1999, 2001). It noted that the majority of the ES literature is centred on the implementation phase and identifies many CSFs that are generally conceived to be static throughout the implementation phase. Literature pertaining to other phases was also found to be engaged in the identification of CSFs or providing prescriptions for the practitioners. The literature review also noted that the literature on ES-mediated organisation change usually subscribes to the technological or the organisational imperative, employs variance based theorising, and is normally confined to a single level of analysis. Finally, it was also found that ES studies normally do not pay attention to the PSO context and often it is implicitly assumed that findings from the private sector studies would also apply to the PSOs. Therefore, this study sought to move beyond a list of CSFs and to offer a mechanism-based account of the ES lifecycle that captures its processual dynamics in the PSO context.

At the same time, literature associated with research methodology (presented in Chapter 3) was also reviewed to clarify the ontological and epistemological assumptions of the researcher. The study subscribes to the process ontology of organisations (Pettigrew, 1985, 1987; Langley, 1999, 2007; Hernes, 2008) that focusses on the sequence of events unfolding over time within a context. To capture the dynamics associated with technology, this study subscribes to the Socio-technical (STS) perspective (Trist, 1981; Winter et al, 2014) that conceives the social and the technical systems as separate from each other. These systems become entwined when a technology is implemented and used in an organisation. The philosophy of critical realism (Bhaskar, 1975, 1989; Sayer, 2000, 2010) provided a sound epistemological basis for conducting this inquiry since it allows the researchers to focus on underlying mechanisms (Avgerou, 2013; McGrath, 2013) that underpin the processes observed at the empirical level. Based on the literature review and the research methodology, therefore, the research question for this study was: *"what are the key factors and underlying mechanisms that underpin the enterprise system lifecycle in Irish public service organisations?"* To execute the fieldwork, longitudinal qualitative case study (Pettigrew, 1990, 1997) was found to be most suitable research strategy, focussing on a single case organisation and tracing the events (George & Bennett, 2005) as they unfolded. Embedding an STS perspective within the processual framework allowed the researcher to collect and analyse data on three levels – work-system , organisational, and macrosocial level. The fieldwork was conducted in the Irish Blood Transfusion Services (IBTS) that engaged in three ES implementations over the period 2000-15.

Chapter 4 presented the case narrative that includes Progesa implementation during 2000-03, eProgesa implementation during 2004-07, organisational activities during 2008-11, and BECS implementation during 2012-15. Due to the focus on multi-level data collection, case narrative also includes the events at the macrosocial level that had an impact on the ES lifecycle in IBTS. The narrative was presented in its entirety without any explicit attempt to apply any theory or offer any analysis.

Based on the analysis of the data collected, an explanatory theoretical framework was presented in Chapter 5 that identifies four underlying mechanisms underpinning the ES lifecycle in IBTS – affordance, control, institutionalisation, and market mechanism. These mechanisms manifest themselves in the emergence of various factors across the ES lifecycle, influencing the outcomes at different levels. The *affordance mechanism* was primarily found to be working at the work-system level and was found to be associated with the features and constraints of the enterprise/legacy systems and business process requirements of the organisation. The *control mechanism* was found to be operating at different levels during different phases of the ES lifecycle. During the adoption, use and maintenance, and evolution phases, it was found to be operating primarily at the work-system and organisation level evident in strict validation and change control procedures. During the acquisition phase, it mostly operated at the macrosocial level with top leadership mediating with the institutional context. It was during the implementation phase when control mechanism was found to be operating at all three levels – macrosocial, organisational, and work-system level. PSO and health service context was found to be a major reason for this prevalence of control mechanism. The *institutionalisation* mechanism was found to be working at the organisational level and was associated with how different ES activities were embedded within the organisation. Finally, the *market mechanism* at the macrosocial level was found to be playing a crucial role due to information asymmetry of the ES market and due to the existence of a dominant supplier in a niche (blood bank) market. The analysis also noted the interaction between different mechanisms resulting in the emergence of various factors.

6.3 Contribution of the Study

This section outlines the contributions of this study. The major contribution of this study is in the form of theoretical contribution outlined in subsection 6.3.1. Subsections 6.3.2 and 6.3.3 respectively outline empirical and methodological contributions. Finally, subsection 6.3.4 outlines contribution to practice.

6.3.1 Theoretical Contribution

While Sutton & Staw (1995) preferred to note ‘what theory is not’, this study adopts the following definition of a theory to outline the theoretical contribution of this study: *“Theory is a statement of concepts and their interrelationships that show how and/or why a phenomenon occurs”* (Gioia & Pitre, 1990). As Corley & Gioia (2011) note, theoretical contribution arises *“when theory reveals what we otherwise had not seen, known or conceived*.” In other words, the theory allows us to explain the phenomena in a profound, imaginative and unconventional way (Mintzberg, 2005). Following paragraphs assess the theoretical contribution of this study based on the above-mentioned criteria.

The primary theoretical contribution of this thesis to the ES area within the IS domain is in providing a mechanism-based explanatory framework of the ES lifecycle. It explains the emergence of various factors in terms of four key mechanisms across five phases of the ES lifecycle. In doing so, the framework allows us to move beyond the surface level description (Anderson et al, 2006) of the ES lifecycle by developing a causal reconstruction of events (Avgerou, 2013) and explain the process through which observed outcomes were generated. It may be noted, however, that a mechanism-based explanation is not like the deterministic laws of natural sciences in which certain inputs lead to certain outputs without an exception (Anderson et al, 2006; McGrath, 2013). Instead, the theoretical framework developed in this study should be seen as a *“sometimes-true”* theory (Coleman 1964, p.516) that moves beyond the description and provides an *explanation* of unfolding events within a contextual condition.

By putting the ES artefact as a central focus of the research, this study answers the calls for including the IT artefact (Orlikowski & Iacono, 2001; Kallinikos, 2004; Currie & Swanson, 2009; Faulkner & Runde, 2010) in the studies of technology in organisations. The focus on the ES artefact reflects in the identification of Technology Affordance (Faraj & Azad, 2012; Leonardi, 2011; Zamutto et al, 2007) as a key explanatory mechanism that is shown to have an impact on all the phases of the ES lifecycle. At the same time, this study also describes and explains the impact of macro-level market mechanism on the technology affordances at the work-system level.

Within the context of ES-mediated organisation change (Markus & Robey, 1988), the framework represents a theory that captures the emergent perspective of technology and organising (Avgerou & McGrath, 2007; Orlikowski & Yates, 2006; Leonardi & Barley, 2008) with affordance mechanism primarily representing technology (Volkoff & Strong, 2013) and the other three mechanisms representing the social processes (Avegerou, 2013). In terms of logical structure, the theoretical framework offers a process theory that explains the sequence of events in terms of their underlying mechanisms. Finally, using a socio-technical perspective, the theoretical framework offers a multi-level analysis of the ES lifecycle at the work-system, organisational, and at the macrosocial level. In this way, the framework also provides a conceptual integration of concepts from the organisation and management theory (via institutionalisation mechanism) and those from industrial economics (via market mechanism) into an IS theory.

Whetten (1989) observes that sensitivity to context is especially important for theories based on empirical evidence since observations are embedded within their context and should be understood within it. Therefore, a significant contribution of this study is in outlining the influence of PSO and health service context (Currie et al, 2009, Mark, 2006) on ES lifecycle particularly via the control mechanism (Mark, 2009, p. 69). In recent years, there has been an increase in research on IS project controls and this study provides a processual and multi-level analysis of control processes for an ES project, something that very few extant studies on IS control have attempted to do (Kirsch, 2004; Weiner et al, 2016). This study shows that control mechanism operates at different levels during different phases of the ES lifecycle. It was found that the health service and the PSO context results in extensive controls, especially during the implementation phase. By providing a context-aware account of ES lifecycle, the study also offers some incidental contribution to the public/health service domain.

Finally, this study also offers a theoretical contribution to the ES literature in the form of a systematic literature review of ES research in leading IS journals for the period 2000-2015. As Okoli (2015) argues, a systematic literature review should be seen as a research contribution in its own right as it might result in publications on its own merit. Indeed a conference paper (Saxena & McDonagh, 2017) based on the systematic literature review conducted in this thesis was accepted and presented at the Twelfth Midwest Association for Information Systems Conference.

6.3.2 Empirical Contribution

The case narrative of the ES lifecycle in IBTS for the period 2000-2015 in Chapter 4 forms an important empirical contribution of this study on its own. As outlined in Section 3.6, the narrative is in the form of process tracing (George & Bennett, 2005, p. 210) and focuses on providing ‘pure’ description (Walcott, 2009, p. 27-29). This is done to present the events as they unfolded without any efforts to interpret or analyse so that the richness of the case is not compromised. In this way, the case narrative presents an empirical contribution that traces the ES lifecycle in IBTS with rich details of its context and process. As presented in Chapter 4, the narrative may independently be analysed using other theoretical frameworks or may be presented as a demonstrative case to emphasise contextual, processual, and multi-level nature of ES mediated change (Avgerou, 2001; Markus & Robey, 1988).

This study is one of the first ES studies to adopt a Biography of Artefact (Pollock & Williams, 2009; Williams & Pollock, 2012) approach by following the biography of an implemented artefact (Progesa/eProgesa) within an organisation. Following a BoA approach, the study was able to show the influence from different locale (e.g. BOSS development by New York Blood Centre) and time (e.g. first eProgesa implementation failure paving the way for successful BECS implementation) on ES lifecycle. By focussing on the complete ES lifecycle, the study also draws a sharp focus on the pre-implementation and post-implementation phases, something which is by and large ignored in the extant ES literature (Esteves & Pastor, 2001; Howcroft & Light, 2006, 2010; Khoo & Robey, 2007). At the same time, this study also moves beyond a single instance of the ES lifecycle and captures the events associated with three instances of the ES lifecycle in a single organisation. In doing so, it uncovers the changing nature and importance of some key factors across three iterations of the ES lifecycle, especially in terms of organisational learning and maturity. It also draws a sharp focus on the impact of the events from the earlier lifecycle instance (e.g. C&AG inquiry and CPA debate) on the events from the next instance of the ES lifecycle (e.g. constitution of PRG, and strict internal controls).

Finally, by including a longitudinal description and explanation of ISBT-128 initiative in IBTS, this study also offers an empirical contribution to the health service domain. The extant literature on ISBT-128 implementation in blood banks remains rather limited and primarily relates to the implementation planning (Ashford et al, 2007), suggested benefits (Distler, 2010; Doughty & Flanagan, 1996; Sharma et al, 2011), and configuration details (Ashford, 2006; Li et al, 2005, 2006; Peck et al, 2005). It exhibits a focus on the technological details and on the impact of change (Aandahl et al, 2007; Doughty & Flanagan, 1996), thereby ignoring the dynamics of change and the organisational imperative. By providing a longitudinal and multi-level description/explanation of ISBT-128 initiative, this study provides an incidental contribution to the Health Information System (HIS) literature.

6.3.3 Methodological Contribution

By embedding the STS perspective within the processual inquiry, this study offers a methodological contribution to the IS literature. It is sometimes (Orlikowski, 2010) seen as a weakness of process perspective that it tends to minimise the role of technology and sidelines the features and constraints entailed in the technological objects (Faulkner & Runde, 2010). Embedding the STS perspective within the process inquiry allows the researcher to explicitly include the technology in the processual analysis by incorporating the work-system level along with organisational and macrosocial levels (Trist, 1981). The analytical framework used in this study also goes outside the organisational boundaries to include other organisations (e.g. the Department, regulators, hospitals) in the analysis, thereby adopting what has recently (Winter et al, 2014) been called a neo-STS perspective. By using critical realism as an epistemological basis for conducting process inquiry, this study also offers an example of executing a longitudinal case study to search for mechanisms underpinning the IS-mediated organisation change. In this way, this study bridges the gap between critical realist philosophy and process organisation studies by providing an example (in Section 3.6) of how data collection and analysis unfolded during this study.

6.3.4 Contribution to Practice

Corley & Gioia (2015, p.15) note that the idea of research contribution rests largely on the ability of the study *"to provide original insight into a phenomenon by advancing knowledge in a way that is deemed to have a utility or usefulness for some purpose."* By developing an explanatory framework of the ES lifecycle in terms of four underlying mechanisms, the study provides a toolkit for implementing organisations guiding them to focus on few 'critical areas' (Rockart, 1979) instead of trying to attend to a myriad of critical success factors (Martin & Huq, 2007; McDonagh, 2016). A key implication of the mechanism-based framework is that managers engaged in ES implementation should be focusing on all three levels (work-system, organisational, and macrosocial level) to successfully execute the ES project. This might involve different managers working at different levels, for example, top leadership working with the institutional context and market mechanisms, middle managers working with the organisational context to support the institutionalisation process, and domain and technology experts working at the work-system level to create required affordances. The hierarchy of control described in this study might work as a blueprint for practitioners in the health/public service context. Finally, the prevalence of different mechanisms across different phases of ES lifecycle also indicates that managers need to reflect upon and revise their mental models (Van de Ven & Sun, 2005) with the unfolding journey of the ES-mediated change in their organisation.

At the same time, by providing a longitudinal description of the three instances of ES lifecycle in a single organisation, the case study also presents an example of the relative change of importance of certain factors. This may be helpful to practicing managers in the form of guiding where to focus attention depending on the maturity if the system use in the organisation. Based on the findings discussed in Section 5.3.7, it may be argued that if the system is new and the users are not exposed to the technology, the managers need to focus more on the user training. On the contrary, if the users are exposed to the system and an earlier version of the system is already in use in the organisation, managers may focus (relatively) less on the user training. The case also indicates that the organisations should allocate more resources on the element of change (e.g. ISBT-128 in the BECS project) when planning and implementing a project that involves change at multiple levels and with multiple stakeholders.

6.4 Emerging Theme

This section discusses an emerging theme that is not directly captured by the theoretical framework presented in the thesis but nevertheless explains a certain sub-period after eProgesa implementation was stopped in IBTS. Subsequent period (2007-2011) provides support for the primacy of legitimisation mechanism (Meyer & Rowan, 1977; DiMaggio & Powell, 1983) which could be defined as a mechanism ensuring that an organisation's actions are desirable, proper, and appropriate within the environment's system of norms, values, and beliefs (Suchman, 1995). eProgesa failure and subsequent C&AG audit (2008) presented a legitimacy crisis for IBTS. IBTS *"ended up in front of the Public Accounts Committee explaining itself why this money was spent and came out of it quite badly"* (R1). Suchman (1985) discusses three strategies employed by organisations to repair its legitimacy in such situations - offering normalising accounts, restructuring, and don't panic. IBTS tried to repair legitimacy by offering normalising account of eProgesa acquisition and implementation (Suchman, 1985) by contextualising the implementation, blaming the supplier, and offering justifications for its acquisition decision. The efforts of repairing legitimacy continued when IBTS engaged in strategic restructuring (Pfeffer, 1981), in which it selectively accepted that limited aspects of its operations were flawed and initiated some changes in its management structure. IBTS also created an ICT council as a monitor and watchdog (Suchman, 1985) of IS strategy in the organisation.

However, the nature of this restructuring remained primarily ceremonial (Meyer & Rowan, 1977) and demonstrative (Berente et al, 2010) since IBTS remained largely functional in its approach. Office of the Chief Information Officer that was recommended by an external expert and also established in other PSOs was never established. The ICT council that was given the mandate of IS-business strategy alignment also ceased to exist before the BECS implementation started. A commissioned project review of eProgesa conducted by KPMG warned against dependency on a single supplier, but there was no serious attempt by IBTS to avoid that dependency. Thus, it may be concluded that the review and restructuring exercises in post e-Progesa period were primarily an attempt to repair legitimacy (Pfeffer, 1981; Suchman, 1985). Control mechanisms operating at various levels during the BECS project, especially the constitution of PRG, may also be seen as a result of legitimisation crisis that IBTS faced earlier. IBTS was *“very conscious of (what) had happened in the past”* (R1) and sought the legitimacy by conforming to established standards of IS project management in the Irish Public Sector.

At a deeper level, the existence of legitimisation mechanism for non-project duration indicates a general prevalence of institutional mechanism at a broader level within the Irish health sector similar to one reported for the UK NHS (Currie, 2012). While the institutionalisation of ES initiative (Baptista et al, 2010) could be conceived as an organisation-level manifestation of the institutional processes (Suchman, 1985), the market mechanism might be conceived as a manifestation of macro-level manifestation of the institutional processes (DiMaggio & Powell, 1983) operating in the institutional field of blood banks. Similarly, specific mechanisms of control might be construed as supporting the legitimisation process (Mark, 2006, 2009) at multiple levels. Finally, affordance mechanism may be related to the process of ‘technical isomorphism’ outlined by Benders et al (2006). However, it is argued here that existing empirical evidence acts only as a pointer towards these themes and it would require further data collection and analysis at the level of institutional field (Davis & Marquis, 2005) of blood banks across the world. Therefore, although there are strong reasons to justify the applicability of the legitimisation mechanism at a deeper level, in the absence of data from relevant levels this lies beyond the scope of this Ph.D. thesis.

6.5 Limitations of the Study

No study is without limitations and this study is no exception either. These limitations primarily relate to the execution of the research methodology to collect the evidence. One methodological limitation of this study is that although the follow-up meetings with the hospitals were conducted to obtain their perspective, ES supplier and members of the PRG could not be contacted due to access limitations. However, the prevailing view across IBTS and the documentary evidence is quite strong in terms of ensuring descriptive and interpretive validity (Maxwell, 2012) of the case narrative. A second methodological limitation of this study relates to limited external generalisability of case study findings to another context. Working within the critical realist philosophy, this study acknowledges the context specificity of the findings and seeks theoretical generalisability (Yin, 2013; Farquhar, 2012; Tsang, 2014) of the mechanism-based account that generates a ‘sometimes-true’ theory (Coleman, 1964). Another methodological limitation of this study might be a possibility of post-hoc rationalisation (Weick, 1995) by the participants to provide some coherence to the events and a rational purpose to their actions. However, interviews across the organisation, C&AG reports and debates from the Public Accounts Committee are used as triangulation device (Yin, 2013; Miles et al, 2013) to ensure internal validity (Maxwell, 2012) of the account.

Although literature associated with the ES implementation in the health service context (e.g. Ayal & Seidmann, 2009; Davis & Hikmet, 2008; Karuppan & Karuppan, 2008; Soh & Sia, 2004; Teoh et al, 2012; Tong et al, 2015) is included in the literature review chapter, it is also acknowledged here that the wider HIS literature may have a bearing on the analysis and findings reported in this study. However, based upon a preliminary survey of the HIS literature it was found that it primarily focusses on the IS associated with the hospitals and patient care (Finnegan & Hamid, 2009; Mantzana et al, 2008) and blood banks form a rather small part of the HIS market (Anyanwu et al, 2003; Raghupathi & Tan, 2002). Even so, relevant works from HIS literature are included in Chapter-5 since health service context was found to be a crucial contextual factor during the analysis of empirical data.

The next section discusses the future research agenda that is focussed towards increasing the theoretical validity of the explanatory theory developed in this study and further application of the research framework employed in this study.

6.6 Future Research Agenda

The future research agenda for this study primarily involves studying the ES lifecycle in different contexts (non-public, non-health, and/or non-Irish context) to increase the theoretical validity of the explanatory theory. As Sayer (2010, p. 138) notes, *"where it concerns human action, the prediction is almost certain to be highly inaccurate, but in so far as it stimulates action this may be better than having no prediction.*" On the same lines, future research agenda includes some theoretical propositions for further inquiry:

Proposition 1: Affordances would be easier to achieve for standard business processes (e.g. accounting, human resources) than for domain-specific business processes (e.g. blood operations).

Proposition 2: Control mechanism would be less influential for the ES lifecycle in the non-PSO and non-health context (e.g. a manufacturing plant).

Proposition 3: If institutionalisation mechanism is dominant during all phases of the ES initiative, there would be less organisation-level problems in implementing ES.

Proposition 4: Market mechanism would have a positive influence on the ES lifecycle if the ES market is oligopolistic (e.g. ES packages for finance or CRM).

A second key agenda is to trace a specific mechanism (e.g. control mechanism) across different IS projects in diverse contexts. This will help in deepening the knowledge about individual components of the framework and in understanding their changing nature in differing context. This, in turn, would help managers in adjusting their mental models during different phases of an ES-mediated change (Van de Ven & Sun, 2011) enabling them to manage it effectively.

As noted in Section 6.4, there remains a possibility of a deeper level institutional analysis in future research executing the empirical data collection and subsequent analysis at the level of the institutional field. Compared to first two research directions, this requires a long-term focus and forms part of a long-term research agenda. The same case may be stated for the research framework used in this study. This study demonstrates that embedding the STS framework within the process inquiry allows the researcher to focus on multi-level dynamics of change unfolding over time. A future research agenda is to engage in further longitudinal studies to refine and develop the research framework. The next section concludes the thesis by noting some personal reflections on my research journey.

6.7 Some Personal Reflections on the Research Journey

To conclude the chapter and the thesis, in this section I offer some personal reflections on the journey of my Ph.D. Process thinking and contextualism also applied to my research journey in terms of the influence of external context (i.e. other than my own and those from the research supervisor) in the research process. I came from an education system where research supervisor tells the student what to do and the student's task is to execute the idea. In the beginning, it was something of a cultural shock to realise that I must take all my research decisions and the research supervisor's task is just to facilitate during this process. After some initial adjustments, I enjoyed the process of deliberation, discussion and decision-making that was part of my Ph.D. journey.

In terms of my educational background, I feel that exposure to the technological perspective during my undergraduate studies (*Bachelor of Engineering in Information Technology*) and exposure to the social perspective during my masters' program (*Masters in Industrial Management*) allowed me to pay equal attention to both aspects during my doctoral study. As noted in Chapter 1, this research was motivated by my personal experience with the ES implementations in two Indian PSOs. This experience helped me in establishing the rapport with the participants from the case organisation when conducting the fieldwork. Moreover, another factor that helped in painting a rich picture is that eProgesa module and ISBT-128 implementation within the BECS project were unfolding when I conducted the interviews. Some interviews that were conducted after the go-live of the system allowed me to ask questions about the performance and outcomes of the project.

Although the final product (Ph.D. thesis) is presented in a linear format, the research process was more iterative and reflexive filled with starts, restarts, twists and turns. Multiple processes unfolding in the external context determined the path of the study. When I entered the Ph.D. program, sociomateriality was the new 'thing' and I too thought of jumping on the bandwagon. However, when I presented my first conference paper on integrating sociomateriality with process inquiry (Saxena & McDonagh, 2014) at the British Academy of Management Conference, the feedback prompted me to question my own ontological and epistemological assumptions, nudging me towards the socio-technical perspective with a critical realist philosophy. Within the critical realist framework, in the beginning, I focussed only on four mechanisms from the process literature (Van de Ven & Poole, 1995) and affordance mechanism from the IS studies (Volkoff & Strong, 2013). However, when I presented this five-mechanism concept to explain technology-mediated organisation change (Saxena & McDonagh, 2016) at the British Academy of Management Conference, I was made aware of the broad array of mechanism-based theorising (e.g. Anderson et al, 2006; Davis, 2006) that prompted me to consider possibility of including other mechanisms or even conceiving new ones. This, in turn, forced me to remain open to new concepts and ideas and to question the merit of existing dogma. This reflects in my papers for the UK Academy of Information Systems conference, where I questioned the one-dimensional construct of ES success and failure (Saxena et al, 2016) and the tendency to present a ‘list’ of surface level CSFs without considering their evolution through time or without giving any consideration to their underlying mechanisms (Saxena & McDonagh, 2017a). Towards the very end of this thesis, positive feedback for my conference paper (Saxena & McDonagh, 2017b) for the European Academy of Management Conference also indicated the theoretical validity of my preliminary findings within the community concerned with the research.

At the end, I would like to stress that the Ph.D. thesis as a book of evidence presents the understanding of the researcher at the time of writing and I acknowledge that the theories could always be reinterpreted or revised in the light of new empirical evidence or emergence of new understanding. As saying from Heraclitus goes*: “No man ever steps in the same river twice, for it's not the same river and he's not the same man.”*

REFERENCES

Aandahl, G. S., Knutsen, T. R., & Nafstad, K. (2007). Implementation of ISBT 128, a quality system, a standardized bar code labeling of blood products worldwide, electronic transfusion pathway: four years of experience in Norway. *Transfusion*, *47*(9), 1674-1678.

Aburub, F. (2015). Impact of ERP systems usage on organizational agility: An empirical investigation in the banking sector. *Information Technology & People*, *28*(3), 570-588.

Ackroyd, S. (2012). Contemporary realism and organizational change. *The Routledge Companion to Organizational Change, Oxon: Routledge*, 230-244.

Ackroyd, S., & Fleetwood, S. (2000). Realism in contemporary organisation and management studies. In *Realist perspectives on management and organisations*. Psychology Press.

Ackroyd, S. (2012). Contemporary Realism and Organisation Change. *The Routledge companion to organizational change*. Routledge.

Adam, F., & O'Doherty, P. (2000). Lessons from enterprise resource planning implementations in Ireland–towards smaller and shorter ERP projects. *Journal of information technology*, 15(4), 305-316.

Addo-Tenkorang, R. and Helo, P. (2011), Enterprise resource planning (ERP): a review literature report, *World Congress on Engineering and Computer Science*, Newswood Limited, San Francisco, CA, October 19-21.

Akkermans, H., & van Helden, K. (2002). Vicious and virtuous cycles in ERP implementation: a case study of interrelations between critical success factors. *European Journal of Information Systems*, *11*(1), 35–46.

Al-Fawaz, K., Eldabi, T., & Naseer, A. (2010). Challenges and influential factors in ERP adoption and implementation. *EMCIS 2010 Proceedings*, *2010*, 1–15.

Al-Fawaz, K., Evaluation, I. S., Al-salti, Z., & Eldabi, T. (2008). Critical Success Factors in Erp Implementation: A Review. *European and Mediterranean Conference on Information Systems*, *2008*(2001), 1–9.

Al-Mashari, M. (2001). Process orientation through enterprise resource planning (ERP): a review of critical issues. *Knowledge and Process Management*, *8*(3), 175–185.

Al-Mashari, M. (2002). Enterprise resource planning (ERP) systems: a research agenda. *Industrial Management & Data Systems*, *102*(3), 165-170.

Al-Mashari, M., & Al-Mudimigh, A. (2003). ERP implementation: lessons from a case study. *Information Technology & People*, *16*(1), 21-33.

Al-Mashari, M., Al-Mudimigh, A., & Zairi, M. (2003). Enterprise resource planning: A taxonomy of critical factors. *European Journal of Operational Research*, *146*(2), 352–364.

Al-Mudimigh, A., Zairi, M., & Al-Mashari, M. (2001). ERP software implementation: an integrative framework. *European Journal of Information Systems*, *10*(4), 216-226.

Aladwani, A. M. (2001). Change management strategies for successful ERP implementation. *Business Process management journal*, *7*(3), 266-275.

Alhirz, H., & Sajeev, A. S. M. (2015). Do cultural dimensions differentiate ERP acceptance? A study in the context of Saudi Arabia. *Information Technology & People*, *28*(1), 163-194.

Allen, D. K., Brown, A., Karanasios, S., & Norman, A. (2013). How should technology-mediated organizational change be explained? A comparison of the contributions of critical realism and activity theory. *MIS Quarterly*, 37(3), 835-854.

Allen, D., Kern, T., and Havenhand, M. (2002). *ERP Critical Success Factors: an exploration of the contextual factors in public sector institutions*. Proceedings of the 35th Annual Hawaii International Conference In System Sciences, 2002.

Allen, J. P. (2005). Value conflicts in enterprise systems. *Information Technology & People*, *18*(1), 33-49.

Allen, J., Jimmieson, N. L., Bordia, P., & Irmer, B. E. (2007). Uncertainty during organizational change: Managing perceptions through communication. *Journal of Change Management*, *7*(2), 187-210.

Aloini, D., Dulmin, R., & Mininno, V. (2007). Risk management in ERP project introduction: Review of the literature. *Information and Management*, *44*(6), 547–567.

Alvarez, R. (2008). Examining technology, structure and identity during an enterprise system implementation. *Information Systems Journal*, *18*(2), 203-224.

Alves, M., & Matos, S. (2011). An investigation into the Use of ERP Systems in the Public Sector. *Journal of Enterprise Resource Planning Studies*, 2011.

Alves, M., & Matos, S. (2013). ERP adoption by public and private organizations–a comparative analysis of successful implementations. *Journal of Business Economics and Management*, 14(3), 500-519.

Alwabel, S. A., Ahmed, A. M., & Zairi, M. (2005). The Evolution of ERP and its Relationship with E-business. *International Journal of Enterprise Information Systems*, *2*(4).

Amid, A., Moalagh, M., & Zare Ravasan, A. (2012). Identification and classification of ERP critical failure factors in Iranian industries. *Information Systems*, *37*(3), 227–237.

Amini, M., & Sadat Safavi, N. (2013). Critical Success Factors for ERP Implementation. *SSRN Electronic Journal*, *5*(June 1999), 30–36.

Amoako-Gyampah, K. (2007). Perceived usefulness, user involvement and behavioral intention: an empirical study of ERP implementation. *Computers in Human Behavior*, *23*(3), 1232-1248.

Amoako-Gyampah, K., & Salam, A. F. (2004). An extension of the technology acceptance model in an ERP implementation environment. *Information and Management*, *41*(6), 731–745.

AMR (2015). *ERP Software Market by Deployment (On-premise deployment and Cloud deployment) and Function (Finance, Human resource, Supply chain and Others) - Global Opportunity Analysis and Industry Forecast, 2013 – 2020*. Allied Market Research

Anderson, P. J., Blatt, R., Christianson, M. K., Grant, A. M., Marquis, C., Neuman, E. J., Sonenshein, S., & Sutcliffe, K. M. (2006). Understanding mechanisms in organizational research reflections from a collective journey. *Journal of Management Inquiry*, *15*(2), 102-113.

Ang, J. S. K., Sum, C. C., & Yeo, L. N. (2002). A multiple-case design methodology for studying MRP success and CSFs. *Information and Management*, *39*(4), 271–281.

Anwar, S., & Mohsin, R. (2011, January). *ERP project management in public sector-key issues and strategies*. In 44th Hawaii International Conference on System Sciences (HICSS), 2011. IEEE.

Anyanwu, K., Sheth, A. P., Cardoso, J., Miller, J. A., & Kochut, K. J. (2003). Healthcare enterprise process development and integration. *Journal of Research and Practice Information Technology, 35* (2), 83-98.

Ash, C. G., & Burn, J. M. (2003). A strategic framework for the management of ERP enabled e-business change. *European journal of operational research*, *146*(2), 374-387.

Ashford, P. (2006). ISBT 128–improving security by international standardization. *ISBT Science Series*, *1*(1), 242-245.

Ashford, P., Distler, P., Gee, A., Lankester, A., Larsson, S., Feller, I., Loper, K., Pamphilon, D., Poston, L., Rabe, F., Slaper-Cortenbach, I., Szczepiorkowski, Z., & Warkentin, P. (2007). ISBT 128 implementation plan for cellular therapy products. *Transfusion*, *47*(7), 1312-1318.

Avgerou, C. (2001). The significance of context in information systems and organizational change. *Information systems journal*, *11*(1), 43-63.

Avgerou, C. (2013). Social mechanisms for causal explanation in social theory based IS research. *Journal of the Association for Information systems*, 14(8), 399.

Avgerou, C., & McGrath, K. (2007). Power, rationality, and the art of living through socio-technical change. *MIS Quarterly*, 295-315.

Avison, D., & Young, T. (2007). Time to rethink health care and ICT?. *Communications of the ACM*, *50*(6), 69-74.

Ayal, M., & Seidman, A. (2009). An empirical investigation of the value of integrating enterprise information systems: the case of medical imaging informatics. *Journal of Management Information Systems*, *26*(2), 43-68.

Bagchi, S., Kanungo, S., & Dasgupta, S. (2003). Modeling use of enterprise resource planning systems: a path analytic study. *European Journal of Information Systems*, *12*(2), 142-158.

Bajwa, D. S., Mooney, T., Garcia, J. E., & Deepinder s. bajwa, J. E. G. (2004). an Integrative Framework for the Assimilation of Enterprise Resource Planning Systems: Phases, Antecedents, and Outcomes. *The Journal of Computer Information Systems*.
Bala, H., & Venkatesh, V. (2013). Changes in Employees' Job Characteristics During an Enterprise System Implementation: A Latent Growth Modeling Perspective. *MIS quarterly*, *37*(4), 1113-1140.
Banneroft, N. M., Seip, H., & Sprenge, A. (1998). *Implementing SAP R/3: How to Introduce a Large System into a Large Organization*. Manning Publication Co., Greenwich, CT.
Bannister, F. (2001). Dismantling the silos: extracting new value from IT investments in public administration. *Information Systems Journal*, *11*(1), 65-84.
Baptista, J., Newell, S., & Currie, W. (2010). Paradoxical effects of institutionalisation on the strategic awareness of technology in organisations. *The Journal of Strategic Information Systems*, *19*(3), 171-183.
Barker, T., & Frolick, M. N. (2003). ERP implementation failure: A case study. *Information Systems Management*, *20*(4), 43-49.
Barley, S. R. (1986). Technology as an occasion for structuring: Evidence from observations of CT scanners and the social order of radiology departments. *Administrative Science Quarterly*, 78-108.
Beard, J. W., & Sumner, M. (2004). Seeking strategic advantage in the post-net era: viewing ERP systems from the resource-based perspective. *The Journal of Strategic Information Systems*, *13*(2), 129-150.
Beijsterveld, J. A., & Groenendaal, W. J. (2015). Solving misfits in ERP implementations by SMEs. *Information Systems Journal*.
Benders, J., Batenburg, R., & Van Der Blonk, H. (2006). Sticking to standards; Technical and other isomorphic pressures in deploying ERP-systems. *Information and Management*, *43*(2), 194–203.
Berente, N., Gal, U., & Yoo, Y. (2010). Dressage, control, and enterprise systems: the case of NASA's Full Cost initiative. *European Journal of Information Systems*, *19*(3), 377–377.
Berg, M. (2001). Implementing information systems in health care organizations: myths and challenges. *International journal of medical informatics*, *64*(2), 143-156.
Bhaskar, R. (1975). *A realist theory of science*. Leeds Books Ltd.
Bhaskar, R. (1989). *The possibility of naturalism: a philosophical critique of the contemporary human sciences.* Harvester Wheatsheaf.
Bizzi, L., & Langley, A. (2012). Studying processes in and around networks. *Industrial Marketing Management*, 41(2), 224-234.
Blick, G., Gulledge, T., and Sommer, R. (2000). *Defining business process requirements for large scale public sector ERP implementations: A case study*. ECIS 2000 Proceedings.
Boersma, K., & Kingma, S. (2005). From means to ends: The transformation of ERP in a manufacturing company. *The Journal of Strategic Information Systems*, *14*(2), 197-219.
Boonstra, A. (2006). Interpreting an ERP-implementation project from a stakeholder perspective. *International Journal of Project Management*, *24*(1), 38–52.
Boonstra, A. (2013). How do top managers support strategic information system projects and why do they sometimes withhold this support? *International Journal of Project Management*, *31*(4), 498–512.
Bordia, P., Hunt, E., Paulsen, N., Tourish, D., & DiFonzo, N. (2004). Uncertainty during organizational change: Is it all about control?. *European Journal of Work and Organizational Psychology*, *13*(3), 345-365.
Bose, I., Pal, R., & Ye, A. (2008). ERP and SCM systems integration: The case of a valve manufacturer in China. *Information & Management*, *45*(4), 233-241.
Bostrom, R. P., & Heinen, J. S. (1977a). MIS problems and failures: a socio-technical perspective, part I: the causes. *MIS Quarterly*, 1(3), 11-32.
Bostrom, R. P., & Heinen, J. S. (1977a). MIS problems and failures: a socio-technical perspective, part II: the application of socio-technical theory. *MIS Quarterly*, 1(4), 11-28.
Botta-Genoulaz, V., Millet, P.A. and Grabot, B. (2005), A survey on the recent research literature on ERP systems, *Computers in Industry*, Vol. 56 No. 6, pp. 510-522.

Boynton, A. C., & Zmud, R. W. (1986). An Assessment of Critical Success Factors. *Sloan Management Review*, *25*, 17–27.
Bozeman, B. (1987). *All organizations are public: Bridging public and private organizational theories*. San Francisco, CA: Jossey-Bass.
Bozeman, B. (2007). *Public values and public interest: Counterbalancing economic individualism*. Georgetown University Press.
British Computer Society (2006). *The Way Forward for NHS Health Informatics*. A report on behalf of the British Computer Society (BCS) by the BCS Health Informatics Forum Strategic Panel 15th December 2006 Version 1.0
Burrell, G., & Morgan, G. (1979). *Sociological paradigms and organisational analysis* (Vol. 248). London: Heinemann.
C&AG (2002). *Special Report on Financial Control and Management in the Irish Blood Transfusion Service*. Comptroller and Auditor General, December 2002
C&AG (2007). *Special Report on eGovernment*. Comptroller and Auditor General, October 2007.
C&AG (2008). *Special Report No. 10 on General Matters arising on Audits: Non - Commercial State Sponsored Bodies, Health Sector Bodies, Vocational Education Committees*. Comptroller and Auditor General, April 2008
Caffrey, E., & McDonagh, J. (2014). The Theory and Application of Process Research to the Study of IT Strategy-Making. in Hai-Jew, S. (ed.) *Enhancing Qualitative and Mixed Methods Research with Technology*, Hershey, PA, IGI Global, pp. 1-30.
Calisir, F., & Calisir, F. (2004). The relation of interface usability characteristics, perceived usefulness, and perceived ease of use to end-user satisfaction with enterprise resource planning (ERP) systems. *Computers in human behavior*, *20*(4), 505-515.
Caldwell, R. (2006). *Agency and change: rethinking change agency in organizations*. Routledge.
Campbell, J. L. (2005). Where do we stand? Common mechanisms in organizations and social movements research. *Social movements and organization theory*, 41-48.
Catersels, R., Helms, R. W., & Batenburg, R. (2010). *Exploring the gap between the practical and theoretical world of ERP implementations: results of a global survey*. In Proceedings of IV IFIP International Conference on Research and Practical Issues of Enterprise Information Systems, Rio Grande Do Norte, Brazil.
Cebeci, U. (2009). Fuzzy AHP-based decision support system for selecting ERP systems in textile industry by using balanced scorecard. *Expert Systems with Applications*, 36(5), 8900-8909.
Cecez-Kecmanovic, D., Galliers, R. D., Henfridsson, O., Newell, S., & Vidgen, R. (2014). The sociomateriality of information systems: current status, future directions. *MIS Quarterly*, 38(3), 809-830.
Centre for Digital Government (2016). Digital States Survey 2016 Results. URL:
Chae, B., & Poole, M. S. (2005). Mandates and technology acceptance: A tale of two enterprise technologies. *The Journal of Strategic Information Systems*, *14*(2), 147-166.
Chang, H. H. (2006). Technical and management perceptions of enterprise information system importance, implementation and benefits. *Information Systems Journal*, *16*(3), 263-292.
Chang, I. C., Hwang, H. G., Liaw, H. C., Hung, M. C., Chen, S. L., & Yen, D. C. (2008). A neural network evaluation model for ERP performance from SCM perspective to enhance enterprise competitive advantage. *Expert Systems with Applications*, *35*(4), 1809-1816.
Chang, J. Y. T., Jiang, J. J., Klein, G., & Wang, E. T. G. (2014a). Do too many goals impede a program? A case study of enterprise system implementation with multiple interdependent projects. *Information and Management*, *51*(4), 465–478.
Chang, S. I., Gable, G., Smythe, E., & Timbrell, G. (2000, December). A Delphi examination of public sector ERP implementation issues. In *Proceedings of the twenty first international conference on Information systems* (pp. 494-500). Association for Information Systems.

Chang, S. I., Yen, D. C., Ng, C. S. P., Chang, I. C., & Yu, S. Y. (2011). An ERP system performance assessment model development based on the balanced scorecard approach. *Information Systems Frontiers*, *13*(3), 429-450.
Chang, S. I., Yen, D. C., Chang, I. C., & Jan, D. (2014b). Internal control framework for a compliant ERP system. *Information and Management*, *51*(2), 187–205.
Chellappa, R. K., Sambamurthy, V., & Saraf, N. (2010). Competing in crowded markets: Multimarket contact and the nature of competition in the enterprise systems software industry. *Information Systems Research*, *21*(3), 614-630.
Chen, C., Law, C., & Yang, S. (2009). Managing ERP implementation failure: A project management perspective. *IEEE Transactions on Engineering Management*, *56*(1), 157–170.
Chen, S. G., & Lin, Y. K. (2009). On performance evaluation of ERP systems with fuzzy mathematics. *Expert Systems with Applications*, *36*(3), 6362-6367.
Chen, W., & Hirschheim, R. (2004). A paradigmatic and methodological examination of information systems research from 1991 to 2001. *Information Systems Journal*, 14(3), 197-235.
Chia, R., & Langley, A. (2004). The first organization studies summer workshop: Theorizing process in organizational research (call for papers). *Organization Studies*, 25(8), 1486.
Cho, W., Subramanyam, R., & Xia, M. (2013). Vendors' incentives to invest in software quality in enterprise systems. *Decision Support Systems*, *56*, 27-36.
Chou, S. W., & Chang, Y. C. (2008). The implementation factors that influence the ERP (enterprise resource planning) benefits. *Decision support systems*, *46*(1), 149-157.
Chou, H. W., Lin, Y. H., Lu, H. S., Chang, H. H., & Chou, S. Bin. (2014). Knowledge sharing and ERP system usage in post-implementation stage. *Computers in Human Behavior*, *33*, 16–22.
Chou, H. W., Chang, H. H., Lin, Y. H., & Chou, S. B. (2014). Drivers and effects of post-implementation learning on ERP usage. *Computers in Human Behavior*, *35*, 267-277.
Chou, S. W., & Chen, P. Y. (2009). The influence of individual differences on continuance intentions of enterprise resource planning (ERP). *International Journal of Human-Computer Studies*, *67*(6), 484-496.
Chung, S. H., & Snyder, C. A. (2000). ERP adoption: a technological evolution approach. *International Journal of Agile Management Systems*, *2*(1), 24-32.
Chung, S., Lee, K. Y., & Kim, K. (2014). Job performance through mobile enterprise systems: The role of organizational agility, location independence, and task characteristics. *Information & Management*, *51*(6), 605-617.
Ciborra, C. (2000). *From control to drift: the dynamics of corporate information infastructures*. Oxford University Press on Demand.
Ciborra, C. U., & Hanseth, O. (1998). From tool to Gestell: Agendas for managing the information infrastructure. *Information Technology & People*, 11(4), 305-327.
Coleman, J. S. (1964). *Introduction to mathematical sociology*. New York: Free Press.
Collier, A. (1994). *Critical realism: an introduction to Roy Bhaskar's philosophy*.
Collins, D. (1998). *Organisational change: sociological perspectives*. New York, London: Routhledge.
Collins, D. (2001). BPR and the substance of change. *Strategic Change*, *10*(3), 163.
Columbus, L. (2013). *2013 ERP Market Share Update*, URL: http://www.forbes.com/sites/louiscolumbus/2013/05/12/2013-erp-market-share-update-sap-solidifies-market-leadership/. Accessed on March 2, 2016
Corley, K. G., & Gioia, D. A. (2011). Building theory about theory building: what constitutes a theoretical contribution?. *Academy of management review*, *36*(1), 12-32.
Cotteleer, M. J., & Bendoly, E. (2006). Order lead-time improvement following enterprise information technology implementation: an empirical study. *MIS quarterly*, 643-660.
Crisostomo, D. T. (2008a). Characteristics and Skills of Implementing an ERP System in the Guam Public Sector. *Journal of International Business Research*, *7*.
Crisostomo, D. T. (2008b). Management attributes of implementing an ERP system in the public sector. *Journal of International Business Research*, *7*, 1.

Cumbie, B.A., Jourdan, Z., Peachey, T., Dugo, T.M. and Craighead, C.W. (2005), Enterprise resource planning research: where are we now and where should we go from here?. *Journal of Information Technology Theory and Application*, Vol. 7 No. 2, pp. 21-36.

Curko, K., Stepanic, D. and Varga, M. (2012), Strategic success factors in ERP system implementation, *Recent Researches in Business and Economics.*

Coulson, T., Shayo, C., Olfman, L., & Rohm, C. E. (2003, April). *ERP training strategies: conceptual training and the formation of accurate mental models*. In Proceedings of the 2003 SIGMIS conference on Computer personnel research: Freedom in Philadelphia--leveraging differences and diversity in the IT workforce (pp. 87-97). ACM.

CPA (2003). *Committee of Public Accounts Debate on Report of the Comptroller and Auditor General on Financial Control and Management in the Irish Blood Transfusion Service*. 2nd April 2003

CPA (2008). *Committee of Public Accounts Debate on Special Report No. 10 of the Comptroller and Auditor General: General Matters Arising on Audits of Non-Commercial State Sponsored Bodies, Health Sector Bodies, Vocational Education Committees*. 23rd Oct 2008

Cumbie, B. A., Jourdan, Z., Peachy, T., Dugo, T. M., & Craighead, C. W. (2005). Enterprise resource planning research: where are we now and where should we go from here? *Journal of Information Technology Theory and Application (JITTA)*, *7*(2), 4.

Curko, K., Stepanic, D., & Varga, M. (2012). Strategic success factors in ERP system implementation. *Recent Researches in Business and Economics*, 23–28.

Currie, W. (1998). Using multiple suppliers to mitigate the risks of IT outsourcing in two UK companies: ICI and Wessex Water. *Journal of Information Technology* 13: 169-180.

Currie, W. L. (1999). Revisiting management innovation and change programmes: strategic vision or tunnel vision?. *Omega*, *27*(6), 647-660.

Currie, W. (2000). The supply-side of IT outsourcing: the trend towards mergers, acquisitions and joint ventures. *International Journal of Physical Distribution & Logistics Management*, *30*(3/4), 238-254.

Currie, W. L. (2008). Evaluating the governance structure for public sector IT: The UK National Programme in the Health Service. *Evaluating information systems*, 199-217.

Currie, W. (2009). Contextualising the IT artefact: towards a wider research agenda for IS using institutional theory. *Information Technology & People*, *22*(1), 63-77.

Currie, W. L. (2009a). Integrating Healthcare. In *Integrating Healthcare with Information and Communications Technology*. Redcliffe, UK.

Currie, W. L. (2012). Institutional isomorphism and change: the national programme for IT–10 years on. *Journal of Information Technology*, *27*(3), 236-248.

Currie, W., Finnegan, D., & Hamid, K. A. A. (2009). Integrating electronic health records. *Integrating Healthcare with Information and Communications Technology*, *135*.

Currie, W. L., & Guah, M. W. (2007). Conflicting institutional logics: a national programme for IT in the organisational field of healthcare. *Journal of Information Technology*, *22*(3), 235-247.

Currie, W. L., Pouloudi, N. and Whitley, E. A. (2016) Entangled stakeholder roles and perceptions in health information systems: a longitudinal study of the UK NHS N3 network. *Journal of the Association for Information Systems*, 17 (2). pp. 107-161.

Currie, W. L., & Swanson, E. B. (2009). Special issue on institutional theory in information systems research: contextualizing the IT artefact. *Journal of Information Technology*, *24*(4), 283.

Currie, W. L., & Seddon, J. J. (2014). A cross-national analysis of eHealth in the European Union: Some policy and research directions. *Information & Management*, *51*(6), 783-797.

Currie, W. L., & Willcocks, L. P. (1998). Analysing four types of IT sourcing decisions in the context of scale, client/supplier interdependency and risk mitigation. *Information Systems Journal*, *8*(2), 119-143.

Currie, W., Willcocks, L. (2009). Analyzing IT Outsourcing Decisions: Size, Interdependency and Risk. In *The Practice of Outsourcing* (pp. 187-212). Palgrave Macmillan UK.

Daniel, D. R. (1961). Management Information Crisis. *Harvard Business Review*, *39*(5), 111–121.
Davenport, T. H. (1995). Business process reengineering: where it's been, where it's going. *Business process change: Reengineering concepts, methods and technologies*, 1-13.
Davenport, T. H. (1998). Putting the enterprise into the enterprise system. *Harvard Business Review*, *76*(4), 121–131. https://doi.org/Technical Report
Davenport, T. H., Harris, J. G., & Cantrell, S. (2004). Enterprise systems and ongoing process change. *Business Process Management Journal*, *10*, 16–26.
Davenport, T. H., & Short, J. E. (1990). The new industrial engineering: information technology and business process redesign.
Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS quarterly*, 319-340.
Davis, G. B. (1979). An Opinion..." Comments on the Critical Success Factors Method for Obtaining Management Information Requirements in Article by John F. Rockart," Chief Executives Define Their Own Data Needs," *Harvard Business Review*, March-April, 1979".
Davis, G. B., & Olson, M. (1985). *Management information systems: Conceptual foundations, methods and development*. McGraw-Hill, New York.
Davis, G. F. (2006). Mechanisms and the theory of organizations. *Journal of Management inquiry*, *15*(2), 114-118.
Davis, G. F., & Marquis, C. (2005). Prospects for organization theory in the early twenty-first century: Institutional fields and mechanisms. *Organization Science*, *16*(4), 332-343.
Davis, C. J., & Hikmet, N. (2008). Training as regulation and development: An exploration of the needs of enterprise systems users. *Information and Management*, *45*(6), 341–348.
Dawson, P. (1994). *Organizational change: A processual approach*. P. Chapman.
Dawson, P. (1997). In at the deep end: conducting processual research on organisational change. *Scandinavian Journal of Management*, 13(4), 389-405.
Dawson, P. (2003a). *Reshaping Change: A Processual Perspective*. Psychology Press.
Dawson, P. (2003b). *Understanding organizational change: The contemporary experience of people at work*. Sage.
Deloitte Consulting (1998). *ERP's Second Wave-Maximizing the Value of ERP-Enabled Processes*. ISBN 1-892383-36-5.
Dery, K., Grant, D., Harley, B. and Wright, C. (2006), Work, organisation and enterprise resource planning systems: an alternative research agenda, *New Technology, Work and Employment*, Vol. 21 No. 3, pp. 199-214.
Dezdar, S., & Ainin, S. (2011). The influence of organizational factors on successful ERP implementation. *Management Decision*, *49*(6), 911-926.
Dezdar, S., & Sulaiman, A. (2009). Successful enterprise resource planning implementation: taxonomy of critical factors. *Industrial Management & Data Systems*, *109*(8), 1037–1052.
Dezdar, S., & Sulaiman, A. (2011). The influence of organizational factors on successful ERP implementation. *Management Decision*, *49*(6), 911–926.
Dhillon, G. S., Caldeira, M., & Wenger, M. R. (2011). Intentionality and power interplay in IS implementation: The case of an asset management firm. *The Journal of Strategic Information Systems*, *20*(4), 438-448.
DiMaggio, P., & Powell, W. W. (1983). The iron cage revisited: Collective rationality and institutional isomorphism in organizational fields. *American Sociological Review*, *48*(2), 147-160.
Distler, P. (2010). ISBT 128: a global information standard. *Cell and tissue banking*, *11*(4), 365-373.
Dobson, P. J. (2001). The philosophy of critical realism—an opportunity for information systems research. *Information Systems Frontiers*, 3(2), 199-210.
Dobson, P., Jackson, P., & Gengatharen, D. E. (2013). Explaining broadband adoption in rural Australia: Modes of reflexivity and the morphogenetic approach. *MIS Quarterly*, 37(3), 965-991.

DoH (2016). *Department of Health*, Retrieved from: http://health.gov.ie/about-us/ Accessed on July 1st, 2016

Doherty, N. F., Champion, D., & Wang, L. (2010). An holistic approach to understanding the changing nature of organisational structure. *Information Technology & People*, *23*(2), 116-135.

Dong, L. (2008). Exploring the impact of top management support of enterprise systems implementations outcomes: Two cases. *Business Process Management Journal*, *14*(2), 204–218.

Dong, L., Neufeld, D. and Higgins, C. (2002), *The Iceberg on the sea: what do you see?*. in Ramsower, R. and Windsor, J. (Eds), 8th Americas Conference on Information Systems, AIS Electronic Library, Dallas, TX, August 9-11, pp. 857-864.

Doughty, R., & Flanagan, P. (1996). ISBT Code 128 and code changes as part of the implementation of a national IT system for the English National Blood Service. *Transfusion Medicine*, *6*(4), 299-301.

Dong, L., Neufeld, D., & Higgins, C. (2009). Top management support of enterprise systems implementations. *Journal of Information Technology*, *24*(1), 55–80.

DPC (2008). *Conclusion of Investigation in relation to the theft of Irish Blood Transfusion Service personal data on a laptop in New York*. Data Protection Commissioner. February 2008

Dreiling, A., Rosemann, M., van der Aalst, W. M. P., & Sadiq, W. (2008). From conceptual process models to running systems: A holistic approach for the configuration of enterprise system processes. *Decision Support Systems*, *45*(2), 189–207.

Dreiling, A., Rosemann, M., van der Aalst, W. M. P., Heuser, L., & Schulz, K. (2006). Model-based software configuration: patterns and languages. *European Journal of Information Systems*, *15*(6), 583–600.

eHealth Irelnad (2015). Ireland to benefit from New Laboratory Information System. URL: http://www.ehealthireland.ie/News-Media/News-Archive/2015/Ireland-to-benefit-from-New-Laboratory-Information-System-.html

Eason, K. (2009). The NHS National Programme for Information Technology: a socio-technical systems perspective. *Integrating Healthcare with Information and Communications Technology*, 183-204.

Easton, G. (2010). Critical realism in case study research. *Industrial Marketing Management*, 39(1), 118-128.

Eden, R., Sedera, D.D. and Tan, F. (2012), *Archival analysis of enterprise resource planning systems: the current state and future directions*, International Conference in Information Systems, AIS Electronic Library, Orlando, FL, December 14, pp. 1-19.

Edwards, P. N., Bowker, G. C., Jackson, S. J., & Williams, R. (2009). Introduction: an agenda for infrastructure studies. *Journal of the Association for Information Systems*, 10(5), 6.

Ehie, I. C., & Madsen, M. (2005). Identifying critical issues in enterprise resource planning (ERP) implementation. *Computers in industry*, *56*(6), 545-557.

Eisenberg, E. M. (1984). Ambiguity as strategy in organizational communication. *Communication monographs*, *51*(3), 227-242.

Eisenberg, E. M., & Witten, M. G. (1987). Reconsidering openness in organizational communication. *Academy of Management Review*, *12*(3), 418-426.

Eisenhardt, K. M. (1989). Building theories from case study research. *Academy of management review*, *14*(4), 532-550.

Elbertsen, L., & Van Reekum, R. (2008). To ERP or not to ERP? Factors influencing the adoption decision. *International Journal of Management and Enterprise Development*, *5*(3), 310-330.

Elragal, A. & Haddara, M. (2012), The future of ERP systems: look backward before moving forward, *Procedia Technology*, Vol. 5, pp. 21-30

Elbanna, A. R. (2006). The validity of the improvisation argument in the implementation of rigid technology: the case of ERP systems. *Journal of Information Technology*, *21*(3), 165-175.

Elbanna, A. R. (2007). Implementing an integrated system in a socially dis-integrated enterprise: a critical view of ERP enabled integration. *Information Technology & People*, *20*(2), 121-139.

Elbanna, A. R. (2008). Strategic systems implementation: diffusion through drift. *Journal of Information Technology*, *23*(2), 89-96.
Elbanna, A. (2009). Rigid technology and improvised implementation: The case of ERP systems. *Bricolage, Care and Information. Claudio Ciborra's Legacy in Information Systems Research.–New York: Palgrave Macmillan*, 327-347.
Elbanna, A. (2010). Rethinking IS project boundaries in practice: A multiple-projects perspective. *The Journal of Strategic Information Systems*, *19*(1), 39-51.
Elbanna, A. (2013). Top management support in multiple-project environments: an in-practice view. *European Journal of Information Systems*, *22*(3), 278–294.
Elder-Vass, D. (2005). Emergence and the realist account of cause. *Journal of Critical Realism*, *4*(2), 315-338.
Elmes, M. B., Strong, D. M., & Volkoff, O. (2005). Panoptic empowerment and reflective conformity in enterprise systems-enabled organizations. *Information and Organization*, *15*(1), 1-37.
Entwistle, I., & Light, B. (2008). Spot the difference: Evaluation of custom and package applications. *Evaluating Information Systems*, 118.
Esteves, J. and Bohorquez, V. (2007), An updated ERP systems annotated bibliography: 2001-2005, *Communications of the Association for Information Systems*, Vol. 19, Article 18, pp. 1-59.
Esteves, J., & Pastor, J. (1999). *An ERP lifecycle-based research agenda*. In 1st International Workshop in Enterprise Management & Resource Planning.
Esteves, J., & Pastor, J. (2000, November). *Towards the unification of critical success factors for ERP implementations*. *In 10th Annual BIT Conference, Manchester, UK (Vol. 44).*
Esteves, J., & Pastor, J. (2001). Enterprise resource planning systems research: an annotated bibliography. *Communications of the Association for Information Systems*, *7*(1), 8.
Esteves, J., & Pastor, J. A. (2006). Organizational and technological critical success factors behavior along the ERP implementation phases. *Enterprise Information Systems VI*, (2000), 63–71.
Fan, M., Stallaert, J., & Whinston, A. B. (2000). The adoption and design methodologies of component-based enterprise systems. *European journal of information systems*, *9*(1), 25-35.
Faraj, S., & Azad, B. (2012). The materiality of technology: An affordance perspective. *Materiality and Organizing: Social Interaction in a Technological World*, 237-258. Oxford, UK: Oxford University Press.
Farquhar, J. D. (2012). *Case Study Research for Business*. Sage.
Faulkner, P., & Runde, J. (2010). The social, the material, and the ontology of non-material technological objects. *Documento de trabajo*.
Faulkner, P., & Runde, J. (2012). On sociomateriality (pp. 49-66). *Materiality and Organizing: Social Interaction in a Technological World*, 49-66. Oxford, UK: Oxford University Press.
Feldman, M. S., & Pentland, B. T. (2003). Reconceptualizing organizational routines as a source of flexibility and change. *Administrative science quarterly*, *48*(1), 94-118.
Fenema, P. C., Koppius, O. R., & Van Baalen, P. J. (2007). Implementing packaged enterprise software in multi-site firms: intensification of organizing and learning. *European Journal of Information Systems*, *16*(5), 584-598.
Finlay, T.A. (1997). *Report of the tribunal of inquiry into the Blood Transfusion Service Board*. Government of Ireland.
Finnegan, D., & Hamid, K. (2009). Information systems (IS) integration approaches in healthcare: a critical review. *Integrating healthcare with information and communications technology*, *1*, 35-63.
Finney, S. (2011). Stakeholder perspective on internal marketing communication: An ERP implementation case study. *Business Process Management Journal*, *17*(2), 311–331.
Finney, S., & Corbett, M. (2007). ERP implementation: a compilation and analysis of critical success factors. *Business Process Management Journal*, *13*(3), 329–347.
Friedland, R., & Alford, R. R. (1991). Bringing society back in: Symbols, practices and institutional contradictions.

Gallagher, K. P., “Jamey” Worrell, J. L., & Mason, R. M. (2012). The negotiation and selection of horizontal mechanisms to support post-implementation ERP organizations. *Information Technology & People*, *25*(1), 4-30.
Galy, E., & Sauceda, M. J. (2014). Post-implementation practices of ERP systems and their relationship to financial performance. *Information & Management*, *51*(3), 310-319.
Garg, P., & Garg, A. (2013). An empirical study on critical failure factors for enterprise resource planning implementation in Indian retail sector. *Business Process Management Journal*, *19*(3), 496–514.
Gargeya, V. B., & Brady, C. (2005). Success and failure factors of adopting SAP in ERP system implementation. *Business Process Management*, *11*(5), 501–516.
Garvin, D. A. (1998). The processes of organization and management. *MIT Sloan Management Review*, 39(4), 33.
Gattiker, T. F., & Goodhue, D. L. (2004). Understanding the local-level costs and benefits of ERP through organizational information processing theory. *Information & management*, *41*(4), 431-443.
Gattiker, T. F., & Goodhue, D. L. (2005). What happens after ERP implementation: understanding the impact of interdependence and differentiation on plant-level outcomes. *MIS quarterly*, 559-585.
Gefen, D. (2004). What makes an ERP implementation relationship worthwhile: Linking trust mechanisms and ERP usefulness. *Journal of Management Information Systems*, *21*(1), 263–288.
Gefen, D., & Ridings, C. M. (2002). Implementation Team Responsiveness and User Evaluation of Customer Relationship Management: A Quasi-Experimental Design Study of Social Exchange Theory. *Journal of Management Information Systems*, *19*(1), 47-69.
George, A. L., & Bennett, A. (2005). *Case studies and theory development in the social sciences*. MIT Press.
Ghosh, S., & Skibniewski, M. (2010). Enterprise resource planning systems implementation as a complex project: A conceptual framework. *Journal of Business Economics and Management*, *11*(4), 533–549.
Gibson, J. J. 1986. *The Ecological Approach to Visual Perception*, Hillsdale, NJ
Gioia, D. A., & Pitre, E. (1990). Multiparadigm perspectives on theory building. *Academy of management review*, *15*(4), 584-602.
GoI (2010). *Peer Review Process in the Public Sector*. Government of Ireland. Retrieved from: http://peerreview.gov.ie/en/ Accessed on July 1st, 2016.
Goodman, J., & Truss, C. (2004). The medium and the message: communicating effectively during a major change initiative. *Journal of Change Management*, *4*(3), 217-228.
Gosain, S. (2004). Enterprise information systems as objects and carriers of institutional forces: the new iron cage?. *Journal of the Association for Information Systems*, *5*(4), 6.
Gosain, S., Lee, Z., & Kim, Y. (2005). The management of cross-functional inter-dependencies in ERP implementations: emergent coordination patterns. *European Journal of Information Systems*, *14*(4), 371-387.
Grabski, S. V., Leech, S. A., & Lu, B. (2001). Risks and controls in the implementation of ERP systems.
Grabski, S. V., Leech, S. a., & Schmidt, P. J. (2011). A Review of ERP Research: A Future Agenda for Accounting Information Systems. *Journal of Information Systems*, *25*(1), 37–78.
Grant, G. G. (2003). Strategic alignment and enterprise systems implementation: The case of Metalco. *Journal of Information Technology*, *18*(3), 159–175.
Grenci, R. T., & Hull, B. Z. (2004). *New dog, old tricks: ERP and the systems development life cycle*. Journal of Information Systems Education, 15(3), 277-286.
Grisot, M., Hanseth, O., & Thorseng, A. A. (2014). Innovation of, in, on infrastructures: articulating the role of architecture in information infrastructure evolution. *Journal of the Association for Information Systems*, 15(4), 197.
Guba, E. G., & Lincoln, Y. S. (1994). Competing paradigms in qualitative research. *Handbook of qualitative research*, 2(163-194).

Gulledge, T. (2006). What is integration?. *Industrial Management & Data Systems*, *106*(1), 5-20.
Gulledge, T. R., and Sommer, R. A. (2003). Public sector enterprise resource planning. *Industrial Management and Data Systems*, 103(7), 471-483.
Gürbüz, T., Alptekin, S. E., & Alptekin, G. I. (2012). A hybrid MCDM methodology for ERP selection problem with interacting criteria. *Decision Support Systems*, 54(1), 206-214.
Hailu, A., & Rahman, S. (Shawon). (2012). Evaluation of Key Success Factors Influencing ERP Implementation Success. *IEEE Eighth World Congress on Services*, 88–91.
Haines, M., & Goodhue, D. L. (2003). Implementation Partner Involvement and Knowledge Transfer in the Context of ERP Implementations. *International Journal of Human Computer Interaction*, *16*(1), 5–22.
Hall, R. (2002). Enterprise resource planning systems and organizational change: transforming work organization?. *Strategic Change*, 11(5), 263-270.
Hammer, M. (1990). Reengineering Work: Don't Automate, Obliterate. *Harvard Business Review*, 104–112.
Hanafizadeh, P., Gholami, R., Dadbin, S., & Standage, N. (2010). The Core Critical Success Factors in Implementation of Enterprise Resource Planning Systems. *International Journal of Enterprise Information Systems*, *6*(2), 82–111.
Hedström, P., & Swedberg, R. (1998). Social mechanisms:An introductory essay. In P. Hedström&R. Swedberg (Eds.), *Social mechanisms: An analytical approach to social theory* (pp. 1-31). Cambridge,UK: Cambridge University Press.
Heeks, R. (2006). Health information systems: Failure, success and improvisation. *International journal of medical informatics*, *75*(2), 125-137.
Henfridsson, O., & Bygstad, B. (2013). The generative mechanisms of digital infrastructure evolution. *MIS quarterly*, *37*(3), 907-931.
Hernes, G. (1998). Real virtuality. In P. Hedström & R. Swedberg (Eds.), *Social mechanisms: An analytical approach to social theory* (pp. 74-101). Cambridge, UK: Cambridge University Press.
Hernes, T. (2008). *Understanding organization as process: Theory for a Tangled World*. London: Routledge.
Hirschheim, R., & Klein, H. K. (2012*). A glorious and not-so-short history of the information systems field*. Journal of the Association for Information Systems, *13*(4), 188.
Hitt, L. M., & DJ Wu, X. Z. (2002). Investment in enterprise resource planning: Business impact and productivity measures. *Journal of Management Information Systems*, *19*(1), 71-98.
Hoermann, S., Langermeier, M., Kienegger, H., Mayer, M., & Krcmar, H. (2011). Comparing risk and success factors in ERP projects: A literature review. *17th Americas Conference on Information Systems 2011, AMCIS 2011*, *3*, 2155–2163.
Holsapple, C. W., & Sena, M. P. (2005). ERP plans and decision-support benefits. *Decision Support Systems*, *38*(4), 575-590.
Hong, K. K., & Kim, Y. G. (2002). The critical success factors for ERP implementation: An organizational fit perspective. *Information and Management*, *40*(1), 25–40.
Hosseini, S. M. S., Heydariyeh, S. A., & Mahmoodi, J. (2012). A New Framework of Effective External and Internal Factors on the Success of Enterprise Resource Planning (ERP). *Journal of Basic and Applied Scientific Research*, *2*(3), 2782–2795.
Howcroft, D., & Light, B. (2006). Reflections on issues of power in packaged software selection. *Information Systems Journal*, 16(3), 215-235.
Howcroft, D., & Light, B. (2010). The social shaping of packaged software selection. *Journal of the Association for Information Systems*, 11(3), 122.
Howcroft, D., Mitev, N., & Wilson, M. (2004a). What we may learn from the social shaping of technology approach. *Social theory and philosophy for information systems*, 329-371.
Howcroft, D., Newell, S., & Wagner, E. (2004). Editoral: Understanding the contextual influences on enterprise system design, implementation, use and evaluation. *Journal of Strategic Information Systems*, *13*(4 SPEC. ISS.), 271–277.
HPRA (2016). *Health Product Regulatory Authority*, Retrieved from: https://www.hpra.ie/homepage/about-us. Accessed on July 1st, 2016

HSE (2016). *Health Service Executive*, Retrieved from: http://www.hse.ie/eng/about/ Accessed on July 1st, 2016

Hsu, P. F. (2013). Integrating ERP and e-business: Resource complementarity in business value creation. *Decision Support Systems*, *56*, 334-347.

Huang, Z. (2010). A Compilation Research of ERP Implementation Critical Success. *Issues in Information Systems*, *XI*(1), 507–512.

Huang, T. and Yasuda, K. (2014), *ERP life cycle models: an annotated bibliographic review*, 15th Asia Pacific Industrial Engineering and Management Systems Conference, Jeju, October 12-15.

Huang, T., & Yasuda, K. (2016). Comprehensive review of literature survey articles on ERP. *Business Process Management Journal*, *22*(1), 2-32.

Hughes, M. (2011). Do 70 per cent of all organizational change initiatives really fail?. *Journal of Change Management*, *11*(4), 451-464.

Hung, W. H., Ho, C. F., Jou, J. J., & Kung, K. H. (2012). Relationship bonding for a better knowledge transfer climate: An ERP implementation research. *Decision Support Systems*, *52*(2), 406–414.

Huq, Z., & Martin, T. N. (2006). The recovery of BPR implementation through an ERP approach: A hospital case study. *Business Process Management Journal*, *12*(5), 576–587.

Huq, Z., Huq, F., & Cutright, K. (2006). BPR through ERP: Avoiding change management pitfalls. *Journal of Change Management*, *6*(1), 67-85.

Hwang, Y. (2005). Investigating enterprise systems adoption: uncertainty avoidance, intrinsic motivation, and the technology acceptance model. *European journal of information systems*, *14*(2), 150-161.

Hwang, Y. (2014). User experience and personal innovativeness: An empirical study on the Enterprise Resource Planning systems. *Computers in Human Behavior*, *34*, 227-234.

Hwang, Y., & Grant, D. (2011). Behavioral aspects of enterprise systems adoption: An empirical study on cultural factors. *Computers in Human Behavior*, *27*(2), 988-996.

IBTS (2016). *Irish Blood Transfusion Services*, Retrieved from: https://www.giveblood.ie/About_Us/ Accessed on July 1st, 2016

ICCBBA (2016). *ISBT 128 Basics*. ICCBBA.Retrieved from https://www.iccbba.org/isbt-128-basics. Accessed on July 1st, 2016

Iacovou, C. L., Thompson, R. L., & Smith, H. J. (2009). Selective status reporting in information systems projects: a dyadic-level investigation. *MIS quarterly*, 785-810.

Iannacci, F., & Hatzaras, K. S. (2012). Unpacking ostensive and performative aspects of organisational routines in the context of monitoring systems: A critical realist approach. *Information and Organization*, *22*(1), 1-22.

Ifinedo, P. (2007). Interactions Between Organizational Size, Culture, and Structure and Some IT Factors in the Context of an ERP Success Assessment. *The Journal of Computer Information Systems*, *47*(4).

Ifinedo, P. (2008). Impacts of business vision, top management support, and external expertise on ERP success. *Business Process Management*, *14*(4), 551–568.

Ifinedo, P., Rapp, B., Ifinedo, A., & Sundberg, K. (2010). Relationships among ERP post-implementation success constructs: An analysis at the organizational level. *Computers in Human Behavior*, *26*(5), 1136-1148.

Ignatiadis, I., & Nandhakumar, J. (2007). The impact of enterprise systems on organizational control and drift: A human-machine agency perspective. *International journal of enterprise information systems*, *3*(3), 36.

Ignatiadis, I., & Nandhakumar, J. (2009). The effect of ERP system workarounds on organizational control: An interpretivist case study. *Scandinavian Journal of Information Systems*, 21(2), 3.

Jacobs, F. R., & Bendoly, E. (2003). Enterprise resource planning: developments and directions for operations management research. *European Journal of Operational Research*, *146*(2), 233-240.

Jacobs, F. R., & Weston, F. C. (2007). Enterprise resource planning (ERP)-A brief history. *Journal of Operations Management*, *25*(2), 357-363.

Jiang, Z., Sarkar, S., & Jacob, V. S. (2012). Postrelease testing and software release policy for enterprise-level systems. *Information Systems Research*, *23*(3-part-1), 635-657.
Johnson, P., & Duberley, J. (2000). *Understanding management research: An introduction to epistemology*. Sage.
Jones, M. C., Cline, M., & Ryan, S. (2006). Exploring knowledge sharing in ERP implementation: An organizational culture framework. *Decision Support Systems*, *41*(2), 411–434.
Kallinikos, J. (2004). Deconstructing information packages: Organizational and behavioural implications of ERP systems. *Information technology & people*, *17*(1), 8-30.
Kallinikos, J. (2005). The order of technology: Complexity and control in a connected world. *Information and organization*, *15*(3), 185-202.
Kaniadakis, A. (2012). ERP implementation as a broad socio-economic phenomenon: The agora of techno-organisational change. *Information Technology and People*, 25(3), 259-280.
Karim, J., Somers, T. M., & Bhattacherjee, A. (2007a). The impact of ERP implementation on business process outcomes: A factor-based study. *Journal of Management Information Systems*, *24*(1), 101-134.
Karimi, J., Somers, T. M., & Bhattacherjee, A. (2007b). The role of information systems resources in ERP capability building and business process outcomes. *Journal of Management Information Systems*, *24*(2), 221-260.
Karimi, J., Somers, T. M., & Bhattacherjee, A. (2009). The role of ERP implementation in enabling digital options: A theoretical and empirical analysis. *International Journal of Electronic Commerce*, *13*(3), 7-42.
Karsak, E. E., & Özogul, C. O. (2009). An integrated decision making approach for ERP system selection. *Expert systems with Applications*, 36(1), 660-667.
Karuppan, C. M., & Karuppan, M. (2008). Resilience of super users' mental models of enterprise-wide systems. *European Journal of Information Systems*, *17*(1), 29–46.
Kauffman, R. J., & Tsai, J. Y. (2009). The unified procurement strategy for enterprise software: A test of the" move to the middle" hypothesis. *Journal of Management Information Systems*, 26(2), 177-204.
Ke, W., Tan, C. H., Sia, C. L., & Wei, K. K. (2012). Inducing intrinsic motivation to explore the enterprise system: The supremacy of organizational levers. *Journal of Management Information Systems*, *29*(3), 257-290.
Ke, W., & Wei, K. K. (2008). Organizational culture and leadership in ERP implementation. *Decision Support Systems*, *45*(2), 208–218.
Keil, M., Rai, A., and Liu, S. 2013. *How User Risk and Requirements Risk Moderate the Effects of Formal and Informal Control on the Process Performance of IT Projects*, *European Journal of Information Systems* (22:6), pp. 650-672.
Keil, M., & Tiwana, A. (2006). Relative importance of evaluation criteria for enterprise systems: a conjoint study. *Information Systems Journal*, *16*(3), 237-262.
Kemp, M. J., & Low, G. C. (2008). ERP innovation implementation model incorporating change management. *Business Process Management Journal*, *14*(2), 228-242.
Khoo, H. M., & Robey, D. (2007). Deciding to upgrade packaged software: a comparative case study of motives, contingencies and dependencies. European *Journal of Information Systems*, 16(5), 555-567.
Khoo, H. M., Chua, C. E. H., & Robey, D. (2011a). How organizations motivate users to participate in support upgrades of customized packaged software. *Information & Management*, 48(8), 328-335.
Khoo, H. M., Robey, D., & Rao, S. V. (2011b). An exploratory study of the impacts of upgrading packaged software: a stakeholder perspective. *Journal of Information technology*, 26(3), 153-169.
Kilic, H. S., Zaim, S., & Delen, D. (2014). Development of a hybrid methodology for ERP system selection: The case of Turkish Airlines. *Decision Support Systems*, 66, 82-92.
Kilic, H. S., Zaim, S., & Delen, D. (2015). Selecting "The Best" ERP system for SMEs using a combination of ANP and PROMETHEE methods. *Expert Systems with Applications*, 42(5), 2343-2352.

Kim, H. W., & Kankanhalli, A. (2009). Investigating user resistance to information systems implementation: A status quo bias perspective. *MIS quarterly*, 567-582.

Kirsch, L. S. (1997). Portfolios of control modes and IS project management. *Information systems research*, *8*(3), 215-239.

Kirsch, L. J. (2004). Deploying common systems globally: The dynamics of control. *Information systems research*, *15*(4), 374-395.

Klag, M., & Langley, A. (2013). Approaching the conceptual leap in qualitative research. *International Journal of Management Reviews*, *15*(2), 149-166.

Klaus, T., & Blanton, J. E. (2010). User resistance determinants and the psychological contract in enterprise system implementations. *European Journal of Information Systems*, *19*(6), 625-636.

Klaus, H., Rosemann, M., & Gable, G. G. (2000). What is ERP?. *Information systems frontiers*, *2*(2), 141-162.

Klaus, T., Wingreen, S. C., & Blanton, J. E. (2010). Resistant groups in enterprise system implementations: a Q-methodology examination. *Journal of Information Technology*, *25*(1), 91-106.

Ko, D. G. (2014). The mediating role of knowledge transfer and the effects of client-consultant mutual trust on the performance of enterprise implementation projects. *Information and Management*, *51*(5), 541–550.

Ko, D. G., Kirsch, L. J., & King, W. R. (2005). Antecedents of knowledge transfer from consultants to clients in enterprise system implementations. *MIS quarterly*, 59-85.

Koch, C. (2001). BPR and ERP: Realising a Vision of Process With IT. *Business Process Management Journal*, *7*(3), 258–265.

Koh, S. C. L., Gunasekaran, A., & Cooper, J. R. (2009). The demand for training and consultancy investment in SME-specific ERP systems implementation and operation. *International journal of production economics*, *122*(1), 241-254.

Koh, S. C. L., Gunasekaran, A., & Goodman, T. (2011). Drivers, barriers and critical success factors for ERPII implementation in supply chains: A critical analysis. *Journal of Strategic Information Systems*, *20*(4), 385–402.

Kræmmergaard, P., & Rose, J. (2002). Managerial competences for ERP journeys. *Information systems frontiers*, *4*(2), 199-211.

Kronbichler, S. A., Ostermann, H., & Staudinger, R. (2009). A Review of Critical Success Factors for ERP-Projects. *The Open Information Systems Journal*, *3*(1), 14–25.

Krumbholz, M., Galliers, J., Coulianos, N., & Maiden, N. A. M. (2000). Implementing enterprise resource planning packages in different corporate and national cultures. *Journal of Information Technology*, *15*(4), 267–279.

Kumar, K., Van Hillegersberg, J., & Experiences, E. R. P. (2000). Evolution. *Communications of the ACM*, *43*(4), 23-26.

Kumar, V., Maheshwari, B., & Kumar, U. (2002). ERP systems implementation: Best practices in Canadian government organizations. *Government Information Quarterly*, 19(2), 147-172.

Kumar, V., Maheshwari, B., & Kumar, U. (2003). An investigation of critical management issues in ERP implementation: emperical evidence from Canadian organizations. *Technovation*, 23(10), 793-807.

Kwahk, K. Y., & Lee, J. N. (2008). The role of readiness for change in ERP implementation: Theoretical bases and empirical validation. *Information & Management*, *45*(7), 474-481.

Kwon, O. B., & Lee, J. J. (2001). A multi-agent intelligent system for efficient ERP maintenance. *Expert Systems with Applications*, *21*(4), 191-202.

Kwon, T. H., & Zmud, R. W. (1987, April). Unifying the fragmented models of information systems implementation. In *Critical issues in information systems research* (pp. 227-251). John Wiley & Sons, Inc.

Lai, V. S., Liu, C. K., Lai, F., & Wang, J. (2010). What influences ERP beliefs—Logical evaluation or imitation?. *Decision Support Systems*, *50*(1), 203-212.

Langley, A. (1999). Strategies for theorizing from process data. *Academy Of Management Review*, 24(4), 691-710.

Langley, A. (2007). Process thinking in strategic organization. *Strategic Organization*, 5(3), 271.

Langley, A., & Tsoukas, H. (2010). Introducing perspectives on process organization studies. *Process, sensemaking, and organizing*, *1*(1), 1-27.

Langley, A., Smallman, C., Tsoukas, H., & Van de Ven, A. H. (2013). Process studies of change in organization and management: unveiling temporality, activity, and flow. *Academy of Management Journal*, 56(1), 1-13.

Laukkanen, S., Sarpola, S., & Hallikainen, P. (2007). Enterprise size matters: objectives and constraints of ERP adoption. *Journal of enterprise information management*, 20(3), 319-334.

Levinthal, D. A., & March, J. G. (1993). The myopia of learning. *Strategic management journal*, *14*(S2), 95-112.

Law, C. C., & Ngai, E. W. (2007). ERP systems adoption: An exploratory study of the organizational factors and impacts of ERP success. *Information & Management*, *44*(4), 418-432.

Leavitt, H. J. (1964). Applied organization change in industry: structural, technical and human approaches. *New Perspectives in Organizational Research*, 55, 71.

Leavy, B. (1991). A Process Study of Strategic Change and Industry Evolution–the Case of the Irish Dairy Industry, 1958–74. *British Journal of Management*, 2(4), 187-204.

Lech, P. (2013). Enterprise System Assimilation: phases, activities, and outcomes.

Lee, J. C., & Myers, M. D. (2004). Dominant actors, political agendas, and strategic shifts over time: A critical ethnography of an enterprise systems implementation. *Journal of Strategic Information Systems*, *13*(4 SPEC. ISS.), 355–374.

Lee, Z., & Lee, J. (2000). An ERP implementation case study from a knowledge transfer perspective. *Journal of Information Technology*, *15*(4), 281–288.

Leonardi, P. M. (2011). When flexible routines meet flexible technologies: Affordance, constraint, and the imbrication of human and material agencies. *MIS quarterly*, *35*(1), 147-167.

Leonardi, P. M. (2012). Materiality, sociomateriality, and socio-technical Systems: What do these terms mean? How are they related? Do we need them?. In *Materiality and Organizing: Social Interaction in a Technological World*, 25-48. Oxford, UK: Oxford University Press.

Leonardi, P. M. (2013). Theoretical foundations for the study of sociomateriality. *Information and Organization*, 23(2), 59-76.

Lewis, L. K., & Seibold, D. R. (1998). Reconceptualizing organizational change implementation as a communication problem: A review of literature and research agenda. *Annals of the International Communication Association*, *21*(1), 93-152.

Li, B. N., Dong, M. C. & Mang V. I. (2005). From Codabar to ISBT 128: Implementing Barcode Technology in Blood Bank Automation System. *Proceedings of the 2005 IEEE Engineering in Medicine and Biology 27th Annual Conference* Shanghai, China, September 1-4, 2005.

Li, B. N., Chao, S., & Dong, M. C. (2006). Barcode technology in blood bank information systems: upgrade and its impact. *Journal of medical systems*, *30*(6), 449-457.

Li, L., & Zhao, X. (2006). Enhancing competitive edge through knowledge management in implementing ERP systems. *Systems Research and Behavioral Science*, *23*(2), 129–140.

Liang, H., Saraf, N., Hu, Q., & Xue, Y. (2007). Assimilation of enterprise systems: the effect of institutional pressures and the mediating role of top management. *MIS quarterly*, 59-87.

Liang, H., & Xue, Y. (2004). Coping with ERP-related contextual issues in SMEs: a vendor's perspective. *Journal of Strategic Information Systems*, 13(4), 399-415.

Liang, H., Xue, Y., & Wu, L. (2013). Ensuring employees' it compliance: Carrot or stick?. *Information Systems Research*, *24*(2), 279-294.

Lim, E. T., Pan, S. L., & Tan, C. W. (2005). Managing user acceptance towards enterprise resource planning (ERP) systems–understanding the dissonance between user expectations and managerial policies. *European Journal of Information Systems*, *14*(2), 135-149.

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry* (Vol. 75). Sage.

Lindsay, A. (2002). *Report of the Tribunal of Inquiry into the Infection with HIV and Hepatitis-C of Persons with Haemophilia and Related Matters*. Government of Ireland

Liu, L., Feng, Y., Hu, Q., & Huang, X. (2011). From transactional user to VIP: how organizational and cognitive factors affect ERP assimilation at individual level. *European Journal of Information Systems*, *20*(2), 186-200.

Liu, P. L. (2011). Empirical study on influence of critical success factors on ERP knowledge management on management performance in high-tech industries in Taiwan. *Expert Systems with Applications*, *38*(8), 10696-10704.

Loonam, J., & McDonagh Joe. (2005). Exploring Top Management Support for the Introduction of Enterprise Information Systems : A Literature Review. *Irish Journal of Management*, *1*(26), 163–178.

Loonam, J., & McDonagh, J. (2009). A grounded theory study of enterprise systems implementation: Lessons learned from the Irish health services. In *Information Systems Research Methods, Epistemology, and Applications* (pp. 58-72). IGI Global.

Lorenzo, O. (2004), A comprehensive review of enterprise system (ES) research, *Revista Latinoamericana de Administración*, Vol. 33 No. 2, pp. 34-51.

Lyytinen, K., & Newman, M. (2015). A tale of two coalitions - marginalising the users while successfully implementing an enterprise resource planning system. *Information Systems Journal*, *25*(2), 71–101.

Lyytinen, K., Newman, M., & Al-Muharfi, A. R. A. (2009). Institutionalizing enterprise resource planning in the Saudi steel industry: a punctuated socio-technical analysis. *Journal of Information Technology*, 24(4), 286-304.

MacKay, R. B., & Chia, R. (2013). Choice, chance, and unintended consequences in strategic change: a process understanding of the rise and fall of Northco Automotive. *Academy of Management Journal*, 56(1), 208-230.

Mackenzie, K. D. (2000). Processes and their frameworks. *Management Science*, 46(1), 110-125.

Macris, A. M. (2011). Enhancing Enterprise Resource Planning users' understanding through ontology-based training. *Computers in Human Behavior*, *27*(4), 1450-1459.

Malaurent, J., & Avison, D. (2016). Reconciling global and local needs: a canonical action research project to deal with workarounds. *Information Systems Journal*. 26, 227-257

Mantzana, V., Themistocleous, M., Morabito, V., & Soulioutis, K. (2008). Evaluating actors and factors associated with healthcare information systems. *Evaluating information systems*, 179.

Mao, J. Y., Zhang, X., and Song, W. 2008. *Information Systems Development in a Low Maturity Environment: An Exploratory Case Study on Control Modes*, in *Proceedings of the 12th Pacific Asia Conference on Information Systems*, Suzhou, China.

Mark, A. L. (2006). Notes from a small island: Researching organisational behaviour in healthcare from a UK perspective. *Journal of Organizational Behavior*, *27*(7), 851-867.

Mark, A. L. (2009). Modernising healthcare: really connecting for health?. *Integrating Healthcare with Information and Communications Technology*, 65.

Markus, M. L. (2004). Technochange management: using IT to drive organizational change. *Journal of Information technology*, *19*(1), 4-20.

Markus, M. L., Axline, S., Petrie, D., & Tanis, S. C. (2000). Learning from adopters' experiences with ERP: problems encountered and success achieved. *Journal of Information Technology*, 15(4), 245-265.

Markus, M. L., & Robey, D. (1988). Information technology and organizational change: causal structure in theory and research. Management Science, 34(5), 583-598.

Markus, M. L., & Tanis, C. (2000). The enterprise systems experience-from adoption to success. *Framing the domains of IT research: Glimpsing the future through the past*, 173, 207-173.

Martin, T. N., & Huq, Z. (2007). Realigning Top Management's Strategic Change Actions for ERP Implementation: How Specializing on Just Cultural and Environmental Contextual Factors Could Improve Success. *Journal of Change Management*, *7*(2), 121–142.

Maruping, L. M., Venkatesh, V., and Agarwal, R. (2009). *A Control Theory Perspective on Agile Methodology Use and Changing User Requirements*, *Information Systems Research* (20:3), pp. 377-399.
Maxwell, J. (1992). Understanding and validity in qualitative research. *Harvard educational review*, *62*(3), 279-301.
Maxwell, J. A. (2012). *A realist approach for qualitative research*. Sage.
May, J., Dhillon, G., & Caldeira, M. (2013). Defining value-based objectives for ERP systems planning. *Decision Support Systems*, *55*(1), 98-109.
Meyer, J. W., & Rowan, B. (1977). Institutionalized organizations: Formal structure as myth and ceremony. *American journal of sociology*, *83*(2), 340-363.
McAdam, R., & Donaghy, J. (1999). Business process re-engineering in the public sector: A study of staff perceptions and critical success factors. *Business Process Management Journal*, *5*(1), 33-52.
McDonagh, J. (2004a). Investigating the Dynamics of IT-Enabled Change: The Appeal of Clinical Inquiry in, editor(s) Whitman, M.E. and Woszczynski, A.B., *The Handbook for Information Systems Research*, Hershey, PA, Idea Group Publishing, pp 103-116
McDonagh, J. (2016). Why Change Programmes Don't Produce Change: The Case of IT-Enabled Change in Public Service Organisations. In *Project Management: Concepts, Methodologies, Tools, and Applications* (pp. 2095–2116).
McGrath, K. (2013). *The potential of generative mechanisms for IS research*. Thirty Fourth International Conference on Information Systems, Milan 2013
Miles, M. B., Huberman, A. M., & Saldana, J. (2013). *Qualitative Data Analysis*. Sage.
Mingers, J. (2004a). Real-izing information systems: critical realism as an underpinning philosophy for information systems. *Information and Organization*,14(2), 87-103.
Mingers, J. (2004b). Re-establishing the real: critical realism and information systems. *Social theory and philosophy for information systems*, 372, 406.
Mingers, J., Mutch, A., & Willcocks, L. (2013). Critical realism in information systems research. *MIS Quarterly*, 37(3), 795-802.
Mintzberg, H. (2005). Developing theory about the development of theory. *Great minds in management: The process of theory development*, 355-372.
Møller, C., Kræmmergaard, P., Rikhardsson, P., Møller, P., Jensen, T.N. and Due, L. (2004), *A comprehensive ERP bibliography – 2000-2004*, Department of Information Science, Aarhus School of Business, pp. 1-54.
Mohr, L. B. (1982). *Explaining Organizational Behavior*. San Francisco: Jossey-Bass.
Moohebat, M.R., Asemi, A. and Jazi, M.D. (2010), "A comparative study of critical success factors (CSFs) in implementation of ERP in developed and developing countries", *International Journal of Advancements in Computing Technology*, Vol. 2 No. 5, pp. 99-110.
Moon, Y. B. (2007). Enterprise Resource Planning (ERP): a review of the literature. *International Journal of Management and Enterprise Development*, 4(3), 235-264.
Moore, M. H. (1995). *Creating public value: Strategic management in government*. Harvard university press.
Morris, M. G., & Venkatesh, V. (2010). Job characteristics and job satisfaction: understanding the role of enterprise resource planning system implementation. *Mis Quarterly*, 143-161.
Morton, N. A., & Hu, Q. (2008). Implications of the fit between organizational structure and ERP: A structural contingency theory perspective. *International Journal of Information Management*, *28*(5), 391–402.
Mu, E., Kirsch, L. J., & Butler, B. S. (2015). The assimilation of enterprise information system: an interpretation systems perspective. *Information & Management*, *52*(3), 359-370.
Murphy, K., Lyytinen, K., & Somers, T. (2017). *How Can Steering Committees Manage Change Through Dynamic Capabilities to Increase System Satisfaction?*. In Proceedings of the 50th Hawaii International Conference on System Sciences.
Murphy, K. E., & Simon, S. J. (2002). Intangible benefits valuation in ERP projects. *Information Systems Journal*, *12*(4), 301-320.
Mutch, A. (2010). Technology, organization, and structure - a morphogenetic approach. *Organization Science*, 21(2), 507-520.

Mutch, A. (2013). Sociomateriality—Taking the wrong turning?. *Information and Organization*, 23(1), 28-40.
Nandhakumar, J., Rossi, M., & Talvinen, J. (2005). The dynamics of contextual forces of ERP implementation. *Journal of Strategic Information Systems*, 14(2), 221-242.
Nah, F. F. H., Lau, J. L. S., & Kuang, J. (2001). Critical factors for successful implementation of enterprise systems. *Business Process Management Journal, Vol*, *7*(3), 285-296.
Nandhakumar, J., Rossi, M., & Talvinen, J. (2005). The dynamics of contextual forces of ERP implementation. *Journal of Strategic Information Systems*, *14*(2), 221–242.
Nazemi, E., Tarokh, M. J., & Djavanshir, G. R. (2012). ERP: A literature survey. *International Journal of Advanced Manufacturing Technology*, *61*(9–12), 999–1018.
Newell, S., Huang, J. C., Galliers, R. D., & Pan, S. L. (2003). Implementing enterprise resource planning and knowledge management systems in tandem: fostering efficiency and innovation complementarity. *Information and Organization*, *13*(1), 25-52.
Newman, M., & Zhao, Y. (2008). The process of enterprise resource planning implementation and business process re-engineerin medium-sized enterprises. *Information Systems Journal*, *18*(4), 405-426.
Ng, C. S. P., & Gable, G. G. (2010). Maintaining ERP packaged software–a revelatory case study. *Journal of Information Technology*, *25*(1), 65-90.
Ngai, E. W. T., Law, C. C. H., & Wat, F. K. T. (2008). Examining the critical success factors in the adoption of enterprise resource planning. *Computers in Industry*, *59*(6), 548–564.
Noudoostbeni, A., Yasin, N. M., & Jenatabadi, H. S. (2009, April). A mixed method for training ERP systems based on knowledge sharing in Malaysian Small and Medium Enterprise (SMEs). In *Information Management and Engineering, 2009. ICIME'09. International Conference on* (pp. 244-247). IEEE.
Nwankpa, J. K. (2015). ERP system usage and benefit: A model of antecedents and outcomes. *Computers in Human Behavior*, *45*, 335-344.
Nwankpa, J., & Roumani, Y. (2014). Understanding the link between organizational learning capability and ERP system usage: An empirical examination. *Computers in Human Behavior*, *33*, 224-234.
Ojala, M., Vilpola, I., & Kouri, I. (2006). Risks and risk management in ERP Project-cases in SME Context. *Proceedings of 9th International Conference on Business Information Systems (BIS 2006)*, (August 2016), 179–186.
Okoli, C. (2015). A guide to conducting a standalone systematic literature review. *Communications of the Association for Information Systems*, *37*(1), 43.
Oliver, D., & Romm, C. (2002). Justifying enterprise resource planning adoption. *Journal of Information Technology*, 17(4), 199-213.
Olsen, K. A., & Saetre, P. (2007). IT for niche companies: is an ERP system the solution?. *Information Systems Journal*, 17(1), 37-58.
Orlikowski, W. J. (1992). The duality of technology: Rethinking the concept of technology in organizations. *Organization Science*, 3(3), 398-427.
Orlikowski, W. J. (2007). Sociomaterial practices: Exploring technology at work. *Organization studies*, 28(9), 1435-1448.
Orlikowski, W. J. (2008). Using technology and constituting structures: A practice lens for studying technology in organizations. In *Resources, co-evolution and artifacts* (pp. 255-305). Springer London.
Orlikowski, W. J., & Baroudi, J. J. (1991). Studying information technology in organizations: Research approaches and assumptions. *Information Systems Research*, 2(1), 1-28.
Orlikowski, W. J., & Iacono, C. S. (2001). Research commentary: Desperately seeking the “IT” in IT research—A call to theorizing the IT artifact. *Information Systems Research*, 12(2), 121-134.
Orlikowski, W. J., & Scott, S. V. (2008). Sociomateriality: challenging the separation of technology, work and organization. *The academy of management annals*, 2(1), 433-474.
Orlikowski, W. J., & Yates, J. (2006). ICT and Organizational Change A Commentary. *The Journal of Applied Behavioral Science*, 42(1), 127-134.

Pairat, R., & Jungthirapanich, C. (2005). A Chronological Review of ERP Research : An Analysis of ERP Inception , Evolution , and Direction. In *IEEE International Engineering Management Conference, 2005.* (pp. 288–292).
Panorama Consulting (2016). *2016 Report on ERP Systems and Enterprise Software*. Panorama Consulting Solutions
Paré, G., Bourdeau, S., Marsan, J., Nach, H., & Shuraida, S. (2008). Re-examining the causal structure of information technology impact research. *European Journal of Information Systems*, *17*(4), 403-416.
Park, J. H., Suh, H. J., & Yang, H. D. (2007). Perceived absorptive capacity of individual users in performance of Enterprise Resource Planning (ERP) usage: The case for Korean firms. *Information & Management*, *44*(3), 300-312.
Paroutis, S., & Pettigrew, A. (2007). Strategizing in the multi-business firm: Strategy teams at multiple levels and over time. *Human Relations*, 60(1), 99-135.
Parr, A., & Shanks, G. (2000). A model of ERP project implementation. *Journal of information Technology*, *15*(4), 289-303.
Peck, K.B, Sher, L.D., Parton, P.A., Wright, J.F. & Menitove, J.E. (2005). ISBT Code 128 implementation at a regional blood center. *Blood Donor and Blood Collection*. 45, 1111-1117.
Pettigrew, A. M. (1985). *The Awakening Giant: Continuity and Change in Imperial Chemical Industries*. Oxford : Blackwell.
Pettigrew, A. M. (1987). Context and action in the transformation of the firm. *Journal of Management Studies*, 24(6), 649-670.
Pettigrew, A. M. (1990). Longitudinal field research on change: theory and practice. *Organization Science*, 1(3), 267-292.
Pettigrew, A. M. (1992). The character and significance of strategy process research. *Strategic Management Journal*, 13(S2), 5-16.
Pettigrew, A. M. (1997). What is a processual analysis?. *Scandinavian Journal of Management*, 13(4), 337-348.
Pettigrew, A. M. (2012). Context and Action in the Transformation of the Firm: A Reprise. *Journal of Management Studies*, 49(7), 1304-1328.
Pettigrew, A. M., Woodman, R. W., & Cameron, K. S. (2001). Studying organizational change and development: Challenges for future research. *Academy of Management Journal*, 44(4), 697-713
Pfeffer, J. (1981). Management as Symbolic Action: The Creation and Management of Organizational Paradigms' in Staw, BM & Cummings, LL (eds.) 1981. *Research in Organizational Behaviour*, *3*.
Pishdad, A., Haider, A., & Koronios, A. (2012). *ERP Assimilation: A Technology Institutionalisation Perspective*. European, Mediterranean & Middle Eastern Conference on Information Systems 2012 (EMCIS2012) June 7-8, Munich, Germany
Poba-Nzaou, P., Uwizeyemungu, S., Raymond, L., & Paré, G. (2014). Motivations underlying the adoption of ERP systems in healthcare organizations: Insights from online stories. *Information Systems Frontiers*, 16(4), 591-605.
Pollitt, C., & Bouckaert, G. (2004). *Public management reform: A comparative analysis* (2nd edn). Oxford: Oxford University Press.
Pollock, N., & Cornford, J. (2004). ERP systems and the university as a “unique” organisation. *Information Technology & People*, *17*(1), 31–52.
Pollock, N., & Hyysalo, S. (2014). The business of being a user: The role of the reference actor in shaping packaged enterprise system acquisition and development. *MIS quarterly*, *38*(2), 473-496.
Pollock, N., & Williams, R. (2007). Technology choice and its performance: Towards a sociology of software package procurement. *Information and Organization*, 17(3), 131-161.
Porter, S. (2007). Validity, trustworthiness and rigour: reasserting realism in qualitative research. *Journal of advanced nursing*, *60*(1), 79-86.
Pozzebon, M., & Pinsonneault, A. (2005). Global – local negotiations for implementing configurable packages : The power of initial organizational decisions. *Journal of Strategic Information Systems*, *14*, 121–145.

Quattrone, P., & Hopper, T. (2006). What is IT?: SAP, accounting, and visibility in a multinational organisation. *Information and Organization*, *16*(3), 212-250.
Raghupathi, W., & Tan, J. (2002). Strategic IT applications in health care. *Communications of the ACM*, *45*(12), 56-61.
Rainey, H. G. (2014). *Understanding and managing public organizations*. Fifth Edition. John Wiley & Sons.
Rajagopal, P. (2002). An innovation—diffusion view of implementation of enterprise resource planning (ERP) systems and development of a research model. *Information & Management*, *40*(2), 87-114.
Ramasubbu, N., Mithas, S., & Krishnan, M. S. (2008). High tech, high touch: The effect of employee skills and customer heterogeneity on customer satisfaction with enterprise system support services. *Decision Support Systems*, *44*(2), 509-523.
Ramburn, A., Seymour, L., Gopaul, A., Town, C., Town, C., & Africa, S. (2013). Learning from a Failed ERP implementation : The Case of a Large South African Organization. In *Proceedings of The 4th International Conference on Information Systems Management and Evaluation ICIME 2013* (pp. 215–223).
Ranganathan, C., & Brown, C. V. (2006). ERP investments and the market value of firms: Toward an understanding of influential ERP project variables. *Information Systems Research*, *17*(2), 145-161.
Rashid, M. A., Hossain, L., & Patrick, J. D. (2002). *The evolution of ERP systems: A historical perspective*.
Raymond, L., & Uwizeyemungu, S. (2007). A profile of ERP adoption in manufacturing SMEs. *Journal of Enterprise Information Management*, *20*(4), 487-502.
Raymond, L., Uwizeyemungu, S., & Bergeron, F. (2006). Motivations to implement ERP in e-government: an analysis from success stories. *Electronic Government, an International Journal*, 3(3), 225-240.
Rhodes, M. L., & Boyle, R. (2012). Progress and pitfalls in public service reform and performance management in Ireland. *Administration*, *60*(1), 31À59.
Robey, D., Anderson, C., and Raymond, B. (2013). Information Technology, Materiality, and Organizational Change: A Professional Odyssey, *Journal of Association for Information Systems* (14:7), pp. 379-398.
Robey, D., Ross, J. W., & Boudreau, M. (2002). Learning to Implement Enterprise Systems : An Exploratory Study of the Dialectics of Change. *Journal of Management Information Systems*, *19*(l), 17–47.
Rockart, J. F. (1979). Chief executives define their own data needs. *Harvard Business Review*, 81–94.
Rose, J., & Schlichter, B. R. (2013). Decoupling, re-engaging: managing trust relationships in implementation projects. *Information Systems Journal*, *23*, 5–33.
Rosemann, M. (2000) Using reference models within the enterprise resource planning lifecycle, *Australian Accounting Review*, **10(3)**, 19-30.
Ross, J. W., & Vitale, M. R. (2000). The ERP revolution: surviving vs. thriving. *Information systems frontiers*, *2*(2), 233-241.
Rothenberger, M. A., Srite, M., & Jones-Graham, K. (2010). The impact of project team attributes on ERP system implementations: A positivist field investigation. *Information Technology & People*, *32*(1), 80–109.
Rubin, H. J., & Rubin, I. S. (2012). *Qualitative interviewing: The art of hearing data*. Sage.
Saldaña, J. (2013). *The coding manual for qualitative researchers*. Sage.
Salge, T. O., Kohli, R., & Barrett, M. (2015). Investing in Information Systems: On the Behavioral and Institutional Search Mechanisms Underpinning Hospitals' IS Investment Decisions. *MIS Quarterly*, *39*(1), 61-89.
Sammon, D., & Adam, F. (2010). Project preparedness and the emergence of implementation problems in ERP projects. *Information & Management*, *47*, 1–8.
Santamaria-Sanchez, L., Nunez-Nickel, M., & Gago-Rodriguez, S. (2010). The role played by interdependences in ERP implementations: An empirical analysis of critical factors that minimize elapsed time. *Information & Management*, *47*, 87–95.

Saraf, N., Liang, H., Xue, Y., & Hu, Q. (2013). How does organisational absorptive capacity matter in the assimilation of enterprise information systems?. *Information Systems Journal*, *23*(3), 245-267.

Sarker, S., & Lee, A. S. (2003). Using a case study to test the role of three key social enablers in ERP implementation. *Information & Management*, *40*, 813–829.

Sasidharan, S., Santhanam, R., Brass, D. J., & Sambamurthy, V. (2012). The Effects of Social Network Structure on Enterprise Systems Success : A Longitudinal Multilevel Analysis The Effects of Social Network Structure on Enterprise Systems Success : A Longitudinal Multilevel Analysis. *Information Systems Research*, *23*.

Sawyer, S. (2000). Packaged software: implications of the differences from custom approaches to software development. *European Journal of Information Systems*, *9*(1), 47-58.

Sawyer, S., & Southwick, R. (2002). Temporal issues in information and communication technology-enabled organizational change: Evidence from an enterprise systems implementation. *The Information Society*, *18*(4), 263-280.

Saxena, D., Dempsey, B. & McDonagh, J. (2016). Beyond one-dimensional Construct of Failure: The Curious Case of Enterprise Systems Failure Rates. *UK Academy of Information Systems Conference 2016*, Oxford.

Saxena D. & McDonagh, J. (2014). Towards a More Holistic Approach to the Study of Enterprise Systems - The Case for integrating Process inquiry and Sociomateriality. *British Academy of Management Conference 2014*, Belfast.

Saxena, D. & McDonagh, J. (2016). Critical Realism as an Underlying Philosophy for Explaining Technology-Mediated Change Processes. *British Academy Of Management Conference 2016*, Newcastle.

Saxena, D., & McDonagh, J. (2017). A Systematic Literature Review of the Enterprise Systems Research in Leading IS Journals (2000-2015). *Proceedings of the Twelfth Midwest Association for Information Systems Conference 2017,* Springfield, Illinois.

Saxena, D. & McDonagh, J. (2017a). Yet Another 'List' of Critical Success 'Factors' for Enterprise Systems: Review of Empirical Evidence and Suggested Research Directions. *UK Academy of Information Systems Conference 2017*, Oxford.

Saxena & McDonagh (2017b). Major Challenges in Implementing Enterprise Systems in the Public Sector: A Case Study. *European Academy of Management Conference 2017*, Glasgow.

Sayer, A. (2000). *Realism and social science*. Sage.

Sayer, A. (2010). *Method in Social Science*: Revised 2nd Edition. Routledge.

Schlichter, B.R. and Kraemmergaard, P. (2010), A comprehensive literature review of the ERP research field over a Decade, *Journal of Enterprise Information Management*, Vol. 23 No. 4, pp. 486-520.

Scott, J. E., & Vessey, I. (2000). Implementing enterprise resource planning systems: the role of learning from failure. *Information systems frontiers*, *2*(2), 213-232.

Scott, S. V., & Wagner, E. L. (2003). Networks, negotiations, and new times: the implementation of enterprise resource planning into an academic administration. *Information and organization*, *13*(4), 285-313.

Seddon, P. B., Calvert, C., & Yang, S. (2010). A multi-project model of key factors affecting organizational benefits from enterprise systems. *MIS quarterly*, *34*(2), 305-328.

Sedera, D., Gable, G., & Palmer, A. (2002) Enterprise Resource Planning Systems Impacts: a Delphi study of Australian Public Sector Organizations.

Sedmak, M. (2006). *The role of communication in enterprise system implementation*. Ph.D. Thesis, Cranfield University

Seethamraju, R. (2015). Adoption of software as a service (SaaS) enterprise resource planning (ERP) systems in small and medium sized enterprises (SMEs). *Information systems frontiers*, *17*(3), 475-492.

Shang, S., & Seddon, P. B. (2002). Assessing and managing the benefits of enterprise systems: the business manager's perspective. *Information systems journal*, *12*(4), 271-299.

Shao, Z., Feng, Y., & Liu, L. (2012). The mediating effect of organizational culture and knowledge sharing on transformational leadership and Enterprise Resource Planning systems success: An empirical study in China. *Computers in Human Behavior*, *28*(6), 2400-2413.

Sharma, G., Parwani, A. V., Raval, J. S., Triulzi, D. J., Benjamin, R. J., & Pantanowitz, L. (2011). Contemporary issues in transfusion medicine informatics. *Journal of pathology informatics*, *2*.

Shaul, L., & Tauber, D. (2012). CSFs along ERP lifecycle in SMEs: a field study. *Industrial Management & Data Systems*, *112*(3), 360-384.

Shaul, L., & Tauber, D. (2013). Critical Success Factors in Enterprise Resource Planning Systems: review of the last decade. *ACM Computing Surveys*, *45*(4).

Shanks, G.G., Parr, A.N., Hu, B., Corbitt, B.J., Thanasankit, T., and Seddon, P. B. (2000). Differences in Critical Success Factors in ERP Systems Implementation in Australia and China: A Cultural Analysis. *Proceedings of the European Conference on Information Systems*, 537-544.

Shehab, E.M., Sharp, M.W., Supramaniam, L. and Spedding, T.A. (2004), Enterprise resource planning: an integrative review, *Business Process Management Journal*, Vol. 10 No. 4, pp. 359-386.

Sheu, C., Chae, B., & Yang, C. L. (2004). National differences and ERP implementation: issues and challenges. *Omega*, *32*(5), 361-371.

Shiau, W. L., Hsu, P. Y., & Wang, J. Z. (2009). Development of measures to assess the ERP adoption of small and medium enterprises. *Journal of Enterprise Information Management*, *22*(1/2), 99-118.

Shirouyehzad, H., Dabestani, R., & Badakhshian, M. (2011). The FMEA Approach to Identification of Critical Failure Factors in ERP Implementation. *International Business Research*, *4*(3), 254–264.

Sia, S. K., & Soh, C. (2007). An assessment of package – organisation misalignment : institutional and ontological structures. *European Journal of Information Systems*, *16*, 568–583.

Sitkin, S. B. (1992). Learning through failure: the strategy ofsmall losses. *Research in organizational behavior*, *14*, 231-266.

Shaw, M. J. (2000). Building an e-business from enterprise systems. *Information Systems Frontiers*, 2(1), 7-17.

Shepherd, C., Clegg, C., & Stride, C. (2009). Opening the black box: A multi-method analysis of an enterprise resource planning implementation. *Journal of Information Technology*, *24*(1), 81-102.

Silva, L., & Backhouse, J. (1997). Becoming part of the furniture: the institutionalization of information systems. In *Information systems and qualitative research* (pp. 389-414). Springer US.

Silva, L., & Fulk, H. K. (2012). From disruptions to struggles: Theorizing power in ERP implementation projects. *Information and Organization*, *22*(4), 227-251.

Sminia, H. (2009). Process research in strategy formation: Theory, methodology and relevance. *International Journal of Management Reviews*, 11(1), 97-125.

Sminia, H., & De Rond, M. (2012). Context and action in the transformation of strategy scholarship. *Journal of Management Studies*, 49(7), 1329-1349.

Sminia, H. (2016). Pioneering Process Research: Andrew Pettigrew's Contribution to Management Scholarship, 1962–2014. *International Journal of Management Reviews*, 18(2), 111-132.

Soh, C., Eng, C., Chua, H., & Singh, H. (2010). enterprise systems projects : a control portfolio approach. *Journal of Information Technology*, *26*(1), 16–31.

Soh, C., Chua, C. E. H., & Singh, H. (2011). Managing diverse stakeholders in enterprise systems projects: a control portfolio approach. *Journal of Information Technology*, *26*(1), 16-31.

Soh, C., Sia, S. K., Boh, W. F., & Tang, M. (2003). Misalignments in ERP implementation: a dialectic perspective. *International Journal of Human-Computer Interaction*, 16(1), 81-100.

Soh, C., & Sia, S. K. (2004). An institutional perspective on sources of ERP package – organisation misalignments. *Strategic Information Systems*, *13*, 375–397.

Soja, P. (2008). Difficulties in Enterprise System Implementation in Emerging Economies : Insights from an Exploratory Study in Poland. *Information Technology for Development*, *14*(1), 31–51.
Somers, T. M., & Nelson, K. G. (2004). A taxonomy of players and activities across the ERP project life cycle. *Information & Management*, *41*, 257–278.
Sommer, R. (2006). *Public Sector Enterprise Resource Planning: Issues in Change Management*, Edward Elgar, London.
Sommer, R. (2011). *Public sector ERP implementation: successfully engaging middle-management*. GMU School of Public Policy Research Paper, (2011-21).
Spano, A., Carta, D., and Mascia, P. (2009). The impact of introducing an ERP system on organizational processes and individual employees of an Italian regional government organization. *Public Management Review*, 11(6), 791-809.
Srivardhana, T., & Pawlowski, S. D. (2007). ERP systems as an enabler of sustained business process innovation: A knowledge-based view. *The Journal of Strategic Information Systems*, *16*(1), 51-69.
Staehr, L. (2010). Understanding the role of managerial agency in achieving business benefits from ERP systems. *Information systems journal*, *20*(3), 213-238.
Staehr, L., Shanks, G., & Seddon, P. B. (2012). An explanatory framework for achieving business benefits from ERP systems. *Journal of the Association for Information Systems*, 13(6), 424.
Stefanou, C. J. (2001). A framework for the ex-ante evaluation of ERP software. *European Journal of Information Systems*, *10*(4), 204-215.
Stiglitz, J. E. (2002). Information and the Change in the Paradigm in Economics. *The American Economic Review*, 92(3), 460-501.
Strong, D. M., & Volkoff, O. (2010). Understanding Organization—Enterprise System Fit: A Path to Theorizing the Information Technology Artifact. *MIS Quarterly*, *34*(4), 731–756.
Strong, D. M., Johnson, S. A., Tulu, B., Trudel, J., Volkoff, O., Pelletier, L. R., ... & Garber, L. (2014). A theory of organization-EHR affordance actualization. *Journal of the Association for Information Systems*, 15(2), 53.
Su, Y. F., & Yang, C. (2010). A structural equation model for analyzing the impact of ERP on SCM. *Expert Systems with Applications*, *37*(1), 456-469.
Suchman, M. C. (1995). Managing legitimacy: Strategic and institutional approaches. *Academy of management review*, *20*(3), 571-610.
Sumner, M. (2000). Risk factors in enterprise-wide / ERP projects. *Journal of Information Technology*, *15*, 317–327.
Sun, Y., Bhattacherjee, A., & Ma, Q. (2009). Extending technology usage to work settings: The role of perceived work compatibility in ERP implementation. *Information & Management*, *46*(6), 351-356.
Susilo, A., Heales, J., and Rohde, F. (2007). *Project Management Effectiveness: The Choice—Formal or Informal Controls*, *Australasian Journal of Information Systems* (15:1), pp. 153-167.
Sutton, R. I., & Staw, B.M. (1995). What theory is not. *Administrative Science Quarterly*, *40*, 371-384.
Sykes, T. A. (2015). Support structures and their impacts on employee outcomes: A longitudinal field study of an enterprise system implementation. *MIS Quarterly*, *39*(2), 473–495.
Sykes, T. A., Venkatesh, V., & Johnson, J. L. (2014). Enterprise system implementation and employee job performance: Understanding the role of advice networks. *MIS Quarterly*, *38*(1), 51–72.
Tang, D. and Wu, Q. (2010), *Research on ERP application from an integrative review*, 2010 International Conference on E-Business and E-Government, May 7-9, pp. 2761-2763.
Tarhini, A., Ammar, H., & Tarhini, T. (2015). Analysis of the Critical Success Factors for Enterprise Resource Planning Implementation from Stakeholders' Perspective : A Systematic Review.
Teoh, S. Y., Pan, S. L., & Ramchand, A. M. (2012). Resource management activities in healthcare information systems: A process perspective. *Information Systems Frontiers*, *14*(3), 585-600.

Tian, F., & Xu, S. X. (2015). How Do Enterprise Resource Planning Systems Affect Firm Risk? Post-Implementation Impact. *Mis Quarterly*, *39*(1), 39-60.
Tingling, P., & Parent, M. (2004). An exploration of enterprise technology selection and evaluation. *The Journal of Strategic Information Systems*, *13*(4), 329-354.
Tiwana, A., and Keil, M. (2009). Control in Internal and Outsourced Software Projects, *Journal of Management Information Systems* (26:3), pp. 9-44.
Thomas, G. A., and Jajodia, S. (2004). Commercial-off-the-shelf enterprise resource planning software implementations in the public sector: practical approaches for improving project success. *The Journal of Government Financial Management*, 53(2), 12.
Tong, Y., Tan, S. S. L., & Teo, H. H. (2015). The Road to Early Success: Impact of System Use in the Swift Response Phase. *Information Systems Research*, *26*(2), 418-436.
Trist, E. (1981). *The evolution of socio-technical systems*. Occasional Paper, 2, 1981.
Tsai, W. H., Lee, P. L., Shen, Y. S., & Lin, H. L. (2012). A comprehensive study of the relationship between enterprise resource planning selection criteria and enterprise resource planning system success. *Information & Management*, *49*(1), 36-46.
Tsai, W. H., Shaw, M. J., Fan, Y. W., Liu, J. Y., Lee, K. C., & Chen, H. C. (2011). An empirical investigation of the impacts of internal/external facilitators on the project success of ERP: A structural equation model. *Decision Support Systems*, *50*(2), 480-490.
Tsang, E. W. K. (2014). Case studies and generalization in information systems research: A critical realist perspective. *Journal of Strategic Information Systems*. 23, 174–186
Tsoukas, H., & Chia, R. (2002). On organizational becoming: Rethinking organizational change. *Organization Science*, 13(5), 567-582.
Umble, E. J., & Umble, M. M. (2002). Avoiding ERP implementation failure. *Industrial Management*, 25-33.
Uwizeyemungu, S., & Raymond, L. (2009). Exploring an alternative method of evaluating the effects of ERP: a multiple case study. *Journal of Information Technology*, *24*(3), 251-268.
Van de Ven, A. H. (1989). Nothing is quite so practical as a good theory. *Academy of management Review*, *14*(4), 486-489.
Van de Ven, A. H. (1992). Suggestions for studying strategy process: a research note. *Strategic management journal*, 13(5), 169-188.
Van de Ven, A. H., & Huber, G. P. (1990). Longitudinal field research methods for studying processes of organizational change. *Organization Science*, 1(3), 213-219.
Van de Ven, A. H., & Poole, M. S. (1995). Explaining development and change in organizations. *Academy of management review*, *20*(3), 510-540.
Van de Ven, A. H., & Poole, M. S. (2005). Alternative approaches for studying organizational change. *Organization Studies*, 26(9), 1377-1404.
Van de Ven, A. H., & Sun, K. (2011). Breakdowns in implementing models of organization change. *The Academy of Management Perspectives*, 25(3), 58-74.
Vannoy, S. A., & Salam, A. F. (2010). Managerial interpretations of the role of information systems in competitive actions and firm performance: A grounded theory investigation. *Information Systems Research*, *21*(3), 496-515.
Velcu, O. (2010). Information & Management Strategic alignment of ERP implementation stages : An empirical investigation. *Information & Management*, *47*(3), 158–166.
Vlasic, A., & Yetton, P. (2004). Effective project control: Insights from the Australian construction industry. *PACIS 2004 Proceedings*, 9.
Volkoff, O., Elmes, M. B., & Strong, D. M. (2004). Enterprise systems , knowledge transfer and power users. *Strategic Information Systems*, *13*, 279–304.
Volkoff, O., Strong, D. M., & Elmes, M. B. (2005). Understanding enterprise systems-enabled integration. *European Journal of Information Systems*, *14*(2), 110-120.
Volkoff, O., & Strong, D. M. (2013). Critical Realism and Affordances: Theorizing IT-Associated Organizational Change Processes. *MIS Quarterly*, *37*(3), 819-834.
Walcott, H. F. (2009). *Writing up qualitative research* - Third Edition. Sage.
Wagner, E. L. (2010). Understanding Project Survival in an ES Environment : A Sociomaterial Practice Perspective. *Journal of the Association for Information Systems*, *11*(5), 276–297.

Wagner, W., and Antonucci, Y. L. (2009). The ImaginePA Project: The First Large-Scale, Public Sector ERP Implementation. *Information Systems Management*, 26(3), 275-284.
Wagner, E. L., & Newell, S. (2004). “Best” for whom?: the tension between “best practice” ERP packages and diverse epistemic cultures in a university context. *Strategic Information Systems*, *13*, 305–328.
Wagner, E. L., & Newell, S. (2007). Exploring the Importance of Participation in the Post-Implementation Period of an ES Project : A Neglected Area. *Journal of the Association for Information Systems*, *8*(10), 508–524.
Wagner, E. L., & Piccoli, G. (2007). Moving beyond user participation to achieve successful IS design. *Communications of the ACM*, *50*(12), 51-55.
Wagner, W., & Antonucci, Y. L. (2009). The ImaginePA Project : The First Large-Scale, Public Sector ERP Implementation. *Information Systems Management*, (26), 275–284.
Wainwright, D., & Waring, T. (2000). The information management and technology strategy of the UK National Health Service–Determining progress in the NHS acute hospital sector. *International Journal of Public Sector Management*, *13*(3), 241-259.
Wainwright, D. W., & Shaw, C. S. (2013). Modernising pathology services : modelling effective IT project collaboration. *International Journal of Public Sector Management*, *16*(4), 268–282.
Walsham, G. (1993). *Interpreting Information Systems in Organizations*. John Wiley & Sons, Inc.
Walsham, G., & Sahay, S. (1999). GIS for district-level administration in India: problems and opportunities. *MIS Quarterly*, 39-65.
Warwick, D. P., Meade, M., & Reed, T. (1979). *A theory of public bureaucracy: Politics, personality, and organization in the state department*. Harvard University Press.
Watson, E., Vaught, S., Gutierrez, D., and Rinks, D. (2003). ERP implementation in state government. *Annals of Cases on Information Technology Applications and Management in Organizations*, 5, 302-318.
Wei, H., Wang, E. T. G., & Pei-Hung Ju. (2005). Understanding misalignment and cascading change of ERP implementation : a stage view of process analysis. *European Journal of Information Systems*, *14*, 324–334.
Weick, K. E. (1979). The social psychology of organizing (Topics in social psychology series).
Weick, K. E. (1995). *Sensemaking in organizations* (Vol. 3). Sage.
Weston, F. (2001). ERP implementation and project management. *Production and Inventory Management Journal*, *42*(3/4), 75.
Whetten, D. A. (1989). What constitutes a theoretical contribution?. *Academy of management review*, *14*(4), 490-495.
Whittington, R. (2003). The work of strategizing and organizing: for a practice perspective. *Strategic Organization*, 1(1), 117-126.
Whittington, R. (2007). Strategy practice and strategy process: family differences and the sociological eye. *Organization Studies*, 28(10), 1575-1586.
Wiener, M., Mähring, M., Remus, U., & Saunders, C. (2016). Control Configuration and Control Enactment in Information Systems Projects: Review and Expanded Theoretical Framework. *Mis Quarterly*, *40*(3), 741-774.
Willcocks, L. P., & Currie, W. L. (1997). Information technology in public services: towards the contractual organization?. *British Journal of Management*, *8*(s1), 107-120.
Willcocks, L. P. and Lee, Allan, eds (2008) *Major currents in information systems* Sage library in business and management, 6. Sage, London, UK.
Williams, S. P., & Hardy, C. (2005). Public eProcurement as socio-technical change. *Strategic Change*, 14(5), 273-281.
Williams, C. K., & Karahanna, E. (2013). Causal Explanation in the Coordinating Process: A Critical Realist Case Study of Federated IT Governance Structures. *MIS Quarterly*, 37(3), 933-964.
Williams, R., & Pollock, N. (2012). Research commentary—moving beyond the single site implementation study: how (and why) we should study the biography of packaged enterprise solutions. *Information Systems Research*, *23*(1), 1-22.

Williams, J., Williams, M. D., & Morgan, A. (2013). A teleological process theory for managing ERP implementations process theory. *Journal of Enterprise Information Management*, *26*(3), 235–249.
Willis, R., & Chiasson, M. (2007). Do the ends justify the means?: A Gramscian critique of the processes of consent during an ERP implementation. *Information Technology & People*, *20*(3), 212–234.
Winter, S., Berente, N., Howison, J., & Butler, B. (2014). Beyond the organizational 'container': Conceptualizing 21st century sociotechnical work. *Information and Organization*, 24(4), 250-269.
Wolcott, H. (2009). Writing Up Qualitative Research. Third Edition. SAGE Publications, Inc
Wong, A., Scarbrough, H., Chau, P., & Davison, R. (2005). Critical failure factors in ERP implementation. *PACIS 2005 Proceedings*, 40.
Wong, B., & Tein, D. (2003). Critical Success Factors for ERP Projects. In *Proceedings of the national conference of the Australian institute of project management*.
Wright, S., & Wright, A. M. (2002). Information system assurance for enterprise resource planning systems: unique risk considerations. *Journal of Information Systems*, 16(s-1), 99-113.
Wu, D. J., Ding, M., & Hitt, L. M. (2012). IT implementation contract design: Analytical and experimental investigation of IT value, learning, and contract structure. *Information Systems Research*, *24*(3), 787-801.
Wu, J. H., & Wang, Y. M. (2007). Measuring ERP success: The key-users' viewpoint of the ERP to produce a viable IS in the organization. *Computers in Human behavior*, *23*(3), 1582-1596.
Wynn Jr, D., & Williams, C. K. (2012). Principles for Conducting Critical Realist Case Study Research in Information Systems. *MIS Quarterly*, 36(3).
Xu, L., Tan, W., & Zhen, H. (2008). An approach to enterprise process dynamic modeling supporting enterprise process evolution. *Information Systems Frontiers*, *10*, 611–624.
Xu, L., Wang, C., Luo, X., & Shi, Z. (2006). Integrating knowledge management and ERP in enterprise information systems. *Systems Research and Behavioral Science*, *23*(2), 147-156.
Xu, Y., Rahmati, N. and Lee, V.C.S. (2008), *A review of literature on enterprise resource planning systems*, 2008 International Conference on Service Systems and Service Management, June 30-July 2, pp. 1-6.
Xue, Y., Liang, H., Boulton, W. R., & Snyder, C. A. (2005). ERP implementation failures in China: Case studies with implications for ERP vendors. *International journal of production economics*, *97*(3), 279-295.
Xue, Y., Liang, H., & Wu, L. (2011). Punishment, justice, and compliance in mandatory IT settings. *Information Systems Research*, *22*(2), 400-414.
Yazgan, H. R., Boran, S., & Goztepe, K. (2009). An ERP software selection process with using artificial neural network based on analytic network process approach. *Expert Systems with Applications*, 36(5), 9214-9222.
Yin, R. K. (2013). *Case study research: Design and methods* - Fifth Edition. Sage.
Yoon, C. (2009). The effects of organizational citizenship behaviors on ERP system success. *Computers in Human Behavior*, *25*(2), 421-428.
Young, R., & Jordan, E. (2008). Top management support: Mantra or necessity?. *International Journal of Project Management*, *26*(7), 713-725.
Zachariadis, M., Scott, S., & Barrett, M. (2013). Methodological implications of critical realism for mixed-methods research. *MIS Quarterly*, 37(3), 855-880.
Zafeiropoulos, I., Metaxiotis, K., & Askounis, D. (2005). Dynamic risk management system for the modeling, optimal adaptation and implementation of an ERP system. *Information Management & Computer Security*, *13*(3), 212–234.
Zamutto, R. G., Griffith, T. L., Majchrzak, A., Dougherty, D. J., & Faraj, S. (2007). Information Technology and the Changing Fabric of Organization, *Organization Science* (18:5), pp. 749-762.
Zmud, R., Carte, T., and Te'eni, D. (2004). *Information Systems in Nonprofits and Governments: Do We Need Different Theories?*. ICIS 2004 Proceedings, 86.

APPENDICES

Appendix-1 Summary of ES CSFs

ES CSFs Based on Content Analysis of Review Papers [37]		
CSF	**Frequency**	**Other Terms**
Change Management	21	Cultural and Structural Change, Resistance to Change, Managing Cultural Change
Project Team	21	Dedicated Project Team, Project Team Competence, Project Team Composition, Best and the Brightest, Balanced Team, Project Team Skills, Project Team Compensation, Execution Team, Teamwork, Small internal team of best employees, Team Morale and Motivation, Technical and Business Knowledge, Employee Turnover, Training of Project Team
BPR	19	Process Management, Job Redesign
Top Management Support	19	Sustained Management Support, Management and Leadership, Top Management Involvement, Top Management Participation
Business Plan and Vision	18	Visioning and Planning, Clear Goals Focus and Scope, Clear Objectives and Goals, Business Case, Strategic Thinking and Planning
Project Management	17	Experience Project Manager, Steering Committee, A formalised project approach and methodology
User Education and Training	17	User Characteristics
Communication	15	Strong Communication inward and Outward, Open and Honest Communication
Project Champion	14	Project Heroes
User Involvement and Participation	14	Client Consultation
Package Selection	14	ERP Version, System Quality
Legacy System	12	
Vendor Aspects	12	Vendor Relation, Vendor Support, Vendor Partnership, Vendor Quality, Vendor Tools, Trust between Partners, IT Supplier

[37] Esteves & Pastor (2000); Al-Mashari (2001); Nah et al (2001); Al-Mashari et al (2003); Wong & Tein (2003); Somers & Neloson (2004); Gargeya & Brady (2005); Aloini et al (2007); Finney & Corbett (2007); Al-Fawaz et al (2008); Ngai et al (2008); Dezdar & Sulaiman (2009); Kronbichler et al (2009); Al-Fawaz et al (2010); Hanafizdeh et al (2010); Huang (2010); Moohebat et al (2010); Hoermann et al (2011); Curko et al (2012); Hailu & Rahman (2012); Hosseini et al (2012); Amini & Safavi (2013); Shaul & Tauber (2013); Tarhini et al (2015)

Consultants	11	Adequate Use of Consultants, Experienced Consultants, Consulting Services, External Advisory Support
Performance Management	11	Performance Monitoring, Performance Evaluation, Measurable Goals, Post-Implementation Evaluation
Testing and Troubleshooting	11	System Integration, System Testing
Organisational Culture	8	
Customisation	7	Vanilla ERP, Minimum Customisation
Data Related Aspects	7	Data Quality, Data Analysis, Data Coversion, Data Accuracy, Data Management, Information Quality
Interdepartmental Dynamics	7	Interdepartmental Coordination, Interdepartmental Communication, Interdepartmental Collaboration, Enterprise-wide communication and cooperation
Implementation Strategy	6	Big Bang Implementation, Roll-out
Project Scope	6	Deliverable Dates, Smaller Scope, Time
Process Fit and Alignment	5	Dealing with Organisational Diversity
Empowered Decision Makers	4	Empowered Decision Makers
Financial Management	4	Project Cost Planning and Management, Project Justification based on cost and economics, Detailed Cost
Managing Expectations	4	Unrealistic Expectations
Project Planning	4	Formalised project plan/schedule
Technical Complexity	4	Software Complexity, Complex Architecture and High Number of Modules, Defining the Architecture
National Culture	4	
IT Infrastructure and Resources	4	IT Systems, IT Maintainability
Configuration	3	
IT Skills and Experience	3	
Localisation Requirements	3	Country Related Functional Requirements
Industry Environment	3	Competitive Pressure
Organisation Size	2	
Knowledge Management	2	

Appendix-2 Case Study Protocol

University of Dublin
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School of Business

CASE STUDY PROTOCOL

Research Context

While there has been significant research on critical success and failure factors associated with the implementation of enterprise-level information systems in private sector organisations, there is a genuine paucity of such research as it relates to a public service context.

Core Research Question

What are the factors that support or impede the process of enterprise systems implementation in public service organisations (PSOs) and how do these factors shape the outcomes of the implementation process?

IBTS and Progesa

The evolution of Progesa over time is of particular interest to the proposed program of research. The intention is to trace from the initial implementation of Progesa in 2003 to the subsequent failed implementation of eProgesa and onwards to the current implementation which is scheduled to roll-out in Q2 2015. Developing a longitudinal view of Progesa along with the related factors that support or impede the process of implementation will provide a rich base of evidence to answer the core research question.

Research Strategy

The proposed program of research will inquire into the process of implementing Progesa, eProgesa and present system, from the identification of initial business needs to the delivery of promised business outcomes, with particular emphases on the collection and analysis of both secondary and primary data.

The research will focus initially on the identification, collection, and preliminary analysis of the trail of documentary evidence associated with the process of implementing Progesa, eProgesa and present system. For example, this might include documentation that relates to business strategy, ICT strategy, business case development, project planning and management, internal audit reports, external assessments and reviews, and other such materials associated with the implementation.

Having developed a rich understanding based on secondary sources of evidence, the research will then focus on the collection of more fine-grained data through in-depth interviews with key individuals and groups involved in the implementation process.

Timeline

It is currently envisaged that the program of research will be executed between March 2015 and February 2016.

Benefits of Participation

By participating in this study, IBTS will support the development of a rich case study that captures the evolution over time of its core blood banking system. As a mark of appreciation for such participation, IBTS will receive in due time a detailed Corporate Mentoring Note that outlines the central factors deemed essential to shaping and delivering successful ICT-enabled change programs in public service organisations.

The Researcher

The researcher holds a bachelor degree in IT and masters in Industrial Management. He has previously worked in India with the Council of Scientific and Industrial Research, the Defence Research and Development Organisation and the Indian Space Research Centre. Currently, he is in the second year of his doctoral studies at the School of Business, Trinity College Dublin. The researcher has also presented some of his initial Ph.D.-related research at the British Academy of Management Conference (2014).

Conduct and Confidentiality

In order to maximise the value of the proposed research for IBTS and to ensure that confidentiality is protected at all times, the researcher is willing to be based at IBTS for an agreed number of days each week during the conduct of this field research. The specific arrangements here will need to be agreed between IBTS and the researcher.

Deepak Saxena
Doctoral Student
Trinity College Dublin

11th March 2015

Appendix-3 Secondary Data Sources

Secondary Data	No of Documents	Source
IBTS Annual Reports (2001-2015)	15	IBTS Websites
IBTS Board Minutes (2002-2016)	146	IBTS Websites
IBTS Strategic Plans (2005-2009, 2010-2012, 2013-2016)	3	IBTS Websites
News Reports	10	News Websites
Internal Project Documents	27	IBTS Participants
Government Reports (other than C&AG reports) and Circulars	10	Government Websites
Reports of Comptroller and Auditor General	3	C&AG Website
Debates of Committee of Public Accounts	2	Oireachtas Website

Appendix-4 Letter to Participants

To,
Mr/Mrs X,
Position,
Irish Blood Transfusion Service
Dublin, Ireland

Dear Sir/Madam,

Please accept my sincere thanks for agreeing to an interview for the purpose of data collection for my doctoral research. As agreed, the interview is scheduled to take place in your office at hh:mm pm on Day, DD Month 20XX. The interview will take the form of a responsive conversation rather than that of structured queries. Although my questions will be broadly directed by my research question[*], you may expect questions flowing through our conversation, rather than following any fixed set of questions.

If you are in agreement, I would like to avail of an audio recording as it will provide a more accurate rendition of the interview than my note taking. I will furnish a copy of the transcript to you if requested. At this point, I also wish to assure you that our conversation will remain confidential and your anonymity is ensured.

I look forward to our meeting.

Yours sincerely,

Deepak Saxena
Doctoral Candidate
Trinity Business School
Trinity College Dublin

[*] What are the factors that support or impede the process of enterprise systems implementation in public service organisations (PSOs) and how do these factors shape the outcomes of the implementation process?

Appendix-5 Ethical Statement

University of Dublin
Trinity College
School of Business

ETHICAL STATEMENT AND PROTECTION OF PARTICIPANTS

Research Topic: An exploration of factors that support or impede the implementation of enterprise-level information systems in public service organisations.

Researcher: Mr. Deepak Saxena, Doctoral Candidate

Information for Participants

1. Your participation in this research is completely *voluntary* and you may withdraw from the research at any point if you feel so.
2. Recordings of the interview will be kept in a password protected and encrypted system and will only be accessible to Mr. Deepak Saxena.
3. Transcripts of the interview will contain no reference to the identity of the participant. Participants will be referred to as Participant 1, Participant 2 and so on. Interview transcripts may be made available to the participants upon request.
4. All the data collected will be used for the academic purpose only and there will not be any commercial use. Even for academic purpose, pseudonyms will be used both for the organisation and the participants.

Should you have any queries or concerns, please do not hesitate to contact me directly at 0899 79 1772 or saxenad@tcd.ie

Appendix-6 Coding Tree

Level	First Order Code	Second Order Code	Mechanism
Macrosocial	Recruitment Embargo	External Control	Control Mechanism
	Regulatory Oversight		
	Departmental Control		
	External Audit		
	External Review		
	Benchmarking with Peers	Institutional Context	
	Financial Environment		
	Nature of Blood Operations		
	Pension Scheme		
	Procurement Process		
	Public Accountability		
	Risk Aversion in HSE		
	Being Public Sector		
	Following Best Practices		
	Following EU Directive		
	IBTS Reputation		
	Being First User	ES Market Structure	Market Mechanism
	Dominant Supplier		
	Niche Market		
	System Usage in the Industry		
	Availability of IT Resources	IT Resource Market	
	Supplier's Push	Supplier's Push	
	Hospital's Supplier	Support from Supplier	
	Supplier Location		
	Linguistic Differences		
	Relationship with Supplier		
	Supplier's Practices		
	Support from Supplier		

Level	First Order Code	Second Order Code	Mechanism
Organisational	Focus on Change Control	Change Control	Control Mechanism
	ICT Council	Internal Controls	
	Internal Control Mechanisms		
	Risk Management		
	TMT Support to Project	Top Leadership	
	Business Integration	Business Vision	Institutionalisation Mechanism
	Fragmented view of the Organisation		
	IS Strategy		
	Quality Focus		
	Risk Aversion in IBTS		
	Safety Focus		
	Operational Improvement		
	Operational Inefficiency		
	Project Initiation		
	Communication with Hospitals	Change Management	
	Communication within Organisation		
	Different Professional Cultures		
	Donor Communication		
	Organisational Boundaries		
	Supporting the Hospitals		
	Understanding Hospital's Needs		
	Understanding Impact of Change		
	Learning from Past	Organisation Learning	
	Competition for Resources	Other Organisational Exercises	
	Industrial Relations Issue		
	Organisational Restructuring		
	Single Site Processing		
	Project Leadership	Project Leadership	
	Dedicated Project Manager		
	Business Process Ownership	Project Ownership	
	Inter-departmental Tension		
	Multiple Responsibilities		
	Management Support to IT	Role of IT	
	In-house/Outsourcing		
	IT Budgeting		
	IT Credibility		
	IT Representation in TMT		
	IT Role in Project		

	IT Staffing		
	Role of IT		
	Single Point of Dependency		
	Superusers Location	Superusers Selection	
	User Buy-in	User Engagement	
	User Involvement		
	User Resistance		
	User Support		
	User Training		
	Staff IT Skills	User Exposure	
	Workarounds	Workarounds	

Level	First Order Code	Second Order Code	Mechanism
Work-system	Change Control	Change Control	Control Mechanism
	Focus on Go-Live	Project Controls	
	Incremental Development		
	ISBT-128 Project Management		
	IT Quality		
	Project Audit		
	Project Communication		
	Project Costing		
	Project Funding		
	Project Governance		
	Project Lifecycle		
	Project Management		
	Project Meetings		
	Project Planning		
	Project Review		
	Project Scoping		
	Project Staffing		
	Testing and Validation		
	Validation View of Project		
	Work Stream Meetings		
	Work Streams		
	Validation Credibility		

Level	First Order Code	Second Order Code	Mechanism
Work-system	Customisation	BPR/Customisation	Affordance Mechanism
	Limited BPR		
	Process Specificity		
	Blood Control System	ES Artefact	
	Data Migration		
	Database Integration		
	e-Financials		
	Implementing BOSS		
	Interim Label		
	Introducing ISBT-128		
	MIS Reporting		
	Special Testing Barcode		
	System Complexity		
	System Configuration		
	System Constraints		
	System Extension		
	System Functionality		
	System Maintenance		
	System Maturity		
	System Performance		
	System Quality		
	System Security		
	System Terminology		
	Following Technology Curve	Gap Analysis	
	Gap Analysis		
	Automation	Hardware/Interfacing	
	Complete Suite		
	Electronic Document Management System		
	Electronic Ordering System		
	Hardware Changeover		
	Hardware Constraints		
	Middleware/Interfacing		
	Internal Readiness for ISBT-128	IS Infrastructure	
	IS Infrastructure		
	IT Readiness of Subunits		
	Hospital's IS Infrastructure	Partner's IS Infrastructure	
	Hospital's Readiness to ISBT128		
	Local LIMS		
	National LIMS		
	Prior Exposure to System	Superusers' Skills	
	System Superusers		

Appendix-7 Patterns across Phases

Representative quotations for the Adoption Phase

Code	Progesa	eProgesa	BECS
ES Artefact	"Progesa was to be implemented because back then they had an old system which was called BBCS. And it wasn't Y2K compliant." (R5) "We had a basic system on the clinic called the BBCS, but we didn't have it on mobile clinics. We just had it on the fixed centre clinics. So, we didn't have laptops or anything like that at that time… Like, the information that was put in the BBCS was quite basic really. It was just for some donation information." (R21) "In 2003, we implemented Progesa which is system provided by a company called Mak systems based in Paris. It, for the first time, linked the donation clinic with the donor record and with all of the testing and processing technologies. So, you had a system from the beginning to the end which was controlled by a computer system. In other words, from with on given the donation, it being processed, tested, labelled and issued to the hospital, all controlled by Progesa." (R2)	"...because of the length of time taken to implement Progesa, the IBTS was left in a situation where the hardware on which it was operating had reached the end of its life and needed to be replaced. It made good economic sense to upgrade the current blood bank control system at the same time." (CPA, 2008) "eProgesa offered the facility to fully recover data from a systems failure right up to the point of failure, in contrast to Progesa which only allowed the system to be returned to the previous day's backup with the loss of all products processed in the intervening period." (C&AG, 2008)	"The reason we ended up doing eProgesa is because our hardware is gone end of life… it's more reactive than prospective." (R3) "(BECS) wasn't just the Progesa; it was the enterprise-wide system. So it covered system hardware, infrastructure system software, it covered the blood management system, which is eProgesa, included laboratory testing and distribution, covered the diagnostic system which is the patient services element of our business. It covered tissue, which is our tissue services. Also, we had a kind of our risk management system." (R3)
Top Leadership	"Once you get the leadership and the buy-in from the top …once you get the support at a senior administration level or whatever within the organisation, you can get the job done." (R3)		

Business Vision	“Traceability with blood is a very important issue. For every unit of blood donated, we must be able to say what patient received it. So, if (not clear) comes, there is a look-back over a particular donor. We have to be able to say (who donated it).” (R16) “That's a real problem I think. Because we are such a small field and we're so information-driven, it's just all information; most fields aren't in this type of need.” (R19) “Faced with such a serious threat to the blood supply, with the potential impact on patient care, the Department agreed to the board's proposals for a major IT programme, including the Progesa project.” (CPA, 2003)	“A project definition for the implementation of eProgesa, which included a business case, was drawn up in May 2004. This explained the rationale for moving from Progesa to eProgesa… eProgesa would allow the IBTS to become a world leader in blood transfusion technology.” (C&AG, 2008) “In April the IBTS hosted the International MAK Users conference. It was attended by 55 delegates from 15 different blood bank establishments throughout the world. We gave a demonstration of eProgesa which was very well received by all in attendance and has resulted in the IBTS being seen as a respected leader within this group.” (IBTS Annual Report, 2005)	“The objective of the Blood/Tissue Establishment Computer System Project is to procure an enterprise-wide off the shelf computer system (to fulfil) the operational needs of a twenty-first century blood, tissue and whole product distribution organisation maximising current technology to deliver the business need.” (IBTS Internal Documents, 2011)
Supplier’s Push		“The hardware platform on which Progesa operated was nearing end of life. Consequently, hardware support agreements could become exceptionally expensive or even unavailable and there was a need to manage this risk.” (C&AG, 2008)	“We have to do it because it the end of life (for the software). If we don't, they (the supplier) won't support any longer.” (R9) “Progesa software is towards the end of its operational life and… Mak has indicated that they could support the existing version of Progesa only around 2014 or so.“ (IBTS Board Minutes, 2010)

Representative quotations for the Acquisition Phase

Cycle-2 Code	Progesa	eProgesa	BECS
Gap Analysis	"The other company that was shortlisted in 1998 for the first version of Progesa still had not progressed beyond the US and had not an integrated system. They had two different software packages to manage, the donor side and the production side. We wanted an integrated system to manage all of it." (CPA, 2008)	"It is also not clear to what extent the Board evaluated the alternatives to eProgesa and how it proposed to mitigate the risks associated with moving to a new and untried system." (C&AG, 2008) "When we made the decision in 2004, there was no other company in the market. The other company that was shortlisted in 1998 for the first version of Progesa still had not progressed beyond the US and had not an integrated system... the company had not progressed beyond that point in 2004. Therefore, there was little point in us going to the market." (CPA, 2008)	"From an IBTS point of view, the decision was taken by the organisation to try and get one solution to cover everything; because what would have happened would have been multiple systems then trying to communicate with one another. Our main system was still going to be provided by Mak and we were going to have to have multiple, I suppose, systems then trying to communicate with them. They already provide a solution in that space." (R5).
Institutional Context	"In 1998, the Department was approached by the board which was seriously concerned that its then existing IT systems were not Y2K compliant nor was there an assurance that they could be made Y2K compliant and that urgent action was required to ensure that the board would be able to secure continuity of its operations post 1st January 2000. Faced with such a serious threat to the blood supply, with the potential impact on patient care, the Department agreed to the board's proposals for a major IT programme,	"A copy of the December 2002 Report of the C&AG, on the Financial Control and Management of the Irish Blood Transfusion Service, was distributed to Board members. It was noted that the Report was critical of the lack of implementation of the Progesa system. It was also noted that the IMB would be monitoring the implementation of Progesa and if the date is not met, that the IMB Board would decide on what	"Yeah, that's politics! Okay, I suppose there were two issues. We were getting at this thing, what we were getting to the decision-making points of this thing, right to the point of the crash hitting the country. So, there was the whole question of how much money we are going to spend. Which were, these were very legitimate questions to ask us - 'why do you need to do this?' But then what also happened at the same time

	including the Progesa project."	action to take." (IBTS Board Minutes)	was, the government introduced one of the, the cost saving measures the government introduced was the pension levy… So, along the way the department said, they were taking out all the sticks. They said, okay unless you pay over this money, this pension levy, you can't have your computer system" (R1).
Top Leadership	Representation by the Chief Executive to C&AG and in the CPA debate	Representation by the Chief Executive to C&AG and in the CPA debate	"[The CEO] eventually wrote them, says - 'That's okay. If the existing hardware falls over, and if the existing software is no longer supported, I'm sure you'll take responsibility for the impact of that on the national blood supply and the supply of that to the patient.'… They straightaway came back and said, okay go ahead." (R1)
User Involvement	"We begin with defining user requirements. This has to be done by user themselves and it has to be based on hard scientific facts. So, it will not be like - we want this and that. It has to be like - this is the specific functionality we want and these are the rules for the particular functionally. Essentially, it is about writing down exactly what do you want." (R15) "(Finding) time to look at all the different systems that are out there, and you know, the evaluation at the start, actually get time to do, to fit something of a project like that on top of your routine day is very difficult… more time should be given to writing the URS for example. Probably not enough time was put in at that stage of the process, in hindsight. Again, that's, you know, just the time, it doesn't exist. It's a case of trying to get fit too many things at one time. But there probably should be more (time)." (R16)		
User Exposure	"When blood services sit down and do the evaluation of a change from the existing computer systems to a new computer systems versus an upgrade, they find that the cost, the true cost of the change can sometimes by double of the quoted cost because… but there is actually massive training cost." (R1) "There is a learning curve for staff if a new system is brought in. In our business, we have to have proven technology. We cannot put		

	a system in that may not work." (R2)		
ES Market Structure	"When we went with Progesa, it was in New Zealand, it was in Australia, it was in Scotland, it was in several places in the US, it was in France, it was in Netherlands, it was in Finland and one or two other places as well." (R19)	"MAK System is the foremost supplier of blood bank control systems to transfusion services across the world. The Progesa system is in operation in Europe, USA, Canada, Australia, New Zealand and Asia. When the Irish Blood Transfusion Service initially purchased Progesa it followed a full tender process and there was only one other supplier short-listed for consideration… There was no evidence… that an appropriate alternative system to Progesa had come to market. Therefore, it was a reasonable course of action not to go through a formal tender process when the decision was taken to upgrade to eProgesa." (CPA, 2008)	"...we went for Request for Information first and then we had the tendering process. The request for information process came back with four suppliers. A lot of the responses didn't cover tissue system and didn't cover a patient or a risk system or whatever else…. we didn't have a conglomerate that came together and say we'll give you all these… The Mak systems came out to be clear winners because they could answer very much all the elements of it." (R3)

Representative Quotations for the Implementation Phase

Cycle-2 Code	Progesa	eProgesa	BECS
ES Artefact	"We uncovered the locking issue in March 2000, whereby one person could issue a product while another could quarantine that product simultaneously." (CPA, 2003)	"It wasn't a mature software application… Mak had converted it from Progesa to eProgesa. We probably would have been one of the first sites to go with it. So, it was, you know, for the want of a better term, it would have been the first time they were really cutting their teeth in the open market." (R3) "I think it was in 2005 we got eProgesa initially and we started to informally validate it. It was formally initially but we came across so many problems with the software and it hadn't been implemented in any country at that stage but the software wasn't really workable. So, we decided to abandon that until later on." (R20)	"The version that we are taking to go-live with is a lot more stable, without a doubt. It has been in production in organisations for a number of years. The software company providers, you know, obviously have a lot of experience now in dealing with whatever initial issues were there." (R8) "This time around it is much better. We are experienced now. We can also study and learn from the experiences of other blood banks where it has been already implemented. The product is more mature now. So yeah, this time it's a lot better." (R18)
Hardware/ Interfacing	"One of the major issues was the underestimation of costs at the beginning of the project, particularly with regard to hardware. There was a lack of appropriate expertise within the organisation to implement such a major system in a pharmaceutical grade operation." (CPA, 2003)		"So, up to while we were working with Progesa, the automates had a direct link an interface with the application, the Progesa application. When we went with eProgesa, Mak said they weren't providing us with the direct link anymore to eProgesa from the automates (and) that we had to send our results to a new

			application called eDMS.” (R20)
Superusers’ Skills	“My main problem would have been lack of knowledge of IT really at the start and that would be main thing really, do you know. Lack of confidence because of a lack of knowledge, if you know what I mean. So, like it was a huge learning curve at the time.” (R22) “Actually when I moved to IT, Progesa was already in, I think 6 months back. I was essentially hired to cover the absence of a Progesa superuser. However, there wasn't any official training per se. For me it was, a kind of, on-the-job training, you know. I'll learn the operation one day, and I am executing the actual operation the very next day. In some way it was stressful but in the other way, it was a big learning curve for me.” (R18)	“We have a lot of the same staff implementing this time. So in way, we also had a bit of an advantage because some of it wasn't brand new. We were able to say - okay, okay it was five years ago, but yeah, I kind of remember x, y or z. So we weren't looking at it necessarily for the very first time either.” (R8) “I suppose, it did (help) in that we were familiar with the system, you know. We didn't get anywhere near going live that time, much to my disappointment… But yeah, I mean, we didn't get as far as training or anything that time but I mean we were well familiar with the system. So, that definitely helped when we started it, you know when we started it up again in 2012.” (R22)	
BPR/Customisation	“A fair amount of it was the integration of the Dublin and Cork systems or deciding whether we could use both or whether we had to make one, one or the other. What I tried to do is that say - we're going to go with this and both centres have to do it. That nearly worked but not quite because people would say - yeah, we'll do that but we can't do this... Because we were trying to, we were almost doing it twice at the same time - once for Dublin once for Cork and trying to put those together. That's I think what took, what took the extra time, or a lot of extra time.” (R19)		“Though as far as BECS is concerned, we are not validating it to death. We are mainly testing it in terms of its transfer from the test environment to the real working environment. The main reason for this is that we are primarily going with the current functionality present in Progesa. It is mainly about the change in underlying technology and infrastructure, but there is not much change from Progesa in terms of the functionality.” (R15)

IS Infrastructure	"There are lot of challenges on the infrastructure as well because like, we're running all versions of windows. We're on all versions of servers. Some of our SQL databases are on old versions. Like, we're still running some from 2000." (R5) "There are 49 different hospitals. Within those 49 hospitals, there are 12 different software applications in use. Within those 12 different software applications, there are number of different versions. It's pushing upwards 18 to 20 different systems in effect." (R3)		
External Controls	"A copy of the December 2002 Report of the C&AG, on the Financial Control and Management of the Irish Blood Transfusion Service, was distributed to Board members. It was noted that the Report was critical of the lack of implementation of the Progesa system." (IBTS Board Minutes, 2003)	"(We) ended up in front of the Public Accounts Committee explaining itself why this money was spent and came out of it quite badly, to be honest with you. So, very conscious of that that had happened in the past." (R1) "There were loads of questions asked from the government point of view at that time as to why so much money was spent." (R22)	"A peer review group was set up and they established checkpoints for each of the different stages of the process. It included tender approval, budget re-approval, and then checkpoints throughout the process. They were sort of milestones." (R15) "It gave you a great oversight. It forced us to ensure that there are certain barriers we had to get through, otherwise, we couldn't progress with the project. So, I think it brought with it a discipline to the project and perhaps made sure, made focussed on delivering the project because we knew we had to get through certain barriers to get to the next phase. I think from that point of view, it (was) helpful." (R2)
Internal Controls	"The project is overseen by a coordinating committee which has membership in the Acting CEO, National Medical Director, Project Manager, Regional Director, Chief Scientific Officer, National Donor Services Manager, National Quality Assurance Manager and other	"An Executive Steering Group (ESG) was established to… Set and monitor project strategy, Assess and manage progress, Make timely decisions on project related issues, Take other IBTS projects into account and indicate to the project team	"I think also, we had used the vendor on the steering committee. By teleconference, every meeting he was there. So… the issues are being raised with the vendor at the highest level." (R2)

	heads of function in the Cork and Dublin Centres." (C&AG, 2002)	where conflicts might arise." (C&AG, 2008)	"It is in control because we put so effort into fixing the cost in as many of the elements we could on one side, but also being very challenging and scrutinising every invoice, time and material invoice that comes in. And linking it back to the work that they've said they're doing. And making sure that they itemise what they say they've done." (R1) "Internally we have a finance committee which is sub-committee of the board and project manager would present at each meeting of the finance committee project update and status of the project." (R2)
Project Controls	"Pretty much in terms of project management, the validation process, validation lifecycle process is very closely akin to project management, especially in terms of specification, design, testing, delivery, and from that, I would've done a lot of project management for the organisation for the introduction of new technologies, new test systems, new laboratories, upgrade of facilities." (R3) "It has a significant impact I would say. Here we put a great emphasis on validation reports for all the software development in IBTS. All the validation reports are sent to quality. Though there is no prescribed standard by the regulator, we follow GAMP due to the nature of the expertise. It follows a life cycle approach which matches well with our operations. We have a quality manager sitting in IT, who ensures that our IT system fulfils all the quality requirements." (R15) "So the testing structure is, we formally qualify a system initial through an installation qualification of test environment. What the installation qualification does is - it records the programs that we use and any configurable parameters in those programs, and we lock it. So that's our test environment. We do our functional testing on that. We call it our OQ tests. A number of deviations come up, we have an iterative process there where we correct it, fix it, retest, so that cycle goes on, a little bit more than you would like but it does. So we get that appointed that our OQ is okay and then we move on to the user acceptance testing. The user acceptance testing is more process based testing from the each of the different work streams; we conduct our user acceptance testing. At that point, then we have our parallel runs can take place, or parallel runs, its full system integration, as much as we can,		

	as we have the operational capacity to do. We've modelled it, it's about a third of what a maximum load day it would be. It would be equivalent of what we would do on a Monday or Tuesday. We would run that through full system." (R3)		
Project Leadership	"So, when we went for Progesa, the project was led by me… but the people on it were the head of production, the head of testing, the head of IT, and the head of quality… So, there were 4 or 5 of us who went in and looked at in the states, went in and looked at it in various places and made the decision as to what we were going to do, which way we were going to go. But by the time we decided, and it was a six-month project, we were pretty familiar with how the system worked. We were also pretty familiar with how our system worked. We could see how the project was going to work and how it was going to be done. We then led the project over the next several years." (Progesa Project Manager)	"But the big thing we did not do the last time is that we did not bring in an outside project manager. We said - 'we're going to run it from IT with current resources that were (available)'. So, the project manager I think was going to be the head of, the project management was run by the CEO and the head of IT." (R19)	"The project management a little bit more removed from the actual technical piece this time around I guess." (R8) "I suppose there was a designated project manager this time. The last time, the IT manager was trying to do it and be the IT manager as well." (R22)
Superusers' Selection	" When Progesa came in, staff were moved to be superusers; and they worked as superusers full time. The same superusers, the girls in Cork, came like, (superuser 1) came from the clinic, or from the labs, (superuser 2) came from the clinic. They are still superusers." (R8) "There are 4 application specialists for Progesa… They actually came originally for Progesa. They came out of the business units. They came from the laboratory, like the testing laboratory, the manufacturing laboratory, the collections team, the nursing medical side, and then the donor services the recruitment side." (R5) "The point of having, I suppose, a user that has knowledge and (who) understands the process, is the... You can just come in, and you know, you understand the system rather than having to have somebody to come in and spend 3 weeks explaining what to do, and then trying to figure it out."(R7)		
Project Ownership/ Role of IT	"They see it as an IT project, whereas we wouldn't see it as an IT project. I would call likes of Windows 7 or, you know, an implementation like that primarily an IT project, as distinct from (BECS). This is an application that they use. It has to be owned by		

	the business. It has to be owned by the business and that's the piece.” (R5) “People were appointed to the team, the kind of bigger project team, but not all of them... either were made by their respective managers get involved to the levels they should have been involved or chose not to involve at the level they should have involved. There were some elements that came very late to the game. They should have been onboard and getting involved a lot earlier, and taking those responsibilities a lot earlier. What IT tend to do is we pick up what other people drop. That is just the nature of what we do. I think it's just a mindset.” (R8)		
User Engagement	“Then, just, that was the whole thing in the project then, you know, trying to bring people along and, there was huge resistance to it because people were so used to the old (BBCS).” (R22) “Since the people have got so used to Progesa, selling (BECS) to these people has become a big challenge. Yeah, now people are more comfortable with the systems now, but they refuse to see the benefits of the new system.” (R18) “You should remember that here people have their own regular core job. For example, my people mainly have quality and validation job - IT comes after that. People in labs have their own work to do. So it would not be possible for anybody to work on another project after these.” (R15) “We've been very busy. We have been struggling to get through the day to day work which has to be done. We can't leave patients without the blood. We can't not monitor the antibody in pregnancy. So, to take on another project on top of that is the most difficult aspect of it for us at the moment.” (R16) “We weren't very happy with the way parallel runs were conducted and there was no sign off of the parallel runs as they went along. We asked for reports of parallel runs and we only got it, kind of, we would go live on Monday and I got the report on Thursday pre-go-live. And then there were all these issues that weren't closed out.” (R6)		
Change Management	“We went from being completely manual to actually having laptops and computers. That was extraordinarily stressful because it was such a big change. You had people who did not know how to turn on a computer, suddenly sitting down trying to figure it out - F11 and F8 and all these different buttons.” (R7) “For most of the end-users, they were using computers the very first time. So it was not just training for Progesa, but also it was their first		“Because the navigation of it is very similar to the old system, I think that's why we, that's why the training wasn't didn't have, the training at the last minute didn't really impact because the navigation is so similar to the old system.” (R22) “I think we completely underestimated the impact of the change of the label, the product label from the Codabar

	exposure to work with computers. So the lack of computer literacy was one of the biggest challenges which (IBTS) faced in the beginning." (R18)		coding system to the ISBT 128 system, we completely underestimated the impact of that on the hospitals." (R1) "I feel that we never really anticipated the consequences of change in labelling system for our customers and we didn't have proper communication with them regarding the change." (R15)
Other organisational exercises	"In 1999 and 2000 the IBTS was planning to move its headquarters and processing and testing facilities in Dublin from Pelican House to James's Street... Considerable resources were devoted to the implementation of a number of IT projects, i.e., a new payroll system, financial control system, and a blood bank control system, to the establishment of a decentralised collection centre in Carlow and to the move to the headquarters in James's Street." (IBTS in CPA, 2003) "Subsequently, industrial relations problems arising in 2001 prevented the implementation of the system as the Labour Court became involved in dealing with re-grading claims." (C&AG, 2002)		"Prior to October 2015 processing of components was carried out in two sites, the National Blood Centre in Dublin and the IBTS Centre in St Finbarr's Hospital, Cork. The Board decided to consolidate processing in one single site and this was implemented over the October Bank holiday weekend." (IBTS Annual Report, 2015) "The emphasis was then very much totally on Dublin because there was no point, I mean, while the people in Cork weren't too happy about (it). I think they would have felt that they were being left behind. There was no point in making major changes in the system to help them in Cork." (R22)
Support from Supplier	"The supplier refused to accept that there was a problem with the software and it was with our procedure rather than with their software. This	"In a single sentence, it was incredibly stressful. I still remember those horrible times. We were the first blood bank	"...their key personal changed during the course of the project. Senior or key people from the company left. So,

	involved serious retesting of the system. In July 2000 the supplier acknowledged the existence of a problem with the design of the locking issue. However, it was unwilling to fix it in our version 4.4E, but it would in a future release. The locking issue resulted in a delay of nine months and a cost of €524,000." (CPA, 2003)	implementing eProgesa and the entire world was looking at us. We were being treated as guinea pigs. There was no other blood bank which we could look at. And to be honest, Mak are a difficult supplier to deal with. There was absolutely no support from the Mak systems." (R18) "If you identified an issue, we would send them to (the supplier) and sometimes you would find it quite difficult to get a response back from them, you know. You might have to send an issue again, or it will take a while for the issue to get an answer to the issue." (R21)	there was a long, there was a big learning curve for another person who replaced him." (R2) "When we went with eProgesa, Mak said they weren't providing us with the direct link anymore to eProgesa from the automates (and) that we had to send our results to a new application called eDMS. It collects all the results from there and sends to the results onto eProgesa. So, that's another interface." (R20) "None of the current suppliers won the tenders. So, they had no incentives to invest or to maintain or to upgrade their systems. So, the systems are all badly maintained, badly developed. They are out of date now mainly because nobody had upgraded them since six years ago." (R19)
IT Resource Market	"We required IT resources and people with those skills, and from 1998-2000 those people came at a premium price because of the Y2K situation… There was a high staff turnover during the project. We have our fifth chief executive officer since 1996 and we have had three IT managers since 1998." (CPA, 2003)		"I can tell you the example of our DBA who left… because he understood that he has to single-handedly manage more oracle servers after the implementation of eProgesa… He also got to know that in the industry he could get higher salary compared to what he was getting here. And now he is gone and we have to manage with only one DBA who is on contract." (R19)

Representative Quotations for the Use and Maintenance Phase

Cycle-2 Code	**Progesa**	**BECS**
ES Artefact	"The CEO informed me that, although the software licences were acquired for eProgesa, the IBTS was able to use these for other applications. The hardware acquired is currently being used to replace Progesa hardware. The CEO stated that the technical specification of the hardware is greater than is required for Progesa but has the benefits of greater performance and resilience. The IBTS is also utilising it in other operational areas rather than investing in new hardware." (C&AG, 2008)	"Because of the nature of the way it is architected, to make changes you have to stop the application. I know that's a safety feature as much as anything else, most new application, modernly architected, you know applications would be like that. You've got to stop the application services, stop database services and things to implement changes. Progesa was never that way. You could nearly implement them on the fly… That's definitely going to be a new reality for the organisation and a new challenge for the organisation because we are going to have to build in maintenance windows and schedule them in a way." (R8) ""So, it just means that you would tell people - we will be doing our changes on a certain day. Like, if you have change, I would say to say - 'well, the next scheduled parameter change is such a date; so, it will be done then.' So, you can kind of tell people more or less when it will be done. You know, that's a difference really I think in making parameter changes than that with Progesa." (R21) "A decision has to be made regarding the Semester patch for eProgesa before the end of the year." (IBTS Board Minutes, 2016)
Change Control	"The very first thing I realised (when I came to IBTS) was that there was an insane amount of change control and very high level of validation. Earlier I didn't realise but when I spoke about it with my friends in the Pharmaceutical industry, they were also surprised about the level of validations and quality control here. To be fair, it is required for the safety of the patients and probably that's why it	

	is pretty stringent." (R18) "There still is a delay in between where you identify you want to develop a new report or you want to get more information; or you want to modify that report, you have to till go through a change control process, you have to go through the quality system. You have to go through a development system, you have to go through a validation system and then at the end of all of that, you get a report. As I said, it is frustrating the length of time that it takes to actually to get done… like, a simple modification report which you would think - okay and just changing this report I want to insert additional information." (R24)	
Mandatory Use	"One of the major goals of the IBTS was achieved in 2003 with the successful implementation of the Progesa project; it went live in Cork and Limerick centres on 18th March and in all other centres on 8th May… Blood Bank Control System... is now used for look back only as not all data in this system was migrated to Progesa." (IBTS Annual Report, 2003)	"We'll leave Progesa running; we'll do the data migration process. Then we've qualification process and set up processes, but we would expect to be moving over to eProgesa at 4 o'clock the following day. So, Progesa will be gone, eProgesa will be up. We can't afford, we can't do a parallel implementation." (R3)
User Exposure	"The main problem I faced while training the users. You know, for most of the end-users, they were using computers the very first time. So it was not just training for Progesa, but also it was their first exposure to work with computers. So the lack of computer literacy was one of the biggest challenges which I faced in the beginning." (R18)	"The main element is with the testing and it's only an upgrade (of) what we have already. There is little change, you know." (R6) "The huge difference with eProgesa was that every single member of staff that we trained, they're familiar with the computer; they're familiar with the keyboard; they're familiar with navigating around the screen because they can all do that." (R17)
Workarounds	"What we had done to solve that problem in the short term was to develop an intermediate solution which stopped sending repeat numbers to particular hospitals. So, we could pick product for the hospitals, then we had to check that the hospital never received that number before and if they did, we had to substitute the product with another one and send it to them… that was a workaround." (R1) "...in the past, we had two coding systems going on. We had the operations code, and we had the finance code...We had our own product code but we had it, we had code and then we had the Codabar	"We had other difficulties with labelling in that the new system operates with an ISBT 128 label; and our machines were not compatible with ISBT 128. So, we had to put it in an additional step now to covert the ISBT 128 donation numbers into Codabar numbers, so that we could enter the sample reference numbers into the machines, into the testing machine, into the testing equipment. So, that was a significant issue." (R23)

	code in the product description, so you could map it that way." (R10)	
Supplier's Push	"The CE outlined the background to the decision on this matter. He pointed out that the priority was to stabilise the current version of Progesa on new hardware as HP won't guarantee service on the existing servers." (IBTS Board Minutes, 2009) "It was noted that the lead time for any new Blood Bank Control System would be 2 – 3 years. MAK have indicated that they will support the current version of Progesa until at least 2014 but will not give a definitive date." (IBTS Board Minutes, 2010)	

Representative Quotations for the Evolution Phase

Cycle-2 Code	Progesa	BECS
ES Artefact	"We were very limited in Progesa as to what, you know there was a standard report and it wasn't meeting our requirements really" (R20). "So, you get a call from a hospital and they say it to you I want 10 units of O negative irradiated product or not irradiated whatever. You hear it incorrectly or you write it down inappropriately, there were mistakes made in orders going to hospital order" (R2).	"There is a system of iReports which basically develops letters and reports from eProgesa" (R24).
(Partner) IS Infrastructure	" I've to say the quality of IT support within the hospitals is very very poor, you know. They wouldn't have the personnel on the ground. So you could actually be talking to a scientist who is trying to get this to work; but they wouldn't have the IT background" (R5). "(Electronic Ordering System) is now live in 6 hospitals. It is proving difficult to contact the relevant IT personnel particularly in the smaller hospitals. The issue of two hospitals sharing the same IP address is still unresolved" (IBTS Board Minutes, 2011). "Because we deal with hospitals. It took us years even for hospitals to get us to paying through the bank. They were all cheque." (R9)	"(By providing dual labels) we've given the hospitals the capacity to migrate across at their time. So, there is no impact going forward for us, if they move or one of them didn't move" (R3).
Project Controls	"We did specs for every one of them (for BOSS reports) and then tested them against the spec. Got them built, got them in, had a look at them, got them refined, then validated them. So, that's how we did it." (R4) "EOS, it was a disaster of a project to be very honest with you. Now, solution in the end, works. Right! EOS was born out of our director of Operations and our Head of processing approaching member of IT directly and asking could we do something. While he was willing to do it in fairness, there were no controls put in place. He provided something;	

	they thought it looked good. Personally it didn't" (R5).	
Project Leadership	"(BOSS) was (operations director's) idea. He had seen it or came across it. He has come-in to the business with no background in medical scientific at all. He came in as an operations director with wanting something different. He wanted to know - 'How many donors have come-in last night? How many were coming tomorrow? How could we predict it was coming?'" (R4) "Typically, most of the projects in the organisation are managed by somebody who is in an area and they run the project as well, that in their area. This was the first time we (had appointed)… a dedicated project manager and that was crucial to getting BOSS over the line." (R1)	
Project Ownership	"We literally started like this saying - So, they had this whole system of what was the report number, what was its name, all that kind, and who owned it? So we set up that kind of system then - who was the owner within IBTS of the report, and they were responsible for specing it." (R4) "Project Manager (provided) a positive contribution but accepted too much ownership… (BOSS was an) Enterprise-wide system without enterprise-wide ownership" (IBTS internal document).	
Integration with other systems	Laboratory Automate Interfaces: "A number of developments in this area have taken place in 2003 where results from various laboratories testing equipment are passed to Progesa. MRTC Autovue is used to cross match samples for patients, this interface was validated and implemented in the 2003. NBC NAT is used for the transfer of results for NAT testing to Progesa for all samples taken nationally. Development and validation of the transfer mechanism was completed towards the end of 2003." (IBTS Annual Report, 2003)	"Phase 2 will move us on to, being able to make appointments for donors at our clinics, a donor relationship management system" (R2). "There is piece within BECS phase 2 with Mak having an application for an online ordering system… (it) doesn't quite… meet our requirement 100%, but what I would be recommending is we actually work with them and develop it" (R5).

	"We have now got, we have dependency on 3 systems - we have BOSS, we have, this is only just but this isn't all our systems but we have BOSS, we have eProgesa/Progesa, we have the electronic ordering system, in that side, not to mention eFinancials which is the system to get the payments out." (R4)	
ES Market Structure	"BOSS is the system that the New York Blood Centre developed where one their guys interrogated the mainframe Progesa system and was able to extract, transform and load, an ETL file that took relevant data, whatever you want it out and put it in, I suppose, an Oracle type database. You could write whatever business report you wanted." (R4)	"(Mak Systems) bought BOSS, from New York. They bought it and they are going to, well, kind of shelve it and develop their own version, I presume in eProgesa, and develop that sort of a suite for people to use, the business side of the, you know, business reports I suppose." (R4)