A Transformational Model to Understand the Impact of Enterprise Systems for Business Benefits

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Abstract

Over the years many organizations have implemented an enterprise system (ES), also called enterprise resource planning (ERP) system, to streamline the flow of information and improve organizational effectiveness to produce business benefits which justify the ES investment. The effectiveness of these systems to achieve benefits is an area being proactively researched by both professionals and academia. However, most of these studies focus on 'what ESs do' rather than 'how ESs do it'. The purpose of this study is to better understand how organizations derive benefits from utilization of an ES and its data. This study utilizes a transformational model of how ES data are transformed into knowledge and results to evaluate the impact of ES information on organizational functions and processes and how this can lead to business benefits. The linkage between expected outcomes, utilization of ES data in decision-making processes, and realized or unrealized benefits provides the reason for this study.

Findings reveal that the key benefits commercial firms seek from an ES include improving information flow and visibility, integration and automation of functions, cost reductions by reducing inventory, and achieving process efficiencies for both internal and external operations. The various tools and methods businesses use for transforming ES data into knowledge include the use of data warehouses and business intelligence modules that assist in extraction and manipulation of data, and reporting on particular data objects. Web portals are actively utilized to collaborate between stakeholders and access real-time information. Business tools such as KPI reporting, balanced scorecards and dashboards are used to track progress towards realizing benefits and establishing analytical decision making.

Findings emphasize that benefit realization from an ES implementation is a holistic process that not only includes the essential data and technology factors, but also includes other factors such as business strategy deployment, people and process management, and skills and competency development. Findings reveal that business organizations generally lack in producing value assessments that often lead to weak business cases and insufficient benefit models which cannot be used for benefit tracking. However, these organizations are now realizing that it is not enough to put in an ES and expect an automatic improvement. Organizations are now establishing analytical and knowledge-leveraging processes to optimize and realize business value from their ES investment.

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List of Publications

The presentations and publications that have been published from this research so far are:

Journal Publications and Book Chapters

1. Mathrani, S., Viehland, D., & Rashid, M. A. (forthcoming 2010). Enterprise Systems Maturity: A Practitioners' Perspective, *Pacific Asia Journal of the Association for Information Systems* (http://journal.ecrc.nsysu.edu.tw/pajais/).

2. Mathrani, S. & Viehland, D. (2009). Business Benefits from Enterprise Systems Implementation in Small and Medium-sized Organizations, *the Australasian Journal of Information Systems, vol. 16, no. 1,* pp. 31-50 (http://dl.acs.org.au/index.php/ajis).

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Conference Papers

1. Mathrani, S. and Viehland, D. (2007). *Business Benefits from Enterprise Systems Implementation* at the 18th Australasian Conference on Information Systems (ACIS 2007), December 5 - 7, 2007, Toowoomba, Australia (http://www.acis2007.usq.edu.au/assets/papers/70.pdf).

2. Mathrani, S., Viehland, D., & Rashid, M. A. (2007). *Enterprise Systems Implementations in New Zealand: A Practitioner's Perspective* at the 11th Pacific Asia Conference on Information Systems (PACIS 2007), 4 - 6 July 2007 at Auckland, New Zealand (http://aisel.aisnet.org/pacis2007/112/).

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5. Mathrani, S. & Viehland, D. (2005). *Using Knowledge-based Processes to Improve Enterprise System Effectiveness* at the International Conference in Knowledge Management in Asia Pacific (KMAP 2005) held on 28 - 29 November 2005 at Wellington, New Zealand (http://kmap2005.vuw.ac.nz/papers/Using%20Knowledge%20based%20Processes.pdf).

6. Mathrani, S. (2005). *A Contextual Framework to Understand the Impact of Enterprise Systems for Business Benefits* at the Qualitative Research in Business Symposium (QRIB 2005) held by College of Business, Massey University Albany campus on 28 October, 2005 at Albany, New Zealand (http://qrib.massey.ac.nz).

7. Mathrani, S. (2005). *A Contextual Framework to Understand the Impact of Enterprise Systems for Business Benefits* at the 2nd IIMS Postgraduate Conference (IIMS-PGC 2005) held at Massey University, Albany campus, on the 27 October 2005 at Albany, New Zealand (http://www.massey.ac.nz/~iimspg/2005conference/call.html).

8. Mathrani, S. (2005). *A Contextual Framework to Understand the Impact of Enterprise Systems for Business Benefits* at the Doctoral Consortium of the 9th Pacific Asia Conference of Information Systems (PACIS 2005) on 6 – 7 July, 2005 at Bangkok, Thailand (http://www.pacis2005.ku.ac.th/).

Chapter 1

INTRODUCTION

Increasing economic globalization, intense competition and rapid technological developments have made businesses look for ways to reduce costs whilst improving efficiency and effectiveness. Increasing the speed and accuracy of information and streamlining the flow to optimize business performance has become a compelling concept. To achieve all of this, large and medium-sized organizations have realized the need to implement enterprise system (ES) software (also called enterprise resource planning system or commonly ERP) since 1990's to achieve integration of business activities (Dalal, Kamath, Kolarik, & Sivaraman, 2004). This off-the-shelf business management system software integrates various disparate facets of business including planning, production, distribution, sales and marketing, finance, and human resource management into one integrated business system and the major benefit is sharing of information. ES applications constitute well-structured, reliable information technology (IT) backbones of Fortune 500 companies worldwide (Hofmann, 2008).

Some authors define enterprise systems broadly, to include all enterprise application systems or enterprise-wide systems. These include enterprise resource planning (ERP), customer relationship management (CRM), supply chain management (SCM), advance planning and scheduling systems (APS), knowledge management systems (KMS), sales force automation (SFA), and Web-based electronic commerce systems. However, for the purposes of this study, an ES is considered the same and equal to an enterprise resource planning system and includes any extended modules to the ERP system such as SCM or CRM modules.

The implementation of enterprise systems is "perhaps the world's largest experiment in business change" and for most organizations "the largest change project in cost and time that they have undertaken in their history" (Davenport, 1995, p. 32 cited in Hedman & Borell, 2002, p. 79). The adoption of ES by industry, "may in fact be the most important development in the corporate use of IT" (Davenport, 1998, p. 122). A 2001 research study of 800 US organizations found that ES comprised 43% of an organization's IT software funding requirements and about half of these organizations had already implemented an ES (Hawking, Stein, & Foster, 2004). Furthermore, an AMR Research study of over 550 companies on their ES investments revealed that 70% of organizations with employee strength 2,500 or more have already implemented an ES (Reilly, 2005).

Ragowsky and Gefen (2008, p. 35) note that ES implementation is expensive. "The cost of implementing an ES – software, incremental hardware, training and implementation support – may reach US$200,000 for a small company (approximately $10M to $20M annual sales), $600,000 to $800,000 for a midsize company (approximately $40M to $80M annual sales), and several million dollars or more for a larger company".

Notwithstanding the costs, there are several factors that have led to the growth in ES adoption, "the need to streamline and improve business processes, better manage information systems expenditure, competitive pressures to become a low cost producer, increased responsiveness to customers and their needs, integrate business processes, provide a common platform and better data visibility, and as a strategic tool for the move towards electronic business" (Foster, Hawking, & Stein, 2004, unpaged).

Enterprise systems often require years of implementation and post-implementation; they become part of the business and support tactical movements and strategic direction. A successfully integrated ES can enhance operational efficiency by supporting a firm's business processes as well as create competitive advantages by enabling innovative practices (Chen, Law, & Yang, 2009). An ES promises benefits of reengineered and improved business processes, increased organizational integration and improved information dissemination. All enterprise system vendors claim that an ES implementation results in improved organizational effectiveness, through better inter-business unit integration, enhanced productivity, and improved business practices (Davenport, 2000). In fact this concept has been so compelling, that organizations have acted fast to implement ES earlier than competitors because of a fear of being left behind. However, reality has not matched promises and outcomes have not turned out as expected. Despite a few dramatic successes and some moderate achievements, many organizations have failed to realize the ES implementation benefits while having incurred major costs and financial overruns (Chen et al., 2009; Lui & Chan, 2008; Poon & Yu, 2006).

There are several questions that remain unanswered: "Why do some implementations fail, even though most of the critical success factors (CSFs) were controlled? Similarly, why are some implementations considered successful by some people while considered failures by others?" (Shaw, 2003, p. 155). The only thing known for certain is that implementation is very resource intensive in time and cost. Companies are realizing that improved organizational performance as a result of ES implementation is only possible through better understanding of business processes and utilization of resources. Having more and more data does not necessarily lead to better business practices.

Hershey's, a confectionery company with a US$4 billion per annum revenue, lost $150 million in sales soon after going live due to logistical issues, after having spent US$112 million for their SAP implementation (Carr, 2002). FoxMeyer Health Corp., a US$5 billion per annum revenue pharmaceutical giant ended up filing for bankruptcy and sued SAP and Anderson Consulting "for US$500 million each" after its SAP implementation failure due to system integration issues (Scott, 1999, p. 223). Similarly, a Standish Group report revealed that ES implementation projects were "on an average 178% over budget, took 2.5 times as long as intended, and delivered only 30% of promised benefit" (Krumbholz & Maiden, 2001, p. 186).

Further, it has been estimated that 66% of ES implementations incurred "project cost overruns" while 58% suffered "project delays" and 42% experienced "conflicts with business strategy" (Themistocleous, Irani, O'Keefe, & Paul, 2001, p. 4). In a study by ICT management consultancy Robbins-Gioia LLC found that 51% of companies across a wide range of industries stated that their ES implementations were unsuccessful (Robbins-Gioia, 2002). Other studies reveal that half of the ES implementations have failed to realize the expected outcomes (Jarra, Al-Mudimigh, & Zairi, 2000; Klaus, Wingreen, & Blanton, 2007). In a review of 117 organizations carried out by The Conference Board, 40% of ES implementation projects failed to meet the business case (Chen et al., 2009).

Organizations do not implement an ES just for transactional data recording or as an accounting package. ESs are implemented to improve an organization's effectiveness and produce an overall impact (Davenport, 1998, 2000; Markus & Tanis, 2000). ES solutions provide decision support to managers based on accurate information reflecting their existing business status as well as connecting and managing information flows across multifaceted organizational structures (Davenport, Harris, & Cantrell, 2002). ESs are implemented to bring about definite business benefits which justify the investment. Donovan (2003, unpaged) states that "return on investment (ROI) comes from process improvements ES supports and not from new ES software". The distinction is that "ES software alone, no matter how good it is, makes little impact on improving business performance". If organizations continue following "the same pre-ES business processes after implementation, they can expect the same or possibly worse performance". Although ES applications can support many new processes, the changes cannot be enabled without the company deciding on its acceptance and use. By transforming the earlier business practice to a faster and improved process that better satisfies the customer requirements at a lower cost can result in positive ROI and, "if that is done well, it will be a winner".

In a *Harvard Business Review* article Warren McFarlan (1984) suggested that an organization might be able to realize strategic benefits in the business environment with the use of information and communication technology (ICT). This has been frequently referred to and

elaborated by researchers (e.g., Nolan & McFarlan, 2005). Ragowsky and Gefen (2008, p. 33) have found little evidence in support of this empirically, specifically in the case of ESs, where ICT is expected to impact significantly. They say it depends on the "specific operational characteristics of each company" and the usability of ES. Sharma and Gupta (2003, p. 7) have, however, noted that "only the most strategically intelligent businesses will remain competitive and thrive in global, Internet-worked economy – those that have an enterprise-wide view of key business operations and have the tools to link business strategy with operational execution".

The next generation or second-wave enterprise system software has evolved from vendors such as SAP and Oracle and has been taken up for adoption. These applications are "promising to improve flexibility, implementation, and support for the extended enterprise through modules for customer relationship management, advanced planning and scheduling systems, supply chain management and collaborative commerce in a Web-based environment" (Dalal et al., 2004, p. 84). Consulting firm Gartner Group notes that the new generation of ERP, which they call ERP II (Zrimsek, 2002), will necessitate replacement of existing ESs, "thus requiring companies to upgrade" (Dalal et al., 2004, p. 84).

AMR Research (2007) has reported that the market for enterprise systems grew by 14% in 2006 to become a US$28.8 billion business. Its annual compounded growth rate is likely to continue at 7% and be worth more than an estimated $50 billion by the year 2011. This is an opportune time to explore the relationship between ES data and business benefits, when many organizations have already implemented such systems and are considering upgrades, and when many more are considering their first implementation. Whilst ES technology has matured, given the mixed results, companies are still unsure about their implementation decision. Rejecting enterprise systems software altogether would not be wise, given the success many companies have realized from their ES investment. At such a juncture, to determine the effectiveness of ESs and impact of its information on organizational benefits would be of immense importance to both academics and practitioners, especially those organizations considering new or upgraded enterprise systems. The issues of enterprise systems effectiveness as assessed in the post-implementation phase and possible linkage of system outcomes to business benefits provides the reason for this research study.

1.1 Aim and Purpose of this Study

A number of research studies have been conducted to establish and understand the critical success factors for ES implementations (e.g., Allen, Kern, & Havenhand, 2002; Bancroft, Sep, & Sprengel, 1998; Chen et al., 2009; Daneva, 2004; Holland & Light, 1999; Lui & Chan, 2008; Pairat & Jungthirapanich, 2005; Parr & Shanks, 2000; Sarker & Lee, 2000; Scott & Vessey,

2002; Skok & Legge, 2001; Sumner, 1999; Yang & Seddon, 2004). However, there has been little research to understand the effectiveness of enterprise systems in the post-implementation phase and to establish that enterprise systems have actually contributed to business benefits or organizational improvements (Hedman & Borell, 2002; Ifinedo & Nahar, 2006). This makes it difficult to draw explicit conclusions on the impact of ES on organizational performance (DeLone & McLean, 1992; Hedman & Borell, 2002; Ifinedo & Nahar, 2006). "Very few studies have gone beyond looking at implementation to tackle issues related to longer-term usage and the impacts of these technologies on organizations" (Gosain, 2004, p. 152). Given the significance, cost, and risk of enterprise systems projects, it is essential to examine and understand the impact of enterprise systems on the decision-making process for producing organizational benefits. Hedman and Borell (2002, p. 91) suggest future research should address "the critical effectiveness constructs of an organization, which can be mapped to enterprise systems".

Davenport (2000, p. 203) notes that one of the key mistakes most companies make is that they consider an ES project as complete when the system goes live, which significantly bounds their capability of realizing benefits. "They view the output of the system as a set of information transactions and do not take advantage of the information to manage the business differently". Enterprise systems do a good job of automating, integrating, and optimizing business processes. However, according to Davenport, potential benefits can also be captured by the utilization of the high quality information which an ES provides, to make improvements in and "even transformation of management and reporting processes" (p. 204).

The purpose of this study is to better understand how organizations derive benefits from utilization of an enterprise system and its information. It does so by evaluating how ES data are transformed into ES knowledge and how ES knowledge leads to business benefits in an organization.

1.2   Research Questions

In this study, the pursuit of business benefits from enterprise systems is conceptualized as a series of steps that begin with goal seeking and conclude with realization of benefits. The stages mirror the typical decision-making process. The research questions addressed in this study are:

1. What key benefits do organizations seek through the utilization of ES and its information?

2. How are ES data transformed into knowledge in relevance to the benefits sought?

3. How is ES knowledge utilized to make business decisions for the realization of the benefits?

4. What are the critical success factors for this transformational process to produce benefits?

Thus, this study evaluates the utilization of ES and its data to support analytical business decisions and how this leads to anticipated benefits. Yang and Seddon (2004) have noted that no previous study has found a theoretical link between ES benefits and critical success factors (CSFs). They found several studies that examined benefits from an ES implementation and also several studies which sought to identify the CSFs for enterprise systems, but none of the studies focused on both benefits and CSFs from ESs. In addition, Yang and Seddon (2004, unpaged) have stated that "the CSF studies have been criticized for lack of theoretical insight linking CSFs to benefits". Finally, most CSF studies "lack a theoretical framework that adequately explains why the investigated project and business outcomes occur". Therefore, these studies contribute little to the understanding of ES implementations (Robey, Ross, & Boudreau, 2002, p. 20 cited in Yang & Seddon, 2004).

The present study proposes to bridge these gaps. This study develops and utilizes a model of how enterprise system data are transformed into knowledge leading to outcomes which result in business benefits. It also utilizes a framework of critical success factors for enterprise systems to support the development of the above model and guide the analysis. Using these frameworks, the impact of enterprise systems and ES data for realization of business benefits is evaluated.

In this study three in-depth case studies are used to gain insights into the practices of three organizations which have implemented enterprise systems. For reasons discussed in Chapter 3, qualitative research methodology is utilized to explore the effectiveness of enterprise systems. The empirical data are collected from two large organizations and one small and medium-sized enterprise (SME) who have implemented enterprise systems for at least three years and are in the mature phase of implementation. The three case study organizations are identified through a preliminary study in which the guidance to case selection is given by experts from the ES industry (i.e., ES vendors, ES consultants, and IT research firms) who are the most knowledgeable in this field.

Semi-structured interviews, organizational documents, observations and practice publications are used to collect the information. The empirical data are organized, integrated, and analyzed to develop a theoretical account of findings. These are further analyzed with published literature to provide deeper insight into post-implementation ES practices and challenges. The inferences, both descriptive and tabular, are reported as a case study report.

1.3   Contribution of the Study

This research study explores the utilization of enterprise system technology and its information to achieve business benefits in organizations. Existing ES literature is synthesized to support the development of a holistic framework that establishes the process of benefit realization from ES data in an organizational context. The framework establishes the transformational processes that effectively relate to the organizational requirements in the current business environment to produce benefits utilizing ES and its information. A summary of the contribution of this thesis is as follows:

1. Recognition of the factors that affect the benefit realization process and examination of the benefits realized through the utilization of an ES and its information. The thesis uses three case studies to empirically explore the process of benefit realization from ES implementation as a result of ES data transformation. Empirical findings have indicated that the transformational process is an on-going improvement initiative in organizations as practitioners strive to better utilize their ES technology and constantly improve their business practices. This study examines the benefits organizations achieve through new initiatives and process improvements utilizing ES and its data. The focus of most research so far has been on "what ESs do" rather than "how ESs do it", which is a contributing factor of this study.

2. This study explores and explains how practitioners use enterprise systems and its data in various organizational functions and processes and specifies the critical effectiveness constructs or key 'enablers' for the transformation process. Although existing literature provides substantial information on the CSFs for the process of initial ES implementation, there has been little or no evaluation on the factors that affect the benefit realization process in the post-implementation phase. The study identifies the issues that relate to the successful outcome of the transformational process. Critical success factors are recognized as organizations mature with their ES adoption, effectively utilizing resources and integrating processes to realize benefits.

3. The development of a transformational model for evaluating the process of ES data transformation and results. The holistic model is based on existing ES theory and is developed to encompass the three vital phases of the transformational process – contextual phase, transformation phase, and outcomes phase – that lead to the realization of benefits utilizing enterprise systems and its data. This model analyzes ES benefit realization practices in organizations and would assist researchers in exploration and evaluation of ES benefit studies in future research. Additionally, theoretical and empirical findings inform

each other resulting in further enhancement of this model into a transformational cycle model as an outcome of this study. This new model modifies the existing sequential start-to-end framework of the transformational model into an on-going cyclic process. This model presents the phases of contextual factors deployment, knowledge transfer processes, evaluation of outcomes, and business performance management as a cycle of on-going improvement in which organizations continue to realize benefits progressively. This model depicts the current organizational environment more accurately and contributes to the literature.

4. The research methodology in this study provides the relevance and rigor required from both the practitioner's perspective and academic research through an idiographic, postpositivist approach to investigate the ES benefit realization process. The process includes a preliminary study that gains insights into current ES implementation practices in industry from the unique perspective of ES vendors, ES consultants, and IT research firms. The repository of knowledge this community has is shared with the reader, which is a distinctive contribution of this study. This is followed by the main study, with three in-depth cases. The research design takes account of environmental variations and differing influences in the attitudes and perceptions of the study participants. The study organizes the data collection and analysis using the theoretical propositions to compare the findings with extant literature providing the required relevance, rigor, and insight into the study.

5. This study empirically examines the methods, tools, and techniques used in multiple case studies for ES data transformation, knowledge creation, and realization of benefits. Finally, the study develops and presents a new model for ES data utilization in strategy for achieving organizational goals and objectives based on the research findings. This model describes the process of how organizations utilize their knowledge assets (e.g., ES data) in conjunction with knowledge-based processes (e.g., balanced scorecard) using knowledge management enablers (e.g., business intelligence system), to monitor business activities for various new projects and initiatives, and realize the strategic objectives of the company. This is another distinct contribution.

1.4   The Conceptual Framework of the Study

Figure 1 illustrates the conceptual framework or roadmap of this study. This conceptual framework concisely explains the background of the research problem, problem statement, purpose of the study, research questions, theoretical context of the study, research methodology, analysis and reporting of findings, and the conclusions and implications of the study.

Background of the research problem

Enterprise systems are, in most cases, implemented to improve organizational effectiveness and bring about business benefits which justify the investment. However, not all implementations achieve the desired benefits. Establishing the linkage between expected outcomes, utilization of ES data in decision-making processes, and realized or unrealized benefits provides the reason for this study.

Problem statement

To understand the impact of ES to achieve business benefits, it is essential to examine how organizations derive benefits utilizing ES information through the process of ES data transformation into knowledge and results.

Purpose

The purpose of this study is to better understand how organizations derive benefits from the utilization of enterprise systems and its information.

Research questions

1. What key business benefits do organizations seek through the utilization of ES and its information?
2. How are ES data transformed into knowledge in relevance to the benefits sought?
3. How is ES knowledge utilized to make business decisions for the realization of the benefits?
4. What are the critical success factors for the transformational process to produce benefits?

Theoretical context

- Business benefits from ES implementations
- ES data transformation by the process of analysis and decision-making leading into outcomes and results
- Knowledge management and business intelligence

Methodology

A multiple case study research design using three cases and three levels of analysis:
- Business benefits organizations seek by utilizing ES
- ES data transformation into knowledge and results
- Critical success factors for the transformational process to produce benefits

Analysis and reporting of findings

- Three case study reports
- Cross-case analysis

Conclusions and implications

Figure 1: The conceptual framework of the study

The flow of the process in the conceptual framework is represented by bold lines. It is recognized that some of the elements in the roadmap may impact each other or may be limited by their ability to directly impact. Such interactions are represented by dotted lines. Finally, the feedback from the empirical outcomes informs the theoretical context and answers the research questions. These are represented by full lines.

1.5   Outline of the Thesis

This thesis is organized as follows:

Chapter 1 includes the introduction, aim and purpose of this study, the research questions, background to the study, contribution of the study, and the conceptual framework of the study.

Chapter 2 provides the theoretical context of the study. Literature on enterprise systems, ES architecture, ES implementation and benefits, CSFs for ES, and success of ES are reviewed. Theories on knowledge management, business intelligence, and models for ES data transformation into knowledge and results are further synthesized to identify the main research constructs for development of the transformational model. This chapter concludes with the extended transformational model that forms the basis of this study.

Chapter 3 discusses the application of the case study research methodology to answering the research questions. The chapter also explains the relevance of this research and how rigor is achieved in the conduct of the study. The chapter concludes with a presentation of the methodological model of the study.

Chapter 4 presents the findings of a preliminary study in which semi-structured interviews have been conducted with ten ES vendors, ES consultants, and IT research organizations who are the key players in the ES implementation industry. Insights have been gained to better understand the current ES implementation scenario in the New Zealand industry and to explore the research questions from the vendors' and consultants' perspective. This has helped to formalize the strategy for approaching the three case study organizations for the main study.

Chapters 5, 6, and 7 present each of the case studies on ES benefit realization conducted in three New Zealand organizations. Each case study provides company background information, main ES benefit realization events in the various organizational functions and processes, the process of ES data transformation into knowledge and results, and a report on the critical success factors for the process. The case study reports detailed findings and document analysis in a descriptive and tabular format.

Chapter 8 provides the cross-case analysis, noting the similarities and differences in the benefit realization patterns, process of ES data transformation into knowledge and results, and the success factors between the three cases and the results of the preliminary study presented in Chapter 4. In this chapter the results are explained through analytical commentary and comparisons are drawn with what was found by previous researchers. The findings of the study are discussed, analyzed, and finally examined to determine whether the results can be generalized to a larger or different population.

Chapter 9 concludes the study. This chapter summarizes the findings from the study and discusses the implications of the study for ES implementation. The importance of the findings is explained. Finally, the limitations of the study are stated followed by recommendations for future research direction.

Chapter 2

ENTERPRISE SYSTEMS AND BUSINESS BENEFITS

Chapter 2 provides the theoretical context of the study. An understanding of the enterprise system environment is developed through the examination of the various research perspectives, attributes, and implications of enterprise systems. Existing literature on ES is examined to establish the nature of these systems, their architecture, implementation, success factors, and benefits. Associated technologies and processes such as knowledge management and business intelligence are discussed. Furthermore, critical success factors for ES, and a model for ES data transformation into knowledge and results are reviewed to identify the main research constructs that support the development of the proposed research model for the study. The chapter concludes with the extended transformational model that forms the basis of this study.

2.1 Enterprise Systems

Enterprise systems (or ERP systems) are packaged software applications that can be configured to meet the functional requirements of an organization. These systems integrate information from various disparate sources such as customers, supply chain, human resources, and financial accounting to make up the value chain of the enterprise allowing an organization to become significantly flexible and efficient (Davenport, 1998). Firms such as SAP and Oracle offer these systems as standardized software packages which allow organizations to procure them off-the-shelf and align them to their individual needs, replacing earlier in-house legacy systems (Allen et al., 2002).

Enterprise systems were implemented as a basic rationale for organizational expansion and extension (James & Wolf, 2000; Shang & Seddon, 2000). In the late 1990s, in response to industry's business integration needs and realization of e-business, the capability to integrate an ES to non-vendor specific applications became possible, desirable, and affordable (Hedman & Borell, 2002), making these systems the principal software platform for many organizations (Markus, Tanis, & Fenima, 2000; Sammon, Adam, & Carton, 2003).

Enterprise systems consist of a series of modules comprising different sets of functionalities that achieve integration through a common database and shared information. In some cases the ES is adapted through customization to meet specific functional requirements of the organization that were not originally offered by that system. Customizations are designed to support various aspects of storage, processing, retrieval, and distribution of organizational data achieving the set

of desired functional requirements. Thus, an enterprise system is "a generic solution with different levels of adaptability, which makes every implementation unique in some sense since an organization must configure the system to its own specific requirements" (Hedman & Borell, 2002, p. 82). Some of the functionalities are implemented through modules such as financial accounting and control, human resource management, sales and distribution, materials management, production planning and control, production management, project management, and plant maintenance (Davenport, 1998). These modules integrate information flows by having a common data repository and achieve standardization with the use of standard templates that reflect "blueprints for best practices" processes (Gosain, 2004, p. 153).

Historically, these systems have evolved from manufacturing resources planning (MRPII) systems which in turn were an extension to material requirement planning (MRP) systems (Davenport, 2000). These MRP-based systems contributed primarily to the manufacturing environment subsequently extending to include other organizational functions such as financial accounting, sales and marketing, and human resources, whilst ES addressed the information requirements of the entire extended enterprise from the supplier to the customer.

The focus of ES has not only been on addressing the manufacturing requirements, but especially on seamless integration of the entire value chain. In this respect, ES helps businesses to refine business processes and leverage information. The ES functionalities lead to benefits as expected outcomes when implemented. The benefits include "not only increased decision making speed, improved control of operation and costs, and cost reductions but, more importantly, improved enterprise-wide information dissemination" (Allen et al., 2002, unpaged). These systems "present a holistic view of the business by permitting the sharing of common data and practices in a real-time environment" (Ifinedo & Nahar, 2006, p. 1554).

With technology advances, ES suppliers have extended their applications to become Internet-enabled and more collaborative. Modules such as CRM, SCM, and BI have been included to achieve the collaboration and information intelligence needs of organizations. Future ES applications are expected to support the competitive business environment through more Internet-enabled collaboration embedded with better intelligence (Subramoniam, Tounsi, Ghani, & Krishnakutty, 2009).

Soh and Sia (2005) suggest that organizations need to assess their ES implementation risks. They state that ES implementations differ according to the organizational contexts in which they operate and a generic standalone ES or "vanilla implementation" may not meet all the specific requirements. The various modules are required to be aligned based on organizational practices, competitive positioning, and industry type. In short, organizations need to identify "misfits

between the package and their organization" and they recommend ES customizations should take account of the company's "contextual factors and organizational structures" (p. 375).

Enterprise systems necessitate alignment of different work streams across organizational boundaries within the specified budget and schedule constraints. These work streams may involve third party logistics companies, project teams, and customer relationship management teams who use online databases with electronic retrieval capabilities to inform each other of task interdependencies (Banker, Bardhan, & Asdemir, 2006). Accordingly, collaborative software tools play an important part in translating business objectives into tangible outcomes as distributed teams interact and align their tasks during various phases of the product lifecycle.

Furthermore, many companies apply the lean[1] manufacturing philosophy to the business management processes integrating human resources with organizational process and strategy through ICT. Leveraging the tools and techniques of lean philosophy using information-based processes improve organizational value creation and management decision making. Manufacturers competing in the global markets consider utilization of lean and ES as the two most important strategies according to ratings in manufacturing improvement surveys (Carroll, 2008).

There are few alternatives to ESs that enable organizations achieve enterprise integration. Other solutions include best-of-breed systems, object-oriented systems, and data warehouses (Davenport, 2000; Markus & Tanis, 2000; Pender, 2000).

The best-of-breed strategy – or the multi-application integration approach – emphasizes the installation of one or more applications from different vendors that best meet the varying needs of an organization, instead of implementing one application as a corporate standard (Bradley, 2009). Although best-of-breed implementations satisfy more specific organizational requirements, these implementations require more skills and knowledge in the adopting company's IT staff to support multiple packages. Furthermore, the technology to support the integration of different vendor's applications is still not mature (Davenport, 2000; Markus & Tanis, 2000; Pender, 2000).

Object-oriented (OO) systems intend to be more flexible, maintainable, simple to understand and install than packaged ES applications although, there are few cases of commercially viable OO implementations in a business organization (Davenport, 2000). The OO design, with its

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[1] Lean "is a systematic approach that focuses the entire enterprise on continuously improving quality, cost, delivery, and safety by seeking to eliminate waste, create flow, and increase the velocity of the system's ability to meet customer demand" (Plenert, 2007, p. 146).

flexibility attribute, can be related to a more flexible architecture such as the service-oriented architecture (SOA). OO programming can be used to implement services within a SOA framework (Nicolescu, Wittges, & Krcmar, 2009).

Data warehousing systems entail collection and aggregation of data from various heterogeneous environments within and outside the organization so that the integrated data become centrally available. This process involves internal and external data integration without any change to the business process or the data source (Markus & Tanis, 2000). These systems however, do not support integration at the transactional level and therefore do not provide detailed and real-time information at the operational level, which is their main drawback.

In summary, the acceptance of ES technology environment to organizational adoption is becoming more widely recognized. The technology is not totally mature, but it is constantly improving and has gained major importance within the knowledge-oriented competitive environment. Enterprise systems must be able to connect different business functions to provide consistent and seamless flow of data, integrating disparate processes so that the information is useful for organizational decision making. The technology supporting these applications is continuously evolving with rapidly changing enterprise system architectures discussed in the next section.

2.2   Enterprise Systems Architecture

Enterprise systems architecture is the method of constructing enterprise software to provide optimal functionality and business value to organizations. The design and implementation of an ES involves capturing the information necessary for implementing the system's structure and behavior that support enterprise management. The process commences at the enterprise modeling stage and finishes at the business function deployment stage, going through different abstraction layers of enterprise requirement, analysis, design, and implementation workflows (Monnerat, De Carvalho, & De Campos, 2008).

The model-based system design of ES has emerged by the application of a model-driven platform-engineering approach for designing a system. This software development practice exercises model construction instead of development of program code. The description of user needs, information requirements and business structures or any other organizational requirements are established using models. The system development process is governed by these models which reflect the executable organizational business system processes (Roser, Lautenbacher, & Bauer, 2008).

As noted by Rockart (2004), in almost all companies information exists in "data islands". The disparate systems are not integrated and fully linked to effectively meet the organization's requirements. The approach from the top management towards "seizing the opportunities provided by effective design and use of information" is perceived as inadequate (p. 143). In the 2004 research study by Rockart, 16 of the 20 companies studied suggested a lack of a business-oriented overview of effective design and use of information in these companies. It was evident that there was both a need and desire for more strategic thinking on the collection, storage, distribution, and use of information. The necessary tools are now available from the recent IT advances, in particular the advent of organizational portals. What remains is the recognition of these capabilities by the company executives and effective design of information required in different business segments (Rockart, 2004).

Notwithstanding the risks, ES implementation has prevailed in various industry sectors and business segments (Kumar & Van Hillegersberg, 2000; Nicolaou, 2004b). The ES implementation objectives not only include internal business process optimization but also integrate externally to support a firm's supply chain. Based on the evolved business model, ES suppliers have re-designed their product to achieve a modular structure, separating ES applications into distinct and often Web-enabled modules. These modules can be configured to match closely to an organization's existing practice for conducting business (Nicolaou, 2004b).

The new generation technology architecture is called the Enterprise Services Architecture (ESA), which is the acronym for an enterprise Service-Oriented Architecture (SOA). ESA follows from the earlier client-server and Internet-based applications architecture. The ES applications using this technology utilize ESA services from service providers as building blocks to convert into a business system platform with reusable utility functionality (Woods & Mattern, 2006). Although the focus earlier was primarily on how to utilize the technology to organize a business, Woods and Mattern suggest ESA is more about organizing a business given the availability of services. The business processes can be modeled into scenarios by assembling high-level process components. The power of enterprise services can then be utilized to transform these models into detailed processes at lower levels. Woods and Mattern further note, with the advent of ESA, a huge expansion of possibilities is seen by organizations. The hard system analysis and design functions such as optimization and adaptation of current processes, design and automation of new processes, and extension of the system to additional user-groups collaborating externally become simpler. The high level IT components are expected to transform various operational modes into a strategic application as an entire inventory of services becomes available. Companies are now able to combine many services by modeling generic and detailed business processes and composing corresponding user interfaces.

According to Woods and Mattern (2006), SAP has taken the lead in developing ESA and is delivering the tools to build extended services. SAP is developing a full inventory of built-up services accessible in a searchable repository that can be used for modeling. As soon as these services are available through ESA-based solutions, organizations will begin to build and adapt these solutions for their individual needs. Businesses will easily be able to meet their specific business requirements by creating solutions built on enterprise services.

Based on this short review, an ES is one of the most feasible solutions to support business integration and system deployment. The technology is constantly evolving to better align within organizational contexts. However, the process of ES implementation is difficult and can be an obstacle organizations face in their pursuit of business integration. The ES implementation process is the focus of the next section of this literature review.

2.3   Enterprise Systems Implementation

There are different reasons for organizations to implement an ES. These relate to two main requirements. The first reason is finding a solution to "existing business problems", which earlier included the year 2000 (Y2K) problem and now includes "inadequate IT infrastructure, and disparate information systems, particularly in the case of mergers and acquisitions". The second reason is concerned with "improving future business operations", including support for customer service, increasing data flow, reducing cost of operations, and achieving better decision making (Shakir & Hossain, 2002, p. 227). The criteria most companies use for selection of an ES for implementation is the best fit with the organizational business processes (Everdingen, Hillegersberg, & Waarts, 2000). The main issue facing most organizations is how to find a match between an ES and the organization's business processes by appropriately customizing both the system and the organization (Luo & Strong, 2004). Viehland and Shakir (2005) note that despite the huge risks and possibility of greater benefits, there has not been much research globally that evaluates the process of establishing strategic decisions for ES implementations.

For many companies, a resolution to the Y2K problem was the main reason for the initial implementation of ES, rather than a search for the many benefits that are associated with these types of systems (Hawking et al., 2004). Organizations underestimated the implementation requirements, oblivious to the extent of change process the companies would need to go through. The shortage of skills, knowledge, and experience in human resources with ES projects led to an initial struggle of organizations with ES implementations. At the same time, the requirement to re-engineer business processes before ES adoption (Everdingen et al., 2000), further aggravated this situation. Firms implementing ES needed to assess and identify gaps

between the ES package and the business processes in order to align either through organizational adaptation or customization (Soh & Sia, 2005). Due to the big implementation costs and the tight Y2K timelines, organizations attempted to complete the implementation process speedily. The complex nature of the project, coupled with inexperienced resources, led many organizations to fail in achieving business process optimization during their initial implementation (Davenport et al., 2002; Hawking et al., 2004).

Whilst an ES implementation could resolve their Y2K problems, many of these firms could not realize the additional benefits from their ES (Davenport et al., 2002; Deloitte Consulting, 1999; Hawking et al., 2004). To overcome this shortfall and achieve the anticipated return on investment, organizations revisited their ES implementation in an attempt to realize the earlier unattained benefits in "second wave" implementations (Hawking et al., 2004), as explained in Section 2.5.

A landmark study by Deloitte Consulting (1999) suggests that organizations consider ES implementation as a continual process. They should endeavor to attain the purported benefits from their ES through continuous value evaluations and process improvements. ES implementations in organizations evolve following the company's evolution to meet new business and information requirements (Hawking et al., 2004). Some processes that are critical to the success of the system in the post-implementation phase include ongoing maintenance, regular support, and post-implementation review (Nicolaou, 2004b).

Organizations have primarily utilized their IT infrastructure to improve their major value-creating, transaction-oriented, business processes such as order intake process, order execution process, and Web-based logistics. In most companies less attention has been imposed on improving the information quality – the data that are used regularly by managers – for business analysis, monitoring progress, and establishing decisions (Rockart, 2004). Businesses are now realizing that making relevant corporate information accessible to approved users at all times through business process integration is a key factor for success (Poon & Yu, 2006). Many organizations have created capabilities for decision support systems (Rockart, 1979), executive information systems (Rockart & Treacy, 1982), balanced scorecards (Kaplan & Norton, 1992), and knowledge management systems (Davenport & Prusak, 1998). Intranets are often used in every organizational division and function that makes information more available to employees. Web portals are installed with additional collaborative and information-accessing capabilities. There has been a substantial growth in data warehouses, both in size and number. Enterprise systems offer the capability to provide such integration and access to organizational data for corporate use through a consolidated system platform.

2.4 Enterprise Systems Implementations in Small and Medium-sized Organizations

The ES market continues to grow as business becomes increasingly global and competitive. Because the market for large enterprise implementation is near saturation, for some time now all of the ES vendors are focusing on the small and medium-sized enterprise (SME) sector for sales growth (Shakir & Viehland, 2004). With this recent shift in direction, numerous research studies have been conducted to understand the opportunities and challenges of ES adoption in the SME sector. Many of these studies have focused on the differences of SME implementations in comparison to large enterprises in the context of pre-conditions, project behaviors, objectives, constraints, success factors and results achieved (Dittrich & Vaucouleur, 2008; Federici, 2007; Koh & Simpson, 2007; Laukkanen, Sarpola, & Hallikainen, 2007; Ravarini, Tagliavini, Pigni, & Scuito, 2000; Raymond & Uwizeyemungu, 2007).

In recent years, several studies have investigated the relationship of enterprise size to ES adoption. In comparison to large firms, when implementing enterprise systems, SMEs experience constraints in the transfer of knowledge (Laukkanen et al., 2007; Light & Papazafeiropoulou, 2004; Van Stijn & Wensley, 2005), in the initial set up costs (Schubert, 2003; Schubert & Leimstoll, 2004), and in the flexibility/rigidity due to ES once in operation (Federici, 2007; Melin, 2003). Whereas large enterprise implementations have emphasized outward business integration, in SMEs business development and efficiency improvement are the critically important factors (Laukkanen et al., 2007). In a manufacturing context, SMEs that have a high commercial dependence in areas such as operational agility, production costs, and product quality are internally predisposed to ES adoption. SMEs that have research and development, logistics, and sales network alliances with external agencies are externally predisposed. SMEs that have a diversified customer market with low commercial dependence, and few logistics, sales network, and research and development alliances, are not favorably disposed to ES adoption (Raymond & Uwizeyemungu, 2007).

2.5 Second Wave Implementations

The process of attaining additional benefits in the post-implementation phase, after the initial ES implementation, is called as second wave implementations (Deloitte Consulting, 1999). ES implementations comprise several phases or "waves" beyond the initial implementation, as shown in Figure 2. The first wave occurs when the ES is implemented for the first time in an organization and the system goes live. Thereafter, the second wave begins. Typically, there are three stages of ES implementation maturity in the second phase. First is the stabilize stage in

which organizations get accustomed to the new system and familiarize with the business process changes. Second is the synthesize stage in which organizations look to further improve business functions, install any bolt-on applications as supporting tools, and encourage staff to implement the new changes. Finally, in the synergize stage organizations achieve optimization of business processes that lead to enterprise transformation (Hawking et al., 2004).
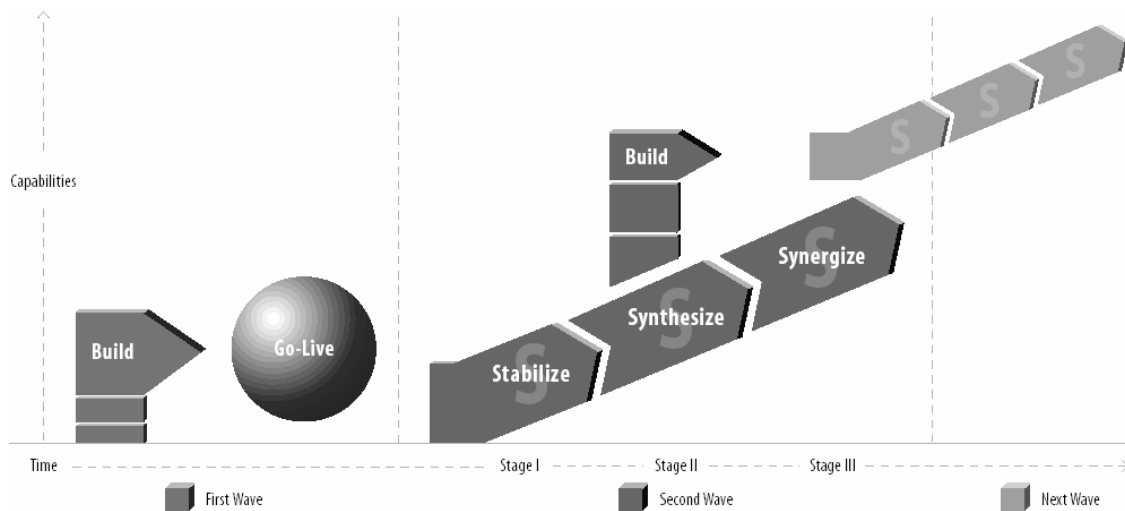
Figure 2: Implementation phases
Source: Hawking, Stein and Foster (2004, p.3)

Hawking et al. (2004) have explained the concept of different phases of ES implementation using the Nolan and Norton Institute (2000) classification that groups implementations into different stages of maturity. Beginning is when an ES implementation is less than one year old. Consolidating is when an ES implementation is between one and three years old. Finally, mature is when an ES implementation is more than three years old and the company is in the phase of achieving the additional benefits. Firms that are in the second wave implementation stage are expected to have reached the consolidation or mature phases. However, an organization's earlier experience with ES must be taken into account when evaluating costs and maturity of ES implementations. For an organization to realize second wave benefits, three factors are important: first, a number of years experience with ES; second, extensive use of ES across the organization; and third, sufficient resource allocations for future add-ons/upgrades (Davenport et al., 2002; Hawking et al., 2004).

Yang and Seddon (2004) have described similar phases or "experience cycle" as suggested by Markus and Tanis (2000), comprising four stages, commencing from the pre-implementation stage to post-implementation (Figure 3). First is the chartering phase, the duration when the company selects the software after assessing value propositions. Second is the project implementation phase that involves all activities before the system goes live such as process mapping, conversion of data, user training, configuration of software and customization, and the

testing of the overall system. Third is the go live phase, when the company transitions to the new ES. After going live, there is a shakedown period usually for one year or so, when the company works with the new ES and resolves any post-implementation issues. It is noted that more often, the organizational performance dips during the shakedown period before going up again. Finally, onwards and upwards is the phase when the system improvements are established, a better understanding of the application is achieved, add-ons to the software are included, and the system is fine tuned to work according to the organizational requirements. In this phase the benefits from the new system are realized.
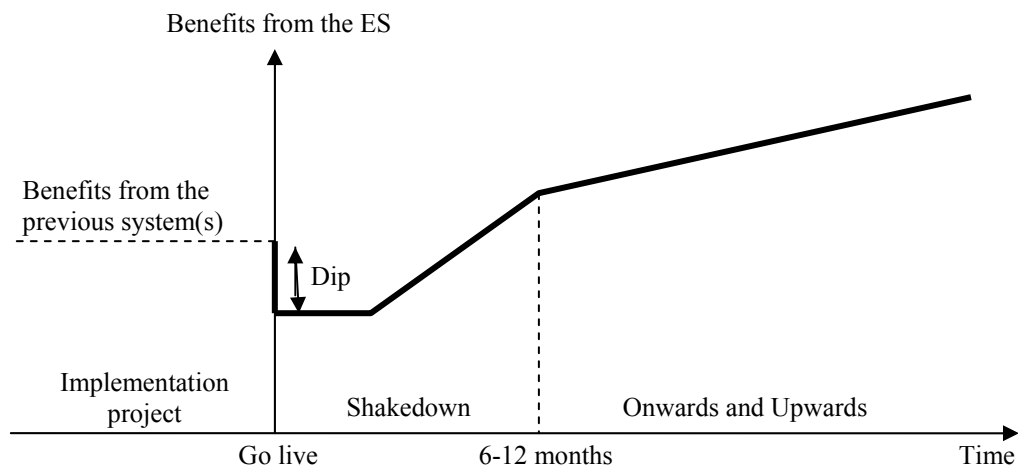
Figure 3: Experience cycle

Adapted from: Yang and Seddon (2004)

Over and above factors for achieving results, there are several limitations or barriers for realizing second wave benefits (Table 1). These are classified as people related, process related, or technological limitations (Hawking et al., 2004).

Table 1: Barriers for realization of second wave benefits

People related	Process related	Technical
Lack of discipline	Poor business performance	Poor reporting procedures
Lack of change management	Inadequate process engineering	Poor prioritization of resources
Inadequate training		Poor software functionality
Inadequate internal staff		Inadequate ongoing support
Misplaced benefit ownership		Poor application management
Under performed project		Upgrades performed poorly

Adapted from: Hawking, Stein and Foster (2004)

Some additional issues identified as leading to implementation failures include poor value assessments or insufficient needs analysis reports, key people not included on the

implementation team, lack of executive team commitment, poor collaboration between team members, and factors such as conflicts, political and human resource issues (Bingi, Sharma, & Godla, 1999; Hawking et al., 2004; Sumner, 1999). However, several researchers have empirically determined that there are "drivers" or "success factors" which contribute to benefit realization from successful ES implementations (e.g., Chen et al., 2009; Nicolaou, 2004b; Pairat & Jungthirapanich, 2005).

2.6   Critical Success Factors Framework for Enterprise Systems

Complexities of ESs, combined with implementation and change management costs, and organizational issues they may introduce, frequently lead new customers to review and reconsider their ES adoption decisions (Allen et al., 2002). Many implementations in the past have been plagued with failure. In a review of the factors for ES implementation failures, several researchers (e.g., Nicolaou (2004b), Koch (2005)) have cited numerous cases where ES implementations resulted in serious financial disasters due to system integration issues. META Group incurred a loss of US$1.5 million as a result of their ES implementation failure over a period of five to six years. Their implementation took 23 months to complete at a cost of $10.6 million with an additional $2.1 million spent over two years to maintain the system. Companies such as Gore-Tex, Whirlpool, Hershey Food, Dow Chemical, and Dell Computer incurred huge financial losses as a result of their failed ES implementations. Some firms not only lost their investment in the implementation but a part of their business as well. Unisource Worldwide, instead of achieving the expected benefits from their SAP implementation had to abandon their implementation program and write off costs worth US$168 million (Nicolaou, 2004b).

The North American division of Hewlett-Packard implemented SAP as their business management solution in May 2004. The system failed to process orders for custom products due to unprecedented data structure problems between their earlier legacy system and the new SAP system. The company failed to deliver products on-time, creating a huge backlog of customer orders. Financially, a US$160 million impact was attributed to the failure. Revenue worth US$40 million was lost in order cancellations and, an order backlog of US$120 million was created. This financial impact was much bigger than the ES implementation cost estimated at US$30 million. Similarly, in 2001, Nike lost US$100 million in revenue when they moved to a new SAP solution due to issues with their demand planning system (Koch, 2005).

The major reasons attributed to the above ES implementation failures are the lack of adequate business contingency planning as well as the integration issues suffered by enterprise systems. The organizational deficiency in aligning the new ES technology with people and processes leads to failure in achieving expected benefits and the return on ES investment (Davenport,

1998; Nicolaou, 2004b). These implications have driven many researchers to evaluate the factors that are responsible for success of enterprise systems implementations. With this view, a critical success factor approach has been developed and used by many researchers (e.g., Aladwani, 2001; Allen et al., 2002; Bancroft et al., 1998; Bingi et al., 1999; Chen et al., 2009; Davenport, 2003; Esteves & Pastor, 2001; Holland & Light, 1999; Markus, Axline, Petrie, & Tanis, 2000; Markus & Tanis, 2000; Nah, Lee-Shang, & Kuang, 2001; Parr & Shanks, 2000; Sarker & Lee, 2000; Somers & Nelson, 2001; Sumner, 1999; Yang & Seddon, 2004).

According to Rockart (1979, p. 85), critical success factors are:

> the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the organization. They are the few key areas where things must go right for the business to flourish. If results in these areas are not adequate, the organization's efforts for the period will be less than desired. These are areas of activity that should receive constant and careful attention from management.

In past research, critical success factors associated with ES implementations include support from top level management, clearly defined and implemented communication avenues, a top level champion, avoidance of customization, including key personnel on the project team, end user training with ongoing support, efficient process reengineering, and well written and complete needs analysis reports (Bingi et al., 1999; Markus, Axline et al., 2000; Nah & Lee-Shang, 2003; Somers & Nelson, 2001; Willcocks & Sykes, 2000). Surprisingly, even though these factors have been identified and documented, organizations implementing ES are still experiencing the same or similar problems (e.g., Foster et al., 2004; Klaus et al., 2007; Lui & Chan, 2008; Poon & Yu, 2006). Many of the larger companies in most developed countries have attained a significant level of implementation maturity after having worked with ES for several years (Stein & Hawking, 2002). However, in studies on benefit realization between 2004 and 2008, these companies indicated that the expected levels of benefit were not achieved (Foster et al., 2004; Klaus et al., 2007; Lui & Chan, 2008; Poon & Yu, 2006).

An analytical CSF framework (Figure 4) has been developed by Allen et al. (2002) as a result of their research in investigating ES implementations in higher education institutions and interpretation of their experiences using the concepts of critical success factors by Holland and Light (1999), Slevin and Pinton (1987), and Sarker and Lee (2000).
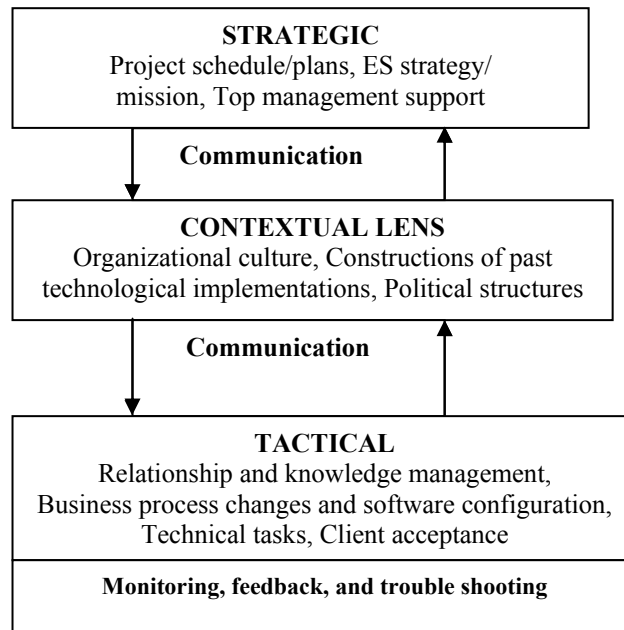
Figure 4: Critical success factor model for enterprise systems

Adapted from: D. Allen, T. Kern and M. Havenhand (2002)

The CSF model which evolved was organized into a strategic - contextual lens - tactical framework. The strategic context specifies the requirement for a clear project mission and objectives, a project schedule/plan to meet those objectives and top management support with strong and committed leadership to support the plan. The contextual lens highlights the importance of the organizational culture, organization structure, other organizational conditions, and the status of past technological implementations or legacy systems. Tactical issues are the action phase issues which include having the correct technology in place, placement of right technical and business specialists, and communicating with all affected parties/users. Tactical issues also include business process design, software configuration with user acceptance, monitoring and feedback at each stage, and constant trouble shooting (Allen et al., 2002).

In a study of sixty enterprise system implementations, Yang and Seddon (2004) compiled a list of CSFs and compared their findings with earlier major studies conducted by Allen et al. (2002), Parr et al. (1999), and Bancroft (1998), as shown in Table 2. Yang and Seddon used Holland et al. (1999) in their comparison, however this study uses Allen et al.'s model since this is a latter extension of Holland et al.'s work. The CSFs in Table 2 are categorized by the key drivers for the process of ES data transformation into knowledge and results (i.e., strategic, organizational and cultural, skills and knowledge, data, and technology) as per Davenport (2000).

Table 2: Categorization of CSFs for enterprise systems

Category	CSFs	Yang & Seddon (2004)	Allen et al. (2002)	Parr et al. (1999)	Bancroft (1998)
Strategic	• Strong project management	• Develop a clear, refined vision/formulation • Define a simple scope • Best people full time	• Project schedule/plans • Communication	• Best people full time • Empowered decision makers • Deliverable dates • Smaller scope • Definition of scope and goals • A balanced team	• Strong project manager • Balanced project team • Select a good project methodology
	• Business leadership of project	• Business driven project/ business working with IT • Project sponsorship • Follow the strategy, process, technology phrases	• Mission • Top management support	• Champion • Management support • Commitment to change	• Executive championship for the project • Expect problems: commit to change
	• Vanilla Implementation	• No customization/ business processes reengineering • Standard content	• Business process changes	• Vanilla ES	
	• Vendor involvement	• Vendor involved in • Outside help from ERP and other firms can assist greatly • Use ERP company's support services effectively	• ES strategy		
Organizational and cultural	• Organizational and cultural		• Organizational culture • Constructions of past technological implementations • Political structures • Communication		• Understand corporate culture in terms of readiness and capability for change • Communicate, communicate
Skills and knowledge	• Training and change management	• Training • Manage communication • Change management	• Relationship and knowledge management • Communication		• User training and change management
	• User involvement	• Group-wide participation/ more user participation • End user feedback • Key users can be used as first line of support	• Client acceptance • Monitoring and feedback		
Data	• Data conversion, testing	• Data management • Less historical data conversion	• Software configuration • Trouble shooting		
Technology	• Technical infrastructure	• Do not underestimate IT infrastructure requirement • Infrastructure complexity • Use internet not just intranet	• Technical tasks		
	• Business process improvement	• Do not forget best practice • Design fewer reports with more attributes • Optimize un-house first	• Business process changes		• Begin business process changes prior to implementation

Adapted from: Yang and Seddon (2004)

This list of CSFs, and especially the CSF framework by Allen et al. (see Figure 4), will be used later in the formulation of the model that is the focus of this study. However, this review now examines an even more important aspect of this research – the identification of expected and realized benefits in ES implementations.

2.7   Enterprise System Benefits

Many researchers have evaluated benefits from ES investments (e.g., Banker et al., 2006; Cooke & Peterson, 1998; Cotteleer & Bendoly, 2006; Davenport et al., 2002; Deloitte Consulting, 1999; Donovan, 1998, 2001; Gattiker & Goodhue, 2005; Hedman & Borell, 2002; Ittner & Larcker, 2003; Jenson & Johnson, 1999; Markus & Tanis, 2000; Ragowsky & Gefen, 2008; Robey et al., 2002; Soh, Kien, & Tay-Yap, 2000; Yang & Seddon, 2004). Hedman and Borell (2002) have stated that there are some perceived benefits associated with enterprise systems. The reason for describing enterprise system benefits as perceived is due to a lack of research in this field. "We don't believe there is enough evidence in the research conducted until now to state that enterprise systems lead to organizational improvements" (Hedman & Borell, 2002, p. 82). However, some of the commonly recognized benefits include improved time-to-market cycles, business process improvement, increased flexibility, competitive positioning ability, increased customer satisfaction, improvement in order-to-cash time, business growth, increased productivity, improved product quality, standardization of company processes, shared services, real-time access to data and information, an optimized supply chain, and integration among business units (Cooke & Peterson, 1998; Hedman & Borell, 2002).

ESs are modeled to integrate business functions and optimally utilize organizational resources. The key benefits that can be expected from an implementation depend upon the extent of integration established across organizational processes. Professional research is proactively pursuing to evaluate the kind of benefits that organizations might expect from their ES and the level to which companies have actually achieved anticipated benefits after adoption. Both strategic and operational benefits may lead to an expectation for improved organizational performance post-implementation (Jenson & Johnson, 1999; Nicolaou, 2004b).

The potential of ES has been classified under four areas: informate, optimize, automate and integrate (Davenport et al., 2002). Informate is when the organizational decision making is supported by contextual information from an ES. Optimize is the ability to incorporate the best business practices as standardized organizational processes to achieve best possible outcomes. Automate is when the business transactions get automated through workflows, from taking orders to paying suppliers. Integrate is when an organization integrates its processes and data

with both external and internal stakeholders through a common platform and database (Davenport et al., 2002; Hawking et al., 2004).

In a study of 85 global companies, Deloitte Consulting (1998) reported tangible benefits (e.g., faster processing, cost savings) and intangible benefits (e.g., improved customer responsiveness, improved/new processes, improved information visibility) post-implementation. In an assessment of benefit expectation from ES implementations, Nicolaou (2004b) reported on the achieved versus expected outcomes for both tangible and intangible benefits. In the Benchmarking Partners study (1998), the tangible benefits expected by the corresponding organizations included productivity improvements, reduction in time taken to close accounts, cost efficiencies in purchasing, inventory, personnel, as well as improvements in the management of customer orders, receivables, and overall profitability. The intangible benefits related to improvement in customer service, improved processes and information availability, and organizational integration. The extent of benefit realization by these organizations via a post-implementation assessment revealed better performance in operational productivity such as improved order intake cycle time, purchasing, on-time dispatch of product, and the timely closure of books for accounts. In contrast, these companies were unable to achieve the cost reductions such as reduced inventories, manpower, or system maintenance costs, and improved profitability as much as anticipated. From the findings of a Conference Board study (Peterson, Gelman, & Cooke, 2001), the corresponding organizations expected similar tangible and intangible benefits, however the time taken for achieving those benefits was much longer than anticipated (Nicolaou, 2004b).

In a survey of 163 large firms (Davenport et al., 2002), primary benefits achieved by companies implementing ESs included faster and more accurate transactions, increased flexibility, ease of expansion/growth, improved customer service and retention, better management decision making, cost reduction, and improved revenue.

In another study investigating the influence of ES implementation on operational efficiencies, the reduction in order execution cycle time leading to shorter order-to-cash cycle was found to be a major improvement area. A performance improvement trend was established after the implementation, compared to a steady performance pattern earlier (Cotteleer & Bendoly, 2006). Ragowsky and Gefen (2008) note that enterprise systems can improve organizational efficiencies by providing real time information, data sharing and collaboration, automation, added value, and business process integration.

Fujitsu, after their SAP implementation, reported a 50 percent reduction of financial closing times, 60 to 85 percent improved delivery performance, and 90 percent reduction of quotation

cycle time – reducing from 20 to 2 days. Also, Boeing officials during an interview stated: "BaaN forced us to look for ways to simplify our processes, and because the software is integrated, end users must now work together to solve problems within the internal supply chain" (Jenson & Johnson, 1999, p. 31).

A comprehensive framework of business benefits (Shang & Seddon, 2000) that organizations might be able to achieve from their use of enterprise systems is shown in Table 3. The 25 enterprise system benefits were consolidated across five benefit dimensions comprising strategic, organizational, managerial, operational, and IT infrastructure benefits.

Table 3: A framework of business benefits from enterprise systems

Dimension	Subdimension	Explanation
1 Strategic	1.1 Support business growth 1.1 Support business alliance 1.3 Build business innovations 1.4 Build cost leadership 1.5 Generate product differentiation (including customization) 1.6 Build external linkages (customers and suppliers) 1.7 Worldwide expansion 1.8 Enabling e-commerce	Enterprise systems with their large scale business involvement and internal and external integration capabilities could assist in achieving these strategic benefits.
2 Organizational	2.1 Support organizational changes 2.2 Facilitate business learning 2.3 Empowerment 2.4 Build common visions 2.5 Change employee behavior 2.6 Better employee morale and satisfaction	The integrated information processing capabilities of enterprise systems could affect the establishment of organizational capabilities.
3 Managerial	3.1 Better resource management 3.2 Improved decision making and planning 3.3 Performance improvement	With a centralized data base and built-in data analysis capabilities, it seems likely that enterprise systems will provide informational benefits to management.
4 Operational	4.1 Cost reduction 4.2 Cycle time reduction 4.3 Productivity improvement 4.4 Quality improvement 4.5 Customer services improvement	Enterprise systems automate business processes and enable process changes. Therefore one would expect enterprise systems to offer all of these types of benefits.
5 IT Infrastructure	5.1 Build business flexibility for current and future changes 5.2 IT cost reduction 5.3 Increased IT infrastructure capability	Enterprise systems with their integrated and standard application architecture provide an infrastructure that could support this dimension.

Adapted from: Shang and Seddon (2000)

Strategic benefits are those that support business strategy. Organizational benefits include support for organizational learning and personnel empowerment. Managerial benefits increase business effectiveness through improved decision making and the better management of

resources. Operational benefits are those that positively influence the efficiency of the business. Finally, IT infrastructure benefits include increasing the flexibility and capability of the infrastructure while lowering its future investment costs.

Yang and Seddon (2004) compiled benefits collected from senior ES implementation project managers of 60 large global organizations who implemented ESs. The findings provide insightful details on the type of benefits that organizations can achieve post-implementation. This analysis, with findings from several similar studies, is shown in Table 4.

These benefits are categorized as resulting from behavioral changes, new initiatives, process changes, and financial impacts, which follow from Davenport's model of ES data transformation into knowledge and results (Davenport, 2000).

Some organizations have expressed an inability to identify any quantifiable benefits or improvements in business processes (Donovan, 2001). Furthermore, Donovan (1998) has noted that to realize ES benefits, first, there must be no misapprehension about the information requirements and its usability and, second, organizational decision makers must have the expertise and experience for this kind of data-oriented decision making.

Many organizations have been trying to measure performance in the past decade, in areas which they consider influence the company's effectiveness, such as employee loyalty and customer satisfaction. In reality, however, not many organizations realize these kind of benefits since the companies are unable to recognize, analyze, and take action on the relevant non-financial measures to achieve strategic goals (Ittner & Larcker, 2003).

2.8   Success of Enterprise Systems

ES success has been defined as "the utilization of such systems to enhance organizational efficiency and effectiveness" (Ifinedo & Nahar, 2006, p. 1554). In their study concerning determination of ES success metrics, Ifinedo and Nahar (2006) note that most studies deliberate and focus on the adoption and implementation of ES, but the success evaluation of these applications in the adopting organizations has been investigated by very few studies. Similar research that focuses on organizational ES success include Gable and colleagues (Gable, Sedera, & Chan, 2003; Sedera & Gable, 2004; Sedera, Gable, & Chan, 2003), Markus and Tanis (2000), Tan and Pan (2002), and Nelson and Somers (2001).

Success for ES, as defined by Markus and Tanis (2000, p. 186) is "the best outcomes the organization could achieve with enterprise systems, given its business situation, measured against a portfolio of projects, early operational and longer term business results metrics".

Table 4: Categorization of realized benefits from enterprise systems

Category	Benefits	Yang & Seddon (2004)	Davenport, Harris, & Cantrell (2002)	Shang & Seddon (2000)	Deloitte Consulting (1998)
Behaviors	• Improved communication and collaboration	• Improved collaboration • Increased communication		• Build external linkages (customers and suppliers) • Facilitate business learning • Empowerment • Build common visions • Change employee behavior • Better employee morale and satisfaction	• Improved customer responsiveness
Initiatives	• Better information, decision making and planning	• Timely and accurate information • Improved plan • Improved report	• Better management decision making	• Improved decision making and planning	• Improved information visibility
	• Improved customer service	• Improved customer services and retention	• Improved customer service and retention	• Customer services improvement	
	• Supporting current and future business growth	• Ease of expansion/ growth • Flexibility to react to business opportunities	• Ease of expansion/ growth and increased flexibility	• Support business growth Support business alliance • Build business innovations • Build cost leadership • Build business flexibility for current and future changes • Support organizational changes	
Process changes	• Modern integrated application platform	• Enterprise integrated solution/single SAP • Consolidate support/ extensive support network • IT strategy alignment/ established strategic enabling technology		• Increased IT infrastructure capability	
	• Improved business processes	• Improved business processes • More effective operations • Cycle time reduction	• Faster, more accurate transactions • Cycle time reduction	• Cycle time reduction • Generate product differentiation (including customization)	• New/improved processes • Faster processing
	• Support for global operations	• Global standardization/ converged processes across systems and regions		• Worldwide expansion	
	• E-commerce	• Enabled e-commerce		• Enabling e-commerce	
Financial impacts	• Cost savings • Improved revenue and profit	• Increased internal productivity • Cost reduction • Headcount reduction	• Headcount reduction • Increased revenue	• Cost reduction • Productivity improvement • Performance improvement • Quality improvement • IT cost reduction	• Cost savings
	• Improved resource management	• Improved inventory management • Fewer physical resources and improved logistics • Improved pricing management	• Improved financial management • Improved inventory and asset management • Fewer physical resources and improved logistics	• Better resource management	

Esteves et al. (2003, p. 449) state that ES success can be defined as "finishing on-time, on budget, obtaining the expected functionality, the system is being used by its intended users and implemented in the correct way taking into account the organizational and cultural values of the organization". Finally, Shanks, Seddon, and Wilcocks (2003) suggest success of enterprise systems depends on effectiveness of the implementation, and on the additional benefits that can be obtained by leveraging the technology.

In the information processing view of knowledge, two key organizational initiatives that assist in leveraging ES technology and improving the quantitative and qualitative value of knowledge available are knowledge management (KM) and business intelligence (BI). Intelligence in enterprises is created through KM and BI solutions that "provide the in-depth analytical capabilities needed to turn raw data into actionable knowledge for an enterprise" (Sharma & Gupta, 2003, p. 2). These associated technologies are discussed in the next section following a review on data, information, and knowledge.

2.9   Data, Information, and Knowledge

To understand the knowledge management and business intelligence environment, it is necessary to understand the rationale behind data, information, and knowledge. The concepts of data, information, and knowledge have been explored by many researchers. Some of the explanations and definitions are discussed below:

Data
"Data is a set of discrete, objective facts about events" (Davenport & Prusak, 1998, p. 2), described as structured records of transactions, readily available, that record day-to-day operational facts in an organizational context (The_OR_Society, 2003).

Information
"Information is data that makes a difference" (Davenport & Prusak, 1998, p. 3), processed into meaningful content by adding value and context (The_OR_Society, 2003).

Knowledge
Davenport and Prusak (1998, p. 5) define knowledge as, "a fluid mix of framed experience, contextual information, values and expert insight that provides a framework for evaluating and incorporating new experiences and information." Knowledge is also defined as information to which human-based qualities such as reflection, interpretation, context, and experience are added making it highly valuable information (Blumentitt & Johnston, 1999).

Data transformation into information occurs when a particular analytical viewpoint is taken. Analysis is a way of processing raw data into information that is useful for a particular purpose. Information is transformed into knowledge when it is incorporated into business rules, adding experience, context, interpretation, and reflection so that it can be used to facilitate decision making.

Organizational knowledge can be viewed as a physical asset or a commodity which is exploited for maximizing return-on-investment. It is a process involving interplay between past experiences and their subsequent applications to create new organizational knowledge through the development of an overall organizational resource in which both technology and humans play an important role (Baskerville & Dulipovici, 2006). This section elaborates on the theoretical foundations of KM and explains how these aspects can be applied to a business scenario such as in the context of an organization's value chain through an ES implementation.

Choo (2006, p. 135) states that organizational knowledge comprises of:

> what the organization believes about itself (identity, purpose), its capabilities, and its environment (communities, markets). Taken together, the knowledge of an organization may be categorized as tacit knowledge, explicit knowledge, and cultural knowledge.

Choo (2006) also notes that all three categories – tacit, explicit, and cultural – are engaged simultaneously in organizational work to create meaningful evaluation and use of organizational knowledge. A further distinction between tacit, explicit, and cultural knowledge is shown in Table 5.

Table 5: Categories of organizational knowledge

Tacit Knowledge	The implicit knowledge is used by people in organizations to perform their work and to make sense of their words.
	Tacit knowledge is hard to verbalize because it is expressed through action-based skills and cannot be reduced to rules and recipes.
Explicit Knowledge	Knowledge that is codified or made tangible and can therefore be easily communicated or diffused.
	Explicit knowledge may be object based or rule based.
Cultural Knowledge	The shared assumptions and beliefs about an organization's goals, capabilities, customers, and competitors.
	The assumptions and beliefs that are used to assign value and significance to new information.

Source: Choo (2006, p. 135)

Nonaka and Takeuchi (1995) have identified two sets of dynamics that drive knowledge creation in organizations: (1) ongoing interactions and conversions between tacit and explicit knowledge through socialization, externalization, combination, and internalization (SECI); and (2) change of knowledge levels spirally from lower to higher levels, that is from individual to departmental to organizational and finally to inter-organizational levels. The four knowledge creating and conversion modes are illustrated in Figure 5.
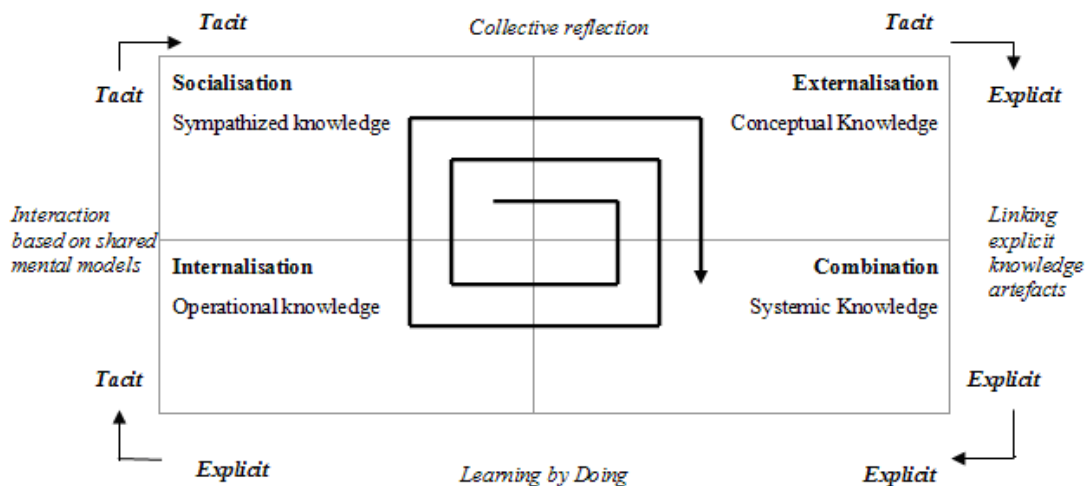
Figure 5: Knowledge creation SECI model
Source: Nonaka and Takeuchi (1995)

Subsequently, the SECI model has been expanded to a three-layered view (see Figure 6) of how organizations create knowledge dynamically (Nonaka, Toyama & Boysiere, 2001). Layer 1 comprises the cyclic conversion of socialization, externalization, combination, and internalization. Layer 2 consists of the contextual aspect of knowledge "in which knowledge is shared, created and utilized, in recognition of the fact that knowledge needs a context in order to exist" (Nonanka et al., 2001, p. 499). Layer 3 involves knowledge assets needed to interact with each other to generate new knowledge. The new knowledge or knowledge assets form the inputs, outputs, and the moderator to the knowledge creation process, as these assets are organized, shared, and made available to many groups in the organization through effective use of information technology (Choo, 2006).

Such a dynamic knowledge creation process in turn builds up an organization's core capabilities comprising "(1) people's skills, (2) knowledge embedded in physical systems (e.g., enterprise systems), (3) managerial processes that support and reinforce the growth of knowledge, and (4) values that encourage or discourage accumulation of different types of knowledge" (Leonard 1995, cited in Choo, 2006, p. 150). Therefore, the organization's core capabilities can be linked to the three dimensions of knowledge – tacit, explicit, and cultural – in which users interact with

technological tools to recognize the firm's capabilities fully. These knowledge creating activities "are dependent on and enabled by the organization's core capabilities" which makes it extremely important that the technological frameworks complement the user environments effectively (Choo, 2006, p. 153).
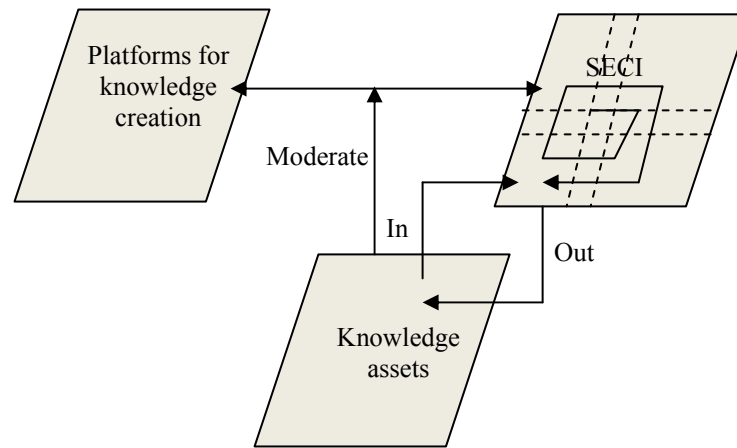
Figure 6: Three layers of knowledge-creation process
Adapted from: Nonaka, Toyama and Boysiere (2001, p. 493)

2.10   Knowledge Management

Knowledge management (KM) is "the ability to selectively capture, archive, and access the best practices of work-related knowledge and decision making from employees and managers for both individual and group behaviors" (Bergeron, 2003, p. 6). KM theories have emerged from a broad range of research fields such as sciences, economics, and management. The diversity of these fields has enabled knowledge to be abstracted at different organizational levels, allowing many viewpoints for understanding organizational knowledge. The rationale for knowledge management is based on the understanding that the most valuable assets of an organization are the skills and knowledge that the employees possess. To be able to utilize and share this expertise within the organization, management must create some means of capturing and sharing that knowledge with other employees. KM helps in creating a collaborative work environment, encourages knowledge distribution and saves on duplicating effort, thus reducing cost and time spent (Berkman, 2005).

To achieve flexibility and adaptability within an enterprise, the rules for the underlying business processes need to be constantly evaluated, and then, the knowledge is created to assess organizational key performance indicators (KPIs), so that the health of the organization is ascertained and actions taken immediately when required. Knowledge management technologies combine content management systems like enterprise systems with the World

Wide Web to derive more value from textual information (Cody, Kreulen, Krishna, & Spangler, 2002).

Technological tools help to process information from different analytical viewpoints objectively incorporated into business rules by codifying experiences and contexts into operational procedures so that the information can be used to facilitate decision making. There are a variety of knowledge management solutions and technologies available from various vendors in the market. KM solutions facilitate knowledge creation and codification by integrating existing IT infrastructure into the organizational culture (Carvalho & Ferreira, 2001) to enable organizational learning as "best practices, sometimes called *preferred practices*" (Keyes, 2006, p. 23, italics in original). These best practices are identified and shared across organizational groups and "can also spark innovative ideas and generate suggestions for improving processes, even if a practice cannot be used in its entirety" (Keyes, 2006, p. 24). To effectively accomplish sound practices for knowledge creation and sharing, KM solutions utilizing IT infrastructure are aligned with organizational goals and objectives. Keyes recommends organizations identify a KM framework that best aligns with their business strategy.

A model (Figure 7) developed by Ward and Peppard (2002, p. 41) illustrates the relationship between business strategy, demand and application focused information system (IS) strategy, and supply oriented IT strategy. In this model, the downward arrows originating from business strategy depict the direction for business highlighting the business needs and priorities. The upward arrows from IT strategy depict the infrastructure and services that support the business.
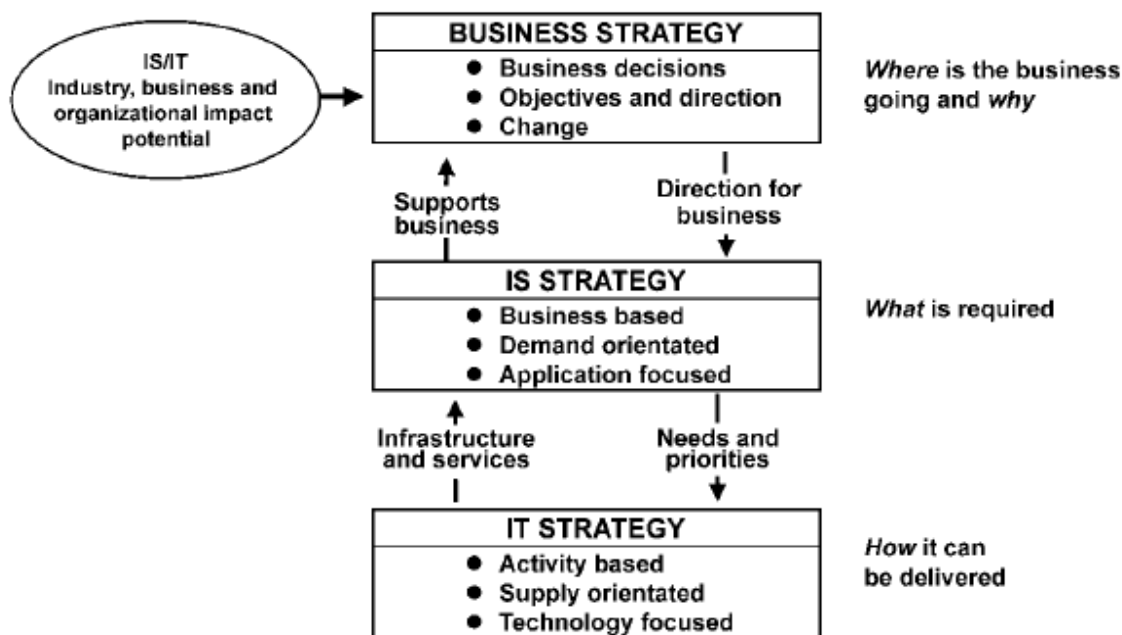
Figure 7: The relationship between business strategy and IT strategy
Source: Ward and Peppard (2002, p. 41)

To answer the question "which framework is best?", Keyes (2006, p. 242) suggests that organizations should construct a framework based upon their choice of "organizational schemes such as balanced set of measures, benchmarking, target-setting, matrices, hierarchies, flow diagrams, and even management systems". She states the right option is dependent on the teams' ability to understand and evaluate their relationships, related benefits, costs and then to measure their impact on each other and to the business objectives. Some organizational schemes relating to KM frameworks (Keyes, 2006) are described as follows:

1. Flow: A flow framework traces KM activities to impacts and related measures to show how the KM activities produce benefits.

2. Matrix: A matrix framework helps to prioritize interdependent complex factors and condense them into a readable format to enable decision making.

3. Causal diagrams: Causal diagrams show the cause-and-effect structure between complicated relationships, and gives an overall view of the organization as a total entity rather than as interdependent units.

4. Balanced scorecard: Balanced scorecards provide a view of business performance by aligning measures with strategies to track progress, reinforce accountability, and prioritize improvement opportunities.

The next section describes a traditional balanced scorecard and how it is used to measure and integrate four business perspectives – innovation and learning, internal processes, customer satisfaction, and financial results – with KM processes.

2.11   Balanced Scorecard

The balanced scorecard (BSC) framework (Kaplan & Norton, 1992, 1996) provides a structure to the strategic intent of an organization translating business objectives into measurable metrics to gauge the company's performance towards achieving the organizational goals.

The BSC framework has four perspectives of performance measurements comprising innovation and learning, internal processes, customer satisfaction, and financial results (see Figure 8). These perspectives define a set of objectives, measures, targets, and initiatives that monitor the achievement of goals of that perspective (Keyes, 2006).
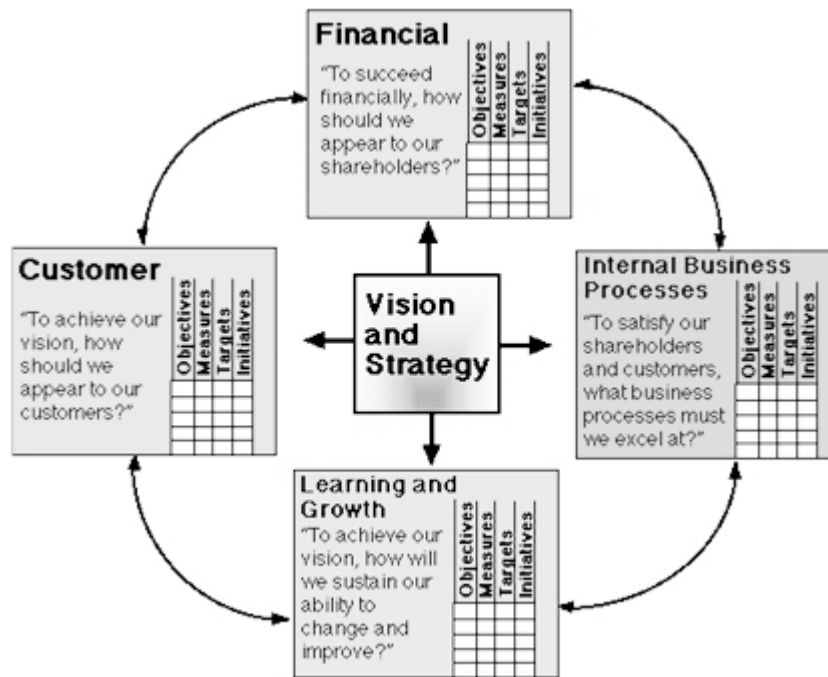
Figure 8: The balanced scorecard framework

Source: Kaplan and Norton (1996, p. 9)

Wright, Smith, Jesser, and Stupeck (1999) suggest business results are linked to daily operational activities through the balanced scorecard cause-effect relationships within these four perspectives:

1. *Innovation and learning.* This focuses on the organizational development through employee perspectives, their knowledge, productivity, innovation, motivation, and satisfaction. These characteristics impact developmental initiatives leading to satisfaction of customer requirements, and finally enterprise success.

2. *Internal processes.* This focuses on the operational aspects of business processes such as cost optimization, efficiency, throughput, and quality perspectives of every function.

3. *Customer satisfaction.* This focuses on the customer-centric attributes of the organization leading to higher satisfaction levels, growth in primary and secondary markets, and finally increased sales.

4. *Financial results.* This perspective focuses on the resulting financial metrics such as growth in revenue, budget control, and capacity utilization based on the above three elements.

In a BSC framework, both non-financial and financial metrics are used. Metrics are also categorized as either lagging or leading in their performance. Some companies call such key metrics as key performance indicators (KPIs). The lagging indicators correspond to the firm's

inability in realizing goals in those areas. The indicators point out to the functions that may need immediate attention. Leading indicators identify areas where the organization has progressed well and are associated with highlighting anticipated performance outcomes (Wright et al., 1999).

Wright et al. (1999) note that the BSC framework correlates an organization's strategic goals with measurement of business process outcomes. The BSC suggests three main aspects. First, it transparently aligns company strategy into departmental tasks providing metrics that direct a firm towards achieving their business goals. Second, it provides a causal relationship between the business activities and financial results. Third, it focuses and relies more on IT investments to accurately provide information for monitoring business activity, producing value assessments for measuring benefits.

Ritchie-Dunham, Morrice, Scott, and Anderson (2000) have noted that companies are looking at leveraging their ES investments in the post-implementation stage at the senior-most level. SAP, in their initiative towards satisfying this organizational need, has developed the Strategic Enterprise Management (SEM) module that utilizes the BSC framework for operationalizing organizational strategies. However, Ritchie-Dunham et al. (2000, p. 1260) state that such a strategy operationalization benefit is viewed as a fifth BSC framework benefit that has yet not been fully realized by enterprises with implemented ESs and "this benefit is also very dependent on the end-user, namely, management. Thus, it is not guaranteed by the presence of BSC or ES, even in combination".

In another study, Western Digital, a manufacturer of hard-drive systems, has built a digital dashboard system called "real-time" that includes both "sensing and responding capabilities" with their ES as the technical backbone. This system includes a management dashboard that automates "the alerting process" and provides the means for a response through various operational indicators supported by an underlying business intelligence and data warehouse application. These indicators include production yields, inventory levels, production output, test equipment utilization, and quality parameters that have enabled the company to improve operational efficiencies, maintain high product quality, and provide better future versions of products (Houghton, El Sawy, Gray, Donegan, & Joshi, 2004, p. 19).

Businesses gather data, analyze information, and utilize knowledge to make well informed strategic business decisions. This decision making affects a variety of organizational disciplines such as research and development, manufacturing, and supply chain management to finally the end customer (Moncla & Consulting, 2000). Even though the importance of knowledge management has been realized, there has been a lack of research and theoretical advances on the

development and outcomes of these technologies (Simmers, 2004). Organizations have deployed enterprise systems to create data sources which provide valuable information to meet their business intelligence and knowledge requirements (Vitt, Luckevich, & Misner, 2002).

2.12   Business Intelligence

To be able to utilize information from ES, organizations deploy business intelligence (BI) tools that assist in extracting relevant data for analytical decision making. BI systems, referred to as "data-driven DSS[2]" (Power, 2007) is an activity that supports business strategy. It is described as a rational approach to management, which is fact-based and analysis-based, converting data into information, and empowering organizations to "make better decisions faster" (Vitt et al., 2002, p. 14). The BI process includes transformation of data into valuable information, insightful analysis leading to action, and finally evaluation and distribution of results. BI supports collection, analysis, and reporting on organizational data in all of the business activities supported by the system throughout the value chain (Nicolaou, 2004a).

Business intelligence has applied functionality, scalability, and reliability of database management systems. The BI tools and platforms are available from large enterprise system vendors such as SAP, Oracle, and Microsoft and mid-sized specialist BI companies such as Cognos, Crystal/Business Objects, and Hyperion/Brio. These vendors have developed business intelligence applications utilizing on-line analytical processing function that provide features such as ad-hoc queries, enterprise and end user analytical reporting, as well as some typical scorecard or dashboard functionalities (Carvalho & Ferreira, 2001). For driving business collaboration, organizations need both business intelligence and content management. Business intelligence focuses on extraction and analysis of structured enterprise data whereas content management relates to management of the unstructured corporate data to make it meaningful. An ES enables this point of convergence and constitutes an important aspect for organizational knowledge creation since it is the fundamental tool in the intelligent enterprise (Framinan, Gupta, & Ruiz-Usano, 2003). Based on such organizational needs, ES vendors have incorporated the BI module and its analytical functionalities into their offering "as SAP has done with Business Information Warehouse (BW)" (Hashmi, 2004, unpaged).

On implementation of an ES, a new platform for transaction processing is established. Transactions are recorded from decentralized locations that get integrated and reside centrally within the ES environment. The function-specific systems are now extended across functional barriers which automate many business transactions and improve response times. However, with business information warehousing, another major step is taken towards data accessibility.

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[2] DSS is a computer-based and knowledge-oriented decision support system

Robinson (2004, unpaged) notes, "islands of highly granular data are created, deeply integrated with historic data and stored in accessible, efficient structures that permit users to rapidly shuttle data between applications and analytical processes in the business intelligence environment". This enables users to extract data and create desired information which may be utilized for analysis and decision making.

It is therefore important to understand the process of identifying and analyzing the right information for effective decision making to achieve the desired benefits, which is explained in Davenport's (2000) model of how ES data are transformed into knowledge and results. This model is discussed in the next section.

2.13   A Model for Turning ES Data into Knowledge and Results

A model conceptualized and applied by Davenport and his team of researchers for turning ES data into ES knowledge is shown in Figure 9. Davenport notes "managing with the information from an ES is not just a matter of installing one, or of developing a data warehouse and populating it with ES data. It is achieved not through technology alone, but through a complex collection of factors that most organizations have never even considered" involved in turning data into knowledge and business results (Davenport, 2000, p. 221).
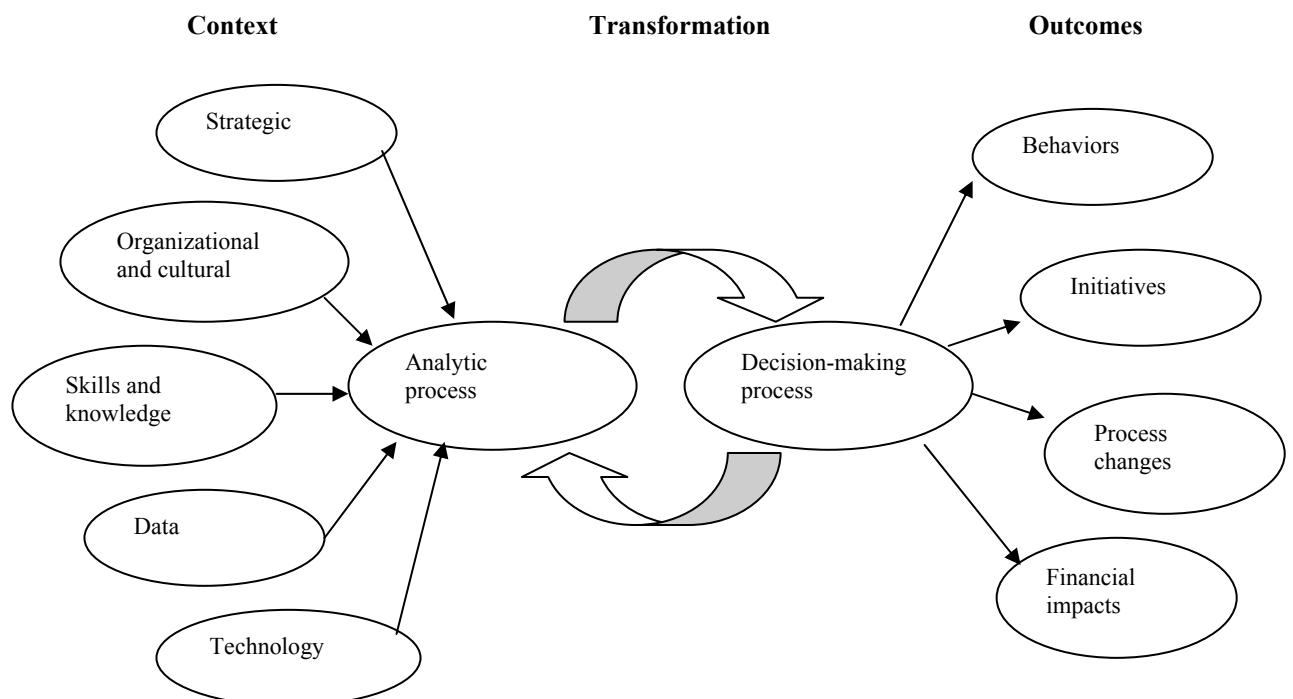
Figure 9: A model of how ES data are transformed into knowledge and results

Source: Davenport (2000, p. 222)

The model comprises three main stages. The first is establishing the context. This includes the pre-existing factors that are present for transformation of ES data into knowledge and results. The second stage is the transformation of ES data into knowledge which takes place through analysis of data and its utilization for decision making. The final stage is the realization of outcomes, which describe what changed resulting from implementation of the decisions (Davenport, 2000). Each of these major components of Davenport's model – context, transformation, and outcomes – are discussed in the following subsections.

Context

Five key factors set the context for the decision-making process by identifying the possibilities and limitations within which decisions can be made and results can be achieved.

Strategic context: This is the business context or the business objectives for which the ES data are to be analyzed and used. The strategic context specifies what is to be achieved, what questions need to be answered by the data, the critical management and business processes where the data are to be applied, and the overall business value which is derived from the data transformation (Davenport, 2000).

Organizational and cultural context: This includes several dissimilar company aspects which can impact the data transformation process. The approach to data-based decision making is fundamental within these aspects: Do the organization's decision makers prefer data to perception? Is it a data-oriented culture? Does the organizational structure support collaborative working? Are the reward systems aligned to goal achievements? "Organizational factors are difficult to measure and change, but without a positive context, successful data transformation is unlikely on a regular basis" (Davenport, 2000, p. 223).

Skills and knowledge: In an effort to use ES data effectively, certain human qualities are essential. There are several different types of skills and knowledge that may be relevant to this contextual objective, including technical skills, analytical skills, and business skills to understand the business and the underlying business processes. Knowledge of the data and information structures are especially critical due to the complexity of ESs. For successful evaluation and utilization of ES data, even the most advanced analytical application does not preclude the requirement for high-quality skills and expertise (Davenport, 2000).

Data: This relates to the data quality from the enterprise system including its accuracy, currency, and availability for analysis and decision making. "Enterprise systems have relatively high data quality compared with most application programs. However, the data that emerges from them is generally intended to serve business transactions, not analysis and decision making." Creating an effective data context is difficult but necessary (Davenport, 2000, p. 222).

Technology: The ability of a company to utilize data and create value depends on the technological factors. "They might include the capabilities of the ES itself for reporting and analysis, software and hardware for data extraction and analysis, the access that potential users have to the data over networks and infrastructure, and even the ability to distribute the results of analysis" (Davenport, 2000, p. 222).

Transformation

Analytic process: This involves the manipulation of the data into a meaningful form (information) and the application of human intuition, judgment, and experience (knowledge). These are mostly numeral and statistical analyses, or reports that also include insights and evaluations by individuals (Davenport, 2000).

Decision-making process: This may be based on "high-quality, well-analyzed ES data, or a multitude of other factors" (p. 224). The more the decision is based on knowledge, then the better are the chances of achieving a successful outcome (Davenport, 2000).

Outcomes

Behaviors: Behavioral transformation of employees, customers, suppliers, and stakeholders are potentially the most important consequence from the data transformation process. Behavior of customers and suppliers may improve due to resolved disputes on prices and invoices which may have existed earlier. Better visibility and information sharing between employees and stakeholders may improve relations and behavior by all (Davenport, 2000).

Initiatives: A new initiative may result from a decision taken based on the ES data transformation process – to execute alterations in some existing project, or implement a completely new business improvement project. "Analysis of customer transaction data may reveal, for example, that a promotion isn't working and that a new marketing initiative is needed" (Davenport, 2000, p. 224).

Process changes: A new process may be developed and implemented as an outcome from an evaluation of the ES data transformation process, that an existing process is not effective. "If ES data transformation suggests that a new product development process takes too long, for example, actions may be taken to shorten it incrementally or radically" (Davenport, 2000, p. 225).

Financial impacts: Finally, the outcome of all of these activities must result in the financial benefits to the company. "Decisions lead to new behaviors, which lead to new initiatives and processes, which don't matter much unless they improve the bottom line and the return to the shareholders". Financial impacts from the ES implementation may be direct, or may be an

indirect outcome "as the end result of a variety of behavioral and organizational changes" (Davenport, 2000, p. 225).

2.14   Extended Model for ES Data Transformation into Knowledge and Results

On reviewing both the CSF model for enterprise systems (Figure 4) by Allen et al. (2002) and Davenport's (2000) model (Figure 9), it was evident that the strategic framework of the CSF model – comprising the constructs project schedule/plan, ES strategy/mission, and top management support – envelopes the strategic contextual factor in Davenport's model.

The contextual lens framework of the CSF model – comprising the constructs organizational culture, constructions of past technological implementations and political structures – is an extension of the organizational and cultural contextual factor in Davenport's model.

The tactical framework of the CSF model – comprising the constructs relationship and knowledge management, technical tasks, client acceptance, and business process changes and software configuration – are related to the skills and knowledge, data, and technology contextual factors in Davenport's model.

Finally, the monitoring, feedback and trouble shooting construct in the tactical framework of the CSF model could be extended to cover the entire cycle of ES data transformation to results in Davenport's model. These similarities and extensions of both models suggest the revised context factors shown in the left side of the extended model shown in Figure 10.

Additionally, the ultimate results of ES data transformation through the decision-making process are not outcomes, but how the business benefits and the ensuing results. Specifically, the benefits defined and categorized in Table 4 earlier form extensions of the outcomes – behaviors, initiatives, process changes, and financial impacts – in Davenport's model. This extension to the model is shown in the far right column of Figure 10.

The framework for the transformational process posits a holistic approach. It not only includes the essential data and technology factors for ES data transformation, but also comprises the other strategic, organizational and cultural, and skills and knowledge factors that are necessary for realizing business benefits.
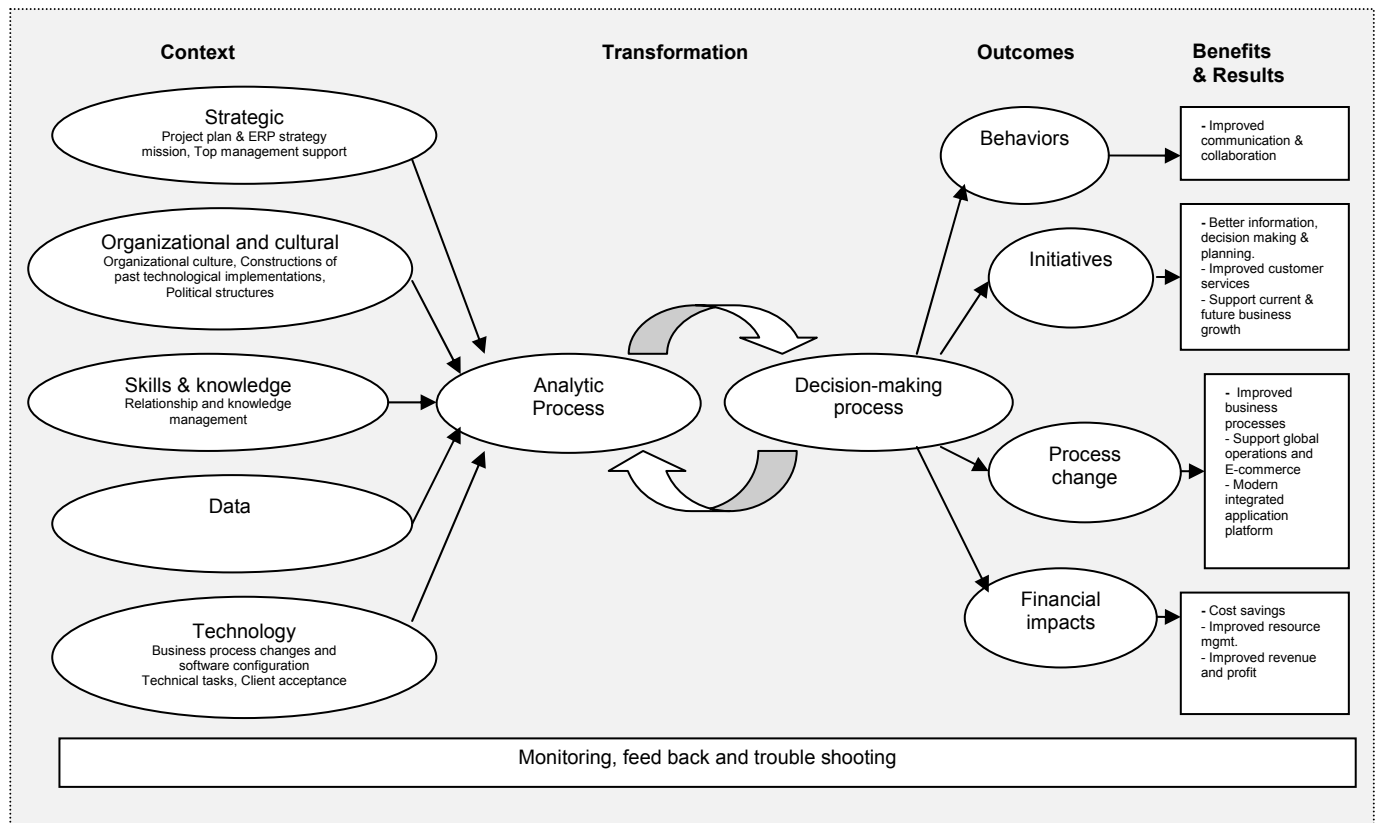
Figure 10: Extended model for ES data transformation into knowledge and results

Davenport (2000, p. 255) notes, "it may be difficult to draw a direct chain of influence from prerequisites to transformation to non-financial outcomes to financial results, but establishing that linkage should always be the objective of an organization that invests effort and resources in ES data transformation". An examination of this process would explain the ES impact to produce business benefits in an organization and is the focus of this study.

2.15 Summary

This chapter presented the theoretical context of the study. Various research perspectives, attributes, and implications of enterprise systems were examined that developed a detailed understanding of the ES environment. Existing literature on ES was explored to establish the nature of these systems, their architecture, implementation, success factors, and benefits. Associated technologies and processes such as knowledge management, balanced scorecard, and business intelligence were discussed. Furthermore, critical success factors for ES and a model for ES data transformation into knowledge and results were reviewed to identify the main research constructs that supported the development of the proposed research model for the study. Finally, the extended transformational model for ES data transformation into knowledge and results that provides theoretical as well as methodological guidance for the conduct of this study was established. The next chapter presents the research methodology for the study.

Chapter 3

RESEARCH METHODOLOGY

3.1   Introduction

The focus of this research is to understand how organizations derive business benefits from utilization of ES and its information. The study answers the four research questions: (1) what key benefits do organizations seek through the utilization of ES and its information, (2) how are ES data transformed into knowledge in relevance to the benefits sought, (3) how is this knowledge utilized to make business decisions for the realization of the benefits, and (4) what are the critical success factors for the transformational process to produce benefits.

The exploratory nature of the research questions necessitates a research design that begins with a preliminary study to understand current ES implementation and post-implementation practices in New Zealand (NZ). The preliminary study involves in-depth interviews with practitioners – ES vendors, ES consultants, and IT research firms – who are key players in the enterprise system industry in NZ. Independent practitioner perspectives assist in refining the study constructs as different ES implementation scenarios described bring focus and structure to the next phase of the study. The preliminary study also assists in identification of the case study organizations for the main study.

The main study uses a multiple case study design to analyze the current ES practices and critical effectiveness constructs of enterprise systems identified by the preliminary study. The research design thus adopts a positivist perspective with assumptions that organizational constructs are based upon "intentional and rational, or at least boundedly rational" practices (Orlikowski & Baroudi, 2002, p. 60).

This chapter first describes the chosen research methodology in this study. Second, the application of the research methodology to this study is discussed, including justification of the research perspective, justification of the case research methodology, case research design and its components, quality tests in research design including triangulation, and selection of the case studies. Third, this chapter discusses procedures for data collection and analysis including data collection preparation, skills, and case study protocol, data collection, integration, and creation of the case study database, data analysis, and reporting of the case studies.

3.2   Justification of the Research Approach

Three philosophical assumptions dominate IS research namely, positivist, interpretive, and critical studies. Positivist studies "attempt to increase predictive understanding of the phenomena" being investigated (Orlikowski & Baroudi, 2002, p. 55) as researchers work within a theoretical tradition. Interpretive studies assume a "non-deterministic perspective where the intent of the research is to increase understanding within cultural and contextual situations" and where researchers do not impose "a priori understanding of the situation". Critical studies adopt "a dialectical analysis" to reveal contradictions within existing social practices (p. 56).

The IS field is a "meta-subject" spanning disciplines in business, economics, social sciences, and natural sciences and is better defined as "an applied discipline, not a pure science" (Galliers & Land, 2002, pp. 14-15). The success of research in an applied field is measured by the extent to which the research can be applied in practice and researchers should adopt a "reality-oriented qualitative enquiry" (Patton, 2002, p. 94). Mixed research methods combine different philosophical perspectives (Khazanchi & Munkvold, 2000) to give a real-life perspective when studying organizational or social phenomena (Galliers & Land, 2002; Lee & Hubona, 2009; Patton, 2002).

This study uses an idiographic research approach to achieve distinctiveness of each case by gaining insights through the description of the study phenomena and establishing discrete interpretations. Idiographic research is concerned with obtaining an in-depth understanding of the process under study or particular situation to accomplish richness and recognize the unique reality of the research situation through a context-dependent description of the process. The research outcomes may be generalizable to other similar situations depending on the extent of similarity (Mingers, 2003).

The study utilizes the model for transforming ES data into knowledge and results to evaluate how organizations derive business benefits from utilization of ES and its information. This assists in organizing the case study constructs to provide an orientation for guiding the case study analysis. Theoretical propositions about causal relations also help answer the how and why questions (Yin, 2003), lead interpretation, make sure that vital issues are not missed out, justify events, and assist in development of theories (Dube & Pare, 2003).

The above two approaches, idiographic and utilization and verification of theoretical proposition, however relate to two different research paradigms which are the most dominant in information system case study research – the interpretivist and the positivist research paradigms. The idiographic approach is based on the interpretivist paradigm that assumes realism consists of numerous perspectives, therefore is subjective, and is constructed by both the researcher and

the research situation (Klein & Myers, 1999). The utilization and verification of a theoretical proposition relates to the positivist paradigm. The positivist approach contends that "reality out there is to be studied, captured, and understood" with respect to theoretical propositions (Denzin & Lincoln, 2003, p. 14).

In a recent study, Lee and Hubona (2009, p. 245) note many parallels between positivist research and interpretive research in the IS discipline and state, "these two forms of research are not opposed and irreconcilable, but compatible". Both types of research build provisional theory through "prediction or observational consequences" and are based upon rigorous methodological techniques to establish formative validity (process of building theory) and summative validity (product of the process namely theory). In the positivist approach, case study research can achieve one or more of three objectives: testing theory, description, and exploration. The aims of interpretivist case studies are the same with the exception of testing theory. Theories are not only guidelines and frameworks for conducting research; they also provide ways of encapsulating the findings from the research work (Walsham, 1993). Lee and Hubona finally advise researchers (positivist or interpretive) who reflect on themselves based on their research approach to "instead see themselves as members of the same team, pursuing the common goal of building a cumulative body of knowledge in the information systems discipline, which they can do by building on a common scientific basis" (Lee & Hubona, 2009, p. 257).

This study adopts "methodological pluralism" by combining the idiographic research approach with the utilization and verification of theoretical proposition, to incorporate both positivist and interpretivist approaches to better achieve the research outcomes. Denzin and Lincoln (2003) use the term postpositivism to capture contextual evidence from a social phenomena for discovery and verification of theories where the investigator recognizes that the investigation is constructed through interaction with the people involved in the setting. The basis for postpositivism is the use of multiple methods to obtain a realistic perspective of the phenomena being researched rather than obtaining a precise scientific view of the phenomena. The epistemology underlying this research utilizes postpositivism for reliable and objective findings. The ontology of this paradigm assumes that the reality of the phenomena is objective, singular and independent from the researcher.

This study, therefore, focuses on such a context-dependent, postpositivist case study approach from a realist perspective, which not only provides guidelines and frameworks for conducting research, but also provides ways of encapsulating the findings from the research work.

3.3   Justification of the Exploratory Case Research Methodology

The primary questions motivating this research are what are the business benefits organizations seek and how are these benefits realized utilizing enterprise systems and its data? The study evaluates a real-life phenomenon within a contemporary setting to understand the complexity of ES implementations and how organizations utilize ESs to realize business benefits. It examines which factors are critical to realization of these benefits. The study investigates what and how questions to make facts understandable. An ES encompasses a wide range of processes which are shaped by the practices within the organization over which the investigator does not have any control. Yin (2003, p. 7) notes "the first and most important condition for differentiating among the various research strategies is to identify the type of research question being asked. In general, 'what' questions may either be exploratory or about prelavence. 'How' and 'why' questions are likely to favor the use of case studies, experiments, or histories".

Yin (2003, p. 13) further notes, "a case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident". Moreover, when the governing objective is to make facts understandable, the case study methodology offers methods for moving back and forth between existing data, and gathering new data, which contributes to the development of knowledge. Case study investigation is useful when an in-depth, holistic research is required to answer the how and why questions, when the phenomenon is complex and broad, and when its study beyond its context of occurrence is not possible (Dube & Pare, 2003).

The main strength of case study research lies in covering contextual conditions highly pertinent to the phenomenon under study, unlike experiments which "deliberately divorces a phenomenon from its context" and unlike surveys which are limited in their ability to deal with a phenomena and its context (Yin, 2003, p. 13). When the focus is on examining the dynamics existing in a specific setting to provide explanation, theory testing, or theory creation, case study research is the preferred strategy (Eisenhardt, 1989). It provides an all-inclusive investigation, well suited to explore the complexities in organizations and interrelation with individuals and technologies (Dube & Pare, 2003). Several attributes of case study research are common to other qualitative methods such as evaluation of participant's insights, data collection through words, the investigator as the primary data collection instrument, and a real-life setting as the data source. However, the differences are in the criteria to review the value of each qualitative practice, as well as the intent and constraints built into each practice (Dube & Pare, 2003). Furthermore, another distinctive characteristic of case study research is its ability to encapsulate the practitioner's knowledge and to generate theories from this knowledge (Benbasat, Dexter, Drury, & Goldstein, 1984; Eisenhardt, 1989).

All of these descriptions mostly match the requirement and conditions of this research. Therefore, the use of exploratory case study approach is the chosen research strategy for this study. This provides a holistic investigation of real-life events, which are the process of ES data transformation into knowledge and results.

For this research, in-depth multiple case studies are used to gain insights into three organizations who have implemented an ES. This enables a theoretical and empirical evaluation in understanding the impact of enterprise systems for business benefits. A preliminary study is first conducted with interview data collected from enterprise systems vendors/consultants, and IT research firms who are the key ES experts in the New Zealand industry. Insights are gained from senior professionals in reputed ES companies who have been involved in many implementations in multiple sectors. In the main study the empirical data are collected from three electronics manufacturing organizations who have implemented enterprise systems for at least three years, and so are in the mature phase of implementation. In all three firms, the system is stable and the organizations are in the phase of realizing the benefits of ES implementation. This provides the necessary conditions to compare the findings from the three case studies with the perspectives of ES vendors and consultants to examine the current status of ES maturity in NZ organizations and identify the reasons for their levels of success.

The criteria for selecting the cases is made in light of the study's main objective of understanding how organizations utilize their ES and its information to realize business benefits. Semi-structured interviews, document analysis, and observations are used to collect information. The data are organized, integrated, and analyzed using the theoretical dimensions/constructs of the ES data transformation process. The inferences are formulated, which are descriptive and tabular, and reported as three case study reports.

This study uses the dimensions and variables of the transformational model (refer Figure 10) of how ES data are transformed into knowledge and results, to guide the analysis of the qualitative data collected. The rich empirical data and analyzed results help in understanding the theoretical framework for this process and evaluating the impact of enterprise systems for business benefits.

In this study, the various specificities of the case research methodology are followed, such as development of case research design and its components. This is followed by the preparation for data collection process and construction of case study protocol. Finally, the framework for data analytical process and reporting of case studies is established. These methodologies add rigor to the study as explained in the next section and are further discussed in the following sections.

3.4   Relevance and Rigor

The utilization of enterprise systems and their information to achieve business benefits is a subject organizations have been pursuing to better understand for more than a decade. However, the link between organizational requirements and expectations, contextual factors, utilization of ES and its information, knowledge management, and outcomes has not been pursued by academic research.

This study provides insights into the utilization of ES and knowledge created through the process of ES data transformation. This study establishes the link between data, decisions, and actions, its impact on functional and business processes, and their outcomes. Yang and Seddon (2004, unpaged) have stated that the theoretical relation between benefits and CSFs has not been identified by any study so far. They found several studies that examined benefits from an ES implementation, and also several studies which sought to identify the CSFs for enterprise systems, but "none of the studies focused on both CSFs and benefits from ES". In addition, Yang and Seddon state that "the CSF studies have been criticized for lack of theoretical insight linking CSFs to benefits" and "lack a framework that adequately explains why the investigated project and business outcomes occur, thus their contribution to understanding of ES implementation is limited".

The present study bridges these gaps. This study develops and utilizes a framework for ES data transformation into knowledge that leads to outcomes and results in business benefits. Using this framework, the impact of enterprise systems and its data for realization of business benefits is evaluated. In particular, no previous study has explored how ES data are transformed into knowledge, utilized for decision making, results, and the success factors. The focus of most ES research so far has been on "what ESs do" rather than "how ESs do it," which is the focus of this study. There are an abundance of frameworks on ES business benefits and success factors, as discussed earlier, but little is known on what happens at the micro-level, how ES are utilized and data are transformed in organizations that lead to realization of benefits. This research addresses such core aspects by investigating the processes by which ES data are transformed in three New Zealand organizations leading to business benefits. The research roadmap is presented in Figure 11.

Research design

Research design is the plan of action that links the study's research questions to the data collected on one hand and to the study's conclusions on the other (Yin, 1994). The main purpose of research design is to answer the four questions of: "what are the research questions? what data are relevant? what data to collect and how? and how to analyze the results and report the findings?" (Yin, 1994, p. 20).

↓

What are the research questions?
- What key benefits do organizations seek through the utilization of ES and its information?
- How are ES data transformed into knowledge in relevance to the benefits sought?
- How is ES knowledge utilized to make business decisions for the realization of the benefits?
- What are the critical success factors for the transformational process to produce benefits?

↓

What are the relevant data?
Three units of analysis:
- Outcomes - business benefits organizations seek and realize
- Transformation - ES data transformation into knowledge and its utilization to achieve business benefits
- Contextual factors - critical success factors for the above processes

↓

What data to collect?
- Stories of the benefits sought from the ES implementation, realized or un-realized benefits, and its reasons
- Stories of the methods and processes of how ES data are transformed into knowledge in relevance to the benefits sought and how this knowledge is utilized for decision-making to realize the benefits
- Stories on the critical success factors for the transformational process

↓

How to collect the data?
- Interviews
- Organizational documents
- Observations
- Practice publications

↓

How to analyze results and report findings?
General analytic strategy: A development of case description
Specific analytic strategy: A combination of pattern matching, explanation building, and addressing rival explanations through development of case study descriptions that use the context, transformation, and outcomes format of the transformational model.
Within case:
1. The benefits sought and realized are explored using the outcome phase of the transformational model.
2. The analytical decision-making process utilizing ES data are explored using the transformation phase of the transformational model.
3. The CSFs for the above process are examined using the context phase of the transformational model.
Cross-case analysis:
- Findings are examined for similarities and differences across the three units of analysis.

↓

Conclusions:
- The conclusions are presented in Chapter 9.

Figure 11: Research roadmap

Given this research is of much significance and relevance, the next question that needs to be answered is whether the research is rigorously conducted. To bring rigor into this study, the dimensions and variables of the transformational model of how ES data are transformed into knowledge and results are used to guide the analysis of the qualitative data collected to evaluate the utilization of ES data for analysis, its use to support business decisions, and how this leads to business benefits. The rich empirical data collected and results analyzed from the three case studies helps in understanding the theoretical framework for this process and is the most appropriate approach to understand the impact of enterprise systems for business benefits.

Furthermore, the various specificities of the case research methodology are followed such as a priori specification of constructs, multiple case design, use of replication logic, units of analysis, quality tests in research design, triangulation, selection of case studies, data collection methods, case study protocol, ethical considerations, conduct of preliminary and main case studies, integration and analysis of data, and the reporting of the case studies.

Yin (2003, p. 10) has voiced great concern over the lack of rigor of case study research by "not following the systematic procedures". Dube and Pare (2003), in their study to investigate and assess the level of methodological rigor achieved in positivist IS case research, evaluated 183 case articles from seven major IS journals. Their study highlighted the extent to which the "valuable methodological insights or guidelines of leading case methodologists" are being used (p. 599). From their study the evaluation attributes or criteria to achieve rigor in IS case research in three main areas, namely, research design, data collection, and data analysis are recommended. These attributes are presented in Table 6. The list of attributes is developed by Dube and Pare based on the work of Yin (1994), Lee (1989), Eisenhardt (1989), and Benbasat, Goldstein, and Mead (1987) all of whom have strongly influenced the conduct of case study research in IS. "Together these authors offer a set of guidelines and operational attributes that bring rigor to positivist case study research" (Dube & Pare, p. 599).

These attributes relate to the exploratory nature of case study research and are listed along with their authors (see Table 6). The use of each attribute in this study (right column in Table 6) confirms the rigor achieved in the conduct of this study.

The different components of the case research design followed in this study include clear research questions, a priori specification of constructs, multiple case design, use of replication logic, units of analysis, conduct of preliminary studies, context of the case study, and selection of case studies. These methodologies add rigor to the study and are discussed in the next eight subsections in the next section.

Table 6: Attributes to assess ES data transformation into knowledge and results

Key attributes	Authors	Use in this study
Research design		
Clear research questions	1, 2, 3	Four research questions are identified to assess ES data transformation and results (Section 3.5.1)
A priori specification of constructs	3	Eleven constructs are specified (Section 3.5.2, Table 7)
Clean theoretical slate	3	Theoretical proposition from literature used (Section 3.5.2, Figure 10)
Multiple-case design	2, 3, 4	A multi-case design of three cases used (Section 3.5.3)
Replication logic in multiple-case design	3, 4	Cases follow literal replication logic based on criterion and snowball sampling strategies (Section 3.5.4 and 3.5.8)
Unit of analysis	1, 2	Embedded units of analysis (context, transformation, and outcomes) comprising three phases of transformational process (Section 3.5.5)
Pilot case	2	Preliminary study is conducted with ES experts (Section 3.5.6)
Context of case study	1, 2	Case setting descriptions (participant details, timing of interviews, rounds, number of meetings) are explained (Section 3.5.7)
Data collection		
Elucidation of data collection process	1	The data collection process from three selected NZ organizations in their mature phase of ES implementation is described in detail (Section 3.8 and 3.9.1)
Multiple data collection methods	1, 2, 3, 4	Multi-methods such as interviews, observations, company documents, organizational reports and memos are used for data collection (Section 3.9.1)
Mix of qualitative and quantitative data	1, 3	Along with interviews, organizational reports with quantitative data such as operating revenue, EBITDA, and profit after tax are used
Data triangulation	1, 2, 3, 4	Multi-methods (interviews/ observations/ reports/ follow up interviews) and multi-data sources (preliminary and main study) are used (Section 3.7)
Case study protocol	1, 2	Interview instrument/ethical considerations are developed through case study information sheet and questions (Section 3.8.3)
Case study database	1, 2	Case study database is created from transcripts, case descriptions, company Web sites, documents, and notes (Section 3.9.3)
Data analysis		
Elucidation of data analysis process	1, 2, 3	Layering, pattern matching, cross case synthesis and explanation building is described in detail (Section 3.10.1 and Figure 14)
Field notes	2, 3	Field notes are used complementing interview data
Coding and reliability check	2	Codes and queries used through NVivo to categorize and analyze interpretations of documentation and reporting (Section 3.10.1)
Data displays	2	Tables, graphs, charts, and diagrams are used
Flexible and opportunistic process	1, 2, 3	Openness to field data from preliminary and main study has led to identification of patterns between CSFs and contextual factor
Logical chain of evidence	1, 2	Linking case study questions, protocol, findings, database, and study report back-and-forth to provide chain of evidence (Section 3.6.1.2)
Explanation building	2	Descriptive explanations provided for every construct, processes, and study findings in the analytical discussion section
Searching for cross-case patterns	3, 4	Cross-case patterns evaluated between the three cases as well as the preliminary study using codes and queries supported through NVivo
Quotes (evidence)	1, 2	Extensive use of interview quotes in case descriptions
Project reviews	2	The credibility of the interpretations reviewed to corroborate essential facts through self reviews, journal publications, and presentations in international conferences and seminars
Comparison with extant literature	3	The emerging concepts are compared with extant literature to enhance confidence in findings
1 = Benbasat et al. (1987); 2 = Yin (1994); 3 = Eisenhardt (1989); 4 = Lee (1989)		

Adapted from: Dube and Pare (2003, p. 606)

3.5   Case Research Design and its Components

A research design is the strategy that relates the initial study questions to the data collection and the research conclusions (Yin, 2003). In an exploratory case study research design strategy, rigor can be achieved by providing for the following (Dube & Pare, 2003):

- Clear research questions

- A priori specification of constructs

- Multiple case design

- Replication logic in multiple case design

- Units of analysis

- Pilot case/preliminary study

- Context of the case study

- Selection of case studies

These components of case study research are discussed in this section.

3.5.1   Clear research questions

Clear definition of the research questions forms an important step in an empirical evaluation (Benbasat et al., 1987; Dube & Pare, 2003). Chapter 1 describes the research background, the definition of the research problem, and the formulation of the research questions which are as follows:

(1) What key benefits do organizations seek through the utilization of ES and its information?

(2) How are ES data transformed into knowledge in relevance to the benefits sought?

(3) How is ES knowledge utilized to make business decisions for the realization of the benefits?

(4) What are the critical success factors for the transformational process to produce benefits?

These questions have been verified and confirmed as appropriate for this research after the conduct of the preliminary study with ES vendors/consultants who are the experts in this field.

3.5.2   A priori specification of constructs

To develop the research design, Eisenhardt (1989) recommends a priori specification of constructs that delineates the theoretical domain and identifies the scope of the study using an existing theoretical framework. It is necessary to identify research constructs early as well as understand that in case study research the constructs are provisional and addressed in the development of the theoretical framework of the study. Chapter 2 provided a critical review and analysis of the ES literature that resulted in adopting the transformational model (Figure 10) to examine the process of how business benefits are realized from utilization of ES and its information. The specifications of constructs within the model are presented in Table 7.

Table 7: Constructs for ES data transformation into knowledge and results

Phase	Framework	Constructs
Phase 1	Contextual factors	• Strategic • Organizational and cultural • Skills and knowledge • Data • Technology
Phase 2	Transformation	• ES data transformation into knowledge through analytical processes • Utilization of knowledge to achieve benefits through decision-making processes
Phase 3	Outcomes	• Changing behaviors • New initiatives • Process changes • Financial impacts

3.5.3   Multiple case design

A critical consideration in case research design is the number of cases to be included in a research design. It is frequently criticized that a generalizable conclusion cannot be drawn from a single case in case study research (Dube & Pare, 2003). The multiple case study not only satisfies external validation but "the evidence from multiple cases is often considered more compelling, and the overall study is therefore regarded as being more robust" (Yin, 2003, p. 46). Multiple cases enable generation of theory (Eisenhardt, 1989; Yin, 2003) and the rationale is comparative studies (Eckstein, 1975; George, 1979; Yin, 2003). "Multiple case designs are desirable when the intent of the research is description, theory building, or theory testing… Multiple case designs allow for cross-case analysis and the extension of theory. Of course, multiple cases yield more general research results" (Benbasat et al., 1987, p. 373).

In a case study design, the number of cases selected depends on the depth of the study. "Selecting cases must be done so as to maximize what can be learned in the period of time available for the study" (Dube & Pare, 2003, p. 609). Patton (2002) suggests there is a tradeoff between the breadth and depth possible in a case study design. Mintzberg (1979, p. 585) states, "No matter how small our sample or what our interest, we have always tried to go into organizations with a well-defined focus". As a general guideline for case research, Yin (2003) recommends a few cases (2 or 3) for literal replications.

Yin's word of advice is "although all designs can lead to successful case studies, when you have a choice (and resources), multiple-case designs may be preferred over single case designs… More important, the analytic benefits from having two (or more) cases may be substantial. To begin with, even with two cases, you have the possibility of direct replication… Having more than two cases will produce an even stronger effect. In the face of these benefits, having at least two cases should be the goal" (Yin, 2003, pp. 53-54).

Considering the above recommendations, the depth of the current case inquiry, and the use of literal replication logic in the multiple cases, the number of cases selected in this study is three. To add rigor into the study, a third case is included to provide substantial analytic conclusion and the generalizability of the findings, and as Yin (2003, p. 54) states "produce an even stronger effect".

3.5.4   Replication logic in multiple case design

Case study research evaluates how outcomes are produced from the dynamics of conditions fitting together within single settings (Eisenhardt, 1989; Ragin, 1999).

The replication logic in multiple-case design provides the rationale for the conditions of the study that replicate the findings. Yin (2003) notes, in a multiple-case design, the case selection must be based on the replication logic – either theoretical replication logic (where contrasting results may be predicted by the case conditions) or literal replication logic (where similar results may be predicted by the case conditions). The cases are selected either due to their "substantive significance or theoretical relevance" (Dube & Pare, 2003, p. 609). In the use of replication methods a key step is "the development of a rich theoretical framework" (Yin, 2003, p. 47). Case comparability with the application of literal replication logic in this study is based on sharing of theoretical concepts predicting similar outcomes.

In this study the three cases are selected because they meet the following three criteria. First, all three organizations are in the manufacturing sector and this is significant because the characteristics of manufacturing organizations within the environmental, organizational, and

technological context especially motivates ES adoption (Raymond & Uwizeyemungu, 2007). Second, the organizations belong to the same class of industry allowing common conditions for comparison. This criterion is particularly important considering the argument that "IS researchers should study the development, use, and impact of information systems at an industry level of analysis, since ES software is specially developed for industries, not individual organizations" (Crowston & Myers, 2004, p. 6). Specifically, all three cases are taken from the high-tech electronics manufacturing industry. Third, all three cases have implemented enterprise systems for at least three years and so are mature with their ES implementation. The system is stable and the organizations are in the phase of realizing benefits. Table 8 below highlights the three criteria for case selection.

Table 8: Criteria for case selection

Criteria	Description of criteria for case selection
1	All three cases must belong to the manufacturing segment
2	All three cases must belong to the high-tech electronics industry
3	All three cases must have implemented ESs for at least three years

The cases are selected within the same settings and conditions; therefore this study follows the literal replication logic with an expectation of similar results. However, the dynamics of varying contexts within each case does not rule out the possibility of different outcomes which is consistent with the basic reason for this study.

3.5.5 Units of analysis

Dube and Pare (2003), in agreement with Markus (1989), have stated that the identification of the appropriate unit of analysis for any research provides a realistic implication of the study findings to generate theory. They state, clearly defining the unit of analysis in an exploratory case study assists in setting the theory limits that decides the boundaries for the application of the theory.

This study uses three units of analysis, or what is called an embedded case (Yin, 2003). The three units comprise the three phases – context, transformation, and outcomes – of the transformational model. Each phase relates to at least one research question as shown in Figure 12.
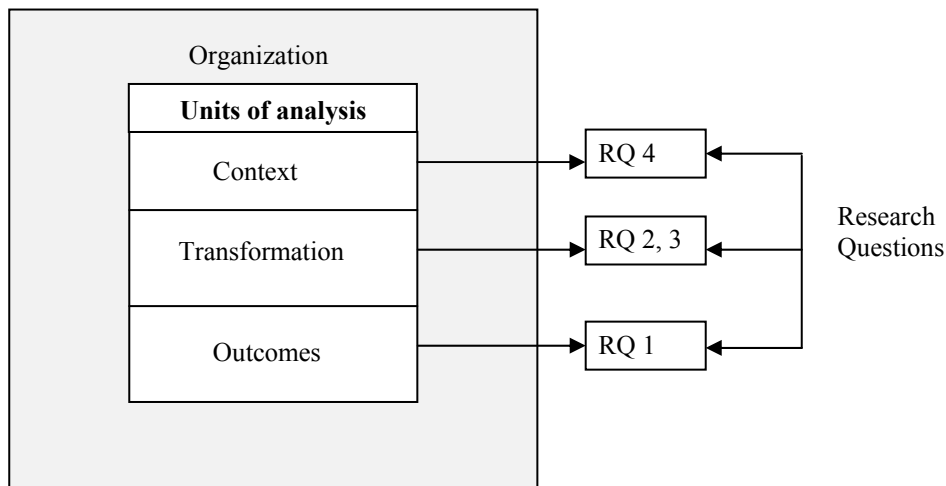
Figure 12: Relation of units of analysis to research questions

(1) The context phase comprises the contextual factors – strategic, organizational and cultural, skills and knowledge, data, and technology – and relates to the fourth research question: "what are the critical success factors for the transformational process to produce benefits?"

(2) The transformation phase comprises the analytical and decision-making process and relates to the second and third research questions: "how are ES data transformed into knowledge in relevance to the benefits sought" and "how is this knowledge utilized to make business decisions for the realization of the benefits?"

(3) The outcomes phase comprises the outcomes – changing behaviors, new initiatives, process changes, and financial impacts – that result in business benefits and relates to the first research question "what key benefits do organizations seek through the utilization of ES and its information?"

The advantage of an embedded case design is to prevent the shift in focus that is a common problem for single unit-of-analysis case designs. The problem occurs when the "entire nature of the study shifts during the course of the study" and a different orientation may emerge (Yin, 2003, p. 45). However, one common problem in the embedded case design is when the case study focus shifts to one of the subunit levels of analysis. If this occurs, the original phenomenon of interest becomes the context, rather than the target of the study (Yin, 2003).

To overcome this problem, this study uses three distinct units of analysis during the data collection and data analysis stages whilst maintaining focus on the overall aim of the study. The interview questions relate separately to each unit of analysis comprising the three phases of the transformational model. The units are validated with case study data before being integrated

together to evaluate the overall knowledge transformation process in accordance with the framework of the study. The rich empirical data collected and results analyzed from the three case studies help in understanding the theoretical framework for this process. The analysis provides an in-depth understanding about the linkage between utilization of an ES and its data in decision-making processes, realized or unrealized benefits, its reasons, or any other important elements contributing to this process.

3.5.6 Preliminary study

In an exploratory nature of research, a preliminary or pilot study helps the researcher become familiar with the phenomenon, refine the instruments for data collection, and establish the proper units of analysis (Dube & Pare, 2003). In this research, before the conduct of the main study, a preliminary study is conducted to gain insights from ten ES vendors, ES consultants, and IT research firms into the current ES implementation scenario in a NZ context. These are key players in the ES industry who collectively have vast multiple ES implementation experience in a variety of industries and business sectors and are the most knowledgeable in this field. Their perspectives assist in confirming the research questions and study constructs based on the different ES implementation practices described to bring focus and structure to the exploratory nature of the research and prepare for the next phase of the study.

There were three objectives of the preliminary study. The first objective was to examine how organizations utilize their ES and its information for realizing business benefits. Therefore, the preliminary study reports on core areas such as key benefits that organizations generally seek from ES implementations, how ES data are transformed into knowledge, how ES knowledge is utilized to achieve business benefits, and what are the critical success factors for this process that reflect on current ES implementation and post-implementation practices in NZ organizations.

The second objective was to understand the current practices of ES implementations in a NZ context and, especially, to identify case study organizations for the main study. The selection of the three organizations considering their industry segment and maturity is done with the cooperation of case key informants because they are the ones who can identify organizations with these characteristics.

A third objective was to test, refine, and become familiar with the data collection instruments before the conduct of the main study. The process and findings of the preliminary study are reported in Chapter 4.

3.5.7 Context of the case study

In order to evaluate the validity of research findings and verify the generalizability of results, it is necessary to establish an accurate description of the study's context (Benbasat et al., 1987; Yin, 2003). The important attributes of research context include the description of the organization and setting where the study is carried out, researcher's "time spent on site", data collection based on the "time events occurred", time period "under investigation", number of "data collection periods", and "whether the researcher collected data during the course of events or posteriori" (Dube & Pare, 2003, p. 611).

These aspects are explained in detail in the research methodology section of the preliminary study in Chapter 4 and in the case study settings section of the narrative descriptions for the main case studies in Chapters 5, 6, and 7.

3.5.8 Selection of case studies

Three case studies of ES implementation in New Zealand provide the primary data to fulfill the research objective. This follows the multiple case design discussed in Section 3.5.3 earlier. This section discusses the detail of the case selection process for this study.

Yin (2003) stresses that multiple cases follow the replication logic to create and verify new interpretations whereas the use of multiple subjects within an experiment or multiple respondents in a survey focuses on the sampling logic where the aim is generalization. Furthermore, Yin advises careful selection of each case in multiple-case studies, "so that it either (a) predicts similar results (a literal replication) or (b) predicts contrasting results but for predictable reasons (a theoretical replication)" (p. 47). The theoretical framework development in these replication procedures is an important step. The likely conditions for the case research phenomena also need stating (Yin, 2003). Eisenhardt (1989, pp. 536-537) notes "the concept of a population is crucial, because the population defines the set of entities from which the research sample is to be drawn". This approach is subservient to the overarching objective of case research where "selection of an appropriate population controls extraneous variation and helps to define the limits of generalizing the findings."

This study selects cases using the literal replication logic to predict similar results. The study adopts the approach of selecting cases of ES implementation based on three criteria. First, the cases should belong to the same industrial segment. Second, the cases should be from the same industry class so that common conditions for comparison exist and the environmental variation is controlled. Third, the cases should have implemented ESs for at least three years and so are in the mature phase of realizing benefits. The reasons for the conditions have been discussed

earlier in Section 3.5.4. Focusing on firms in the same industrial segment (in this case manufacturing) and in the same industry class (in this case electronics) constrained variation due to differences among the firms. Thus, specification of this population reduced extraneous variation and clarified the domain of the findings as organizations operating in specific types of environments as recommended by Eisenhardt (1989). Such cases will provide an in-depth understanding about the process of utilization of ES and its information in NZ electronic manufacturing organizations. The results are likely to extend or replicate the evolving theory relating to the transformational model for turning ES data into knowledge and business benefits.

Patton (2002) has suggested a purposeful sampling strategy is the best approach to meet the conditions for case study research. Sixteen different types of purposeful sampling strategies have been defined and listed in Table 9 along with their purpose. These sampling strategies relate to different operational objectives. Table 9 has been applied to this study and resulted in the use of two sampling strategies.

First, the criterion sampling strategy applies when cases are selected because they meet one or more predetermined criteria. Cases that belong to the manufacturing sector, in the high-tech electronics industry, and are in the mature phase of ES implementation are identified (refer Table 8). The choice of cases using the predetermined criteria may exhibit a literal replication, with important common patterns that cut across variations, allowing a rich comparative analysis. Although selecting cases with predetermined criteria can make the selection challenging, this feature contributes to the strength of the results because any emergent trends that are common across the cases are of great value and significance in corroborating the unique events and experiences of the cases (Patton, 2002).

Second, the snowball sampling strategy applies when cases of interest are referred by people who are knowledgeable about the cases and recommend them as good examples for the study. Patton (2002) advises the selection of the cases should be "field-determined". In this study, the three cases have been recommended by the ES vendors and consultants interviewed during the preliminary study who are the most knowledgeable in the ES industry and have been involved in many ES implementations in multiple sectors.

With the use of the above case selection criteria and the strategic advice of the ES vendors, ES consultants, and IT research firms, three cases in the high-tech electronics manufacturing industry are chosen that have implemented ES at least three years back and are in the mature phase for realizing benefits. These choices satisfied the purpose of this study to answer the proposed research questions. However, one practical consideration that remained was the acceptance of these identified companies as case research organizations. The assistance from the

ES vendors, consultants, and IT research firms in this regard achieved the recommended case study organizations willingness to accept and go ahead with this research study.

Table 9: Purposeful sampling strategies

Type	Purpose
Combination or mixed purposeful	Cases are flexible, achieve triangulation, and meet different interests and needs.
Convenience	Case is selected on the basis of saving effort, time, and money. Exhibit poor rationale for selection, are information-poor, and low credibility cases.
Politically important case	Case is selected or eliminated because they are politically sensitive cases.
Random purposeful	Cases are randomly selected from a large sample for the purpose of increasing credibility, and not for generalization or representation.
Opportunistic	Cases from following new leads during fieldwork.
Confirming and disconfirming	Cases elaborate on initial analysis to seek exceptions or test variations.
Theory-based	Cases are manifestation of a theoretical construct that is used to elaborate and examine the construct.
Criterion	Cases are picked because they meet some predetermined criterion.
Snowball or chain	Case of interest is identified by people who know people who are knowledgeable about cases that are information rich and form good examples for the study.
Critical case	Case permits logical generalization to other cases because if it is true to this one case, it is likely to be true to all other cases.
Stratified purposeful case	Case illustrates characteristics of particular subgroups of interest to facilitate comparison.
Typical case	Case illustrates what is typical, normal, or average.
Homogeneous	Cases are focused and exhibit minimal variation, therefore analysis is simplified.
Maximum variation	Documents diverse variations due to different conditions, cases identify important common patterns that cut across variations.
Intensity case	Information rich cases manifest phenomena intensely, but not an extreme case.
Extreme or deviant case	Shows unusual manifestation of the phenomenon, such as an outstanding success or a notable failure.

Adapted from: Patton (2002, pp. 243-244)

3.5.9 Summary of the research design

The research design for this study is a multiple case study strategy of three cases using literal replication logic and three embedded units of analysis. The case research utilizes and verifies a theoretical framework from the literature and establishes the attributes of study's context. The cases are selected based on predetermined criteria and snowball sampling strategies through a preliminary study with ES vendors and consultants. The next section explains the quality validations for the study including triangulation.

3.6 Quality Tests in Research Design

To establish the quality of case study research design, four tests are recommended. These are construct validity, internal validity, external validity, and reliability tests (Yin, 2003). These four tests are used in this study. The definitions and the various tactics identified for dealing with these four tests are explained in this section.

3.6.1 Construct validity

Construct validity addresses development of a sufficient operational set of measures of the study's phenomena to ensure data collection is based on such measures and not on the researcher's subjective judgments (Yin, 2003). To meet the test of construct validity, Yin suggests two steps:

1. Based on the study's objectives, select the specific types of variations that are to be researched, and

2. Demonstrating that the specific types of variations that have been selected are reflected by the chosen measures for these variations.

In this study, the specific types of variations being researched include the contextual factors, transformation process, and the outcomes in relation to the study's objectives and research questions. The measures selected for these variations are the three units of analysis which are also the types of variations selected. The three tactics suggested to achieve construct validity include multiple sources of evidence, establishing a chain of evidence, and getting informants to provide feedback (Yin, 2003). Triangulation, another tactic for construct validity for multiple sources of evidence, is discussed in Section 3.7 below. Construct validity is addressed in the present study by the use of these suggested methods.

3.6.1.1   Multiple sources of evidence

A distinct advantage of case study data collection is the possibility to use multiple sources of evidence that provide a more robust representation of the research phenomenon in comparison to any single procedure (Dube & Pare, 2003; Yin, 2003). A multi-method approach in this study entails various techniques for data collection such as semi-structured interviews, document analysis, use of archival records, and direct observations in the technical areas during visits to the facilities. This provides data sets from multiple but dissimilar sources regarding the same phenomenon (Dube & Pare, 2003; Mingers, 2001). Field notes are also used in addition to recording the interviews on tapes to not only include the verbal communication but nonverbal information and explanations of the conversational perspective.

The interviews were validated through successive follow up interviews and getting informants to provide feedback on the interview transcripts and the case study report. The follow up interviews were conducted six months after the original interviews to review any changes to the earlier situation or clarify any issues that needed further discussion. The interview transcripts and the case study report have been reviewed with the study participants and any suggested changes incorporated into the final case study.

3.6.1.2   Logical chain of evidence

A key principle for construct validity is the maintenance of a logical chain of evidence to enhance the case study data quality presented in the research (Benbasat et al., 1987; Dube & Pare, 2003; Yin, 2003). A chain of evidence allows, "an external reviewer or observer to follow the derivation of any evidence from initial research questions to ultimate case study conclusions. Furthermore, the observer is also able to trace the steps in either direction (from conclusions back to initial research questions or from questions to conclusions)" (Dube & Pare, 2003, p. 618).

The logical flow is adequately controlled assuring that the evidence collected during the data collection process remains unchanged and the same information is presented in the case report (Dube & Pare, 2003). This can be demonstrated in several ways. First, the report itself has a sufficient number of citations to the case study database. Second, an inspection of the database reveals the original facts and also indicates the conditions for the data collection. Third, the conditions are in coherence with the specificities and the inquiry stipulated in the case study protocol to demonstrate that the data were collected as per the specified protocol procedure. Finally, the correlation between the initial research inquiry and the protocol content emerges by the reading of the protocol (Yin, 2003).

The current study clearly provides a logical chain of evidence, back-and-forth. The link between the case study questions, case study protocol, citations to specific evidentiary sources in the case study database, and case study report is shown in Figure 13 below.
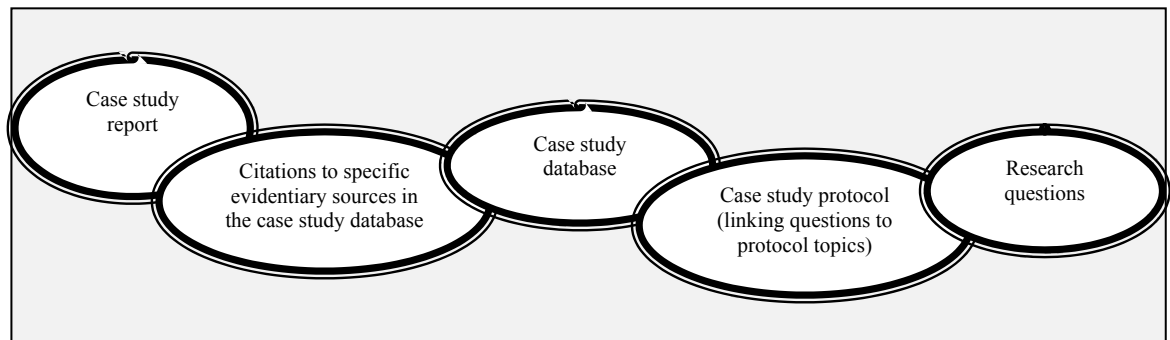
Figure 13: Maintaining a chain of evidence

Adapted from: Yin (2003, p. 106)

3.6.2   Internal validity

Another key question in postpositivist case research is how data are analyzed and interpreted. Internal validity is mainly concerned with causal relationships, making inferences that one event led to another, since it is not possible to observe all events in case study research directly. Therefore, based on the case study data collection, a researcher will "infer" that a specific occurrence was the result of some earlier event. The questions that need to be addressed are: "is the inference correct? have all the rival explanations and possibilities been considered? is the evidence convergent?" (Yin, 2003, p. 36)

Dube and Pare (2003, p. 618) suggest:

> every case investigation should have a general analytic strategy, so as to guide the decision regarding what will be analyzed and for what reason. Moreover, a data analysis strategy is even more important in the context of an exploratory or explanatory case study since the goal of the investigations is to develop or test theories.

In this study, the strategies adopted for internal validity include pattern matching, explanation building, and addressing rival explanations. Pattern matching in this study compares the empirical pattern from the case findings with a predicted pattern from the theoretical framework. When the pattern coincides, internal validity is established. Explanation building, that is another form of pattern matching, is performed by constructing "a textual explanation of the case". Such a method is "most useful in exploratory case studies" (Dube & Pare, 2003, p. 619) such as the current study.

Rival explanations have been considered and addressed in this study. The insights gained from ES vendors, ES consultants, and IT research firms through the preliminary study have been compared with the main case study findings. These insights help assess and explain the outcomes found in the main case research. The real-life rival explanations are the ones that should be carefully identified prior to data collection (Yin, 2003). These validations are further discussed and covered in the data analysis section of this chapter.

3.6.3   External validity

External validity addresses whether a study's findings can be generalized (Yin, 2003). Generalizability has been a major concern in IS research. Beyond the statistical, sampling-based generalizability, researchers have been aware of further generalizability conceptions. Lee and Baskerville (2003) have classified various forms of generalizability through a framework. The distinct forms of generalizability are organized into three main types that are described through the differentiation between theoretical and empirical generalizations and affirm the statistical, sampling-based generalizability. These comprise theoretical to empirical, empirical to empirical, and empirical to theoretical generalizabilities. Alternatively, when the investigation limits even exceed the boundaries of a sampling-based study, the framework specifies the way to generalize.

In the present study, both empirical and theoretical generalizations are accomplished through a sample size of three cases, to achieve external validation using the replication logic. Theoretical to empirical generalizability is achieved based on the utilization of the theoretical transformational model to evaluate the empirical findings from the case studies. Empirical to empirical generalizability is based on the cross-case comparisons between the three case studies and evaluation of their results. The replication logic used in this study is discussed in Section 3.5.4 and Section 3.5.8 (selection of case studies) earlier in this chapter.

3.6.4   Reliability

The main objective of reliability is to reduce the research biases and errors to minimal levels. Reliability implies that the outcomes from the research instrument are "stable and consistent" (Creswell, 2008, p. 169) and that the outcomes of the research study should yield similar results if the same data collection processes are used (Yin, 2003). Although the general aim of reliability is to conduct the research so that same conclusions could be arrived at by another investigator's repetition of the procedures, in qualitative research it is not feasible to have an exact replication of case study. Patton (2002, p. 93) states that "realizing the absolute objectivity of a pure positivist variety is impossible to obtain" within a reality oriented "messy world".

Documentation of the research methods pursued is one prerequisite that allows other researchers to repeat an earlier case study.

Dube and Pare (2003, p. 615), recommend two tactics suggested by Yin (1994) to achieve reliability, "establishment of a case protocol and development of a case study database".

The reliability in this study is achieved through the use of the following:

(1) The establishment of the case study protocol. This is discussed in Section 3.8.3.

(2) The development and maintenance of the case study database. This is discussed in Section 3.9.3.

(3) To make as many steps as operational as possible, such as the detail documentation and reporting of data collection, data analysis, and reporting strategies. These are discussed in Sections 3.9 and 3.10 in this chapter.

3.6.5 Summary of the quality tests

The four quality tests considered appropriate in evaluating the validity of the research design are discussed above. Various tactics used in the study to address these tests are described. Generally, the construct validity and reliability are mainly established during the data collection phase of the research process; external validity is addressed during the design phase; and internal validity is achieved in the data analysis phase.

3.7 Triangulation

The process of bringing together numerous sources of data is called triangulation (Jick, 1979). The use of multiple sources of evidence provides the progressive convergence of lines of enquiry which is its major advantage (Dube & Pare, 2003; Patton, 2002; Yin, 2003). In a case study, the results are likely to be much more accurate and convincing if numerous diverse sources of information are used to reach any finding or conclusion. The possibility of using several diverse sources of evidence is one of the main strengths of case study data collection, that surpasses other strategies for investigation, such as histories, surveys, or experiments (Yin, 2003). Creswell and Clark (2007) suggest that the triangulation process involves separate, but concurrent, gathering and analysis of data so that the research problem is best understood by the investigator. Stake (1995) has further suggested that triangulation must be applied to minimize invalidity and misperception, in the process of data collection. The process intends to (a) provide the reader insight into the case analyses and the generation of inference and (b) improve the validity of case analysis. In triangulation one has the option of not only using the standard

tools of qualitative research but also the alternate theoretical viewpoints of reviewers, panelists, or co-observers (Denzin & Lincoln, 1994; Scholz & Tietje, 2002). The assurance of the results gets enhanced based on the convergence of evidence from multiple sources (Eisenhardt, 1989).

In this study, triangulation is applied through the use of multiple sources of evidence as discussed in Section 3.6.1.1, the use of multiple methods of data collection in a multiple case research environment, and a variety of informants from different functional areas. A multiple method process in case study research provides different but multiple sets of information concerning the same events through various data gathering practices, such as document analysis and face-to-face interviews (Dube & Pare, 2003).

Triangulation is further achieved in this study through comparison of main study insights gained from ES users and practitioners in organizations that have implemented ES with the perspectives of ES vendors and consultants, who are the experts in ES industry, based on the preliminary study findings. The next section explains the preparation for the data collection phase including data collection methods, case study protocol, and the ethical considerations.

3.8 Data Collection Preparation, Skills, and Case Study Protocol

Yin (2003) identifies four prerequisites for preparation for data collection. These include "desired skills" of the investigator, preparation and "training for a specific case study", "development of a protocol" for the case study investigation, and the conduct of "a pilot (preliminary) case study" (p. 57). The first three prerequisites are discussed in the following subsections. The preliminary case study has been discussed in Section 3.5.6 earlier in this chapter.

Collection of data without preparation can be difficult and complex. "If not done well, the entire case study investigation can be jeopardized, and all of the earlier work – in defining the problem and designing the case study – will have been for naught" (Yin, 2003, p. 57). The above prerequisites and principles are discussed next in the context of this study.

3.8.1 Skills of the investigator

The data collection procedures for a case study are not standardized, therefore the researchers' personal traits such as intellect, ego, and emotions play an important role in case study research, more than other research approaches. Due to the constant interaction between the data collection and the related underpinning theories, Yin (2003) recommends case study be conducted by a well-trained investigator for quality results. In an unanticipated situation during case data collection, an experienced investigator "will be able to take advantage of unexpected

opportunities rather being trapped by them – and will exercise sufficient care against potentially biased procedures" (p. 58).

Yin (2003, p. 59) suggests the following commonly required skills for conducting case studies:

- Be able to ask good questions – and interpret the answers.

- Be a good listener and not be trapped by one's own ideologies or preconceptions.

- Be adaptive and flexible, so that newly encountered situations can be seen as opportunities, not threats.

- Have a firm grasp of the issues being studied. This reduces the relevant events and information to be sought to manageable proportions.

- Be unbiased by preconceived notions including those derived from theory. Be sensitive and responsive to contradictory evidence.

In this study, as part of the case study protocol, a research study information sheet that included a brief background of the study, its purpose, and the interview questions was prepared, and sent to the study participants prior to the conduct of the interviews. The answers to the questions were discussed during the interviews.

Question asking

The interview practices that were followed to gain precise insights included a thorough preparation on the study subject before the interview. The interviews were semi-structured and the data collection followed a formal plan. Some background about the study and its perspective were provided to generate participant interest in the study. Sometimes, the format of the predefined questions was not followed and participants digressed from the main subject. In these instances, the researcher tactfully brought the participant's focus back to the interview questions. As the new insights were gained, the evidence was reviewed to help decide whether additional evidence was required that led to asking further questions.

Listening

According to Walsham (1995, p. 78) "access to people's thoughts, views and aspirations requires good social skills and personal sensitivity on the part of the researcher, and these are less easily acquired than matters of technique". Walsham suggests an interview approach involving a "non-judgmental form of listening" (p. 78). In this study, listening for the researcher

meant receiving information through multiple modalities with an open mind. This included observing and noting non-verbal communicative gestures, assimilating large amounts of new information without bias, interpreting accurately by listening carefully, capturing the mood and affective components, and probing further if required. An appropriate seating arrangement with proper eye contact made the communication more effective. These listening skills were also applied to the inspection of documentary evidence, as well as to observations of real-life situations. If any important message between the lines was perceived in the review of documents, this was corroborated with either other sources of information, or clarified with the participants. Any important non-verbal finding or inference was noted for future review.

Adaptiveness and flexibility

As the case research progressed, the researcher encountered situations where the researcher was required to be adaptive and flexible to emerging trends. These ranged from the need to pursue an unexpected lead to the need to follow up a new opportunity. Although in all instances, the original purpose of investigation was kept in focus to maintain the required rigor, the researcher maintained a willingness to adapt to changes in procedures and plans due to unanticipated events or new opportunities. One example was during the course of an interview on a specific topic if the participant suggested seeking perspective from a specific functional area or manager, the meeting plans were revised and scheduled to do so.

Understanding of the issues being studied

To stay on target, the understanding of the purpose of the case study and the issues under investigation is an important skill for the researcher. Understanding the theoretical considerations for the study phenomena and its application in practice are basic requirements that enable the researcher to make judgments during the data collection phase. Thorough reviews of literature, the preliminary study with ES consultants and vendors, and several publications (e.g., Mathrani, Rashid, & Viehland, 2009a, 2009b; Mathrani & Viehland, 2005, 2007a, 2007b; Mathrani, Viehland, & Rashid, 2005; 2007), formal and informal discussions with academia and practitioners in industry provided the necessary inputs to the researcher to achieve the constancy of purpose and subject expertise.

Control of bias

Preconceived notions and bias leads to nonacceptance of findings contrary to what was expected. The researcher achieved control of bias by testing tolerance for contrary findings. The researcher reported preliminary findings while still in the data collection phase to three expert colleagues and discussed interpretations, as recommended by Yin (2003). Converging

perceptions add to the empirical grounding of the hypotheses, while conflicting or diverging perceptions keep the subject open from premature closure (Eisenhardt, 1989; Trauth & O'Connor, 1991). The researcher was open to critique to understand whether biases existed and accepted both deviating and converging suggestions. Through such discussions and evaluation of different interpretations the researcher controlled bias and kept an open mind to contrary findings.

3.8.2 Training and preparation for the specific study

Researcher training and preparation for the study is an important aspect before the conduct of the research (Yin, 2003). The training for the research study commenced right from the beginning when the researcher attended training seminars and a doctoral consortium (Mathrani, 2005b) that covered all phases of the planned case study investigation, including readings on the subject matter, the theoretical issues that led to the case study design, and case study methods and tactics.

The researcher also presented and discussed the detailed research proposal at two conferences held at Massey University in the formative stage. The first was a post graduate conference in information systems designed for discussion and review of the research proposal (Mathrani, 2005c). The second was a symposium on qualitative research where the researcher presented the research methodology of this research for a detailed discussion, review, and feedback by experts (Mathrani, 2005a).

The detailed proposal for the conduct of the study was reviewed by a senior academic committee that led to transition to full candidacy. The researcher further presented at various international conferences during the course of the study (Mathrani & Viehland, 2005, 2007a, 2007b; Mathrani et al., 2005; Mathrani et al., 2007). These presentations and reviews helped bring clarity on the subject, improved the research design, and brought more focus to the review of relevant literature.

3.8.3 Case study protocol

A case study protocol is an essential requirement in multiple-case research and is developed before the data collection phase. It not only includes the instrument for the interview but also contains rules and procedures that are required to be followed during the data collection. The protocol is a key method for guiding the investigator in conducting the data collection from individual cases leading to more reliable case study results (Dube & Pare, 2003; Yin, 2003).

Eisenhardt (1989) argues early construction of research design and identification of research questions is beneficial, however it may be essential to recognize that these aspects are not firm in case research. Yin (2003, p. 55) also notes any new information, discovery or revelation, even at the data collection stage, can lead to "altering or modifying your original design". The development of the protocol includes defining the case study research objectives, data collection methods, interview instrument, and the design of the case study report.

The case study protocol development in this study has been an on-going iterative process from the initial stages of the research design until the conclusion of the pilot phase. The development of the case study report is explained in the "reporting of case studies" Section 3.10.2. The field study reviews that led to the development of the field procedures and the development of the main study interview instrument are explained as follows:

(1)   The initial design and structure was conceptualized through various formal and informal discussions with academic and industry experts. Meetings with academic ES experts from universities, ES vendors and consultants from the ES industry, senior managers from the organizations that have implemented an ES, along with exhaustive reviews of literature led to development of the research questions and the roadmap for the study.

(2)   Additional major inputs came from a doctoral consortium (Mathrani, 2005b) and the various conferences the researcher attended that improved the theoretical concepts and the research design, and brought rigor and relevance into the study.

(3)   Finally, the preliminary study with the ES vendors, ES consultants, and IT research firms helped evaluate the current ES implementation and post-implementation practices of NZ organizations. The research instrument that was used for data collection for the preliminary study listed the interview questions in the form of preliminary research study information sheet (included in Appendix A). The participants discussed the business benefits organizations seek from ES implementations, the ES data transformation processes, the various challenges organizations face, and the CSFs for the transformational process to produce benefits. This study further strengthened the research credentials, clarified the research questions, brought focus into the methodology for data collection and interview questions, confirmed the theoretical framework, and provided confidence that the research was moving in the right direction.

At this stage the research instrument for the main study was prepared and the field procedures finalized to commence the semi-structured interviews in the three organizations identified through the preliminary study. The research instrument included a brief background and the purpose of the study. The instrument listed the main study interview questions in the form of a main research study information sheet (included in Appendix B) that was used for data collection. The field procedures included preparation of a schedule and timeline for data collection, identification and gaining access to the interviewees in the study organizations, preparation of a detailed interview schedule and contacting the participants, fixing interviews, and timely sending the main research study information sheet and the interview instrument to the participants prior to the interview.

3.9   Data Collection, Integration, and Case Study Database

Yin (2003, p. 83) suggests three principles for collecting the evidence for the conduct of case studies: 1) use of "multiple sources of evidence", 2) creation of a "case study database", and 3) maintaining a logical "chain of evidence". The "multiple sources of evidence" and "logical chain of evidence" for this study were discussed earlier in Sections 3.6.1.1 and 3.6.1.2 respectively. The data collection process, integration of data collected, and creation of a case study database are discussed in this section.

3.9.1   Data collection

Data collection is the stringent process in which meaningful insights are gathered from multiple sources that provide evidence to the research phenomena. In this study evidence was gathered using a multi-method approach. "Multi-method research is typically done by drawing on data collection methods that accommodate each other's limitations" (Sawyer, 2001, p. 2). Case research data are collected in this study through various sources of qualitative evidence including interviews, direct observations, and examination of various company documents such as reports, email messages, memos, statements of work, functional/ISO 9000 procedures, work instructions, presentation slides, and industry publications. However, the primary source of data collection is the semi-structured interviews, given the exploratory nature of the study. "Interviews are the primary data source, since it is through this method that the researcher can best access the interpretations that participants have regarding the actions and events which have or are taking place, and the views and aspirations of themselves and other participants" (Walsham, 2002, p. 108).

Dube and Pare (2003, p. 611) reiterate Pettigrew's (1989) view that providing the specific period of time (case period) under investigation is important "since the case period defines the frame of reference under which the phenomena are investigated". In this research, the specific

time period under study was the recent past, comprising the last three years when the ES was implemented in the organization until the current period with data collected through the on-going events. In all of the case organizations, the interview data were "participant observation case data"; therefore, the data are more valid and the information can be relied upon (Miller, Cardinal, & Glick, 1997).

Given the study is largely exploratory, in-depth semi-structured interviews were conducted with the participants. The participants mainly included the general manager and the functional managers who were most utilizing the ES and its information, such as the operations manager, supply chain manager, purchasing manager, and ES/IT manager. These main study informants were selected based on the review of the literature and as suggested by the ES vendors, ES consultants, and IT research firms during the preliminary study. If the need to interview additional persons was realized during any main case study interview, the concerned persons were interviewed and added to the list of participants. The interviews were tape recorded and transcribed as early as possible so the interviews remained fresh in the researcher's mind at the time of transcription. The interview transcripts were complemented with the hand-written notes that included the researcher's observations and interpretations.

3.9.2 Data integration

A prominent aspect of case study research is "the frequent overlap of data analysis and data collection" (Dube & Pare, 2003, p. 616; Eisenhardt, 1989; Miles & Huberman, 1994). "This not only gives the researcher a head start in analysis, but more importantly allows researchers to take advantage of flexible data collection" (Eisenhardt, 1989, p. 539). Miles and Huberman (1994) recommend operational tactics "to help fieldwork cycle back and forth between thinking about existing data and generating strategies for collecting new, often better data used by the researcher for data collection and integration" (Dube & Pare, 2003, p. 616).

In case study research, information is often collected "in casual conversation and needs to be recorded in the form of field notes" (Dube & Pare, 2003, p. 616). In this study, field notes were used to capture explanations of the conversation contexts and included not only verbal communication but also nonverbal information. Additionally, data were collected in the form of various reports, email messages, memos, presentation slides, and industry publications. Therefore, the first step that emerged for the researcher was to manage and link the different types of data from the different sources of evidence and integrate into one case study data repository.

3.9.3   Case study database

A case study database is a repository that generally includes "raw material (including interview transcripts, researcher's field notes, documents collected during data collection), coded data, coding scheme, memos and other analytic material, and data displays" (Dube & Pare, 2003, p. 616). The four components of case research database suggested by Yin (2003, p. 102) include "notes, documents, tabular materials, and narratives" for the case study.

In this research, a case study database was created by compiling all the data collected from the various sources for this study. A prime consideration in this process was maintenance of traceability of the documentation by creating the relevant chain of evidence. Sawyer (2001, p. 19) stresses "one under-explored issue relative to the synthesis of multiple data sets is data reduction – the process of abstracting themes from the evidence" to reduce data and draw conclusions. The development of a methodical case study database helps to reduce data and establish valid conclusions (Miles & Huberman, 1994).

Case study notes

For case studies, notes are likely to be the most common component of a database (Yin, 2003). Case study notes in this study, included research interview transcripts, observations and document analysis in handwritten, typed, audio, and electronic formats. The notes were organized by case and indexed for easy retrieval.

Case study documents

During the course of the study many documents relevant to the cases were collected. The case study documents included various organizational reports, email messages, memos, and industry publications. These documents were maintained separately for each case study organization. The documents existed both in physical form as paper documents and in electronic form. The physical documents were properly filed for easy access and the electronic version was indexed for instant retrieval.

Tabular materials

The database consisted of several tabular materials, either constructed by the researcher from the case study information collected or from the sites studied. Such tabular materials in the form of tables and spreadsheets were both in the physical document and electronic mode. These were organized by case study chronologically and indexed for fast retrieval.

Narratives

The case narratives developed for the three case studies formed the fourth component of the case study database. Case study narratives provide the organizational evidence in the relevant format to facilitate within-case and cross-case analysis. Case study narratives comprise "open-ended answers to the questions in the case study protocol" (Yin, 2003, p. 103). Data were organized as case narratives that described the findings for each case separately. First, the narratives present an organizational overview that provides a background of the case. Second, the narratives explain the context phase of the ES data transformation framework and present the strategic, organizational and cultural, skills and knowledge, data, and technology factors found in each case. Third, the transformation phase is examined that covers the knowledge-leveraging processes for ES data transformation into knowledge and the utilization of knowledge to achieve benefits. Fourth, the outcomes phase is evaluated that encompasses the changing behaviors, new initiatives, process changes, and financial impacts. Finally, the critical success factors for the transformational process to produce benefits as explained by the participants are described in the case narratives.

The case study narratives enabled within-case analysis, cross-case evaluation, and also comparisons with the preliminary study. The synthesis of these evaluations resulted in developing case study reports. Qualitative software QSR NVivo was used to code and categorize the large amounts of narrative text collected from semi-structured interviews and organizational documents.

3.10 Data Analysis and Reporting of Case Studies

Analyzing data and reporting case studies are the processes that include "examining, categorizing, tabulating, testing, or otherwise recombining evidence to address the initial propositions of a study" (Yin, 2003, p. 109) and "bringing its results and findings to closure" (p. 141). Eisenhardt (1989, p. 539) points out that in practice, data analysis is "both the most difficult and the least codified part of the process". Yin (2003, p. 109) states "analyzing case study evidence is especially difficult because the strategies and techniques have not been well defined".

3.10.1 Data analysis

In this study, the strategy for data analysis has been conceptualized from the initial research design phase, with the development of the research questions, multi-case design, and the definition of the units of analysis. As the research progressed with the development of the study protocol and conduct of the preliminary study, the data analysis strategy was confirmed. It was

put into action with the commencement of the data collection and data integration phases of the research.

Yin (2003, p. 109) suggests that all case study investigations must include a "general analytic strategy" that direct the researcher in prioritizing what to analyze and why. The general analytic strategy in this study included relying on theoretical propositions based on Davenport's framework (Figure 9) from the literature and addressing rival explanations through development of case study descriptions. The context, transformation, and outcomes phases of the process for ES data transformation and results were used along with a description of the critical success factors for the transformational process to produce benefits.

Specific analysis of the case studies was carried out using a combination of pattern matching, explanation building, and cross-case synthesis using the context, transformation, and outcomes format of the transformational model. The main analysis was carried out by extending the cross-case comparisons between the three case study organizations to include the preliminary study perspectives of the ES vendors and consultants, deriving explanations through triangulation. Such a synthesis helped develop valid explanations for the transformation and benefit realization processes in organizations, considering rival explanations and drawing conclusions based on the most compelling and logical explanation.

Pattern matching is a method for empirically evaluating qualitative data (Yin, 2003). The pattern matching technique has been used in this study for two main evaluations. First, the technique is used to compare the empirical data patterns emerging within the cases from the context, transformation, and outcomes phases of the transformational model to verify the theoretical proposition. This has been achieved by developing case descriptions using the theoretical constructs and building valid explanations for each construct that led towards achieving the case outcomes. The basic approach for pattern matching evaluates the empirical results against a predicted pattern and "internal validity is enhanced when the patterns coincide" (Dube & Pare, 2003, p. 619). Several such iterations of comparisons between the theoretical framework and the empirical findings confirmed that all rival explanations had been evaluated to establish internal validity and conclude that the findings were convergent. Second, these patterns have been matched across cases to understand reasons for any differences that existed in the outcomes of the three cases and build valid explanations, establishing external validity.

Dube and Pare (2003, p. 619) state cross-case search for patterns are driven by the premise that "people are considered poor processors of information". Based on little information, people tend to jump to conclusions under the influence of "more elite respondents" or "vividness of the data" or "they sometimes inadvertently drop disconfirming evidence". Therefore, countering such actions by divergently analyzing data is "the key to good cross-case comparison". In this

study, any emerging patterns were compared with the preliminary study patterns to confirm and re-validate the study findings, achieving triangulation and reaching logical conclusions.

The most preferred strategy for analyzing empirical data is to utilize the theoretical case study proposition and constructs. A theoretical orientation guiding the case study analysis helps in organizing the overall case study, bringing focus on vital data, and defining various explanations for examination (Yin, 2003). Dube and Pare (2003, p. 620) have noted:

> examining literature that conflicts with the emergent theory is likely to enhance confidence in the findings and forces researchers into a more creative, framebreaking mode of thinking than they might otherwise be able to achieve. Literature discussing similar findings is important as well because it ties together underlying similarities in phenomena normally not associated with each other. The result is often a theory with stronger internal validity, wider generalizability, and higher conceptual level.

In this study, the data have been organized using the theoretical propositions to be able to compare the findings with existing literature. In order to do so, layering of themes and interconnecting them is established based on Creswell (2008), to add additional rigor and insight into the study. This is achieved as shown in Figure 14. The first layer is the raw data that includes interview transcriptions, observational field notes, reports, and publications. The second layer includes descriptive analysis of the constructs from the theoretical framework. The third layer includes the three phases of context, transformation, and outcomes for ES data transformation into knowledge and results, and the critical success factors in the three organizations. The fourth layer includes the cross-case comparisons and comparison with ES vendor and consultant perspectives into the eleven constructs of the three phases. The emerging trends for ES maturity in NZ organizations are also included in this layer. Finally, the fifth layer provides the business benefits organizations realize from their ES and its information and explains the impact of ES for business benefits.

The process of analyzing text in qualitative research begins when the data are coded (Creswell, 2008). According to Dube and Pare (2003, p. 616):

> codes are especially useful tools for data reduction purposes and having a coding scheme helps to facilitate a replication or an extension to a study and allows the reader to see the logical link between the theoretical model and the codes. Systematic coding also provides a means to avoid bias and validate interpretations through inter-rater reliability techniques.
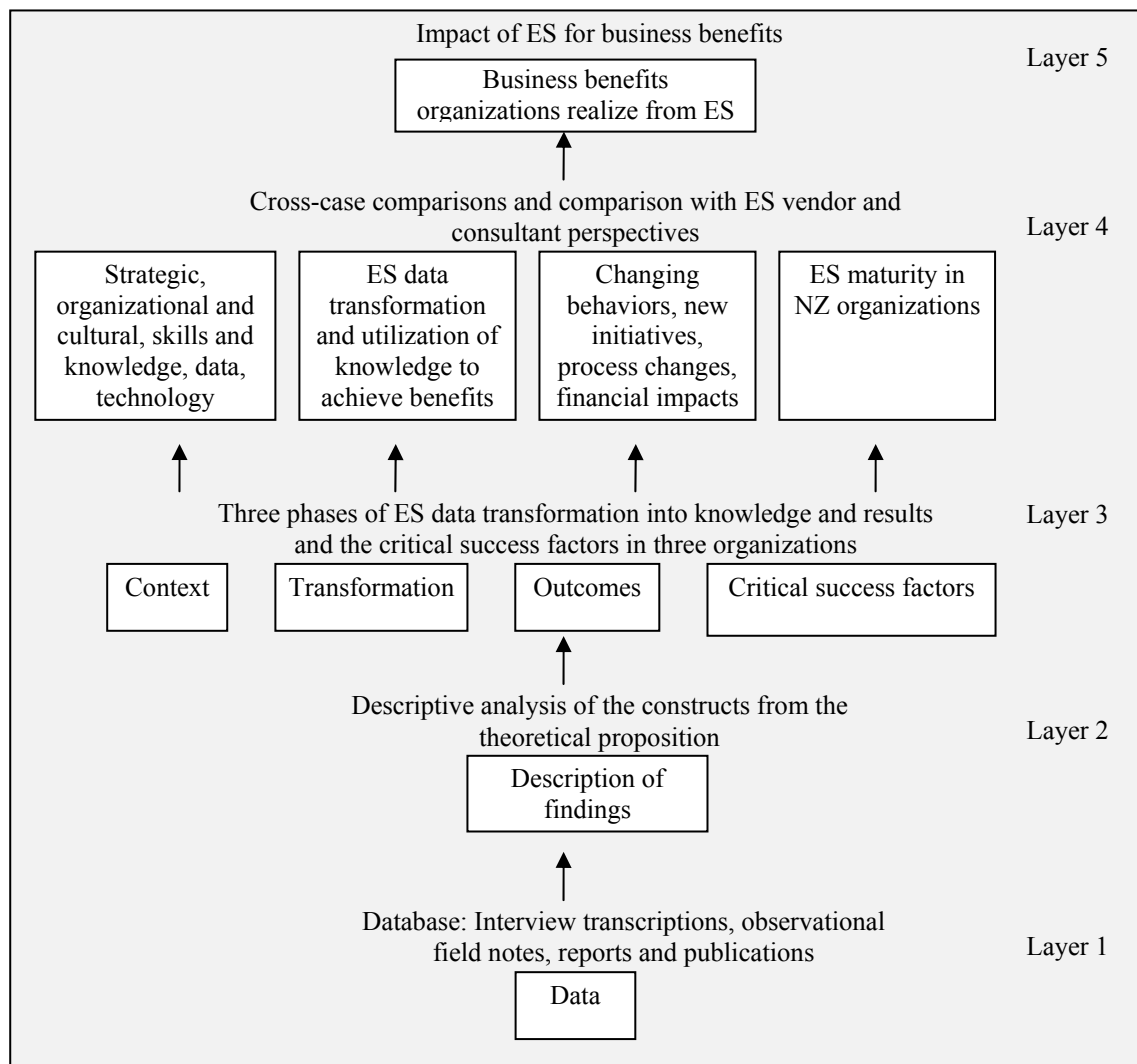
Figure 14: Layers in the ES data transformation into knowledge and results study

Adapted from: Creswell (2008, p. 259)

A coding procedure based on the theoretical framework constructs has been used to reduce the information into categories as shown in Figure 14. The basic four codes included context, transformation, outcomes, and critical success factors for the transformational process to produce benefits as per layer 3. These codes were sub-categorized into the eleven constructs and ES maturity in New Zealand organizations as per layer 4. There was another layer of sub-categorization of 75 elements within the eleven constructs of context, transformation, outcomes, and critical success factors which emerged from the collected data. Data were further coded into these 75 categories and used for cross-case comparisons and comparison with ES vendors and consultants' perspectives. These included six methods of ES data transformation into knowledge (Table 30), seven methods of the utilization of knowledge to achieve benefits (Table 31), five functional behavioral changes (Table 32), six functional new initiatives (Table 33), and fifty one functional process changes for business benefits (Table 41). The qualitative data analysis

software QSR NVivo was used to code, categorize, and support analysis of data. This software program efficiently integrates and manages processes to search, index, and theorize unstructured and nonnumerical data. The NVivo toolkit provides the ability to code efficiently, explore thoroughly, and analyze and manage rigorously. Especially valuable has been the ability of the program to create text data matrixes for comparisons. It also provides for visually mapping categories identified in the analysis (Creswell, 2008).

3.10.2 Reporting of case studies

The case research evidence and empirical findings are reported in this study through narrative descriptions and using tabular formats. Yin (2003, p. 141) finds "reporting case study results is one of the most challenging aspects of doing case studies". Yin suggests three steps that underlie composition of case study reports. First, is identifying the report audience. Second, is designing the structural composition. And third, is adhering to methods such as composing portions of the case study early.

In this study, all three steps were followed for the composition of the case study report. First, academic audiences such as information system and business management scholars were identified as the preferred audience. The case study report could have a diverse set of possible audiences including (a) academic scholars; (b) industry practitioners, ES vendors, professionals, and policy makers; (c) special groups; and (d) funders of research. "Because case studies have more potential audiences than other types of research, it is essential to identify the specific audiences in designing the overall case study report" (Yin, 2003, p. 143). No single report serves all audiences alike since each audience has differing requirements. Therefore, since academic scholars were identified as the target audience for this study, "the connections among the case study, its findings, and previous theory or research are likely to be most important" (Yin, 2003, p. 143). Second, the compositional structure for the case study report was developed through the initial design of the case research and its components "using the case study report as tool for communication" Yin (2003, p. 144) and "orienting the case study report to the needs of the target audience" Yin (2003, p. 145), in this case academic scholars. Third, the case study write-up commenced as soon as the data collection phase began. Starting the report writing early helped bring clarity into the research findings, its analysis, identifying and resolving any issues, monitoring of tasks, and timely completion of the project.

Among written forms of case studies, there are four different types – the classic single-case narrative format, the multiple-case narrative format, the question-and-answers based format, and the multiple-case cross-case analysis format, where there may be no separate chapters or sections devoted to the individual cases (Yin, 2003).

This study adopted the question-and-answers based format in which the composition of each case follows a series of questions and answers, based on the questions and answers in the case study database. The content of the database is shortened and edited for reporting purposes, with the final product still assuming the format of a comprehensive examination. When used for multiple-case studies this format has the advantage of providing similar sequence of descriptions within each case study to enable cross-case comparisons not only at the time of composition but also when reviewed by the readers (Yin, 2003). Furthermore, since this study utilizes the theoretical proposition in evaluating the ES data transformation and results, the case study findings have been presented in the theoretical framework format. Each phase of the process comprising the context, transformation, and outcomes are presented to cover a similar emphasis and focus.

The structure of this thesis follows the standard approach for composing research reports using the linear-analytic structure. The sequence of topics starts with an introduction and background of the research problem being studied (Chapter 1) and the review of relevant literature (Chapter 2). This is followed by the research methodology (Chapter 3), preliminary study (Chapter 4), and case study reports (Chapters 5, 6, and 7). The cross-case analyses, results, and discussion are presented in Chapter 8. Chapter 9 concludes the study and provides implications, limitations, and suggestions for future research.

3.11   Ethical Considerations

Before the conduct of this research, permission was sought from the Massey University Human Ethics Committee, and this project was evaluated by peer review and judged to be low risk. The researcher has been responsible for the ethical conduct of this research. The study participants had been informed through written communication that if they had any concerns about the conduct of this research they could contact the Assistant to the Vice-Chancellor for Ethics & Equity. However, no such concerns have been raised in the conduct of this study.

The two main ethical considerations, confidentiality and anonymity, of the case study organizations and the participants are addressed in this research. The participants were informed about the confidentiality and anonymity that would be maintained in the study prior to the interviews. This was further explained at the start of the interviews. The participants were also requested to confirm their agreement for participation by signing a participant consent form.

3.12   The Methodological Map for the Study

The methodological map for the study is shown in Figure 15 which explains the various steps and the main stages of the research process.
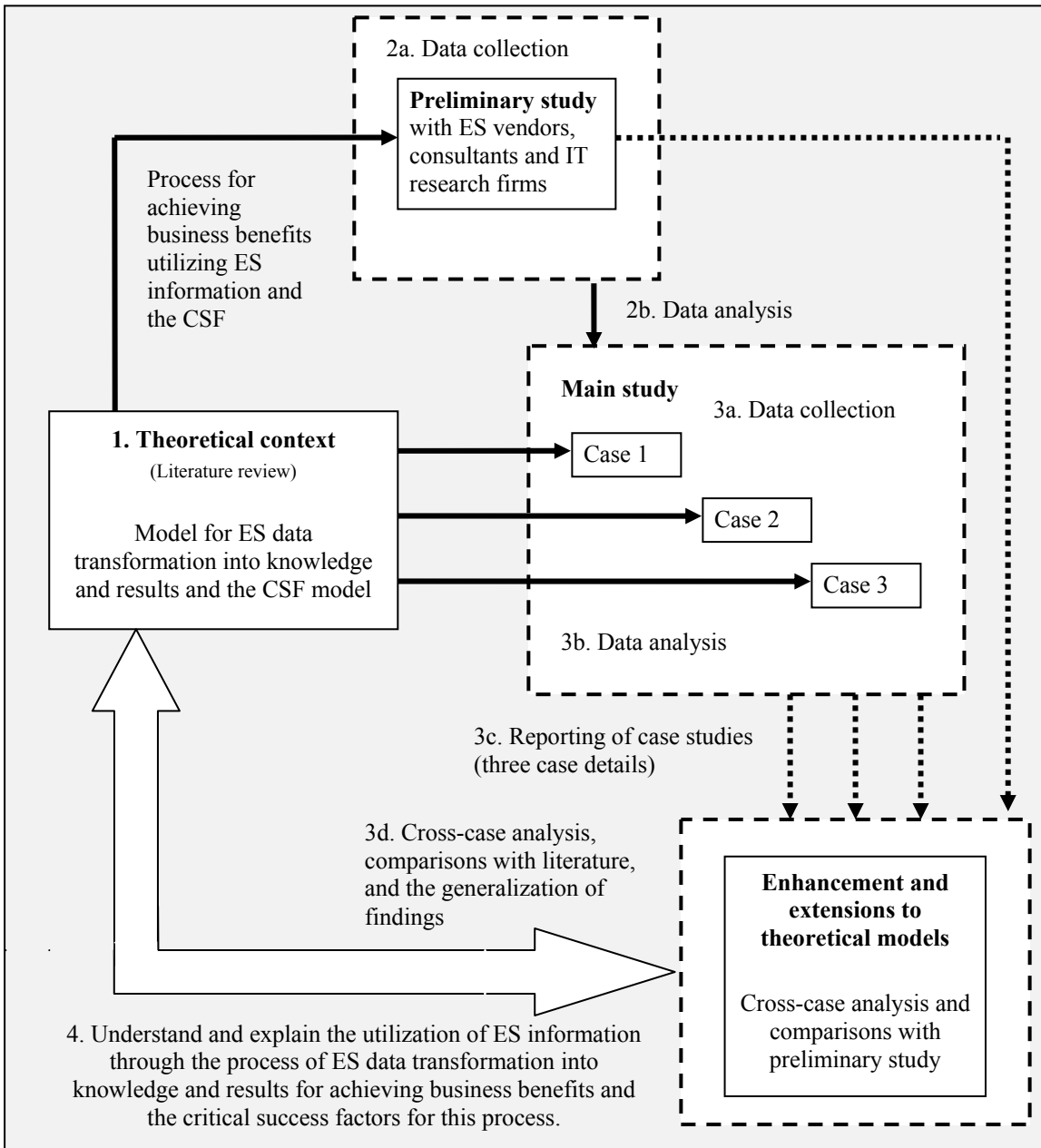
Figure 15: The methodological map for the study

3.13   Conclusion

This chapter explained the research methodology for this study. The multiple case study design was judged suitable for answering the research questions using a postpositivist research approach. The identification of units of analysis, measures to ensure research quality, guidelines for case study selection, data collection methods, data analysis, reporting of case studies, and the methodological map for the realization of the case study design was established. The next chapter presents the preliminary study.

Chapter 4

PRELIMINARY STUDY

4.1   Introduction

This chapter explains the findings of a preliminary study conducted to examine the current ES implementation scenario in New Zealand and understand how organizations realize business benefits from their ES investment. The research utilizes a vendors' and consultants' perspective, with interview data collected from ES vendors, ES consultants, and IT research firms who are actively engaged in ES implementation. This approach differs from the organizational approach usually found in the literature, which focuses on the users' perspective. This is a distinctive contribution of this study to the literature. Vendors and consultants are experienced practitioners actively engaged with numerous large organizations and SMEs in a variety of industries who are purchasing and deploying enterprise systems. The repository of knowledge in this community has been captured in this study (e.g., Mathrani & Viehland, 2007a; Mathrani & Viehland, 2009; Mathrani et al., 2007; Mathrani, Viehland, & Rashid, forthcoming 2010) and has helped in formalizing a strategy to further explore these aspects with the three case study correspondents in the main study.

The main purpose of this preliminary study is to better understand the ES vendor/consultant perspective on the business benefits organizations seek from their ES investment. This research provides insights to the academic and practitioner communities about how ES data are transformed into knowledge, how this knowledge is utilized for decision making, and the critical success factors for the transformational process to produce benefits, insight that is mostly lacking in the literature. A secondary purpose is to explore the current practices of ES implementations in NZ organizations and identify three organizations for the main study.

This chapter is organized as follows. The first section has introduced the preliminary study. The next section presents the conceptual framework and research questions that are the basis for this preliminary study. The third section outlines the research methodology. The fourth to eighth sections present the description of the empirical findings. The discussion section analyses the findings and presents the results on usability of ES and its information by organizations from the ES vendors and consultant's perspective. Finally, the concluding section summarizes the current status of ES implementation in New Zealand and offers direction for the main study.

4.2   Conceptual Framework and Research Questions

The preliminary study utilizes a conceptual framework developed by the researcher (Mathrani & Viehland, 2009) to examine ES implementation practices in NZ organizations. The framework takes into account the organizational, process, and strategic contexts of ES implementation and is presented in Figure 16. The framework provides a holistic lens to analyze ES implementation practices and their business benefits in organizations. The elements of this conceptual framework are examined through the viewpoints of vendors and consultants who are key players in the ES industry and are the most knowledgeable to provide a comprehensive interpretation of ES implementation determinants for ES adoption in the current NZ market.
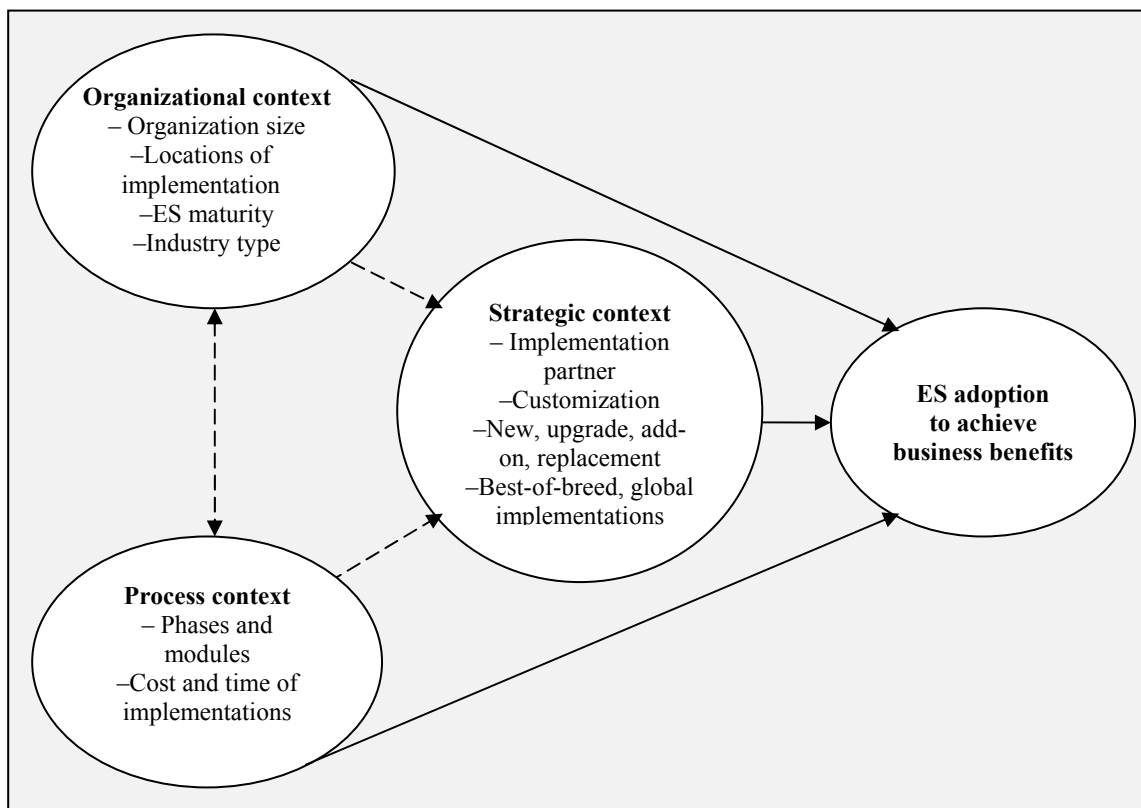
Figure 16: ES implementation determinants for ES adoption

4.2.1   Organizational context

Significant differences exist between small, medium-sized, and large enterprises in terms of revenue, number of employees, number of ES users, and their locations of implementation. These elements mostly determine the organizational context for ES implementation practices. In the past, the revenue for small organizations was $10M-$50M with 25 ES users, the revenue for medium-sized organizations was $51M-$250M with 100 ES users and the revenue for large companies and government agencies was more than $251M (Shakir, 2003). In an Australian

study (Parr & Shanks, 2000), the number of ES users for small firms were less than 100 users, for medium-sized organizations were 101-200 users, and large organizations were more than 200. Regards locations of implementation, in the past multi-site implementations in NZ were found more commonly in SMEs where the ES was installed in one main organizational site and extended to multiple locations of company operations. In comparison, large organization implementations had its own separate implementation in each location (Shakir, 2003).

ES maturity in an organization depends on the number of years of experience the organization has had with ES and the stage of ES implementation (Hawking et al., 2004). This concept of ES maturity and the different stages of ES implementation is reinforced by the Nolan and Norton Institute (2000) classification that groups implementations into levels of maturity such as beginning when ES has been implemented in the past 12 months, consolidating when ES has been implemented between 1 and 3 years, and mature when ES has been implemented for more than 3 years.

4.2.2   Process context

There are different phases or "waves" of ES implementation. The core operational modules such as finance, sales and distribution, production planning, materials, and production management are implemented in the first wave (Shakir 2003). The second-wave ES (or ERP II as per Gartner (Zrimsek, 2002)) includes the "extended enterprise through modules for customer relationship management, advanced planning systems, supply chain management and collaborative commerce in a Web-based environment". These modules are extensions to the current ES thus requiring companies to upgrade (Dalal et al., 2004, p. 84).

ES vendors have changed their business model and moved towards an Internet-enabled component design, providing a modular strategy for ES platforms. A related development is a "consensus on the need for interoperable components that can be customized to model a particular enterprise as close as possible to its actual way of doing business" (Nicolaou, 2004c, p. 29). The design and implementation of an ES involves capturing the information necessary for implementing the system's structure and behavior that support enterprise management (Monnerat et al., 2008).

The costs of implementation are related to the number of modules, their types, the software package size and brand, the number of user licenses, training, hardware and implementation costs paid to the vendor, and consultant and/or implementation partner. Time of implementation is determined by a number of factors, many (e.g., size of implementation, modeling the organization, configuring the design) that are closely related to cost.

4.2.3 Strategic context

ES implementation is not a solitary, independent exercise. All firms require implementation partners. Especially, in response to knowledge barriers that hinder technology diffusion, new mediating institutions (e.g., service bureaus, consultants) move into supportive action "which progressively lower those barriers and make it easier for firms to adopt and use the technology without extensive in-house expertise" (Attewell, 1992, p. 1).

Customization is the process in which changes are made to the ES software during the implementation phase to suit the needs of the organization in which it is being implemented. Customization is necessary when the best business practices embedded in the ES software do not satisfy the needs of the business, and the software is changed to meet the requirements of the organization (Davenport & Prusak, 1998; Kumar & Van Hillegersberg, 2000). There are two principal implementation strategies for customization, and variations between them. The first is "comprehensive customization", when many and sometimes major changes are made to the software to satisfy business requirements. The second is "vanilla implementation", when the ES software application is implemented without any changes to the software and the business processes within the organization are changed to suit the functionality of the software.

An implementation is considered new when it is implemented in an organization for the first time. An upgrade is when a revised version of the software with some additional functionality is implemented to upgrade the existing software in the current implementation (Dalal et al., 2004). Add-ons, also called bolt-ons, include adding new modules to the existing implementation. Replacement means changing the existing implementation with a different vendor's software. Another model used during ES implementation is the best-of-breed, as opposed to a single vendor implementation. The best-of-breed model includes implementation of a mix of different vendor modules which the vendor specializes in, to have the best of everything (James & Wolf, 2000; Pender, 2000; Shakir, 2003). A single vendor implementation includes all the modules from a single vendor as an integrated package. Another model referred to as the application service provider (ASP) implementation model is one in which a service provider provides an ES application software as a service or hosting to organizations at a fixed cost for a specific period (Malcolm, 2002; Pamatatau, 2002; Shakir, 2003). Yet another model is the business process outsourcing (BPO) or the managed service model in which outsourcers run a customized managed service of ES implementation for customers where effectively a single solution is sold to a customer. This is a growing implementation model in NZ, as cited by respondents in this study.

4.2.4 Research questions

In line with the aim of the study, the research questions examined in this preliminary study are:

1. What are the key business benefits that organizations seek through the utilization of an enterprise system and its information?

2. How do organizations transform ES data into knowledge and how is that knowledge applied to decision making to maximize benefit realization?

3. What are the critical success factors for the transformational process to produce benefits?

4. What are the current ES implementation practices in New Zealand organizations?

As emphasized earlier, this part of the research builds on and extends existing ES research by the utilization of a vendor/consultant perspective. A study of technology diffusion found that adoption of complex technology is dependent on organizational learning, skill development, and knowledge barriers (Attewell, 1992). That same study found that mediating institutions, such as the ES vendors and consultants who are part of this study, provide the technology and the know-how, making it easier for firms to adopt and use the technology.

The ES vendor/consultant perspective offers unique insight to addressing the research questions because these individuals have considerable experience in the ES industry and are actively engaged in ES implementation across several industries and business sectors. Their insight and 'real-world' knowledge yields new understanding about ES benefits and implementation practices in organizations and increases the practical relevance of the main study.

4.3 Research Methodology

4.3.1 Research design

The design of this research links the data collection and the resulting conclusions to the initial study questions. The epistemology underlying this research utilizes a positivist approach based on semi-structured interviews conducted with key representatives in the ES industry for reliable and objective findings. The ontology of this paradigm assumes that the reality of the phenomena is objective, singular, and independent from the researcher. Rigor is achieved by providing explicit research questions, a priori specification of constructs, and a clear focus for the analysis and the context of the study.

To examine the current practices of ES implementations in New Zealand organizations, a priori specification of constructs based on the ES implementation determinants for ES adoption is developed and shown in the conceptual framework in Figure 16. A similar approach was used by Shakir (2003), who also investigated ES implementation practices in NZ from a vendor/consultant perspective. The focus of that study was to identify key drivers influencing typical ES implementations (e.g., Shakir & Viehland, 2004) whereas the focus of the current study is on the realization of business benefits from ES. Data from Shakir's (2003) study were collected between November 2001 and May 2002; data in the current study were collected between February and August 2006. Insight evolving in current ES implementation practices within the NZ context is provided by comparing the two studies in the discussion section. This study also compares findings with other similar studies such as Parr and Shanks (2000) who studied ES adoption in an Australian context and Brehm, Heinzl, and Markus (2001) who investigated customization in ES implementations, but these studies did not use the vendor/consultant perspective. The units of analysis for this study include (1) the key business benefits organizations seek through ES, (2) ES data transformation into knowledge and utilization of this knowledge to achieve benefits, (3) the critical success factors for the transformational process to produce benefits, and (4) the organizational, process, and strategic contexts of ES implementation practices.

Aspects of research context that are important for the study include the description of the setting where the research is conducted, specific period of time under investigation, data collection method, data collection periods, and time spent on site by the researcher. These aspects are explained in the following subsections.

4.3.2   Sample

Using a qualitative survey research methodology, primary data were collected through a series of semi-structured interviews with participants in the ES implementation industry. The interviews were carried out between February and August 2006 with key experts and practitioners of ES. The participants were senior ES consultants or senior managers in organizations who are key players in the field of ES in New Zealand, principally major ES vendors, ES consultants, and IT research organizations (see Table 10).

4.3.3   Process

Contact was first established with the informants through email and by phone. An introductory letter briefly explaining the study and seeking an appointment for an interview was then sent to the informants. When the appointment was confirmed, the research information sheet and

questions (included in Appendix A) were sent to the participant. One face-to-face interview of between 60 and 90 minutes was conducted with each participant at their organization. The informants discussed ES implementations based upon their perspective and experience in terms of their ES products, their clients, and their implementation methodologies.

Table 10: Key informants for the study

ES Vendors (Flagship ES products)	ES Consultants	IT Research
SAP NZ (SAP)	PricewaterhouseCoopers NZ	Gartner Limited NZ
Oracle NZ (Oracle, J.D. Edwards, PeopleSoft)	Ernst & Young NZ	IDC NZ
Microsoft NZ (Dynamics (earlier Navision))	KPMG Consulting NZ	
Infor NZ (Mapics, SSA Global (earlier BaaN))	EMDA NZ	
The positions of the participants included: director professional services, consulting manager, managing director, consulting practice director, partner group manager, vice president, consulting partner, general manager and business consultant.		

4.3.4   Analysis and evaluation

The interviews were tape recorded and transcribed immediately after each interview. The NVivo 7.0 qualitative software tool was used for data analysis using the condensation approach. This approach condenses the data into multiple groups according to pre-defined categories, which follow the scope of the research questions. There were no identifiable differences in viewpoints between vendors and consultants, and for this reason a unitary vendor/consultant perspective is reported in the findings and discussion.

4.4   Key Business Benefits Organizations Seek through ES

In this study, the business benefits that organizations seek through utilization of ES and its information was discussed at length with the informants. The results are summarized in Table 11 and further explanation, principally in the words of the informants, is offered in the following paragraphs.

SAP explained that many organizations now adopt the supply chain operations reference (SCOR) model to identify their KPIs. According to SAP, some of the key business benefits sought by organizations include reducing time for month-end closure of accounts, to get better information flow and transparency of transactions, to reduce head count due to automation, integration of processes to achieve seamless resource management, and others as listed in Table 11.

Table 11: Key business benefits that organizations seek through ES

Participants	Business benefits
SAP, OR, MS, EMDA	• Improve information flow
SAP, OR, MS, EMDA	• Reduce inventory and reduce out-of-inventory events
PWC, OR, MS, EMDA	• Improve process efficiencies
PWC, OR, MS,	• Overall cost reduction by automating functions
SAP, PWC	• Reduce head count
SAP, EMDA	• Increase information visibility
SAP	• Supply chain operations reference (SCOR) model KPIs
SAP	• Reduce month-end closure time
SAP	• Integration of processes to achieve seamless resource management
SAP	• Increase productivity and throughput
SAP	• Incorporate vendor-managed inventory (VMI)
SAP	• Become more agile and efficient
PWC	• Drive efficiencies in the supply chain
OR	• Automate processes
MS	• Improve response time
EMDA	• Transparency in costing information
EMDA	• Reduce work-in-progress
EMDA	• Improve bill-of-materials management
Notes: OR = Oracle, MS = Microsoft, PWC = PricewaterhouseCoopers	

PricewaterhouseCoopers (PWC) noted that organizations are investing in technology for ultimately saving costs:

> either their old systems are inefficient, costly to maintain, obsolete, outside support, or in some cases it is not a justification for benefit at all. It is a must do to maintain a continuity of processes.

In terms of the business benefits PWC suggested that organizations are typically looking at head count reduction, improving process efficiencies, and driving efficiencies in the supply chain. The Microsoft respondent emphasized that typically organizations are looking for efficiency through their people. The cost reduction is achieved through not having to use as many people or by increasing throughput with the same number of people:

> in general, systems are put in to become more efficient and increase profit. Reducing cost through efficiency and increasing profit through reducing cost. That's the number one that everybody wants. In a manufacturing context, planning and forecasting are absolutely essential and most people

want to use the integrated systems to get their information because better information leads to those efficiencies that they need.

Oracle suggested that the business benefits depended on the modules implemented and many organizations want to streamline specific functions, such as the procurement process or the financial process:

> the ES information helps take critical decisions such as whether the function should be centralized or de-centralized, how more money can be saved, and can bulk purchases be organized instead of few at a time. A manufacturing company would look at demand planning. One of the typical problems in a manufacturing company is that the supplier agreements do not necessarily match the changing demand. The end result is a shortage of a particular component which has an impact on the assembly line. It is a huge cost. On the financial side, organizations are trying to assess which measures from a financial perspective will best indicate the business's health, can getting the right information required be automated, can reports be produced to provide sales figures for the previous week, or who are the organization's top consumers.

EMDA identified some of the benefits organizations want to achieve from an ES:

> first, it is inventory reduction which is generally achieved in the first phase. Second, improvements in the planning systems since organizations get the benefit of having a total picture and recommendations. Although their processes may not be perfect, the information on quantity required for procurement are quite accurate because these are derived from the demand. The third is the transparency in costing information since ES provides constant updating of purchase costing information. This makes the costing far more accurate and if the planning and scheduling are pushed from there, it can lead to shortened lead times which also reduce work in progress.

4.5   ES Data Transformation into Knowledge

The respondents in this study confirmed that creation of knowledge for decision making was a key motivation for ES implementation, especially in the second wave of implementation. In second wave (or phase 2) implementations, companies implement supplementary modules for collaboration scenarios (e.g., supply chain management, supplier relationship management) and

advanced management services (e.g., business intelligence) (Mathrani et al., 2007; Shakir, 2003).

A typical complaint from organizations about first wave implementations was that although a lot of information was available within the ES, only standard reports and standard query forms were provided in the software, with a limited capability for data mining and data analysis.

Microsoft explained that user organizations considering a move to second wave ES implementation posed questions such as what does the system offer in terms of integrated reporting or integrated query to better use the data in the ES. For example, if an organization sought information on raw material availability, do they need to run a report or is there a dynamic on-line query that can be used to show how much raw material is available to meet their needs. Organizations are looking for systems that have an inherent capability to give them that kind of information. Organizations want to extract data, manipulate it, and then present the information in the form of a report, dashboard, scorecard, or KPI. The traditional reporting mechanism is a paper-based report with a list of deliverables, the KPI reporting provides information on how the organization is performing against pre-defined key metrics, and the typical operational reports provide information such as how many products were produced, when, and where. As shown in Table 12, this study found that organizations approach reporting requirements differently.

Some organizations use the inherent capability of the software for generating reports, whereas other organizations have created multi-dimensional cubes of data warehouses to manipulate large amounts of data. If the data are located in a single place then the enterprise software is expected to provide the report straightaway, but if the data are in multiple places then the organizations are using customized data warehouses to bring those disparate forms of data together and manipulate the data into a format needed for effective management reports and conversion into knowledge for decision making.

To make better decisions, business executives need relevant and useful information at their fingertips. But often there is a large gap between the information that decision makers require and the large amount of data that are available in the system that businesses collect every day. This is called the "analysis gap". The BI systems access large volumes of data and deliver relevant information instantly to decision makers in a form to which they can easily relate. These systems provide the tools and the functionality to retrieve data from the operating systems specifically required for analytical decision making. This makes possible a huge improvement in the quality of analysis that can be performed, which leads to a better understanding of the business. But the hardest aspect is being able to define what information is useful and relevant

to a decision. BI systems at the enterprise level collect and report a company's most important metrics or the KPIs which guide managers in making decisions that affect a particular business unit as well as the company at large.

Table 12: How organizations transform ES data into knowledge

Participants	How organizations transform ES data into knowledge
SAP	• Organizations convert data into knowledge by using proper tools such as data warehouse and business intelligence systems. • Organizations generally lack clarity on which information is critical to the success of the organization and the data views that are needed to get valuable information.
PWC	• ES products come with predefined reporting tools which provide a generic way of presenting data. To make this into useful business information to suit specific needs requires customization; and organizations do not want to customize because it drives up their life time costs.
Microsoft	• Organizations are looking to see what the system (especially at phase 2 implementation) is offering in terms of integrated reporting or query that allows them to use data and whether the system has an inherent capability to give them the required information. • There are organizations that want to extract data, manipulate it, and then present the information in the form of a report, dashboard, scorecard, or KPI. • Some organizations use the inherent nature of the software directly, whereas other organizations have created customized data warehouses to manipulate data into a format needed for management reporting.
Oracle	• Most of the time ES is just used as a financial system and a storage repository therefore lacks knowledge-producing results. Major ES vendors have business intelligence built into their ES which companies use for converting ES data into knowledge. Organizations also use business analytics or reporting tools or a combination of both to extract information and create knowledge. • Organizations put together a data warehouse, bring in data not captured in ES from other heterogeneous environments, mine it, and present the information to user communities on a regular basis. They are also now producing enterprise portals which are Web interfaces for the senior managers to see financial trend analysis and a whole variety of other key requirements.
EMDA	• Initially an ES implementation can be overwhelming because organizations do not always see that they have information. What they see is data. They have to convert the data into a meaningful form to distil information. That way people think more about their information and start looking for correlations, causal relationships and look at data with specific questions using business intelligence. • Organizations also use standard reports in the system such as aging or ABC analysis on inventory management, which also provides good information.

The results of this study (see Table 12) support the increasing use of ES to support business intelligence and knowledge management applications in organizations. Enterprise systems vendors are recognizing this need by incorporating BI infrastructures, as SAP has done with Business Information Warehouse (BW) (Hashmi, 2004).

4.6   Utilization of Knowledge to Achieve Business Benefits

To receive benefit from an ES, there must be no misapprehension about the information requirements and its usability and, second, organizational decision makers must have the expertise and experience for this kind of data-oriented decision making (Donovan, 1998). Many organizations have been trying to measure performance in the past decade, in areas which they consider influence the company's effectiveness, such as employee loyalty and customer satisfaction. In reality, however, not many organizations realize these kind of benefits since the companies are unable to recognize, analyze, and take action on the relevant non-financial measures to achieve strategic goals (Ittner & Larcker, 2003). It is therefore important to understand the process of identifying and analyzing the right information for effective decision making to achieve the desired benefits.

Table 13 shows the responses of the interviewed professionals that explain how organizations utilize ES knowledge to achieve benefits from ES implementations. The results reveal that organizations use balanced scorecard type of performance evaluation techniques to identify the drivers for the success of their business strategy. Kaplan and Norton (1992; 1996) developed the balanced scorecard as a strategic business tool to link a firm's strategic objectives to performance measurements in order to evaluate the enterprise's performance in meeting strategic objectives. A balanced scorecard explains causal relationships between current activities and the strategic aims of the organization linking actions with metrics.

The drivers identified through setting up a balanced scorecard are used in tools such as management cockpits which have data mining capability to understand what the problem is and how managers should intervene. Organizations also use business process simulation techniques, scenario planning, and "what if" analysis when they want to examine a problem under various scenarios to explore possible outcomes. These tools typically are provided in second wave ES. SAP confirmed they had strategic enterprise management functionality tools that allow organizations to use balanced scorecard functionality to develop management cockpits for current and accurate reporting, perform business process simulation, try out different budget scenarios, and determine the impact and sensitivities of various models.

A key issue with balanced scorecards is that companies need to understand what the balanced scorecard is going to do for them. The balanced scorecard is not a reporting tool but it is a point-in-time view of how the business is performing against some pre-set KPIs or other measures. So the organizations have to understand what they want to measure and use it for. Generally when organizations talk about balanced scorecards, they are often referring to KPI reporting. However, most informants suggested that these tools are only being used by sophisticated,

mature organizations as using these tools requires high-level strategic thinking about what the true business strategy is and what determines success of the business strategy (see Table 13). Microsoft specifically reported that most New Zealand organizations are not yet ready to employ such a strategic business tool, at least not to the extent one might expect.

Table 13: How organizations utilize ES knowledge to achieve benefits

Participants	How organizations utilize ES knowledge to achieve benefits
SAP	• Organizations use balanced scorecard techniques in conjunction with data mining capability to understand what the problem is and how managers should intervene. • Organizations also use business process simulation techniques and scenario planning when they want to analyze the problem by assessing different possible outcomes. These tools are being used by sophisticated, mature organizations with high-level business strategy analysis in place.
Microsoft	• Information is transformed into knowledge by adding experience, context and interpretation so that it is used for decision making to achieve benefits. • There have been very few examples of a company using business intelligence tools strategically. • The issue with balanced scorecards is that, firstly companies need to understand what the balanced scorecard is going to do for them. It is not a reporting tool but it is a point-in-time view of how the business is performing against some pre-set KPIs or measures. • NZ organizations are not yet ready for a high level of strategic analytical tools, at least to the extent that might be expected.
Oracle	• Companies are now asking how to actually optimize and improve. • Although, scorecards are as part of ES, NZ companies are not actually managing scorecards, but are just reporting KPIs. • Benchmarking is done by industry. The software vendors give clients a base line, with possibility to further build upon. This a good place to start because many companies do not even know what it is they want to measure.
EMDA	• More and more of the ES vendors are developing their own business intelligence engine since the business process and the underlying information are not mutually exclusive. • Each of the major ES vendors has some form of scorecard in their software. • The abilities to drill down through layers of data, and do the analysis in any form, then lead to managerial insight.

Findings from this study also revealed that more and more software vendors are developing their own BI engine to provide the database foundation to customers. They are providing the middleware tools to tie the technology layer with the user applications. Businesses need to be in control of both because the business processes and their underlying information are not mutually exclusive.

Three or four years ago, there were a lot of unique BI organizations such as the SAS group, Cognos, and Microsoft Business Objects. These organizations are still there and have a significant market share, but the bigger ES companies are realizing that they need to take ownership of the database layer. PeopleSoft expressed this need-for-ownership: "it needed to

be part of the DNA of the software". So, when the computer is turned on the first screen reports how the business is performing. The ability to drill down through layers of data and do the analysis in any form then leads to managerial insights. Actions backed up by good analysis give confidence to the action taker. If that data are not controlled through the software, it is harder to integrate it and it does not perform as a natural part of the software. So the vendors are trying to capture the BI component for decision making.

In the context of NZ companies, Microsoft reports there have been very few successful business intelligence implementations. The implementations work in that the reporting metrics are also provided, but examples of companies using them strategically to make decisions are not evident.

4.7   CSFs for the Transformational Process to Produce Benefits

Substantial research has been conducted to determine ES success. A number of researchers argue that "ES outcomes, including both success and failure, are non-deterministic, recognizing that ES implementation is an ongoing process during which conditions could change" (Liang & Xue, 2004, p. 401; Markus et al., 2000; Robey et al., 2002). However, Markus and Tanis (2000, p. 186) have defined ES success as "the best outcomes the organization could achieve with an enterprise systems, given its business situation, measured against a portfolio of projects, early operational and longer term business results metrics".

Esteves, Casanovas, and Pastor (2003, p. 449) suggest that ES success can be defined as "finishing on-time, on budget, obtaining the expected functionality, the system is being used by its intended users, and implemented in the correct way taking into account the organizational and cultural values of the organization".

Shanks, Seddon, and Wilcocks (2003) state success of ES depends on effectiveness of the implementation, and on the additional benefits that can be obtained by leveraging the technology.

Given the significance and risk of ES projects, it is essential to examine and understand the factors which determine ES effectiveness and the influence of ES on the decision-making process for organizational benefits. In this study, most informants agreed that there certainly were CSFs for the ES data transformation process to produce benefits. Table 14 summarizes the critical success factors for the transformational process to produce benefits, as identified by the various participants.

Table 14: CSFs for the transformational process to produce benefits

Participants	CSFs for the transformational process to produce benefits
SAP, MS, OR, EMDA	• Active executive commitment in the project, including translation into departmental or divisional strategies and visions
SAP, IDC, OR	• Effective change management process
SAP, IDC, MS	• User feedback, involvement and understanding of the process and expected outcomes
SAP, MS	• Business strategy is clearly defined, articulated and aligned
IDC, OR	• Clear definition of scope before implementation
SAP	• Understand the key drivers, and have the means to influence the drivers
SAP	• Quality of data since unclean data can be very risky
SAP	• Consistent data management and clear data definitions
SAP	• Technology, although with the development of services oriented business architecture (SORBA), this will be less of an issue in the future
IDC	• Proper project management from both vendor and client
IDC	• Managing client expectations – do not over commit and under deliver
MS	• Design of information retrieval process appropriate to the business
MS	• The technical parameters e.g., proper design of the mechanism of delivery
OR	• Clear identification of the problems requiring resolution
OR	• Expected end results or desirable solution
OR	• Training
EMDA	• Information gathering and application is seen as a technical project rather than a business project
Notes: MS = Microsoft; OR = Oracle	

4.8   Current Practices of ES Implementations

While the primary purpose for the interviews with the ES vendor/consultant was an evaluation of the ES data transformation process for business benefits, complementary data about current practices of ES implementations in New Zealand organizations were also collected. These findings are presented in this section to address the fourth research question: What are the current enterprise system implementation practices in the New Zealand organizations?

Each of the elements of the organizational, process, and strategic contexts are presented first, followed by a separate discussion section that compares these results with other studies in New Zealand and elsewhere.

4.8.1　Organizational context

4.8.1.1　Organization size

Most classifications of organization size use the number of employees and/or revenue (e.g., in the New Zealand business environment, 20-299 employees is medium size, 3-19 employees is small, and less than 3 is micro). Until recently, the focus of implementations was on the large enterprise – businesses and government agencies with more than 500 employees and revenue greater than $250M. But now the focus for new implementations has shifted to the SME sector. The higher end of medium-sized organizations in NZ employ between 100 to 299 staff and have revenue between $50M to $200M. At the lower end of this segment, employees are between 20 to 99 and revenue is between $10M to $50M. In the small organization segment in NZ, employees are less than 20 and revenue less than $10M.

Another measure of organization size that is more relevant for the participants in this study is number of users or "seats" licensed to use the ES software. A classification by consultancy firm IDC, provided as part of the current study, shows the sizes of companies based on the number of users where ES is implemented as a percentage of companies in NZ (see Table 15).

Table 15: Number of users in NZ companies where ES is implemented

Size of organization	Number of users	Percent in NZ
Large	>200	25%
Medium	20-200	49%
Small	<20	26%

Most respondents agreed that current implementations in NZ are predominantly in the small and medium-sized enterprise category of 20 - 200 users. The large corporate and governmental agency sector is nearly saturated and the many small businesses in NZ find it hard to justify an ES investment from a cost perspective. When small organizations do invest in an ES, they typically do not implement comprehensive enterprise solutions from large vendors. These businesses prefer smaller inexpensive fragmented solutions. However, the major vendors have also moved their business model and are now targeting smaller sites with products such as Business One from SAP.

Microsoft estimated that there are about 3,500 medium-sized companies in NZ. Microsoft believes they have 400 of these as their current customer base. Many of the other medium-sized firms are not using traditional ES as their core technology. A large proportion of these businesses did not have any technological solution to help them with their business problems

and they represent a growth market in NZ. The declining markets include large companies which have already made their $10M investment and are not looking to make another investment: "these companies might make a million or half a million dollar investment but they are not the growth area for software companies".

Other participants confirmed this view as the typical small firm and even some medium-sized organizations are using home grown PC-based systems or disparate non-integrated systems, in which their usage has outgrown the technology. The software vendors are trying to push into this market, although there are many challenges such as limited resources, lack of infrastructure or lack of necessary in-house skills to cope with changing requirements associated with implementing an ES.

The challenge facing software vendors is to figure out how they take the learning acquired in the large enterprise implementations to a smaller enterprise. Some informants believe it is a fallacy to believe that small organizations require different information. They actually require quite the same information as a larger organization, but to a different degree.

Since the SME space offers the most opportunity, therefore larger players like SAP and Oracle are focusing on the SME sector which was overlooked earlier:

> whenever any new technology evolves there are leaders, followers and the laggards. Typically the large enterprise organizations are the leaders but now they are beyond the leader category and it's the SMEs now which are going up in that curve.

Traditionally SAP customers were the large enterprises, companies like Fonterra, Telecom, and Carter Holt Harvey in NZ. However, in the last 5 years due to shift in focus on the SMEs, SAP is now moving to smaller companies with annual revenues $5M or more and are offering two different types of solutions. One is similar to a Microsoft-based type solution called "Business One". The other is "All-in-One" and is the traditional SAP solution. The large enterprises are probably old SAP or one of the Oracle family customers having implemented either PeopleSoft, JD Edwards, or Oracle systems. Now the focus of the software vendors is to compete for winning upgrade or add-on contracts from such large enterprises. SAP recently bagged such a contract from Fonterra which is an old loyal customer of SAP. But the main battlefield for new implementations is in the SME sector.

The Microsoft respondent, who had earlier worked with other vendors (i.e., JD Edwards, PeopleSoft, and Oracle), remarked: "there's no such thing as a typical enterprise solution implementation in NZ". According to him, the size of enterprises ranges from large with 500

or more users through to SME with 5 to 10 users at the lower end and hence there is no typical organization. He suggested however, the size of an organization that may drive business intelligence (BI) and knowledge capital as information tools are the medium-sized and large organizations. Organizations that employ 100 plus staff and have an ES with a user base of more than 40 are more mature in the context of using ES information for business benefit. Microsoft's largest customer in NZ has a user base of 130 while their smallest customer has just two with the majority of customers in the range of 15 to 50 users in NZ.

From an Oracle perspective, Oracle has three ES product lines - Oracle E-Business Suite, PeopleSoft, and JD Edwards (JDE) from their acquisitions. The E-Business Suite and PeopleSoft are generally implemented in the larger enterprises and JDE in the SMEs:

> unfortunately, some of these lines are blurred because while a company may be a SME in NZ it may have some large offshore subsidiaries and therefore the group may not necessarily be tiny. For example, Fisher and Paykel might not be considered one of the largest companies in NZ but if you consider its holdings and offshore organizations, it is quite substantial from the NZ perspective of a large company category that runs JDE. But typically, we apply the rule, an SME will be putting in JDE and if it is a large enterprise it will be putting in E-Business Suite or PeopleSoft.

4.8.1.2 Locations of implementations

Findings in this study show that currently more implementations are multi-site while in the earlier years implementations were more single site. Especially, SMEs are now using one implementation at multiple locations: "organizations are realizing its no use having IT administrators in all the locations doing a similar task".

The growth in the NZ export market coupled with availability of Internet-capable technology are also factors driving multi-site ES implementations in NZ, according to respondents. As explained by SAP, these implementations are single instance in which one installation of the software is on one server in the business centre, but the client software is at multiple locations, for example, subsidiary sites, distribution warehouses, and sales offices.

4.8.1.3 Industry type

Despite its high risks and costs, ES implementation "is pervasive in many different types of industries" (Nicolaou, 2004c, p. 29). A majority of the respondents noted that enterprise systems are implemented in most industry sectors in NZ. Some respondents provided specific examples in highlighting trends. SAP explained that traditionally, over the last 10 years, there have been

many implementations in the consumer packaging goods, manufacturing, forestry, and pulp and paper industries. However, in the last two years a slight shift is seen in the ES market in NZ with several implementations in the retail and utilities industry, and this trend is likely to continue for the next two years.

4.8.1.4   ES maturity

Most informants agreed that ES maturity has occurred at a slow pace in New Zealand organizations. This is mostly attributable to the small size of most NZ businesses. However, this trend is now changing and many organizations are approaching a fairly advanced level of maturity with ES technology and IT in general. The informants identified the following four issues in managing ES projects which highlight the slower pace of ES maturity within the New Zealand organizations.

- Many NZ organizations do not conduct a proper business justification of their implementation. Although some improvement has been made in the past few years, most NZ organizations produce little or no value assessments and that often leads to weak business cases and insufficient benefit models which cannot be used for benefit tracking.

- Many organizations in NZ believe implementation of ES is a technology challenge. However, according to most informants, it is more about people, process and change management, and less about technology.

- Informants revealed that typically when a new system is implemented, productivity drops for a period and then goes up. Oracle suggested the depth of the drop depends upon how well the system is implemented, how well the change process is managed, how well the business case is defined, and how well the managers are measuring and managing benefits before and after the implementation.

- Until a few years ago, the majority of companies did not use the ES in its true capacity. ES was used as a financial system, as a central repository for personnel records, or as a method for raising purchase orders. This was because the organizations had not thought about what they were trying to optimize, what benefits they were trying to bring into the organization, what they were trying to change, how they were trying to manage the business, and whether they could actually get the information they needed to manage the business from the ES. However, software vendors report that now several organizations are seeking ways to get more value out of their ES investment. These companies have started asking how to establish analytical processes to optimize and realize business value from their ES investment.

4.8.2   Process context

4.8.2.1   *Phases and module*

Most informants suggested that the ES implementations are typically divided into two "waves" or phases. In New Zealand organizations, the first wave or phase 1 is the implementation of core ES modules such as finance; materials management including purchasing, warehousing, and inventory; and operational modules including, as appropriate to the business, production management, production planning, logistics, sales, and distribution. Some companies also include HR and payroll in the first phase. In the second wave or phase 2, the companies implement supplementary modules, which include collaborative scenarios such as CRM, SCM, and supplier relationship management (SRM) as well as management services applications such as business intelligence (BI).

According to the respondents, many of the New Zealand large and larger medium-sized organizations have already completed their first phase of ES implementation and are now extending into the second phase with CRM, SCM, and/or BI. This is attributed to advancing ES maturity in the New Zealand market where firms are realizing the value of technology and its use to stay ahead of competitors.

4.8.2.2   *Cost and time of implementation*

According to informants in this study, in the SME sector, cost is the most important factor in selecting an ES for implementation. This is attributed to the limited funds these firms have for investment. The cost of implementation is related to the number of modules, their types, the software package size and brand, the number of user licenses issued, consulting costs, customization levels, and the vendor or third party implementation cost. The hardware cost, and the cost of training and change management, may be additional. One vendor explained that large organization implementation costs are higher because their operations are more complex and they require more customizations. Their decision-making processes may not be as efficient, and require a lot of change management procedures. On the other hand, smaller companies are more agile, more decisive and especially more inclined to adopt a best practices implementation, greatly reducing customization and change management costs. The average costs suggested by the participants for large enterprises are more than $2M, for SME $1M to $2M and for a small organization $100,000 to $1M based on the size of the project.

With the shifting focus towards SMEs, ES implementation-time has decreased, according to all the respondents. Earlier, processes such as modeling the organization and configuring the design used to take time. Now, using accelerators such as preconfigured business processes, the time to

implement has been slashed, and so has the cost of implementation, which has made these systems much more affordable for the small businesses. Although the time for implementation varied between different respondents, the general consensus was that currently large projects take 12 to 24 months and SMEs 3 to 12 months to complete.

4.8.3 Strategic context

4.8.3.1 Implementation partner and post implementation support

An implementation partner is mostly used for implementing an enterprise system and its associated project management. Respondents confirmed that currently both large firm and SME customers prefer the software vendor's direct involvement whereas a consultant-based implementation was a more accepted trend in the past, especially for large organization implementations. A majority of the participants in the current study suggested that there has been a shift over the last five years. Customers traditionally preferring to work with the big 5 consulting companies for implementation are now more inclined to work with the software vendor directly so that they have a one-stop shop. All firms, regardless of size, are realizing that the technical skills provided by a software vendor may not be possible from consultants. One vendor explained that customers prefer to talk to the software owners, to get the best value from a price perspective and from the perspective of having the best experts involved in the project.

The post implementation and after sales support from the software vendor or the implementer to the customer organization normally includes three levels of support (see Figure 17).
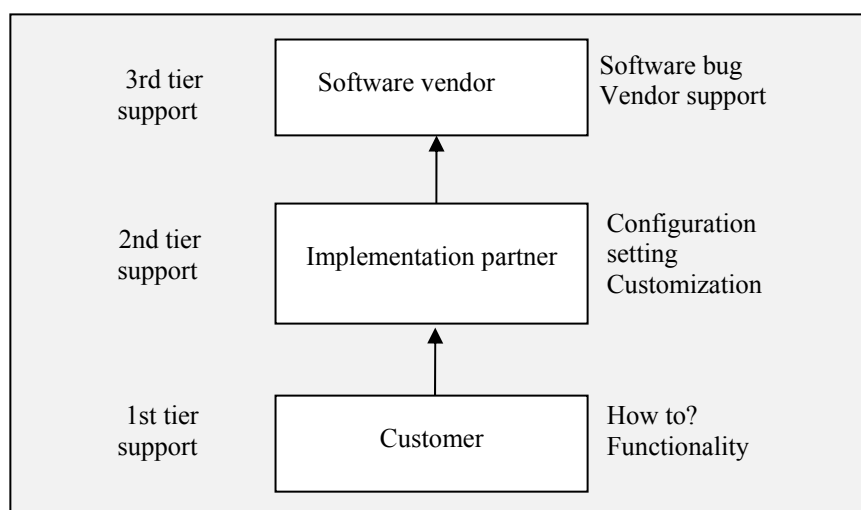
Figure 17: Three tier post implementation support model

The first level is at the customers' end where the customers' super user (i.e. ES champion), determines whether it is a "how to" question, where the user does not know how to use the

system. If the problem is related to the user or an organizational issue it is resolved at the first level. If not an end-user problem, then is it a general business requirement issue? If so, it is referred to the second level support which is the local vendor implementer or the implementation partner. The second level support determines whether it is a functionality or software performance setting issue that requires additional configuration to make it work and meet the business requirement. Finally, if the local implementation partner determines that the problem is a software bug or a product-related issue it is raised to level three which is the support channel inside the software vendor.

4.8.3.2   Customization

The findings from this study revealed that vanilla implementations are much more the norm in SMEs, in comparison to larger organizations. This is not surprising considering the desire for SMEs to reduce the cost of implementation and related factors noted earlier (e.g., less complex, efficient decision-making processes, agility, decisiveness).

SAP explained that there is a potential source of confusion about the extent of customization used in implementations as every project needs some form of customer specific reports, customer specific interfaces, and customer specific data conversion programs:

> ES software is designed to meet most customization requirements by adjusting parameter settings. All modern software vendors now have a software architecture that does not require modification to the core software statements to achieve results. The user access can be built through parameter settings to accommodate specific requirements. However, this should not be confused with what is called true customization in which the core software is actually modified.

Findings in this study revealed that organizations view the ES software not as a bunch of statements but as pre-defined business processes. Organizations prefer or even insist on adherence to the pre-defined best-practice business processes in the software and are willing to change their own processes to the software's requirements. These companies are more likely to be successful in capturing the benefits, controlling the cost of the implementation in future upgrades, and reducing the overall cost of ownership.

4.8.3.3   New, upgrade, add-on, replacement

Participants in this study suggest an equal split between new implementations versus upgrades, add-ons, and replacements in NZ organizations. SAP suggested:

we're definitely focusing on new implementations because that's where our goal is. However, we have to look after our existing customer base and as their requirements change, the presentation of our software in their business may also need to change.

In the case of replacements, Oracle noted that an organization will replace an ES only if there is a need to satisfy some major benefit which remains unsatisfied in their existing system, because it is expensive to replace. It is not just the cost of the software, but it is the huge organizational change that the organization has to go through to replace an enterprise system. Oracle also revealed that in the past this cost was underestimated, but "replacement cost is three times the cost of upgrade". Oracle also revealed the maintenance aspect which included the cost of upgrading the ES:

typically in every five-year period, companies spend up to four times the initial purchasing implementation cost, just to maintain the ES. That is why IT budgets in organizations allocate substantially for upgrade support as opposed to new requirements.

4.8.3.4   *Best of breed, and global implementations*

Findings revealed that the best-of-breed model was adopted by many organizations in the past. For example, an organization might install HRM module from PeopleSoft, financials from Oracle, and manufacturing from SAP in the first phase. Then subsequently install bolt-on modules such as CRM from Microsoft, SCM from SAP or Oracle, or BI from Cognos in the second phase. New implementations also consider the best-of-breed model especially to achieve a specific business requirement for a company. However, both customers and vendors are now moving towards single vendor implementation. This is because the additional benefit received from a best-of-breed implementation is vastly outweighed by the cost of implementing, maintaining, and managing those disparate systems. Organizations have realized that although there are really good benefits in PeopleSoft, SAP, and Oracle for the different modules, the cost to implement and maintain is enormous. While they may only get 85% to 90% of the best-of-breed benefit in a single vendor implementation that is preferable especially since it can save three times the cost of implementation and maintenance. Vendors also do not release new versions of the software exactly at the same time, therefore managing the upgrade path becomes difficult, the investment depreciates faster than expected, and organizations are unable to take advantage of the new features of the software.

The mix between national and international ES implementations is also an equal split in NZ. Respondents noted that on several occasions the implementations started as a national

implementation but quite quickly reached out to countries like Fiji, Australia, Europe, Singapore or wherever the sales and distribution offices are located. Although many NZ companies are based in NZ and the reach is national, there is a growing trend in NZ organizations to expand to global markets; therefore their reach is becoming increasingly global. This is also supported by the growing export-oriented market of NZ organizations. Global implementations are also part of multinational organizations that implement ES within their NZ sites. These implementations are normally "roll outs" using a template that incorporates common business practices throughout the organization. The "roll out", as explained by one consultant, is an implementation generated from a standard template, customized for an overseas location. The roll out starts with a massive data set prepared by the first implementation, followed by the addition of country specific and localized data. For example, GST or VAT percentages are different, the states as part of the addresses are different, and therefore a couple of master files which are country specific are implemented on top of the local customer and vendor base that is created. The data-set roll out is established using country specific data where new country settings override the generic template settings. Separate dedicated warehouses for each of the locations are set up in the system for tracking transactions. However, many NZ companies are governed by their parent organizations; hence all the decision making for the ES implementation is done offshore by the parent company, without much control from the NZ businesses. In summary, ES implementations in NZ organizations are moving from national towards a global reach either by expansion into overseas markets or off-shore ownership.

4.8.3.5   *Application service provider and business process outsource models*

There was a mixed response from respondents on this model. One vendor noted:

> ASP pops up every 5 years and was a bit like an economy that came and went and nothing really happened. I'm not too sure it is addressing a real market requirement need.

Another vendor responded "I don't think this model has picked up at all". However, yet another vendor confirmed that the ASP model is used in NZ:

> we use it. Customers are happy with it. We have time and resources for providing the service. There's a huge market there. These are small companies that do want an ES and they don't mind paying sixty to seventy thousand dollars a year but are not able to spend half a million to one million dollars for buying the software. It is not too difficult for these companies to put up a few servers each with the latest operating system of Windows. We've got the people and it's not much of their time, so we can

provide this service. There is no trend, but there is a huge market out there if marketed properly.

These findings suggest that although one vendor found potential in use of ASP model due to cost efficiency and resource constraints as reasons for organizations selecting this model for deployment, the overall response was not very positive regarding the trend of this implementation model in NZ.

The business processes outsource (BPO) model was explained by one consultant as a low cost commodity solution where the customer prefers not to manage the ES. This model positions itself very much in the SME market for example, in outsourcing transaction services or specific functions like finance, or payroll, or a similar function to a third party supplier:

an organization may have implemented Oracle financials or SAP finance for example, but may be paying, say to IBM, to run the technology and specific functions for them.

The adoption of ES by organizations is based on the benefits that can be justified from the investment. "Return on investment comes from process improvements ES supports and not from new ES software". The difference is that "ES software alone, no matter how good it is, makes little impact on improving business performance" (Donovan, 2003, unpaged). If organizations continue to follow "the same pre-ES business processes after implementation, they can expect the same or possibly worse performance" (Donovan, 2003, unpaged). It is therefore of immense importance especially those organizations considering new or upgraded ES to determine the business benefits organizations seek and understand how organizations realize business value from their ES investment.

4.9   Discussion

The first objective of this preliminary study was to understand how organizations utilize their ES and its information to realize business benefits. The study reported on core areas such as key benefits that organizations generally seek from ES implementations, how ES data are transformed into knowledge and utilized to achieve business benefits, and the critical success factors for the transformational process that reflect on current ES implementation and post-implementation practices in New Zealand organizations. The key findings are summarized in Table 16.

The findings suggest that the contextual factors of the transformational model (Figure 10) – strategic, organizational and cultural, skills and knowledge, data and technology constructs –

closely match and are linked to the critical success factors identified by participants in this study (bottom of Table 16).

Table 16: Key findings on usability of ES and its information by organizations

The key benefits organizations seek • Improve information flow • Reduce inventory and reduce out-of-inventory events • Improve process efficiencies • Overall cost reduction by automating functions • Reduce head count • Increase information visibility
How organizations convert ES data into knowledge • Organizations use data warehouse and business intelligence systems • Organizations extract data, manipulate it and report it in the form of a report, scorecard or KPI • Organizations use standard reports such as aging or ABC analysis on inventory management • A clear definition of what information is critical to the success of the organization is required • This is an area where organizations are still struggling
How organizations utilize this knowledge to achieve benefits • Organizations use balanced scorecard type of performance evaluation techniques to monitor drivers for the success of their business strategy • Organizations use business process simulating techniques, scenario planning, what-if analysis and management cockpits to identify problems and analyze potential solutions • These tools are provided in ESs but are usually limited to sophisticated, mature organizations with high level strategic thinking about what the business strategy is and what determines its success
Critical success factors for ES impact to produce organizational benefits • Active executive commitment in the project, including translation into departmental or divisional strategies and visions • Effective change management process • User feedback, involvement and understanding of the process and expected outcomes • Business strategy is clearly defined, articulated and aligned • Clear definition of scope before implementation • Quality of data and consistent data management • Appropriate technology

The second objective of this preliminary study was to understand the current practices of ES implementations in New Zealand utilizing the organizational, process, and strategic contexts and identify three organizations for the main study. Most respondents in this study agreed that current implementations in New Zealand are predominantly in the medium-sized organization category of 20 - 200 users (see Table 15). These findings are similar to results from a similar study (Shakir, 2003) in NZ four years previously in which the majority of implementations were found to be in medium-sized organizations with approximately 100 users. An earlier Australian study Parr and Shanks, (2000) also categorized organizations by number of users: small firms were less than 100 users and medium-sized organizations were 101-200 users. The variation in

number of users between the Australian and New Zealand contexts points out that organization size may be defined differently between countries, largely depending on the size of the country and its economy. Research findings from the current study indicate that the ES implementation focus has moved from large to medium-sized organizations. The findings also confirm that the majority of small organizations in NZ, those with less than 20 employees, have not ventured into an implementation from a large ES vendor yet, due to the cost factor.

Findings in this study revealed that the implementations in the large organization segment with revenues more than $250M are currently in phase 2 and the organizations are fairly mature with their ES. These organizations are likely to be in the phase of acquiring collaborative scenarios like SCM or CRM, or management services applications such as BI. These can be single or multi-site implementations. The number of users is estimated to be 200 or above and the cost of the project is likely to be more than $2M. Findings in this study also revealed that the phase 1 ES implementations frequently include the implementation of core ES modules such as finance, purchasing, warehousing, inventory, and, sometimes, operational modules, human resources and payroll. These findings differ from the Shakir (2003) study, which included financials plus one or two other modules in phase 1 implementations. This change could be attributed to the larger number of modules that ES vendors have put into the market in the last five years, SME owners being more ambitious in phase 1 implementations, and decreases in time, cost, and complexity in the module installation.

Four years ago, the length of time varied from 2.5 months to 2 years for first phase implementations in NZ (Shakir, 2003). In the current study, although the time for implementation varied between different informants, the general consensus was that most projects with large organizations take 12 to 24 months and those with SMEs took 3 to 12 months. Earlier studies did not distinguish implementation-time between SMEs and large organizations.

This study also confirms the findings of Shakir (2003) that: (1) SME customers continue to prefer the software vendor's direct involvement as an implementation partner; (2) cost is a factor that encourages vanilla implementations without extensive customization; and (3) the trend of there being an increasing proportion of multi-site implementations continues. Additionally, this study has revealed that many NZ companies are governed by their parent organizations; hence all the decision making for the ES implementation is done offshore by the parent company, without much control from the NZ businesses. Shakir (2003) also observed that global templates and critical decision making by offshore groups influenced NZ implementations.

Regards vanilla and multi-site implementations, Parr and Shanks (2000) reported in their study on different ES implementation approaches that vanilla implementations are usually single site and comprehensive or heavily customized, are multi-site. However, the current study suggests that vanilla implementations could be single or even multi-site and currently more implementations are multi-site. This change is attributed to improvements in ES technology in the past decade. Earlier, the software required comprehensive customization to integrate ES data across different company sites. Current ES software architecture provides the multi-site function as a pre-configured business process. Therefore, more organizations currently use the multi-site function as part of a vanilla implementation.

The results from this study found that organizations prefer to adhere to the pre-defined business processes in the ES software and change their own processes to the software's requirements. The companies doing this are more likely to be successful in capturing the benefits, controlling the cost of the implementation, facilitating future upgrades and reducing the overall cost of ownership. These findings confirm the results found by Brehm, Heinzl, and Markus (2001) in which they estimated that with greater customization, the more likely it is that the implementation will run into complexities, suffer on performance and schedule metrics, cost, and experience difficulties when attempting to upgrade to a later package release.

Furthermore, the key respondents in this study helped in identifying three organizations that met the selection criteria for the main study: (1) cases belonging to the manufacturing segment; (2) cases in the high-tech electronics industry; and (3) cases having implemented ESs for at least three years. Thus, using the snowballing sampling technique (Patton, 2002), three information-rich cases were identified for the main study.

4.10   Conclusion

This chapter presented the conduct of the preliminary study and its findings. The study explored the current ES implementation scenario in NZ. The study evaluated how organizations utilize their ES technology and its information to achieve business benefits – the business benefits organizations seek, how ES data are transformed into knowledge, how this knowledge leads to business benefits, and the critical success factors for the transformational process to be successful. The study also examined the current practices of ES implementations in a NZ context. The insights gained helped finalize the case study protocol and formalize a research strategy for the conduct of the main case studies. The next three chapters, 5, 6, and 7, present the cases of the main study.

Chapter 5

AEVON CASE STUDY

Chapter 5 provides the data collected from the first case study. This chapter presents the empirical findings from a company called Aevon (a pseudonym) that is involved in the design and manufacture of electronic products in New Zealand and has implemented SyteLine 7 (ES) as their business management system. This chapter is organized as follows.

The case study interview settings for Aevon and the details of the persons interviewed are first presented. The next section introduces Aevon and provides background on its operations. This is followed by an analytical description of the empirical findings using the format of the transformational model (refer Figure 10) to investigate the process of ES data transformation at Aevon. The main ES benefit realization events in the various functions and processes at Aevon are evaluated. The case description highlights the way the business is managed at Aevon, their post ES implementation practices, and how the organization's ES investment has impacted their functions and processes. It also helps to identify the ES practices that have either benefited the organization or need special attention. Finally, the critical success factors for the ES data transformation process to produce benefits at Aevon are summarized.

5.1   Aevon Case Study Settings

A series of semi-structured interviews with key respondents in Aevon were carried out between August 2007 and April 2008. The interviewees included senior executives, managers, and operational staff in the organization. Seven face-to-face meetings between 50 minutes and 3 hours each took place at Aevon.

The positions of the participants included: general manager, operations and supply chain (O&SC) manager, purchasing manager, and IT manager. Table 17 gives details of the roles of the persons interviewed. Two rounds of meetings were conducted. In the first round, one meeting was conducted with each participant between August and September 2007. The second round repeated the meetings with each participant between February and March 2008. In the second round, due to the unavailability of the general manager and the IT manager, one interview with the production engineer was conducted instead, and that added a different perspective to the study. Access was obtained to company reports, e-mail messages, minutes of meetings, and organizational manuals. Promotional material and the Web site of the organization were reviewed.

Table 17: Key respondents for the study at Aevon

Job title	Number of meetings	Role in the company
General manager	1	General management and in charge of the Aevon Auckland site including factory operations
Operations and supply chain manager	2	In charge of all operational activities including procurement, supply chain, manufacturing, and dispatch functions
Purchasing manager	2	In charge of purchasing and vendor development
IT manager	1	In charge of SyteLine and general IT administration
Production engineer	1	In charge of production activities in the shop floor including machine loading and managing production staff

5.2   Company Overview

Aevon is an electronic weighing instruments design and manufacturing company that was started in 1978. For the first five years, until 1983, the company carried out research and development (R&D) activities for the local industry as its core business. The owner and former CEO started the business by developing a cycle timer for a friend's injection molding company in his garden shed. Since 1982 the principal business of Aevon has been the design, manufacture, and supply of precision electronic weighing instruments. The company also manufactures specialized measurement and control equipment for a wide range of industries including the mining, quarrying, and forestry sectors.

In October 2008, Aevon celebrated 30 years in business. The company's sales turnover was $24 million at March 2007 closing. Aevon has its headquarters in Auckland with about seventy-five employees. All of the R&D and manufacturing functions such as hardware and software development, product development, project management, finance, planning, procurement, and production are managed at the Auckland HQ. In addition, Aevon has another fifteen employees based in the USA (5 employees), Australia (4), Europe (4), and China (2). They are the company's sales representatives and manage the business in these regions.

Aevon's main markets are in the US with more than 60% of the business from North America, 10 to 15% business is from Australia, and the balance is from Europe and China. The business model adopted for Aevon sales is the after market channel and currently 90% of the sales goes through the after market business. Aevon supplies the product to their distributors who in turn supply to the distributors of various original equipment manufacturing companies. Aevon is also

focusing on the original equipment manufacturer (OEM) market whereby the product is sold and fitted in the factories where the heavy equipment is manufactured. Aevon is not in the direct OEM business yet but has plans to venture into that business sector soon.

Aevon's products facilitate lower wastage and better results, providing productivity solutions through weight measurements to customers who operate in difficult environments such as open mining, waste management, and forestry. Aevon's principal goal is to be the best in their industry segment for design, manufacture, and supply of productivity solutions.

5.3   Context

Managing company operations with ES information is achieved "not through technology alone but through a complex collection of factors that most organizations have never even considered" (Davenport, 2000, p. 221). The contextual factors – strategic, organizational and cultural, skills and knowledge, data, and technology – for ES data transformation were discussed in-depth with the Aevon participants. These are presented next.

5.3.1   Strategic context

Aevon's core competencies and competitive advantage are in precision electronic weighing systems, product design for difficult environments, product performance and durability, distributor sales and service performance, and brand awareness. The company's vision for 2011 (as stated on their Web site) is to become "the world leader in designing, delivering, and supporting productivity solutions for customers operating in difficult environments".

Growth strategy

Aevon's financial goal is to achieve a sales turnover of $55M by 2011. This growth is expected to be partly organic, in addition to introducing some new products:

> our growth strategy involves subcontracting and outsourcing the PCBA [printed circuit board assemblies] and cable assemblies. We procure the plastics and the metal work from outside, and only do the final box assembly and testing of the products in-house before shipping out. (general manager)

Aevon previously used Symix ES from Mapics which was the standard Mapics platform available in the early 2000's. Since Mapics was bought by Infor in 2004, the application has been upgraded to a newer version of SyteLine. Aevon, being in the manufacturing business, with many electronic components and in-house processing, soon realized that they would not be

able to survive without the latest ES platform to meet their growth targets. Aevon realized that they "would not be able to get the manufacturing efficiencies and the relevant operational information without upgrading the business system". Therefore, in 2004, as part of the business strategy, Aevon upgraded their ES to SyteLine's latest version 7 (SL7) to improve the operational efficiencies and information flow in the company.

The key benefits that Aevon sought from their ES implementation relate to the improvement of process efficiencies and better utilization of the plant and offices primarily in the finance and production areas. During the interviews it was revealed that earlier the visibility of demand and available stock was inadequate leading to inaccuracies in both raw material and finished goods inventory. Aevon wanted to improve the information visibility throughout their value chain to be able to monitor the business activities and make better decisions. Aevon now runs the entire manufacturing system through the SyteLine ES to forecast customer orders, drive purchasing, plan production, coordinate warehousing, and dispatch shipments. Aevon also uses SyteLine for their entire sales and distribution operations, financial accounting, and preparation of financial statements.

Aevon is looking for a very strong growth strategy in terms of sales as it currently expands operations in several countries to becoming a global company. In the last two years the sales offices based in the US, Europe, and China have required systemic support from their enterprise systems. With the SL7 support available, Aevon hopes to be able to achieve their growth objectives and targets as planned by senior management.

5.3.2 Organizational and cultural context

Aevon currently employs about ninety employees and has an organizational culture that is self-motivated. Aevon has maintained harmonious human relations through the years and new organizational initiatives have always been accepted readily by their workforce:

> our people are open to improvements. Having such a workforce helps, it
> works well in an international marketplace. (general manager)

The organization structure at Aevon is collaborative. The subordinates have been given latitude in carrying out their work and the employees are encouraged to participate in the decision-making process. The staff is motivated to identify and solve customer needs:

> we have built a culture of understanding customer needs and solving
> problems with a hands-on approach. This same attitude has become our
> core competency today. Because we are focused on producing innovative
> solutions to client problems, our people from a range of disciplines think

about how to approach major challenges set by our clients. Our people have a high level of interest in different points of view that help in designing or delivering a better solution. (general manager)

The compensation system in the company is aligned to achieving goals. The company has created a congenial atmosphere within the organization through team building and learning which has fostered an orientation towards achieving goals:

the organization culture in 2004 was such that people did not use computers much and the modules were a handful for a start, but over the years, this trend has changed. (general manager)

With the implementation of SL7 in 2004, the company adopted a knowledge-sharing culture. This has encouraged employees to share ideas and knowledge, and make decisions. The employees have meaningful discussions with available information and use SL7 extensively within the company in the day-to-day operation of the organization.

5.3.3 Skills and knowledge context

Aevon staff are quite competent both technically and commercially. Their teams include marketing professionals, industrial and mechanical designers, software and electronics technicians, and manufacturing engineers:

we try to achieve the best industry standards through quality in our products and that has brought us success, but this has been possible only due to the skills and competency of our people and our high performance criteria. (general manager)

Aevon has over twenty-five qualified engineers in their manufacturing, design and development, quality, and sales functions. The workmen in the manufacturing section are skilled. The company has been providing training to upgrade and develop the skills and knowledge of their employees including training in the organization's functional processes for efficiently managing the day-to-day business activities.

The SyteLine users have been trained extensively in the use of the enterprise system for their specific requirements. Training has also been imparted to some employees on the use of Crystal Reports for the development of customized reports within SyteLine. Specific training has been provided for SyteLine administration within the IT team. Along with the SyteLine usability, the employees have also been trained in the commercial and managerial aspects of the business.

Employees are encouraged to share their knowledge and skills with others through participation in in-house conferences, meetings, group discussions, and the provision and use of various IT tools. Overall, Aevon employees possess good business, technical, commercial, and managerial skills. Knowledge and expertise is commonly shared within the organization.

5.3.4 Data context

Prior to ES implementation, quality of data were not a focus area for Aevon:

> the data records maintenance was not consistent and we often
> encountered discrepancies in the data records. The discipline in updating
> transactions in the warehouse was not adequate and regular which led to
> frequent stock inaccuracies in the organizational records. The availability
> of information and transactional data were an issue then. (O&SC manager)

Earlier, the tools for data extraction were inadequate. Data extracts could not be made easily available and in time. The decision-making process was also not as efficient and not fully supported by the correct and precise information.

This situation has improved after the implementation of SL7. The new system has in-built processes to maintain integrity of information by timely and accurately capturing the transactional data. The new system also has the ability to provide information through the various system functionality and reports based on which decisions and actions can be taken:

> even in the current situation due to lack of discipline in updating
> transactions in the warehouse, the information is sometimes not as
> current as could be expected and the accuracy is poor. This leads to data
> integrity issues amongst employees such as system stock not matching
> with physical, so the operational staff cannot entirely rely on the system
> data for taking immediate actions. (O&SC manager)

5.3.5 Technology context

Aevon upgraded their earlier Symix enterprise system from Mapics to SyteLine version 7 from Infor in 2004. The Aevon respondent explained that the Symix product was an old system with limited functionality. It did not have a friendly GUI (graphic user interface) and was difficult to use since its database language (Progress) was neither Web-based nor could it use external data from document files (e.g., .doc, .pdf) and images (e.g., .gif, .bmp):

> with this software, our data were accessible only from a Unix-based
> terminal, and in that format, it was very user un-friendly for someone

working on the shop floor. Also, the program only managed its own data
and could not manage data outside of its own database. (IT manager)

Aevon wanted a more customizable user interface accessible with a Web-based front end that
could manage external data files such as image files and text documents associated with their
records. Thus Aevon decided to implement SL7 that uses a SQL database and had all the
functionalities that they wanted:

since this was a recollection of the Symix product with a similar scheme
therefore was an easy upgrade to do. (IT manager)

At the time of the upgrade to SL7, the ES was being used by finance, purchasing, and the
factory. Since then Aevon has progressively enhanced the functionality of their ES. The SL7
modules implemented were finance, manufacturing (including purchasing, planning,
warehousing, production), and sales. Subsequently, more modules were added including BI
tools, CRM, and a field service module called FS-Plus to include more functionality. The FS-
Plus module was still under roll out at the time of this research study and anticipated to be fully
operational by the end of 2008.

Aevon currently has twenty-four SyteLine user licenses as concurrent users, but when they
converted from Symix, the company had only seven users. At that time Aevon had a staff of
about thirty-five employees, now the staff is ninety. So both the number and the percentage of
staff that are using SyteLine have increased since its introduction in 2004. For analytical
reporting, Aevon uses Crystal Reports, a SyteLine reporting tool. There are some pre-defined
reports within SyteLine but with the use of Crystal Reports existing reports can be modified or
new reports created. A few people in the company have been trained to create these reports.
Using these reports, Aevon can access their historical data and report information from their ES.

Aevon has created three different sites within their system thus transacting in a single instance
multi-site environment. The main system is implemented and based in Auckland. The NZ site is
used for the Auckland manufacturing operations. The US site focuses on the US sales and
distribution operations. The site for the rest of the world (ROW) runs the sales and distribution
operations for all other regions. Access is allowed to individuals remotely through user logins
into one or more sites. All the regions can connect through a virtual private network (VPN)
connection into their respective systems.

These systems interact with each other through the multi-site functionality in SL7 such as
"move stock" between two sites, without going through the process of having purchasing in one
site and a customer order in the other site. The system does not have the need to set up the two

entities with separate customer/supplier accounts. The system also allows payment of account payable invoices from another site that is not liable but has done the vouchering of the invoice on behalf of the other site. The payment leads to two simultaneous postings – (1) in the paying site which was not liable for the payment, the cash decreases and (2) the site for which the payment was made now owes the amount. The liability is then moved to an inter-company liability account.

There are two methods for receiving and entering customer orders into the SyteLine system. The first is the standard manual entry which is done in the Auckland office on receipt of an order. The second is creation of customer orders directly by Aevon's distributors who log into the SyteLine system through a CRM portal and place the order over the Internet. Since 90% of Aevon's production is sold by distributors in the after market, these distributors access the Aevon's system through this portal. The portal is a Web site created by Aevon where Aevon's distributors who have been given access can log-in, load and configure their orders into the system. Aevon has a utility by which the orders coming through the portal are automatically transferred as jobs into the SyteLine system. This cuts out the human factor for receiving and entering orders, and therefore reduces the possibility of a data input error. When Aevon implemented SyteLine they decided they would keep external data warehouses as minimal as they could. Aevon has kept the implementation as standard as possible. They have preferred to not make modifications or "have touch points" that might cause issues when they choose to upgrade.

In terms of Aevon's future plans with SyteLine, they intend "pushing out further". They currently have a limited interface with their CRM module and want to make more use of that and give their distributors better information.

5.4   Transformation

The transformation process at Aevon is based on the information extracted from SL7. For achieving the company's strategic objectives, the SL7 data are interpreted and analyzed in the various operational areas to support decision making using standard reporting templates. Many of these reports are transformed into Excel spreadsheets and manipulated for analytical processes that provide the inputs for establishing business decisions. Aevon has a business strategy but it is not clearly articulated and aligned into departmental or divisional strategies. The organization lacks in clearly defining the information critical to their success:

> we're in the very initial stages of creating a roadmap for achieving our
> strategic objectives. We don't have a roadmap yet. We're just starting to set

up KPIs for some of the functional areas. This is one of the exciting things
we want to do once the business intelligence module is fully operative.
(O&SC manager)

So far, Aevon has not identified their KPIs and key measurable. They do not have clarity on how they want to achieve their goals, which data needs analysis, where it is to be applied, and to achieve what results.

Furthermore, the analytical and decision-making process is based on ES data which are sometimes unclean and inaccurate. The data extracts are not timely available to support analytical decision making. The link between data, decisions, and actions is missing.

5.4.1   ES data transformation into knowledge

Aevon retrieves and transforms data in two ways. One is through normal day-to-day queries. There are some standard reports and queries that are available in the system. Typically, the user logs into the ES, runs a query and retrieves the data:

> a simple query could be in which the user drills down into a functional
> screen and reviews information. For example, the user drills down into the
> planning detail screen of a specific product and reviews the forward orders
> for that product. Here, there is no need for the user to generate a report.
> (IT manager)

So, a simple query is just a visual inspection of the related standard functional detail form to retrieve the information:

> this can also be done by running generic query forms that are also
> available within the functional module by selecting the parameters
> required for the query. For example, entering the product code, customer
> name or code, buyer or planner code, or salesperson into the relevant
> textbox and retrieving the information. (IT manager)

Another way of information retrieval is by running a report within the functional area. There are standard generic reports within SyteLine for this purpose:

> these reports provide the convenience of configuring to select the criteria
> from drop-down menus by selecting date ranges, item-code ranges, value
> ranges or any other such parameter depending on the type of report…
> There are usually three types of user groups. The first are the regular
> users who have the access and the basic knowledge to access data. The

second group are not regular users and do not have the knowledge or the access, so they approach the relevant people from the first group who help in retrieving the data and providing the information. The third group, are some users who may not have a full user license to access SyteLine, but can access SyteLine Viewer, which is an extended SyteLine application with a read-only functionality for which a user license is not required, but through which the data can be retrieved and information gathered. This data retrieval is ad-hoc and in piecemeal. There is also another category of information retrieval and conversion, through the use of special reports that are created and customized specifically to the needs of Aevon. (IT manager)

Although Aevon has tried to keep these customized reports as few as possible and has encouraged the use of standard reports most of the time, there are some customized reports developed in this category. For example, Aevon has customized their inventory report to break down the categories of inventory into purchased items, finished goods, and work-in-progress along with their valuation. The Crystal Reports tool within SyteLine is used to modify existing reports or create new reports which are used to provide relevant information as and when needed. Also information from these reports can be easily exported into an Excel spreadsheet and manipulated as required. These are some of the ways Aevon transforms data into information for knowledge creation.

The IT manager further revealed that the majority of the people who use SyteLine and regularly run these reports are at a tactical level:

these people run reports on a daily, weekly, or monthly basis to generate the information that they are looking for and use it in their reporting or analysis. (IT manager)

In certain other instances, such as doing a cycle count once in a quarter or re-qualification of ABC analysis of the inventory (explained in Subsection 5.5.3.4); such reports are created by the people who are trained to use Crystal Reports. In some cases, where Aevon staff is unable to do the report, Aevon takes assistance from EMDA, the consultants who implemented SyteLine. EMDA consultants develop the specialized report for Aevon, install it in Crystal Reports and charge Aevon for this service. Finally, the Aevon respondent explained that there are a few manufacturing companies locally who are using SyteLine, there is some networking among these companies to help each other and take advantage of the learning that is available within these organizations to support each other in times of need.

Aevon also uses business intelligence to get reports that are not possible through Crystal Reports:

> when the data are required to be manipulated in a different way, a cube with different bits of information at different times is created. The BI tool is then used to drill into the cube data level and create a report. (IT manager)

Aevon is using the bolt-on Symix BI, which their IT advisors had recommended. However, BI at Aevon is not fully operational yet. Aevon has created a couple of cubes for different business areas but has not been able to use the BI tools as a standard functionality as they are supposed to.

As discussed earlier, Aevon uses a Web portal for their CRM, so that the distributors log in through the portal, use the system, and retrieve information.

5.4.2 Utilization of knowledge for decision making to achieve benefits

The Aevon operations and supply chain manager suggested that there was no one type of method to utilize the information and create knowledge for decision making. This is done in several ways at Aevon. Most of the time, the information that is captured within SyteLine is manipulated and made available through the various forms, queries, or reports, and used for decision making on a day-to-day basis.

The O&SC manager cited an example of how ES data are utilized for decision making:

> there is a lot of information that is required before a purchasing decision can be taken. The information required could be what the current rate of consumption of a particular item is, how much would be consumed in jobs on hand, what is the current inventory, at what price the item has been last purchased, and whether the consumption pattern of the item is changing. There are many instances where such information from SyteLine is used on a regular basis for decision making.

The O&SC manager suggested some additional methods of utilizing ES information for decision making at Aevon: "we want to create dashboards and monitor them for the key financial and operational areas once our business intelligence module is operative".

At this time, Aevon's focus is to set up BI for sales reporting and, later, to have such information available for the other areas. Aevon is planning to start using a balanced scorecard, but it will not be a part of the SyteLine system which, according to the respondent is an

"unfortunate thing". However, the O&SC manager reiterated that the process has just been initiated at Aevon:

> Aevon is planning to commence setting up the KPIs [key performance indicators] for some of the functional areas. The idea has been transferred across by the executive team to the functional lines and they would be setting up KPIs for their approved goals soon. Once these have been set, the executive team would begin monitoring and controlling using the scorecard and SyteLine information.

As an example, the O&SC manager explained one of his personal KPIs may be in the operational area, to control and monitor the inventory against the benchmark set in the scorecard. So, the manager would be expected to control inventory on an on-going basis. The manager's performance would depend upon the achieved inventory level against the benchmark. Another KPI could be to bring down the purchasing costs for Aevon. In order to do this, the manager would have to "control the purchasing costs and improve the savings that have been accrued". For achieving such goals, SyteLine and its information would be extensively utilized. Aevon has added the BI functionality to make such information easily available to its employees. Now they want to make the module operational as soon as possible.

Therefore, these kinds of business objectives and monitoring processes are being talked about at Aevon. According to the O&SC manager, Aevon does not have the scorecard/KPI type of business monitoring yet but they see it coming through in the next few quarters and is expected to be implemented soon.

During the follow up interviews at Aevon about six months later, the O&SC manager confirmed that the company had initiated a dashboard program with core KPIs for the various functional areas that they wanted to monitor. The first goal-setting was expected to be completed by May/June 2008, and the first review was expected to happen in July 2008 with a regular monthly review thereafter. The next major review was expected in March 2009 at the time of the year closing, which would be the year end review. Based on this, remuneration changes for the next financial year would get reflected as an outcome. Therefore, Aevon is currently at a very preliminary stage of implementing the program for monitoring KPIs through a scorecard. But according to the respondent's belief, by the end of 2008 they would have this program fully operative.

The purchasing manager confirmed that Aevon was using benchmarking as a tool for their day-to-day business activity, monitoring tasks, and utilizing the ES data for establishing decisions. For Aevon benchmarking basically relates to comparisons against industry standards. As an

example the respondent suggested that in purchasing, if a cable assembly is currently bought from a vendor and they want to buy from another vendor, they would like to compare the prices of the two vendors before making the buying decision. They would also like to review the business plan cost of the cable in their SyteLine database as industry standard before finalizing the contract. Aevon is beginning to execute such kind of comparative analysis and there is a heavy reliance within the company on their ES data. An analogy cited by the respondent was that of ground water which runs below the soil but it supports all the life above:

> the trees tap into the ground water; water supports soil conservation, and provides support to the entire plant and animal life. Similarly the SyteLine information flow into the business is like the ground water supply. As every tree uses ground water similarly every business unit and every function taps into the SL data and uses the information. So, the SL data are fundamental to our business, growth, and success. (purchasing manager)

Aevon's intention is to collaborate and extend their system by further integrating with their distributors, customers, and suppliers. This would improve their throughput due to the different time zones where their business activities operate helping the business immensely. Additionally, the distributors will be able to rely more on the system. Aevon's plan is to identify some key customers and provide them with relevant ES information to enable them to track their orders through restricted access that the company could provide. Aevon also intends to extend their system to key suppliers who could utilize the forecasting information to plan materials and capacities for their manufacturing.

5.5   Outcomes

"In this entire process of converting ES data to knowledge to results, prerequisites and transformation count for little unless something changes in the organization as a result" (Davenport, 2000, p. 224). The outcomes as a result of the enterprise system deployment and the utilization of ES information, analysis, and decision making were critically discussed with the participants. The findings are presented next.

5.5.1   Changing behaviors

There have been a number of key measurements where behavior changes have been observed. Earlier when Aevon was using Symix before SyteLine, there was not a great deal of respect as far as the availability and visibility of the information was concerned: "the system inventory

was inaccurate and there was little transparency and visibility of information". (IT manager)

Use of incorrect prices and terms of business in Aevon's invoices sometimes led to unpleasantness amongst Aevon's suppliers: "there were also mistakes in shipment dates, modes of shipment, and destinations, all of which made customers unhappy". (purchasing manager)

Therefore, accuracy of data were a focus area when SyteLine and all the enhancements were implemented at Aevon: "now coming back, it is the same people who do have a great deal of respect and praise for the availability and transparency of the data. The system inventory has improved though it could still be better". (IT manager)

The realization that the inventory accuracy is important is changing the attitude and behavior of various groups towards how they stock material in the warehouse:

> the warehouse staff now do not grab more than the inventory requirement so that they do not duplicate work for themselves and they follow the right processes. However, due to the lack of discipline perhaps in timely updating transactions in the warehouse, the information is not as current as could be, and sometimes the accuracy is poor. (O&SC manager)

With the persisting data quality issues such as system stock not matching with physical, data integrity issues amongst employees and the staff continue. The purchasing and production engineers sometimes show discontent since they cannot completely rely on the ES data for taking actions. With better communication and visibility of information, the business relationships with suppliers and customers have improved. The disputes on prices and terms of business have reduced, but due to inaccuracies in data some disputes and resentment still exist.

5.5.2 New initiatives

There have been several new initiatives at Aevon as a result of the new ES:

> the major ones are in the production areas which include the implementation of lean manufacturing principles that involve the use of automated stock back flushing in SyteLine. This functionality automatically posts all the items consumed in the production jobs based on the bill-of-materials[3] when the operations are confirmed. The earlier process of picking jobs one-by-one and manually posting the usage by item

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[3] Bill-of-materials (BOM) is a collection of materials that make up a product.

was tedious and prone to mistakes leading to inventory errors. An inventory mismatch was also created earlier due to the time lag between the consumption and the manual posting of transactions. The focus is now on improving the production flow throughout the operations. (O&SC manager)

The production leveling with the "pull" approach by the use of kanban[4] systems have been implemented in Aevon. This is fundamentally different to the earlier "push" approach that Aevon had. All of this has been possible for Aevon with the help and support of SyteLine at the back end. With the implementation of lean principles Aevon has been able to identify and steadily eliminate waste:

the lean implementation introduced one-piece-flow in our production lines that reduced inventory, exposed operational bottlenecks and quality issues, and so we could control costs. (O&SC manager)

The advantage claimed by Aevon with this initiative is that it focuses on creating more value as a natural outcome. The goal however has been on reduction of production-time and cost by the elimination of waste.

There have been some other similar new initiatives and process improvements planned where SyteLine has been the backbone for improvements. Such an area has been the implementation of the field service module called FS-Plus as a separate bolt-on to SyteLine. Aevon had been planning and executing their service repair jobs using their manufacturing system within SyteLine. The FS-Plus module has recently been added and has yet to leverage the information that is available. Aevon had been using another practical way of retrieving the product fault information by using an Access database. Therefore, the big task still remains for Aevon to integrate the Access database information into SyteLine so that the field service module database could be used as a service system. With this system Aevon plans to link their finance function to customer service with the ability to issue credit notes against warranty returns. Aevon can also monitor the product faults, its reasons, and associated costs. However, Aevon has not been able to fully utilize this system with the pending historical data transfer from their Access database. The new system is expected to be fully operational by end of 2008.

Aevon has established a communication mode using SyteLine for internal communication at their Auckland site. Aevon has implemented what they call the "LOOP network", in which six

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[4] Kanban is a concept related to lean production. "It is a system of production control that dispatches work based on the needs of the succeeding workstation" (Koenig, 2007, p. 416).

to seven large LCD displays have been set up within the facilities at different places. These LCD monitors constantly show relevant data picked up directly from their ES:

> certain information displayed is part of the PowerPoint slides shown continuously, but certain other data are actually picked up from SyteLine and displayed. For example, the sales information by product is displayed for the previous day. SyteLine runs a program overnight to calculate the previous days total invoice values for the company. Then through the LOOP network, the value of the total sales for the previous day is displayed on the TV monitors. From the CEO down to the production shop floor, anybody in the premises including the visitors could see the information being displayed on the LCD's. These are critical data that are queried from SyteLine and displayed. (O&SC manager)

In the next stage, Aevon plans to provide access to their employees who could then go to a particular screen in SyteLine and pull out the information they would like to display on to the LCD screen. Aevon wants to use such technologies for communication as they grow and later enable their overseas offices to put their commentary into this. Aevon promotes the use of this tool for communication across the company "so that everybody is on the same page".

5.5.3 Process changes

The entire business for Aevon is run on SyteLine as the new platform that has resulted in several process improvements achieved by the company. Aevon realized that some of their business processes could be redesigned for better management and control with the opportunities created by SyteLine and its data. The findings suggest the following process improvements as an outcome in the different business areas.

5.5.3.1 *Sales, distribution, and customer services*

The order intake process requires customer orders to be entered into SyteLine. Through the remote access using Aevon's Web portal, the regional sales persons create and enter the order data themselves:

> they can find out, for example, how much inventory of parts is available, their costs, make commercial decisions and commit deliveries to customers without having to wait for this information to come from the Auckland operations team. (O&SC manager)

This process change has proved a major advantage to Aevon's business. Additionally, since most of Aevon's business is overseas, the regional time differences now do not disrupt the transactions within the system due to the Auckland office closing in the evenings.

Aevon has created a utility by which the orders that come through the portal are automatically transferred as jobs into their SyteLine system, cutting out the human factor for order entry. This allows Aevon automated twenty-four hours order entry into SyteLine by sales persons, distributors and customers directly from different time zones:

> these people enter the order through the portal which automatically transfers into SyteLine and then by running a utility these orders are converted into jobs in the system. This eliminates any possibility of errors when the orders are converted into jobs. This also eliminates any other issues that existed earlier such as sometimes the orders coming through fax would go missing or the fax machine could be under maintenance. This was another major improvement. (O&SC manager)

Through the CRM module, Aevon has achieved the ability to offer products to customers over the Internet with on-line delivery commitment, book orders through the Internet, automatically update production plans, track assembly and dispatch for committed delivery date, and generate an invoice. The system also provides an on-line receivables check while accepting orders so that Aevon could timely review receivables with defaulted customers who have not made payments before executing their new order.

It is now possible for Aevon to view their order intake details. This can be viewed by product, by date, by customer, or by division. Aevon can also run reports to review their forward order status by week, by month, by quarter, or by year monitoring expected sales and capacity utilization. Aevon has started producing variance analysis reports such as selling price variance, general ledger business unit cost variance, and distribution cost variance to understand the areas where the costs deviated from Aevon's business plan and perform possible corrective actions.

Some of the regular SyteLine reports used by Aevon in the sales area are customer by item sales analysis report, item availability report, order status report, sales value report, to be shipped report, item pricing, item stockroom locations, and order promise date performance report.

To provide better customer service, Aevon has established a new process using the field service module FS-Plus implemented recently and is expected to significantly improve services to customers:

> the service personnel can now promptly book RMA [return material
> authorization] and issue the RMA numbers to customers for field return or
> warranty return of products due to product faults. This module manages
> the process for inward RMA goods, schedules repair of products in the
> factory, and prompts timely shipping of the repaired product back to the
> customer. (O&SC manager)

Aevon can also analyze the faults found in the products for improvements in future designs.

5.5.3.2   Planning

Aevon has been able to improve the planning process as a result of the available functionalities
and information from SyteLine. The company has put a sales and operations planning process in
place in which the orders and forecasts are updated through regular communication and reviews
within the regions. The planners in the Auckland factory review demand with the regions on a
regular basis using a six-month horizon. This has brought accuracy to the planning process and
improved visibility of demand. With these processes Aevon has been able to successfully supply
stock to regions and fulfill customer demand while continually monitoring and minimizing
inventories.

Aevon has set up multi-level bill-of-materials (BOM) in SyteLine which provide all the item-
level details of a product in the exploded BOM view:

> when the customer orders for the finished products are put in, depending
> upon the BOM configuration, the manufacturing and purchasing actions
> are driven through a MRP [materials requirements planning][5] order action
> report. The operations team executes the MRP generated plans and reviews
> on a weekly basis. This has reduced the out-of-inventory events which
> happened more frequently earlier and affected the production lines. The
> supply flexibility has also improved, reducing the overall costs. (O&SC
> manager)

Pricing of products to customers has improved by the use of built-in customer item cross
reference pricing functionality. SyteLine maintains a database of the various products and their
prices for specific customers so that when an order is created for a specific customer the item
price loading is automated.

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[5] Materials requirements planning (MRP) "is a computer driven purchasing and inventory management
program. It evolved to satisfy the requirements of supplying materials to shop operations. This system
optimizes the purchase and distribution of materials to the shop floor" (Koenig, 2007, p. 397).

The O&SC manager explained the use of Planners Workbench in SyteLine as an improved process for planning material and production jobs:

> this is used for creation, opening, and closing of jobs. This function is used for both the regular in-house production jobs and also for outwork jobs where the material is given to an outside vendor for doing some processing based on the requirements. Within the planning function, the system also includes the process of execution of jobs and the material and labor cost allocation to jobs. All of this is driven through SyteLine, including the shipment data such as the packing list with packaging details, and the serial numbers that are generated through the system and sent to the customers.

Aevon is now able to send automated order verifications to customers with firm and accurate delivery dates. The regular queries and reports from SyteLine used at Aevon for planning and purchasing are customer order creation and query, order entry exception report, order verification report, forecast query, planning detail query, and master planning report.

5.5.3.3 Purchasing

The Planners Workbench is also used by buyers in the Purchasing Department:

> instead of generating a report, the items that are required to be ordered appear in a specific screen, and all the buyers do is tick all the lines that need to be ordered. Since the vendor cross-reference is already created against individual items, the system automatically creates the purchase orders and what remains is just printing out the orders if required. (purchasing manager)

This is a very useful functionality that Aevon uses regularly in purchasing goods. With the new system a material shortage report is run by Purchasing for information with respect to pull-ins/push-outs, and the exceptions where some actions are required. Exception reports such as on-hand below safety stock, receipt projected late, requirement projected late, negative quantity on-hand, move-in receipt, move-out receipt, and receipt not needed are used for actions to keep stock in control:

> the buyers in Purchasing are now able to analyze the cost of items procured. They examine how the costs have varied over the last few years and execute a usage analysis of parts to understand the changing trends in consumption. This is especially useful for our 'A' category expensive items for which the cost and usage analysis is quite beneficial. Questions

> such as who are the vendors with specific payment terms or what are the
> terms of business for the different vendors, what are their year-to-date
> business, and how much has been paid to them are also reviewed. This
> kind of information helps in fixing more favorable payment terms with
> vendors with higher business levels. SyteLine helps in accessing this data.
> The reports can be processed in grid form and transferred into an Excel
> spreadsheet to analyze the information. The entire Purchasing Department
> at Aevon is now dependent on the system. If a buyer needs to look at the
> planning details, or make a query on any particular purchase order, or
> needs any vendor information, it has to come out of the system. For any
> pull-ins, push-outs, change data, or change quantities, all of this can
> happen only through SyteLine. (purchasing manager)

Standard reports for the Purchasing Department include MRP order action report, purchase order report, PO analysis for overdue orders by buyer code, by product range, by date, by vendor, by PO status such as ordered, planned, filled and complete, and customer item cross references prices. Some of the benefits Aevon now enjoys are the automated release and e-mail of purchase orders/schedules to vendors, cutting delays, effort, and cost.

5.5.3.4   *Inventory management*

The management of the inventory has been an important requirement for Aevon. In late 2007, Aevon planned to move their factory and office premises to another location. They decided a strategy to build up inventory of finished goods before moving so that they have enough stock to fill customer orders during the move period. After the move, when their factory was operative again, they would bring the inventory down. They wanted to keep a close track of the inventory during this period, which was a corporate strategy:

> one thing is to have a strategy to achieve something, the other is to be able
> to track the performance and actually accomplish it successfully.
> (purchasing manager)

Aevon was able to track their inventories at regular intervals as they built up the inventory and then put in steps so that they could bring it down again, monitoring the entire process closely. Aevon started using the inventory management reports in SyteLine to track the inventories.

They decided to ramp up production to reach the desired inventory levels, which they monitored by analyzing inventory reports on a weekly basis. The report conveyed the inventory holding of Aevon by item along with its valuation. This helped Aevon to keep a close track of the inventory and manage the funds flow that could get tied up in slow moving inventories. The

report classified the inventory into purchased, work in progress, and finished goods. It also classified items in inventory into the A, B, and C category. The ABC classes are categorized in Aevon around the standard 75%-20%-5% respectively in terms of value and throughput:

> not all stock is equally valuable and therefore does not require the same management focus. The results of the ABC analysis provides information that helps evaluate how each inventory part should be monitored and controlled. The ABC analysis could be executed for the various categories of materials such as purchased, manufactured, and transferred items specifying percentages for the A, B, and C categories. We find this inventory report a very useful tool. (purchasing manager)

Despite all of this, Aevon did not achieve their inventory targets. Aevon was able to build up inventory the way it was planned, but the forecasts from their distribution channel and customers changed, sales slowed and inventory exceeded target levels in the last few months. Had the sales not slowed down, Aevon would have achieved the targets that were set according to the O&SC manager. This aspect was outside the framework of Aevon's inventory management strategy. Although Aevon has not achieved their target, now they know what the new forecast is. The respondent further explained had they not used the inventory reports from SyteLine, they would have been in a worse situation.

To improve accuracy of the inventory, Aevon has very recently established regular cycle counts in their warehouse for the various categories of items, using the standard SyteLine functionality for this process. The ABC analysis report is used extensively for this process. The process generates a cycle count variance report which is used by Aevon to understand the reasons for the variance. The materials transaction report helps by providing all the details of transactions to resolve the variances for those items.

5.5.3.5   *Manufacturing*

The manufacturing process is driven by the released jobs due dates and the production schedules assigned by the advanced planning and scheduling (APS) system in SyteLine:

> automated production schedules are created for all released jobs, optimizing the capacities and resources available in the factory. This helps us to prioritize production based on customer due dates and the material available. The use of APS has helped in achieving production targets due to greater visibility and instant alerts for exceptions raised. (production engineer)

The system generates information and reports on the manufacturing costs associated with the production of job orders, job material usage analysis and labor usage analysis by specific orders or by period. The general ledger production variance is also analyzed to evaluate reasons for the production cost differences with the business plan.

The integration of an engineering change note (ECN) management system, bill-of-materials, and inventories, relating ECN implementation date to interactively projected inventories has led to a sharp decline in inventory obsolescence at Aevon.

The integration of quality/sampling plans with purchase orders and schedules to suppliers, including inwards goods receipts and receipt inspection, at Aevon has improved the quality of material receipts and reduced quality issues with suppliers.

Aevon has achieved better control on third party subcontracting with increased visibility of information:

> the subcontractor gets automated delivery instructions related to number of days supply configured in the system or even changes in balance days' delivery requirement, depending on the production progress in the factory. We have the record and visibility on the various materials sent and available at our subcontractors end. (O&SC manager)

Aevon has established the SyteLine preventive maintenance functionality that interrelates with production and maintenance plans and optimizes maintenance schedules, reducing factory down times due to machine and equipment breakdown. The system provides projection features to make preventive plant maintenance more proactive and data based.

With the above process changes Aevon has achieved a much improved fulfillment of promised delivery dates to customers.

5.5.3.6   *Dispatch*

In the shipping area, Aevon is using FedEx as their shipping company. FedEx provides a door-to-door service, picking up goods from Aevon's warehouse and delivering them to the customer's address. FedEx has supplied a software application that Aevon runs through a utility in SyteLine:

> this utility exports our shipment data into the FedEx application and provides us the ability to get our database transmission. With this process our dispatch achieves much better speed in terms of passing the shipment information to the customers for tracking consignments. (O&SC manager)

Aevon now plans to extend this further by having their shipping and tracking information in their CRM module so that their distributors can see the shipment status along with their order placement. These process changes have improved Aevon's shipping function to a large extent.

SyteLine also provides the facility by which the details of dispatches can be e-mailed/e-faxed automatically by Aevon to the regions and customers. This has reduced the time and cost Aevon used to incur in collating information such as consignment and serial number details in separate spreadsheets and sending those spreadsheets to the customers.

Some of the SyteLine queries and reports regularly used by the Dispatch Department are serial numbers query, warehouse query, item serial number report, due for shipping and ship to report, and consolidated invoicing.

5.5.3.7 *Finance*

The SyteLine system at Aevon helps the finance function with various functionality, analysis and reports. For example, now it is possible for the Aevon finance team to know what Aevon owes to the suppliers or what the customers owe to Aevon instantaneously:

> the accounts payables and receivables are driven from the system through the release of purchase orders to suppliers and invoices to the customers. This has led to improved working capital management through better and real-time debtors control and generation of exception reports. This has also helped in assessing company or enterprise-wide funds position. (O&SC manager)

It has become possible for the company to analyze accounts payable payment distribution, which has streamlined the process for releasing funds to suppliers:

> this process has improved the company's cash flow and relations with suppliers who have started receiving their payments timely and do not have to follow up with the company any more. (O&SC manager)

SyteLine has also enhanced the visibility into financial transactions such as the posted transaction details and summary, vouchers and adjustments, and distribution to vendors.

The accounts receivables process has improved at Aevon through SyteLine with the account receivable payment distribution analysis and use of pending receivable reports with aging analysis. Aevon now follows up with their customers in case of non-payment, regularly supported with the relevant information. This has brought down the receivables status,

improving the cash flow. The company has started using automated "credit hold" functionality in SyteLine which puts customers who have defaulted in payments on credit hold:

> through this system, the dispatch is unable to process a shipment to those customers who are on credit hold unless the hold is released through finance. (O&SC manager)

Customer creation in SyteLine is part of the finance function. SyteLine provides the ability to view historical and open orders by customer, currency, customer order cross references - prices, customer ship-to, customer communication logs, and customer orders. This allows the finance team to organize all customer-related activities, view posted transaction details and summary, customer details, finance charges, invoices, and debit and credit memos. With this information, the finance team is better equipped to manage and control the business. They can now do an on-line profitability analysis by division, product, or customer. In situations where there are changes in duty and tax structures by the government, the system enables an instantaneous all-round effect of changes in applicable duty/tax rates on purchase orders, bills inward, customer invoices, and product costing. The use of automated electronic funds transfer from the regions to the HQ at Auckland through SyteLine has led to a reduction in the working capital for the company.

Aevon now uses SyteLine functionalities for the general ledger (GL), assets, liabilities, posted transactions, and account summaries. The company also manages fixed assets, fixed assets costs, depreciation, disposal, distributions, and transfers through SyteLine. Bank reconciliations, journal entries, account balances, and cash impacts are controlled using SyteLine reports. All of these processes have improved the financial management and control at Aevon.

5.5.3.8 *Systems*

From the systems management standpoint, SyteLine has given Aevon readily available and adaptable common integrated systems covering all core business requirements implemented within months:

> a similar in-house development for integrating and automating the systems would have required years of effort and sustenance and still would have been a difficult task due to programmers' turnover. (IT manager)

The IT manager explained that SyteLine is designed to cater for the next 15 years of business functionalities including any diversification/expansion, requiring only incremental implementation support, minimal hardware and network connectivity upgrades, and is pre-designed for ready integration of advanced application packages:

in-house software is invariably designed for the current business scenario and fails to respond to major functionality changes. Time taken to modify, or enhance, or redevelop in-house software by IT teams can severely affect the business itself in the changed scenario… The benefits of SyteLine within systems management include elimination of paperwork and stationery costs in most areas through elimination of intermediate documents, printed reports, copies, and memos. Also, a standard analytical decision support information system is built-in for each functional area. (IT manager)

According to the IT manager, SyteLine has enforced changes in work patterns and thinking from function to process-based, leading to dismantling of departmental barriers with visibility and access to required information without waiting for "the other" department to provide it.

5.5.3.9 *Product development*

In the product development and innovation function at Aevon, SyteLine is partially used for the new product development cycle with information such as the costs incurred against specific projects:

the project plans are created outside SyteLine using MS Project. This includes project related information such as work breakdown structures, budgeting and resource allocation, labor hours consumed, and the project timeline Gantt charts. But, when an order is released to a vendor to do the preproduction build against specific projects, this is processed through SyteLine. Then, the project manager can retrieve the relevant information about the project's status from SyteLine. (O&SC manager)

In new product development, SyteLine helps in providing information on how the cost of the new product is coming through. The new bill-of-materials (BOM) is configured in SyteLine that provides information on the BOM cost break-down, costs spent on tool development, and one time non-recurring engineering (NRE) charges covering the cost of arranging set up for the production of the printed circuit board (PCB) design:

all of this information is available in the system because of the orders that are released to vendors. This information and analysis are very useful to us. The general ledger codes are linked to the various project codes within SyteLine. When parts are procured, the costs get booked directly to the general ledger through the project codes. This provides project costing details as the project progresses. Such information is used by the project and product managers to analyze the project costs and compare with

> budget to contain costs within budget or to understand areas of cost
> overruns. (O&SC manager)

Similarly, the general ledger codes are also linked to various department codes or employee codes for cost allocation. SyteLine captures the transactions that are project specific and provides an account summary to help assess the progressive costs incurred against the project.

The operations and supply chain manager further explained that for an R&D engineer, it is a very common query to know where specific components are being used to decide commonalities of the components for standardization. This can be performed very quickly in SyteLine through a functionality called "where used":

> through this process the engineers are able to find out if the parts are
> being used in any of the existing products so that when new items are set
> up, the engineers can select the parts that are currently in use from the
> description and part numbers of existing items. This again encourages
> standardization. If the system is not available, the R&D engineer will not
> be able to perform such queries and checks, and will end up with
> unnecessary procurement of new parts, increasing the inventory of
> existing parts. (O&SC manager)

SyteLine provides Aevon with the facility to maintain a history of engineering change requests (ECRs)/engineering change notes (ECNs), with information such as when and why an ECN was raised, when it was implemented, and who was the approver to maintain full traceability for the change. As per the O&SC manager, in a typical product life cycle, the graph is normally bell-shaped:

> the beginning phase includes the concept development, the design and
> development of prototypes, and trials and testing, until the launch of the
> product in the market. In the growth phase the graph goes up, peaks and
> then finally tapers down until the end-of-life. At every stage of the product
> life cycle SyteLine provides support. The system may not help much in the
> concept stage but when the components are selected it definitely helps.
> The system provides specifications on the components that are currently
> used in existing products, components that can be selected for use in the
> new product. At the prototyping stage, we would like to know the inventory
> of the parts available that can be used. As new component samples are
> procured and start coming in, the system starts to build historical data as
> to which supplier has been supplying parts at what price. This helps in
> developing costs for project planning and budgeting. This also helps to

build the product BOM costs, or provides an ABC analysis of the existing products. In the growth phase the system provides information on forecasts to the suppliers, the demand and order booking pattern, and requirement to expedite orders, pulling-in, and pushing-out. All of this is managed out of SyteLine. Then, when the product comes to the end-of-life phase, SyteLine provides information on the liability with respect to the components that are in stock to avoid obsolescence. (O&SC manager)

Being a specialized measurement and control application firm in a niche industry, the end-of-life management is important for Aevon to reduce the obsolescence of parts and minimize material exposure. Aevon has a liability to service the units in the field for a period of 7 to 10 years, depending on the contract. Analysis from SyteLine helps the company to decide what inventory of spares they need to maintain and what the associated costs are. This kind of information from SyteLine helps Aevon in decision making at every stage of the product lifecycle.

5.5.4   Financial impacts

Aevon has achieved an improved financial performance since their investment in SyteLine 7, although the company has not been able to realize all of their anticipated objectives and growth expectations. From a $15M sales turnover in 2003, Aevon has grown to become a $24M company by 2007 achieving a growth rate of 12.5% per annum.

Aevon had expected their cost efficiency to improve by 40-50% and inventory levels to reduce by 60-70%. However, the cost efficiency for the company has improved by only 10% and the inventory levels have reduced by only 25%. Another expectation of Aevon was that the human resources would become "highly" motivated after their ES implementation. This did not occur but the human resource motivation did improve. There was a slight improvement in the areas of delivery performance and time taken for new product introduction.

Finally, the improvement expectation in Aevon's profit after tax by Aevon was about 20% by 2007. An improvement of only 8% was achieved, which is less compared to Aevon's target. Their operating revenue has marginally increased by 10% and EBITDA (earnings before interest, taxes, depreciation, and amortization) by 12%.

5.6   CSFs for the Transformational Process to Produce Benefits

The operation and supply chain manager suggested that there were critical success factors (CSFs) for benefit realization from ES utilization and data transformation:

> the number one is data integrity. The accuracy of information builds up the faith of the people in the system and that is important. The system inventory accuracy is closely related to the discipline to maintain desirable level of the inventory. (O&SC manager)

In the O&SC manager's previous job, he had experienced inventory maintenance as the key to the manufacturing environment:

> there were basically two groups of people – one were those who hated it because it made them do the work and complete the transactions on a timely basis as per the laid out process. The other group were those who loved it because if they treated the processes correctly, the outcome was what they wanted – accurate inventories. (O&SC manager)

According to the O&SC manager, SyteLine is a bit more flexible in the ways the material transactions could be entered, but to make the system work requires discipline. If this is not followed, satisfactory results could not be expected and the information would not be reliable.

Second is support from the top management in areas such as KPI monitoring and performance management, employee training, and improving the general morale of employees.

The third CSF is employee reward and recognition. Employee reward and recognition programs both financial (e.g., salary raise) and non-financial (e.g., performance award in a year-end ceremony) lead to staff motivation and are important for achieving goals.

The fourth CSF is the usability of the ES. According to the respondent, the system should be simple to use, learn, and train so that the people are able to get what they want from it easily.

Fifth, the system should be flexible and scalable. There should be enough flexibility within the ES to provide the required information and generate reports easily. Also, the ES should be able to adapt to the way the business is being managed. If there are any changes to the business model, the system should have the flexibility and scalability through configuration setting changes to adapt to the new requirements.

Sixth, the system should provide interoperability:

> how well can the ES integrate with the systems of business partners, how well compatible it is, how well can it communicate and exchange data? (purchasing manager)

Seventh, features such as multi-currency, multi-location, and global-implementation in today's global environment are quite important.

Eighth, the ability to interface through the Internet with Web-based functionality is important. For example, to provide customers the ability to load customer orders or view shipment details by connecting into the ES through the Internet.

The critical success factors for the transformational process through the utilization of SyteLine and its data to produce benefits at Aevon are summarized in Table 18.

Table 18: CSFs for the transformational process to produce benefits at Aevon

Critical success factors	Description
Data integrity	The accuracy of information builds up faith of the people in the system and that is important. It leads to better decision making.
Support from top management	In areas such as KPI monitoring and performance management, employee training, and improving the general morale of employees.
Employee reward and recognition	Employee reward and recognition programs lead to staff motivation that are required for achieving goals.
ES usability	The system should be simple to use, learn, and train so that the people are able to get what they want from it easily.
Flexibility and scalability of ES	There should be enough flexibility within the ES to provide the required information and generate reports easily. Also, the ES should be able to adapt to the way the business is being managed. If there are any changes to the business model, the system should have the flexibility and scalability through configuration setting changes to re-adapt to the new requirements.
Interoperability	The system should be able to integrate with the business partners, be compatible, and be able to exchange data with other systems.
Support global transactions	Features such as multi-currency, multi-location, and global-implementation in today's global environment are considered important.
Web-based functionality	The ability to interface through the Internet is important. For example, to provide customers the ability to load customer orders or view shipment details by connecting into the system through Internet.

5.7　Summary

This chapter presented the conduct of the first case study and its findings. The study investigated the process of ES data transformation and results at Aevon using the format of the transformational model (refer Figure 10). The contextual constructs comprising the strategic, organizational and cultural, skills and knowledge, data, and technology factors were assessed. The methods and techniques for ES data transformation into knowledge and its utilization for decision making were explored. The outcomes comprising behavioral changes, new initiatives, process changes, and financial impacts were examined. The ES benefit realization events in the various functions and processes were evaluated.

The case study presented insights into Aevon's post ES implementation practices focusing on usability of ES and its information, and how the ES investment has impacted Aevon's functions and processes. Finally, the study examined and summarized the critical success factors for the transformational process to produce benefits at Aevon. The next chapter presents the second case study.

Chapter 6

BEVON CASE STUDY

Chapter 6 provides the data collected from the second case study. This chapter presents the empirical findings from a company called Bevon (a pseudonym) that is involved in the design and manufacture of electronic products in NZ and has implemented mySAP as their business management system. This chapter is organized as follows.

First, the case study interview settings for Bevon including the details of the persons interviewed are presented. The next section introduces Bevon and provides background on its operations. This is followed by an analytical description of the empirical findings using the format of the transformational model (refer Figure 10) to investigate the process of ES data transformation at Bevon. The main ES benefit realization events in the various functions and processes at Bevon are evaluated. The case description helps to identify the areas that have either benefited Bevon from the ES implementation or need more attention. It discusses the implications for practice with a focus on usability of ES and highlights the impact of ES implementation on Bevon's functions and processes. Finally, the critical success factors for the ES data transformation process to produce benefits at Bevon are summarized.

6.1   Bevon Case Study Settings

The interview data have been collected through a series of semi-structured interviews with key respondents in Bevon. Seven interviews were conducted with operating staff between September 2007 and April 2008. The interviews took place at Bevon and each interview lasted between 50 minutes and 3 hours each. The positions of the participants included: general manager, operations manager, senior purchasing officer, and project manager information system.

There were two rounds of meetings. In the first round, one meeting was carried out with each participant between September and November 2007. The second round of meetings was repeated with each participant between March and April 2008 with the exception of the general manager who was unavailable at that time. The Table 19 gives the details of the roles of the persons interviewed.

In addition to face-to-face interviews, access was also obtained to company reports, e-mails, minutes of meetings, and organizational manuals. Promotional material and the Web sites of the organization were reviewed to gain insights on Bevon's operations and market situation.

Table 19: Key respondents for the study at Bevon

Job Title	Number of meetings	Role in the company
General manager	1	General management and in charge of the Bevon Auckland site including factory operations
Operations manager	2	In charge of all operational activities including procurement, supply chain, manufacturing, and dispatch
Senior purchasing officer	2	In charge of purchasing and vendor development
IS project manager	2	In charge of SAP and general IT administration

6.2   Company Overview

Bevon, founded in 1967, is one of New Zealand's leading technology companies with offices in New Zealand, North America, Asia, and Europe. Bevon's headquarters, based in Auckland, comprise manufacturing, R&D, and engineering facilities. Bevon is involved in the design and manufacture of electronic products and specializes in supplying customized products for specific market needs in 40 countries. Bevon's products are used in high performance industrial applications such as radio and telecommunication. Bevon is reputed in the electronics industry for supplying reliable products and leads in the development of highly technical components for the telecommunication industries globally. Bevon prides itself for its position in the electronics industry and has developed unique test protocols to achieve high consistency in their product standards. Bevon has recently invested heavily in new research and development facilities.

Bevon's products are designed specifically for every customer. The company works very closely with each customer to design a product that works best for them and it is very unlikely that another customer will use the same product "as-is". Thus, Bevon combines their unique designs and quality-testing expertise with large production volumes.

Bevon has expanded operations to include three major production facilities and fifteen sales offices across four continents. The organization structure of the company is as follows. The head office is based in NZ with fifteen sales offices across Europe, US, China, Taiwan, and other parts in the world. The company has a total strength of about 750 employees. About 250 employees are in the marketing and sales function based in the various sales offices globally. The other 500 employees are located in Auckland in the production and R&D centers.

The materials used in the Bevon products such as integrated circuits (ICs), capacitors, inductors, resistors and the ceramic/resin bases are sourced from overseas vendors in Singapore, China,

and Taiwan in Asia. Whilst most of the production processes operate from Bevon's facilities in NZ, there is some specific processing using specialist technology that is subcontracted from outside suppliers. Bevon orders materials and arranges to send to the subcontractor, who processes and assembles them based upon their specialist technology that Bevon has not invested in.

In 2003, Bevon became a public limited company. Bevon's sales turnover was about $100 million for 2006 and the company's share price has tripled since 2003. Bevon is an ISO 9000 certified company and intends to achieve TS 16949 accreditation to further improve their quality systems. With this accreditation, Bevon will be able to supply their products to the GPS system manufacturers for use in the automobile industry.

The future outlook is very positive for Bevon with many new product and business opportunities. Most of Bevon's customers remain very positive about the company's prospects, although there is some uncertainty in several industry sectors currently as to what impact the looming recession will have. While the Bevon management is cautious about the possibility of a slowdown in telecommunications spending, they recognize ample growth opportunities for Bevon by entering into new markets and enhancing their business share with existing and new products.

6.3   Context

"Context includes the factors that must be present before any specific attempt to utilize ES and transform ES data into knowledge and results" (Davenport, 2000, p. 221). The strategic, organizational and cultural, skills and knowledge, data, and technology constructs that comprise the contextual factors were discussed at length with the Bevon participants and are presented next.

6.3.1   Strategic context

There is an increase in demand for Bevon's products with the increasing use of telecommunication networks and use of GPS systems in automobiles for navigation as well as vehicle fleet tracking. The integration of cellular and telecommunication devices such as personal digital assistants (PDAs) and mobile phones with GPS technology has further enhanced this demand:

> we're seeing a rapid increase in demand for our products and we're committed to improving our market share and retaining our leadership in the technology market. To achieve this we continue to grow our

> manufacturing capacities and enhance our product quality. (general
> manager)

Bevon continues development of their next generation product platforms, the focus being not only on improving the product performance but also on miniaturization of their product size. Bevon strives to maintain and continue its leadership in manufacturing a wide range of electronic products that perform consistently well to the satisfaction of their customers.

Based on a recent government mandate, Bevon expects location-based products and services to become a multi-billion dollar industry. A complete new market segment is expected to be created for this requirement by 2010. All cellular phone manufacturers will include GPS modules in their products and the demand for the GPS receivers is expected to increase dramatically. To meet this market requirement, Bevon has developed new miniaturized devices that support low GPS signal performance:

> we have the first mover benefit since we could foresee the demand… We
> have been able to establish ourselves well in this market. (general
> manager)

Bevon has wanted to achieve an average unit shipment growth of more than 50% since 2004:

> we wanted to re-organize the manufacturing process and marketing
> support to be able to supply our products at competitive prices, also
> secure new customers, and continue to maintain our position as a global
> leader in the technology industry. (general manager)

Bevon management said that they have the advantage of a one year competitive lead due to their technology advances backed by innovation achieving high international manufacturing and quality control standards. To achieve their business goals, Bevon decided to double its production capacity through a major facility expansion plan in 2006. Bevon has already been continuously increasing their production capacity in the past but based on their recent strategic plan they decided to double their capacity in the manufacturing area. However, after all this expansion, Bevon still continues to lag in fulfilling the ever growing customer demand. Due to the shortfall in capacity, Bevon also procures ready made devices from external Asian sources.

Several key investments were made by Bevon during the 2008 financial year, both to increase their productivity as well as position themselves for long-term growth. Bevon has commissioned a new test system in their factory designed to enhance the capacity of their earlier system. The new system provides a significant increase in production output together with their existing test systems, which remain an essential part of their manufacturing facility. The new

system is integral to Bevon's strategy of maintaining their market position in the electronics industry as that market continues to expand.

Bevon has also increased their global sales and business development teams in the 2007-08 periods. One of the company's main strengths is their ability to recognize their markets' future requirements by associating with their customers, and to make investments where necessary to capture new opportunities. Bevon's business expansion implies that in order to continue operations they require more competent staff, closer to their markets:

> our sales and R&D engineers work closely with our customers' to ensure
> that we understand their requirements... our development teams continue
> to refine our products and create new innovations so that we can compete
> in the global markets. We continue to develop revised variants of our
> current designs, with improved functionality at lower prices, as part of our
> strategic plan. (general manager)

To be able to market products at more competitive prices, Bevon wanted to implement methods for controlling costs, integrate their finance and manufacturing processes, and achieve higher efficiencies in their operations:

> we historically lacked integration between our finance and the
> manufacturing systems with lack of coordination between our order-
> intake, order-execution, and accounts receivable processes. We had limited
> visibility into information such as product costs and customer pricing.
> There were disagreements on the pricing structures and cost information
> of the products which were not very transparent and accurate. (operations
> manager)

Bevon did not have the ability to access data for decision support at the various stages of operations. The process for forecasting sales of products also required a re-look to build accuracy in the planning process:

> historically, the manufacturing capacity has always been a constraint with
> us and we could never predict a shortage of the line capacity until the
> capacity ran out. (operations manager)

The management was also not very well-informed as to whether the procurement of parts was being executed efficiently and cost-effectively. Since Bevon's products were highly customized, the company needed to interact with its customers throughout the product development process to avoid failures in the later stages of development. The research and development systems in

Bevon lacked integration with the manufacturing processes, thus the time lag between the new product introduction and production ramp-up after the market launch was large. Bevon realized that with the shortening product lifecycles, the time for rolling out new products to the market had to be reduced to remain competitive.

The management team recognized the constraints Bevon faced to support their strategic objectives but did not have the ability to utilize the operational data for improvements. The situation changed with the implementation of mySAP in 2004. Bevon developed and gained the visibility into its operations and customer base. Bevon could now extract and analyze information to support business decisions for achieving their strategic goals.

6.3.2   Organizational and cultural context

At Bevon, the production areas have been organized into process-related teams with deployment of Total Quality Management[6] (TQM) throughout the organization. Employee involvement is encouraged in all areas of the business. The company has adopted a quality framework for achieving business excellence based on the Malcolm Baldrige award[7] criteria which encourages employees to excel in their specific areas of business:

> our commitment towards TQM and adherence to the quality standards has led us to achieve the high quality and success of our products. (general manager)

Bevon has implemented a global support system, using the Internet to respond immediately to product sales queries, service requirements, and customer feedback. Bevon is reputed for being easily accessible and providing timely and knowledge-based service to their customers. Bevon has been able to secure business agreements with several top global organizations through its customer-focused approach, technological advances, and sales network, supporting their customer's ability to supply products to the market:

> building customer relationships has been an important aspect to our company's culture. This has been very helpful to our business. We enjoy a long-term close relationship with many of our top customers. (operations manager)

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[6] Total Quality Management (TQM) is a process of establishing quality in an organization "with the purpose of making continuous improvements" and delivering better products (Koenig, 2007, p. 517).

[7] The Malcolm Baldrige National Quality Award, given by the United States National Institute of Standards and Technology, evaluates the Baldrige Criteria for performance excellence. This has been used by many organizations to "improve organizational performance practices, capabilities, and results" (Quinn, Faerman, Thompson, McGrath & Clair, 2007, p. 137).

Bevon has developed an honest and amicable work culture within the company. Bevon enjoys the advantage of having highly qualified and motivated employees. The company provides a harmonious, synergistic, and friendly working environment to its people at all levels with excellent in-house facilities. The communication is open, congenial, and interactive at all levels. The company considers its employees as important assets:

> in the past, our people had been keen for a change. They did not really like the old legacy system and wanted a new system that was more collaborative, with the ability to integrate all the business functions, and provide real-time information for the running of the business. We implemented SAP in 2004... In the process of SAP implementation, we aligned our organizational functions to support the use of the new system. (general manager)

The findings suggest that Bevon employees expected a lot more from their SAP system. They expected to be able to get many customized reports or create their own as and when required. "They wanted all the information in their fashion at their finger-tips which has been a shortcoming."

However, the global team is working well together at Bevon utilizing the SAP information and building a strong culture of "profit-focused innovation" keeping the company ahead of the competition. With the SAP support, the NZ operations team has been able to manage with a much increase in demand while maintaining their reputed quality.

6.3.3 Skills and knowledge context

Bevon has highly qualified and technically skilled staff in areas of engineering, research and development, quality assurance, manufacturing, and commercial functions. All new staff who join Bevon undergo a comprehensive induction training program that includes training in their functional areas. The training is generally imparted by the concerned functional departments:

> all the functions already have their procedures documented since we are an ISO 9000 certified company so when a new person comes to the job the induction and the functional training is easily taken care of. SAP is the only tool that requires specialized training to enable the new employees to start using it. There are some instances where we use our IT team to train a new person, especially when the new person joins at a senior level. Otherwise, generally the individual departments do the training. (operations manager)

Bevon also provides extensive training both in-house and externally to their employees as and when required. The workforce at Bevon has the skills and capabilities to adopt and execute advanced manufacturing techniques using the latest technologies and machine tools. Bevon uses statistical process control[8] (SPC) methods such as failure mode effect analyses[9] (FMEA), and process controlling charts[10] to control their manufacturing processes. With the view to provide Six Sigma[11] training for process engineering staff, Bevon are evaluating programs at Motorola University in the US.

The SAP specialists within Bevon have undergone extensive training to possess comprehensive operating skills in the various functional modules installed in the company. They further support and train end-users on the usage of different analytic, reporting, and data presentation tools. They possess the analytical knowledge to interpret the SAP data based upon the company's underpinning business processes. To Bevon's advantage, none of the original SAP implementation team members have left the company in the last four years. So the core of SAP knowledge as well as the technical expertise of the staff has been retained within the organization.

6.3.4 Data context

The transactional data captured in the SAP system are current and accurate based on the internal transactions recorded, from sales orders to shipping invoices:

> this is one of the beauties of SAP. Every thing is got to be done right
> otherwise you can't do the transaction. For example, at the time of booking
> out stock if the transaction makes the stock go negative, it won't let you do
> it. So, from a data quality point of view it's great and people have faith in
> the data. (IS project manager)

Updating and monitoring of data is a routine activity at Bevon. The transactional data and data extracts are made available easily and in a timely fashion to support decision making. The SAP system provides the ability to drill down information, change data views with grids, graphs and charts, send alerts or warnings, and analyze data to create meaningful information.

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[8] Statistical Process Control (SPC) is a method of monitoring process variability.

[9] Failure Mode and Effect Analysis (FMEA) is a process for "mistake-proofing" and evaluating potential failure modes (Koenig, 2007, p. 421).

[10] Control chart is a tool used to determine the process variation limits and "then monitoring the process to determine when it is nonrandom" (Koenig, 2007, p. 280).

[11] Six Sigma is a management approach "using statistics and probability theory to reach a zero defect state in the manufacturing process" (Koenig, 2007, p. 516).

6.3.5   Technology context

Previously Bevon used an in-house developed legacy system which was not properly integrated and could not be utilized efficiently. There were two distinct parts of the legacy system. One was the financial system that served the finance area and the other was the manufacturing system for the rest of the business including the factory. These two separate systems communicated once a month by a flat file[12] that came from the manufacturing system and was merged into the financial system. But the integration between the two systems was not adequate and the company had issues around costing of products:

> the product details were available in our manufacturing system but the
> cost information resided in the financial system. The old system was text
> based. It did not have the MS Windows environment nor could it use a
> mouse as user interface. It would have cost the company a reasonable
> amount of money to upgrade all of that. (IS project manager)

Bevon decided to get an off-the-shelf package to resolve these issues. SAP was the choice since it was reputed as being a system for the future:

> since the SAP brand had become a world leader in business software,
> serving more than 20,000 customers worldwide. (IS project manager)

With the implementation of mySAP on April 1st 2004, Bevon's situation with data availability for establishing business decisions changed. mySAP is a software system comprising of SAP R/3 4.7 which provides functions for corporate services, operations, human resource management, financials, analytics, and self-services. mySAP also provides management support for systems maintenance such as Web services management, centralized data management, configuration management, and user administration. The system had substantial functionality that Bevon was not necessarily going to use straightaway but may be useful later as the company grew. At that time, the strategy of SAP was to get into as many small-to-medium-sized businesses as possible and so the mySAP package was priced very competitively. The investment for Bevon was around half a million in terms of the software licenses and the implementation:

> what we saw was the best we could get and decided to go for it. The
> business partner selected for implementation was Soltius who
> implemented all of the systems and modules. (IS project manager)

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[12] A simple unformatted data-file or spreadsheet.

When Bevon went live with SAP in 2004, the company had bought 50 user licenses, which have now been extended to 130 at the Auckland site. The implementation is single instance multi-site. The main SAP software is implemented at the Auckland site, however the system is extended and connected to the regional offices including sales and distribution centers at Taiwan, UK, and the US. As the system is Web-based, users can log-in from any remote location through an Internet connection and use the system.

The initial implementation of SAP at Bevon was completed in two phases. Phase 1 was finance, materials management, and sales and distribution. Phase 2 was production execution, production planning, and product classification. Bevon went live with phase 1 in April 2004, and with phase 2 in August 2005. Phases 1 and 2 have given Bevon powerful tools to plan and control their production facilities, which in turn have allowed Bevon to run more efficiently and reliably. Bevon has just recently gone through and completed the process of upgrading to the latest version from R3 4.7 to ECC 6.0:

> we decided to go for a three-tier system so that the product development, product quality and test, and the production function from the technology standpoint are all working together coherently. (IS project manager)

Bevon is now focusing on extended applications of SAP such as customer relationship management (CRM), business data warehouse, and Web services. These applications specifically improve organizational collaboration and business analytics. Bevon has yet not integrated the system with external suppliers or customers. They are also not using EDI or any other tools for data exchange. The entire communication with customers and suppliers is done via email. Bevon has still not permitted their customers to enter into their system to transact or view information. The customers send separate purchase orders that are entered into the system from the Auckland office. However, some customers have requested Bevon to incorporate the facility that allows them to enter Bevon's system to view the progress of their orders. The possibility for creating this capability will be investigated by Bevon in the near future.

Bevon implemented SAP business data warehouse (BW) in 2005. The original implementation was BW version 3.5. This has recently been upgraded to business intelligence (BI) version 7.0. The reason Bevon implemented BW3.5 in the first place was:

> the company had a requirement to forecast sales and needed to store the forecast information somewhere. Our IT specialists recommended that the BW was the place to store because the information could then be extracted into the R3 environment. (IS project manager)

This status remained so for quite some time until recently the company decided to upgrade to BI7, as this would enable them to create more reports from the available data leading to better accuracy in the sales forecasts. But Bevon has not been able to use the BW or BI to its full capability. The reason cited by the IS project manager is that the BI system is rather cumbersome to set up. This is not what they had anticipated. However, the system administration at Bevon is still committed to utilizing the BI module:

> very little initiative has been taken towards utilizing this functionality which has been quite disappointing. The reports from this module take a long time to create and cost a lot of money due to the labor hours required for setting it up…. although, to be able to create reports, was the reason why we had upgraded to BI7 in the first place. (IS project manager)

Whilst Bevon is on the latest BI platform, their existing functionalities are not fully operative, or at least not to the extent they want.

The respondent explained that SAP has not been able to provide the flexibility which users want around reporting. The day-to-day functions run well through SAP. For example, if a dispatch person wants to know the dispatch requirements for the day, the system provides this standard information through regular reports. But, if some specific information or a report is required to answer a specific question, such as commissions paid, or not paid, for a month specific to the business process of Bevon, that is difficult to get. Custom reports are required for specific requirements and generally such reports cost ten to twenty thousand dollars each:

> for a company of our size this is a ridiculous amount of money to pay. If we agree to pay for every such report that people ask it will cost us millions. (IS project manager)

The respondent expressed concern that this issue will not get resolved even after Bevon starts using the BI7, at least not in entirety. The reason is that such reports require transactional data, but the present SAP BI architecture is not fully integrated to the main R/3 environment, therefore it is not possible to drill into the R/3 transactional database. The respondent explained that the SAP BI module combined with Business Objects (BO) will provide the solution:

> SAP has now acquired BO and their latest BI module has enhanced functionality which enables drill down to the database layer. But until the BI module is upgraded at Bevon, it is just not cost effective to create ad-hoc reports. The current BI is definitely better than BW, but it is still cumbersome to use and requires further enhancement. (IS project manager)

6.4   Transformation

The transformation process at Bevon is the result of utilizing the knowledge-based activities:

> we have implemented KPI reporting in which the organizational objectives have been categorized into functional goals and deliverables. These deliverables are benchmarked against the targets the company has set to achieve. We review the departmental goals each month by measuring and monitoring the KPIs. The ES data extracted from the standard and custom SAP reports, and also through BI tools is compiled and presented in the KPI reports. Review meetings by executive management team are held on a monthly basis. Based on the results of the KPI performance, decisions are taken for further actions. (operations manager)

The processes for converting ES data into knowledge and the utilization of knowledge for decision making to achieve results were topics discussed in detail with the Bevon respondents. The findings are presented next.

6.4.1   ES data transformation into knowledge

Knowledge creation from ES data is an on-going process that happens almost all the time at Bevon. The ES data are transformed into knowledge by collecting, analyzing, and interpreting real-time SAP information in all the different functions and processes that are SAP supported. This happens through the use of various reports, forms, queries, and some other SAP functionality such as information in the data warehouse based on user requirements.

In some knowledge creation requirements a different method for SAP data transformation is utilized in Bevon instead of using a standard SAP report. The SAP data output is directly transferred into a structured query language[13] (SQL) database, which can be manipulated, and viewed using an Excel spreadsheet. Bevon uses several SQL structures for knowledge creation:

> with this method it is possible to generate information by making SQL queries to exactly match the business operational data. The users can have graphs, pivot tables, and many other user-friendly data manipulation facilities in Excel that are more flexible and useful than a standard ABAP report from the SAP system. (IS project manager)

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[13] Structured query language (SQL) is a data access standard that enables users to "create database and table structures, perform various types of data manipulation and data administration, and query the database to extract useful information" (Rob, Coronel, & Crockett, 2008, p. 292).

The IS project manager further elaborated upon the steps involved in this process of data extraction:

> first, through a basic program in SAP, the ES data are extracted most of the times – a table at a time, looking at what the actual output requirement is. The tables are then joined and based on some filter such as the date range or any other requirement, the output is then transferred into a SQL database. Then using open database connectivity[14] [ODBC] the information is outputted into an Excel spreadsheet.

Bevon is still not using BI7 functionality for extracting reports because the BI tools, as explained earlier by the respondent, are "non-transactional". The IT team at Bevon believes that the transactional data cannot be brought directly into BI system because of the way SAP BI is designed:

> that would swamp the BI tool with data. The transactional data are transferred by running some summary type programs so that only summaries of the data are built that can be used for reporting. The SQL database is used to do the number crunching to get the transactional data into a summarized cube which can then be sliced and diced any way required for reporting on any of the fields very quickly because the summary is already created. (IS project manager)

Bevon finds this method more powerful than the use of the BI functionality from the data transformation point of view. But if there is a need to view the production order or sales order the information came from, that is not possible because summary data are used and there are no drill down capabilities:

> although the current version of SAP BI is not effective, when the company upgrades to Business Objects, which is more powerful, the system will be able to handle transactional data. That will be beneficial for knowledge-building and will be used in addition to just the standard ABAP custom reports. (IS project manager)

There are many standard reports within SAP which Bevon uses and finds very useful. The respondent suggested that in most cases the business functions use the standard business processes that are set up in SAP to perform their tasks. Most of the time the Bevon users do not actually need anything more than what the system provides:

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[14] Open Database Connectivity (ODBC) "allows any Windows application to access relational data sources, using SQL via a standard application programming interface" (Rob et al., 2008, p. 764).

the standard reports that come along with the system are designed to
provide the information required for the business. (IS project manager)

In some cases the users may have a need for customization, which Bevon has restrained from
doing. This is an issue at Bevon "because of the costs involved in customization and the
future upgrade problems". However, there are some customized reports that Bevon has paid
for which "were just necessary to the business". Bevon has developed some internal
capability within the organization to make changes to reports as well. Bevon has one software
programmer from their old system trained in ABAP which is the programming language used in
the SAP software, but the users are encouraged to use the standard inbuilt SAP reports instead
of having new customized reports developed:

although the reports within SAP are generic, these could be configured to
what the user wants to see. For example, in our production order report,
the production planners can view orders of different product groups from
different production lines. The report can show details of all production
orders for that particular product group. These reports are also
configurable to the different functions so that each department has their
own variant of the same report. All they have to do is select that variant
which will provide the information for their specific use. (IS project
manager)

There are many such generic reports within the SAP system which provide good information
and are in regular use. Some examples of these reports are the aging analysis report for
inventory and accounts payables/receivables, and the activity-based costing reports used in
manufacturing, finance, and new product development.

6.4.2   Utilization of knowledge for decision making to achieve benefits

Bevon uses KPI reporting and benchmarking methods for utilizing knowledge for decision
making. The Bevon management has benchmarked KPIs for functional areas they want to
monitor each month, against set targets. The drivers that create value for each functional area
are identified and defined in detail as KPIs. These are set as targets for each month and the
actual performance is measured for determining the affectivity of the organizational strategy.

Top-level metrics are reviewed by identifying, extracting, and interpreting the SAP data for
each indicator to monitor improvements in realization of business strategies. Decision making is
supported by analyzing and evaluating the performance of each indicator. The information for
measuring and monitoring the KPIs is collected from the SAP system. Bevon calls this process
KPI reporting and finds such monitoring of actual processes very useful for identifying areas

where they are doing well and also those that need more attention. This helps Bevon take timely actions supported by critical business decisions, backed up with high-quality and well-analyzed ES data:

> today there is a growing requirement for more business monitoring which creates more data which in turn presents the opportunity for greater knowledge. (operations manager)

Although the data for the KPI reporting are gathered through the SAP system, Bevon does not have the KPI reports extracted directly from SAP through automated KPI processing such as a portal. This is something that the SAP system can support as per the IS project manager and Bevon would like to have such a process in the future:

> we use the standard SAP business analytics and reporting tools to create the KPI and benchmarking reports for our operational functions on a monthly basis. The data are collected, manipulated, and the business performance report is put together each month for the review of the executive management team. The business KPIs are also monitored through trend analysis using graphical representations. These reports get passed off from the middle management to the top and supports organizational decision making. (IS project manager)

Many of these reports are transferred into Excel spreadsheets to facilitate analytical processes. Business decisions are based on the analyzed SAP data and a number of other factors.

The IS manager noted that Bevon has not established the use of a balanced scorecard, or a dashboard, as a performance measuring technique through their SAP system:

> we're currently looking at having Business Objects which is the latest acquisition by SAP as our next BI upgrade. With the use of Business Objects it will become a lot easier for us to develop balanced scorecards and dashboards for tracking our business performance.

The regular financial reports which are part of the executive team function are also reviewed for decision making. Bevon uses standard sales reports that provide information on the average cost of the product and the profitability on each product. A few key improvement areas where SAP data are utilized for decision making include sales forecasting and operations planning analysis, raw material cost analysis, inventory analysis, customer and product profitability analysis, and delivery performance analysis.

In conclusion, by utilizing the integrated SAP business solutions, Bevon has been able to make vital data available on a timely basis, use the information to improve operational efficiencies, and facilitate better decision making for achieving targets. Moving forward, SAP will be utilized for achieving greater business efficiencies through a more scalable, open, and cohesive integrated system.

6.5   Outcomes

"Converting transaction data from ES to knowledge is only effective if it produces business outcomes" (Davenport, 2000, p. 234). The outcomes as a result of the transformation process from the utilization of the ES and its information at Bevon were discussed with the Bevon participants. The findings are presented next.

6.5.1   Changing behaviors

One of the major outcomes from the SAP implementation at Bevon has been changing behaviors and attitudes. First, an immediate improvement in behaviors of employees resulted from much better availability, visibility, and accuracy of information through the automated processes:

> the inter-personal and business relations with customers and suppliers
> has improved as a result of the openness, transparency of information,
> and collaboration between all stakeholders. (operations manager)

The earlier sudden demand changes by customers reduced as a result of real-time visibility and sharing of information through the integrated SAP system. Similarly, the requirement forecasts throughout the supply chain improved. This resulted in improved customer and supplier relationships and more streamlined supplies since Bevon was able to be more flexible and could respond better to change orders now in the manufacturing environment. Bevon has been able to synchronize prices and improve collaboration with customers and suppliers with fast access to purchase order, sales, and invoice information. There has been a significant reduction in earlier disputes on purchase orders and invoices relating to prices and terms of business with improved communication. This has resulted in major behavioral changes within suppliers and customers achieving new levels of trust in business relations.

6.5.2   New initiatives

Bevon has been able to implement several new initiatives with the ability to use data and the SAP functionalities to achieve their business objectives.

The use of barcode labels on dispatch boxes has been introduced as a new initiative. The barcode labels designed by Bevon's customers are printed and put on the packaging boxes by Bevon's dispatch personnel through the SAP system:

> the scanning and label printing is generated through SAP. With this application the customers can transfer stock into their warehouses efficiently and accurately. It has become easy for customers to scan the boxes in. (operations manager)

Another new and major initiative for Bevon has been the improvement to their product costing:

> not knowing what the products cost was a big pain for the company. Now we know the cost of our products and we continue to improve it. The ability to be able to cost products has led to another new initiative of value engineering. (operations manager)

The design engineers at Bevon now strive to improve and modify designs by using more cost effective parts to make the products more profitable. Unprofitable products are identified and evaluated to either revise existing designs or to develop a new and more profitable variant.

Yet another new initiative has been towards implementing Six Sigma projects in areas critical to the organization. As a result of the Six Sigma initiatives utilizing the SAP data and the Six Sigma principles, several critical focus areas for Bevon are improved such as delivery performance, first-time pass yields, inventory control, warranty costs, purchase costs, and direct factory contribution.

With the ability to analyze demand, Bevon has incorporated several changes into its demand planning process. Bevon has been able to analyze and classify its different product families based on the market segmentation, and determine their product demand. Monthly sales and operations planning reviews have been initiated by Bevon for a formal assessment of their demand versus supply program. Constraints in material and production are discussed, specific customer needs are considered, and availability of stock both locally and at regions are factored into plans.

The initiatives in the order receipt, planning, and execution processes have led to improved customer services at Bevon. With the ability to accurately confirm deliveries and due dates to customers, on-time deliveries to customers have improved. According to the operations manager, as the business grows, SAP supports business growth in all the functions:

the system consolidates the data and provides information in each of the areas of business. Since the company has many products with many different parts, to configure and have real-time information for every part and be able to achieve production efficiencies was the reason for the implementation. And, we have been able to achieve this.

6.5.3   Process changes

There have been several process changes in different business functions at Bevon as a result of the SAP implementation and ES data transformation.

6.5.3.1   *Sales, distribution, and customer services*

Over the past few years Bevon has achieved an impressive average unit-shipment growth of more than 50% per annum. Bevon has supplied quality products at very competitive prices by improving their manufacturing process and automating marketing support processes.

The most important process change implemented at Bevon is the integration of finance with the rest of the business. This was a major requirement of the company and one of the basic reasons for implementation of SAP. This change has enabled Bevon to have sales and customer-related data in a single database which could be drilled down to the transaction level:

> with the integration of company's financials, Auckland warehouse stocks, subsidiary stocks, and the receivables information, we now have an instant overall view of the real exceptions such as receivables exceeding a month's stock. (operations manager)

The system has built-in alarms on stock piling, depletion, and provides aging information at the distribution center warehouses.

Bevon has some old customers whom the company has been serving for many years and Bevon intends to retain business with these customers by improving services including response time, supplying on-time, and providing better after-sales support. Based on the customers' past requirements, future plans, and the current open orders in the SAP system, the sales and operations planning team can plan and forecast accurate requirements:

> they have the required knowledge about the availability of products – what is available in the factory, when can the factory produce more, and what is the spare capacity available – so that they can commit accurate deliveries to customers. SAP has been beneficial to us in all of these areas. (operations manager)

Furthermore, the SAP system has features for analyzing market trends by product/product-group and by division/sales-region that helps Bevon decide on future sales strategies. By utilizing the integrated SAP solution, Bevon management has immediate access to vital data which can be analyzed to improve business efficiencies and practices.

6.5.3.2   *Planning*

Since the implementation of SAP, the planning function has become more streamlined with better visibility into the past, present, and future forecasted demand from customers. Powered with this information Bevon plans materials, production capacities, and shop-floor manpower through the integrated SAP system to meet the demand:

> SAP runs the MRP process each night reviewing the latest product
> demand, stock on-hand and in the pipe, availability of production
> capacities and resources, providing an optimum plan for manufacturing.
> Based on this information the buyers release purchase orders to the
> vendors wherever required. (operations manager)

According to the respondent, there are features in SAP for simulating constraint-based production planning scenarios which are essentially useful for finalizing the monthly production plan and gearing up to achieve it. After the system finishes planning all the demands as per the order priority, it performs a second time-phased planning run. This provides the ability to view specific items and compare the on-hand quantity with its expected usage over time, showing details of expected transactions based on the demand. The system prompts actions with exception messages such as "On Hand Below Safety Stock".

Bevon has been able to set up many spreadsheet-based processes through SAP. For example, the MRP information is transferred into Excel spreadsheets and used by the planners and buyers for further manipulation and action. This information enables visibility into the in-house manufacturing and bought-out requirements for Bevon, prompting job order and purchase order release reports. The MRP runs overnight at Bevon, but if there is a known change in requirements the planners run MRP during the day as well:

> if done for one product takes no time at all, but if done for the whole
> database it takes about ten minutes which is not too much for the size of
> Bevon. After the run, we are ready for action based on the latest
> information. (operations manager)

6.5.3.3 *Purchasing*

The Bevon Purchasing staff run many different types of SAP reports for managing the procurement functions that have improved internal processes. For example, as explained by the senior purchasing officer in Bevon, one of the features in SAP provides information on vendor quality. The buyers in Purchasing extract a report on supplies from individual vendors that informs how many "lots" of material have been received in the past one or two years and what has been the basis for acceptance or rejection of the parts:

> such information helps to understand the reliability of the suppliers and decide on their future share of business. (senior purchasing officer)

Bevon procures most of the parts from Asia, with many of their subcontractors based in that region. Although Bevon has their own manufacturing based in Auckland they also have augmented their manufacturing capacity with subcontractors located in the Philippines, Thailand, and other parts of Asia. Bevon supplies material to these subcontractors for processing, or sometimes gets their vendors to supply parts directly to the subcontractors depending on geographical proximity. All of these transactions are recorded in Bevon's SAP system, managed from Auckland. Therefore, Bevon has the information on the parts inventory with their subcontractors. Bevon procurement staff collates the requirements of parts by various subcontractors at different locations to generate a cumulative demand for better management:

> the buyers assess where the parts are expected to be consumed first and whether it is possible to divert some stock from one location to another optimizing inventory. (senior purchasing officer)

Bevon has not permitted the subcontractors to log into their SAP system for any transactional data so far and the day-to-day operations with subcontractors are managed by Bevon themselves through their SAP system.

Another example of purchasing process change cited by the senior purchasing officer was the process to review the terms and conditions of business with vendors for further negotiations and improvement as an ongoing activity:

> from the materials management module in SAP, our operations team extract information on all of the suppliers and their different payment terms to review, for example, how many of our suppliers are on advance payment terms where we have to pay upfront before we receive material or with how many suppliers we enjoy a credit of a month or two. (senior purchasing officer)

The operations team evaluates a vendor's frequency of supply, that is, whether the vendor is a regular supplier or a one time slow-moving supplier, from the SAP database. The vendor evaluation process allows the purchasing team to see the vendor's status on their delivery performance, supply quality, and price effectiveness. It had not been possible for Bevon to conduct a comprehensive vendor evaluation before SAP implementation. Now the purchasing team can proactively chase vendors to give supplies that are over the due date.

Another process improvement, as an example cited by the respondent, was the process of receiving order acknowledgements from vendors based on the purchase orders sent. If Bevon does not receive an acknowledgement or confirmation within a week, then the system informs the buyers about the orders that have not been acknowledged so far and from which vendors:

> this information is really useful to the purchasing team to identify the
> pending order confirmation from suppliers for their further follow up.
> (senior purchasing officer)

The operations manager stated that there have been several improvements in their supply chain functions. For example, Bevon being in the business of manufacturing electronic devices, at the same time also manufactures testing equipment used in testing of their products. This testing equipment is of high value and recently there was one big project in which some panels were required to be sourced for eleven multi-chamber testing machines. Initially, the purchasing did not have any data or sourcing information to base their procurement actions on, because this was a first time buy of the testing machine. But with SAP and its bill-of-materials functionality, it became possible for Bevon to create the BOM quickly for the testing machine. With the BOM in place, all the requirements for the new testing equipment, including the quantity of parts, their specifications and sourcing details, became available to the buyers for action:

> now in future, if there are any further requirements for spares or
> additional testing equipments, we will have all the relevant data such as
> the vendors' details, the manufacturers' names and brands, specifications,
> type numbers, prices, and all the required information already available in
> SAP for immediate actions. This now becomes good historical information
> in the data repository for future use. These are the advantages of the SAP
> system. (senior purchasing officer)

Some other purchasing process improvements are in the areas of vendor master creation and maintenance, purchasing item data creation and maintenance, vendor/item cross reference including unit price maintenance, and purchase order creation, its approval, release, and maintenance. The purchasing team regularly performs purchase order analysis by product

group, buyer code, date, and vendor, to evaluate the vendor ordering pattern and examine the pending open orders, its reasons, and possible impacts. This helps in establishing decisions to streamline material flow and avoid out-of-inventory events for both inventory and non-inventory items.

6.5.3.4 Inventory management

The inventory management process changes at Bevon include improvements in the inwards goods receiving and quality assurance processes with better warehouse stock control, picking, and management processes. With the implementation of SAP, best business practices related to inwards goods and warehousing processes have been introduced in Bevon. These processes have enabled swift and accurate receipt of materials, efficient storage in the warehouse including first-in first-out (FIFO) process for shelf-life items, just-in-time parts supply to the factory for processing, and on-time dispatch of the finished goods to customers. The SAP system has built-in checks to avoid any data entry errors, triggering rule-based alerts such as transactions leading to a negative stock, and creating transactional records that could easily track stock movements for traceability.

Bevon staff can now track inventory within the various company stock locations such as inwards goods, distribution warehouses, and production shops through the SAP system. The raw material inventory is tracked by lot numbers and finished goods by serial numbers. After the goods are dispatched to the customer, the in-transit movement of the finished goods is tracked by serial numbers until the goods reach the final destination:

> with such controls in place, the accuracy of stock and visibility to all stakeholders has improved dramatically. In case of any shipment errors or product quality issues, the transactions are traced back to explore and resolve discrepancies and identify the production job the lot relates to. We have also established the process of regular cycle counts in the warehouse to improve the accuracy of on-hand stock. (operations manager)

The above controls through SAP, have led to improving inventory reliability and traceability in the main warehouse, production lines, work-in-progress, with subcontractors, and the finished goods warehouse. Bevon has been able to further reduce inventories with the implementation of the just-in-time[15] (JIT) inventory system:

> the raw material inventories range used to be 30-40 days and finished goods 15-20 days at material cost. Notwithstanding the tight inventories, a

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[15] Just-in-Time (JIT) is a management strategy that avoids any inventory build up "resulting in elimination of waste" (Koenig, 2007, 512).

further reduction of 5 days each in both has been achieved at material cost
that has translated into $100,000 per annum saving in the interest cost on
account of Auckland operations. (operations manager)

Based on some customers' request, Bevon has implemented a vendor-managed inventory (VMI)
system at their customers' end. In this program, Bevon stocks and holds inventory of their
products in their customers' warehouse but are paid only when the stock is consumed by the
customer. It is in Bevon's interest to monitor and replenish the inventories optimally so that the
stock quantities are just right to avoid both out-of-inventory and over-stocking situations:

the VMI program is managed very efficiently and effectively through the
SAP system by our operations team. (operations manager)

6.5.3.5   *Manufacturing*

The most effective change in the manufacturing environment for Bevon is the improved agility
to respond to any demand changes in the dynamic market place. Despite Bevon's close
monitoring with customers through regular reviews and demand planning, frequent changes to
the demand pattern occur that are unforeseen based on the market conditions:

in the event of a sudden increase or decrease in demand or revision in
product shipment dates from customers it is expected that we should be
able to respond to such changes positively and effectively. SAP has
provided us the flexibility to handle such changes. The system responds
with exception messages and reports on the actions that are required to be
taken to meet the revised plan. It highlights areas for purchase order
adjustments or changes to the manufacturing plans and schedules to the
factory. (operations manager)

The ability to respond to changes with improved flow of materials, shop floor scheduling, and
availability of resources, has enabled Bevon to achieve improvement in production staff
productivity. It is estimated that Bevon has been able to achieve up to 10% higher labor
productivity valued in practical terms of temporary labor deployment avoidance implied at a
saving of about $50,000 per annum, according to their operations manager.

With up-to-date and reliable costing available through SAP, Bevon is able to monitor and
enhance the factory contribution by reducing the non-value adding costs such as "reducing set
up, change-over, transportation, and material down times", and focusing on "doing right
the first time". The operations manager confirmed that there has been a "real" improvement in
the quality of information that the production line staff now receive to make product:

they get a traveler [kanban] card set out from SAP which has all the relevant information about the job order. This has been a real advantage. Another advantage has been that the production staff is now able to track the products through all of the manufacturing sections, whereas earlier all the production staff knew was the start of the production, that it was started, and then knew that it was finished. There were many processes in the middle that the manufacturing staff had no idea where the production was at, and it was just like a black hole. This was basically because of the poor system support and visibility earlier. Now we have a full bill-of-materials structure, so the production staff gets a production order for every sub-product or semi-finished product and they know exactly where it is along the process. It is now the same people in the production line who confirm that they have done their job. The visibility and information flow within the operations has really improved. This situation is much better now than it was earlier, and that is a big achievement. (operations manager)

The operations manager further noted that SAP provides valuable information to the production planners such as open vendor purchase order details for individual items with expected arrival dates. Such visibility assists planners to finalize build plans for manufacturing products. The system also provides material availability information of products, showing items available and out-of-inventory items based on the quantities entered for one or more products:

> these reports highlight on-hand stock, quantity required and short, procurement lead times, and any open purchase orders on vendors with due dates for the items required in the build. This information is then used to procure the short items expeditiously and investigate the reasons for the out-of-inventory situations to avoid recurrence in the future. (operations manager)

SAP also provides the "reject" information from the production line. Production orders are reviewed for specific operations to examine the number of units lost in that operation and its reason:

> the data analyses helps in gaining insights into the organization's biggest reject rate and its reasons, based on which actions are taken. Quality related real-time alarms are triggered by the system, rather than just providing an 'MIS' report, which is a proactive rather than reactive response, reducing quality costs. (operations manager)

The introduction of a built-in process sheet system with multiple routings, integrated with the production planning process facilitates execution of production jobs by the manufacturing staff as per production plan. Bevon is now able to maintain different versions of production plan in the SAP system and activate the most suitable by a single command:

> the capacity planning process has improved through SAP, showing peaks and troughs over time with instant graphical representations. The system also provides an automated and optimized capacity improvement solution leveling out the graph with revised capacity plans. Graphical visual representations are displayed at the end of the production lines for monitoring production with information such as produced so far, line rejections, hourly updated target, and production asking rates. All of this helps us get an immediate view of tasks on hand. (operations manager)

The facilities maintenance system through SAP configures scheduling and monitoring of plant preventive maintenance, jigs and tools reconditioning, and gauges recalibration which are linked directly to production. The system is used for machine performance analysis by date, by department, and by work centre to achieve and maintain accuracy and quality of the products being manufactured in the factory.

In the second phase of implementation at Bevon, a "production optimizer" module has been added as a bolt-on to the SAP system for constraints-based dynamic machine loading:

> this module is especially useful for scheduling and loading SMT [surface-mount technology] machines for manufacturing PCBs [printed circuit boards], improving utilization, productivity, and execution of plan in the factory. With this process change, our order-to-invoice time has reduced from 3 months to 6 weeks. (operations manager)

The company has recently introduced the use of a barcode system, a functionality that SAP supports, for correct and efficient tracking/picking of goods through the widespread use of barcode scanners in the factory.

Bevon has been able to supply highly advanced, reliable, and customized products meeting the customer specifications at competitive prices by improving their manufacturing processes and automating marketing support.

6.5.3.6   *Dispatch*

The shipping and dispatch processes have become streamlined with the integrated information after the introduction of SAP:

the dispatch staff now understands the shipping priorities and has the visibility on the goods available for shipping. They can proactively plan and execute the picking and shipping function as opposed to earlier having to wait for products to come in and then finding out where these were to ship. The dispatch team now optimizes the product packaging with weight/volume considerations and consolidates destinations. This has improved the manpower utilization as well as achieved cost savings in the dispatch area that the company has been looking for. This has also made the management with freight forwarders easier as all the information and documentation is timely available for the shipping companies to arrange consignment pick-ups. The customer invoicing process has improved with the elimination of earlier errors such as mismatch in the physical dispatch quantity or serial numbers in the invoice data, bringing accuracy in the shipment and invoicing process. The transmission of the shipment information to the customers has become a very simple process providing the speed and visibility that the customers wanted. (operations manager)

6.5.3.7 *Finance*

The most significant change for Bevon was the integration of the finance function with the rest of the business:

at the financial month end, accounts closing used to take weeks if not months to finalize earlier. With the new processes and as a result of SAP, it now takes 2 to 3 days. Any delay beyond that is a calculated business decision, not system limitation. (IS project manager)

Another area of improvement is the material costing. Earlier, Bevon could not work out the material costs due to the financial and the manufacturing systems being separate. With the new system, the finance and manufacturing processes are integrated and the operational team now understands what their costs are. Bevon is now working towards further improving the accuracy with regular "roll-overs" of their cost data with periodic procurement updates.

Yet another example cited by the IS project manager was based on product costing:

the company now has a costing run through SAP every month to re-cost all of their products and to review what the changes are since the last run. The variances are evaluated to review the reasons for product cost increases and its impact on product profitability.

SAP provides facilities such as real-time cash flow projection and critical cash flow analysis:

> fully on-screen supplier bill-passing, vouchering, and integrating purchase
> data and accounts for provisioning have sharply pruned manual work-
> load, without sacrificing control… The system enables multi-currency
> dealings with necessary built-in documentation that assists the regions to
> conduct business in the NZ offices using their country currency. (IS project
> manager)

The automated SAP multi-currency functionality converts foreign currencies into local NZ dollars for parity and control reducing manual effort and improving resource efficiency. The system also provides up-to-date and on-tap financial obligations of the sales regions such as interest computation by defined rules and debit/credit note generation as and when required:

> the on-line cost related data with drill down facility has brought in focus
> and timely control on the various costs and expenses of the company.
> Each finance and accounts figure can now be drilled down to the
> transaction level leading to tighter expense control. (IS project manager)

The budgeting and commitment accounting feature has enabled budget and compliance control for Bevon, further strengthening the finance control function.

6.5.3.8   Systems

The findings at Bevon confirm that the executive team has monthly meetings in which the KPI reports are presented. The KPIs in these reports focus on objectives and deliverables for functions at all levels – at the highest executive team level, middle management, and the operational level – that lead to achieving the company goals:

> if the objectives set are trailing such as a business initiative to cut costs or
> increase productivity that has not been achieved, then the KPI result
> would appear negative but if the objectives are met the result will show a
> positive trend in the tracking reports. (IS project manager)

Built-in performance management tools are available in the SAP system for in-depth, enterprise-wide performance management. This enables real-time or near-time (interval-based) supervision of performance and analysis-based reporting. SAP provides the ability to drill down to particular performance elements, and adjust through automated alerts and triggers:

> SAP has specialized components with the ability to communicate with end
> users responding to particular process outcomes and actions are initiated
> to resolve those specific issues. (IS project manager)

Specified information requirements are easily and quickly achieved in SAP, through the drill down facility, without programming every time:

> with some training, the executive management team members could
> themselves extract different information that they required from the
> captured data, carry out what-if analysis without the frustrating wait for
> someone to compile and provide the information. This has been done
> across the factory and the regional offices. For example, users are able to
> review items availability, product profitability, capacity comparisons, and
> consolidations. (IS project manager)

The system provides built-in tools to monitor and administer the computer resources. For instance, the system performance manager tool provides the administrator a view of the concurrent sessions and users, utilizing checkpoints, enforcing locking of user sessions, or enabling logging into the system:

> the system enables monitoring of the various applications, tasks, and
> activities under processing. Information on the pre-programmed activities
> scheduled to run are available confirming the processes that have run
> successfully and highlighting any processes that have failed to run
> including its reason. We also use the daily back-up facility for information
> storage and data security, so that information can be retrieved and
> restored for viewing if required at a later date. (IS project manager)

SAP provides database performance tuning opportunities comprising the administration of system parameters such as system buffer monitoring. The system monitors input/output and hard-disk usage through partitioning versus available-space maintenance including monitoring of the processor (CPU) speed:

> tweaking any of these parameters potentially can improve performance. (IS
> project manager)

The system is configured or set up through the parameter settings to respond to different scenarios. The respondent noted that the condition technique was the single largest configuration within the SAP system. This technique helps to make choices based on conditions in various processes such as pricing, output determination, account determination, and material determination. An example was cited by the IS project manager:

let's say SAP must find a price for a product, but a number of prices can exist for a product. There could be the list price that applies to that group of products, a special price for that customer, or a specific price for that product. What product is being sold, who it is being sold to, and the product group the product belongs to, are the conditions. These are specific situations that apply to that sale. Different conditions for different products will have different prices. These different conditions and the prices associated with each are stored as condition records. SAP uses an access sequence to decide the order of search for finding the price. For example, search first for the price of a customer, if one is not found, continue looking at the other conditions for a product price. If a price is still not found, look for a product group price. Conditions are grouped together in condition types for prices, which contain the conditions such as customer price, product price, product group price, discounts, and so on. The discounts are also set as conditions... Let's say if an order quantity is greater than 500, apply a 10% discount. These conditions can be changed or applied to specific customers.

The condition technique is used in other areas as well such as account determination:

whenever a sale is posted to accounting, SAP determines the GL account to which the revenues and discounts are posted based on the conditions of the sale. For example, sales of different product families can go to different revenue accounts, export sales to another account, and local sales to yet another. These processes help in determining outcomes triggering further automated actions to achieve the final result. (IS project manager)

Easy and instant enforcement of accountability are built-in features of the SAP system that are activated through work flow and alarm alerts, including instant highlighting of inaction to a higher-level manager. For example, alerts are communicated in case of a failure to timely release a purchase order (PO) that may lead to an item shortage on the line:

the system eliminates many value added activities through electronic work flow setting features such as streamlining and accelerating the entire process from indent to PO approval to PO release through electronic work flow, eliminating paper work such as hand-filled purchase requisitions and approvals prior to the actual PO printing itself. (IS project manager)

It is now possible for the Bevon staff to mark some information on the SAP screen they are working in, append a message to it and transmit to any colleague. The receiver can see the message, drill down to details if required, and transmit a reply. It is also possible for the sender

to receive an alert if the reply is not received within the specified period. This makes follow up and monitoring much easier.

The Bevon IS project manager also noted that the system has successfully been able to handle an increased work span on an on-going basis. The number of transactions and products has been increasing over the last four years without a corresponding increase in staff strength.

6.5.3.9   *Product development*

The product development process at Bevon has improved since the implementation of SAP. The new system has the ability to maintain different BOM versions, each with a distinct validity date. The separate yet integrated BOMs co-exist based on their specific requirements in the different phases of development such as one version for the design phase, another for the purchasing phase, and yet another for production:

> the system provides a one-stroke change from one BOM version to another, resulting in error-free changes in actions required from the design phase to procurement and finally production. (IS project manager)

This functionality helps in keeping different versions of product BOMs during the various phases of product lifecycle:

> a 'design' BOM version is meant for 'development only' and provides an understanding to the purchasing and production teams that any actions originating from the use of this BOM may have an implication of design changes to the parts. A 'purchasing' BOM version suggests that the design of the parts is finalized but subject to the verification and validation of the parts and product. And [finally], a 'production' BOM confirms that the parts and the product have been validated and the BOM is released for regular production. (IS project manager)

The system further supports on-going BOM updating with automated version control and release on a pre-defined date.

SAP provides Bevon the ability to configure items in their item master so that new part numbers can be assigned with a pre-configured logic. Before creation of new parts for use, the review of existing parts is facilitated to support standardization. Alternate parts are assigned to existing part numbers in the system and used in an event of any supply issues to existing items:

> parameters such as lead times, minimum order quantities, days supply, and lot sizes, are configured for each item that supports MRP to plan

> requirements from vendors. The drawings and specifications of parts, along with vendor quotes and price agreements are appended to the SAP database against each item that helps in the sourcing of the parts. (IS project manager)

The product development time is slashed at Bevon through the use of built-in multi-user project management and work flow features with instant projection of delays or hold-ups in project plans:

> SAP tracks project development cost on a real-time basis including a product-wise update after an engineering change. (IS project manager)

The engineering change request (ECR) and engineering change note (ECN) system provides a controlled creation, approval, and release of engineering changes that are implemented to projects:

> SAP provides the most feasible ECN implementation date based on existing and pipeline stocks, and projected consumption. This ensures a smooth transition of the change without impacting inventories or creating stock obsolescence. (IS project manager)

Such changes to the processes has smoothened the product development process at Bevon expediting new innovations, utilizing the advantage of technological advances, and ensuring the company is well positioned for the future market growth.

6.5.4   Financial impacts

Bevon has achieved a fast sales growth with a dramatic improvement in operational performance. The sales turnover of Bevon has grown from $44M in 2003 to $106M by 2007. As per Bevon's expectation and business strategy, the company has been able to achieve an average unit shipment growth of more than 50% in 2008. The NZ factory has met the growing market demand and delivered the increased volumes to customers.

Bevon has reduced their operating costs through new product designs, material cost savings, and increased productivity. Bevon has achieved a sales turnover of $174M in 2008. Volumes out of Auckland went up nearly 50% in the 2008 financial year when compared to 2007. Although, in 2003, Bevon had made a loss in their operations and was in the red by $2M in their net profit, however 2004 onwards, their net profit has improved:

> we had rough times initially in 2002-2003 but 2004 onwards our performance has been very good. (general manager)

Overall, Bevon's cost efficiency has increased by 20% and inventory has reduced by 40%. Their new product development time has halved through process improvement and now the company takes about eight months to deliver a new product to market. The company's human resources are highly motivated. Bevon has achieved an on-time delivery performance of 85% with much improved relations with customers and suppliers. Finally, Bevon has surpassed their target and achieved a 64% improvement in profit after tax in 2007 against their 40% improvement expectation. Their operating revenue has increased by 42% and EBITDA by 71%.

6.6   CSFs for the Transformational Process to Produce Benefits

According to the Bevon operations manager, the involvement of key people is imperative in realizing organizational benefits for any rationalization or improvement projects. The key people include functional managers and technical experts of the company that have the support of the executive team throughout the process.

The use of appropriate technologies with precise configuration settings to match the organizational requirements helps in achieving results:

> it is essential to put together reporting tools for measuring and reporting company performance. We have not been able to really achieve this yet which is quite a shortfall. Therefore, the company had to resort to doing workarounds to achieve this which is time consuming, expensive, and cumbersome. The company has got the reporting but it is not really directly through the standard SAP process yet. (operations manager)

Training for usability of the technology makes it possible for the staff to understand technology capabilities and leverage the functionalities to the best possible advantage:

> creating in-house skills in writing reports, setting up authorizations, configuring modules such as setting up the quality function deployment to be able to report on defects and so on reduce the operational costs for the company in the long run. This also helps in not having to depend on outside consultants for such changes and saves on cost. (IS project manager)

Bevon has developed the skills to achieve changes to the system configuration in-house. This has also helped Bevon in implementing changes quickly, rather than having to wait with time lost in coordination with external consultants.

Clarity has been realized on the project deliverable plans, objectives, and timelines:

> alignment of the organizational business strategy with the SAP implementation decisions have been the essential ingredients for achieving benefits. (operations manager)

Involvement of all the staff in organizational change management programs "helps in keeping the general staff morale high". Providing a forum for discussions, suggestions, and staff feedback to create an understanding of the achievement processes and expected outcomes leads to the realization of objectives. Creation of organization cultures that promote sharing of knowledge and skills between employees fosters the transformation process. Putting together repositories for information sharing and knowledge creation assists in making timely decisions to achieve desired benefits.

Data quality is an important factor for achieving benefits since poor data quality leads to inaccurate decisions and poor outcomes. Good data quality also provides the appropriate time to the teams for realizing outcomes. Inadequate time may lead to rash decisions with pre-mature results and the projects may fail. Additionally, proper assessment of scope and allocation of budget is necessary before the project execution stage, otherwise any subsequent changes may impact the outcomes.

To achieve ongoing success, it is especially beneficial for the company to have the people who were involved in the original project to be around and available to answer user queries, share their expertise and knowledge, and get involved in future organizational initiatives. It is in the company's interest to retain these employees as they hold past knowledge of business practices used in legacy systems. Finally, peer relationships between employees, key stakeholders, and business partners matter because a company may not really have all the skills and knowledge available at all times. The company may need to seek help and rely on information from their business partners in some situations.

The Bevon IS project manager explained "for the size of Bevon, taking on a system like SAP was quite a big ask. The company took that decision with the future direction in mind".

Bevon as a company has complex processes, manufacturing hi-tech products, within the typical research and development environment. Since the processes at Bevon are complex, the company needed a system such as SAP that could cope with all the complexities. When the system was first implemented, Bevon had only 400 employees and they did not have any manufacturing operations outside NZ. Now, Bevon has expanded to other Asian countries and the new system

has stabilized, becoming quite mature. There are certain areas where Bevon wants to further improve, but they consider what they have achieved so far, to be good. The Bevon operations manager found the business reporting and analytics the only area that was lagging and needed improvement:

> we definitely want to drive the business with data and cannot do that well unless we have the reporting processes in place which is something we are working on. (operations manager)

According to the Bevon respondents these are the success factors, a majority of which Bevon has been able to achieve. The one that is not achieved is the business performance reporting and that is still a "work-in-progress" for Bevon. A summary of the critical success factors for the transformational process through the utilization of SAP and its data to produce benefits at Bevon is presented in Table 20.

6.7 Summary

This chapter presented the conduct of the second case study and its findings. The study investigated the process of ES data transformation and results at Bevon using the format of the transformational model (Figure 10). First, an assessment of the contextual constructs comprising the strategic, organizational and cultural, skills and knowledge, data, and technology factors was conducted. Second, the methods, tools, and techniques for transforming ES data into knowledge and utilization of knowledge for decision making were examined. Third, the outcomes comprising behavioral changes, new initiatives, process changes, and financial impacts were explored. The ES benefit realization events in the various functions and processes were evaluated.

The case study presented insights into Bevon's post ES implementation practices focusing on usability of ES and its information, and how the ES investment has impacted Bevon's functions and processes. Finally, the study examined and summarized the critical success factors for the transformational process to produce benefits at Bevon. The next chapter presents the third case study.

Table 20: CSFs for the transformational process to produce benefits at Bevon

Critical success factors	Description
Involvement of key people	Key people are the most resourceful. They include functional managers and technical experts that have the support of the executive team.
Use of appropriate technologies	Technologies with precise configuration to match the organizational requirements help to achieve results. It is essential to put together reporting tools for measuring and reporting company performance.
Training	Training for usability of the technology makes it possible for staff to understand technology capabilities and leverage the functionalities. Creating in-house skills in writing reports, setting up authorizations, configuring modules and so on, reduces the operational costs. This also helps in not having to depend on outside consultants for changes.
Clarity on the project plans, objectives, and timelines	Clarity on project goals, objectives, and timelines assigned for realization. Alignment of the organizational business strategy and the ES strategy in-use are the essential ingredients for achieving the benefits and success.
Change management	Involvement of all the staff in organizational change management programs helps in keeping the general staff morale high.
Forum for discussions, suggestions, feedback	Providing a forum for discussions, suggestions, and staff feedback creates an understanding of the achievement processes and expected outcomes.
Organization culture to promote knowledge creation and sharing	Creation of organization cultures that promote sharing of knowledge and skills between employees. Putting together repositories for storage of information and knowledge management helps in making information available in a timely manner to achieve benefits.
Data quality	Managing the data quality within the company since poor data quality leads to inaccurate decisions and poor outcomes.
Timeline to achieve results	Providing sufficient time to realize outcomes as a natural consequence of actions since less time leads to pre-mature results and project failures.
Assessment of scope and budget	Proper assessment of scope and allocation of budget is necessary before the project execution stage. Any changes may impact the outcomes.
Retaining key staff	It is beneficial to have people who were involved in the original project to be available to answer user queries, share expertise, and get involved in future initiatives. It is in the company's interest to not permit attrition of such employees and retain their knowledge from the legacy systems.
Relationships within all stakeholders	Peer relationships between employees, key stakeholders, and business partners matter because a company may not have all the skills and knowledge available at all times. The company may seek help and rely on information from business partners in some situations.

Chapter 7

CEVON CASE STUDY

Chapter 7 provides the data collected from the third case study. This chapter presents the empirical findings from a company called Cevon (a pseudonym) that is involved in the design and manufacture of electronic products in NZ and has implemented SyteLine 7 as their business management system. This chapter is organized as follows.

First, the case study interview settings for Cevon including the details of the persons interviewed are presented. The next section introduces Cevon and provides background on its operations. This is followed by an analytical description of the empirical findings using the format of the transformational model (refer Figure 10) to investigate the process of ES data transformation at Cevon. The main ES benefit realization events in the various functions and processes at Cevon are evaluated. The case description highlights the way the business is managed at Cevon. It provides insights into Cevon's post ES implementation practices focusing on usability of ES and its information, and how the ES investment has impacted Cevon's functions and processes. It identifies the areas that have either benefited the organization or need attention. Finally, the critical success factors for the ES data transformation process to produce benefits at Cevon are summarized.

7.1 Cevon Case Study Settings

The interview data have been collected through a series of semi-structured interviews with key respondents in Cevon. The interviews were carried out between June 2007 and July 2008. The participants included senior executives, managers, and operational staff in the organization. Nine face-to-face meetings between 50 minutes and 3 hours each took place at Cevon.

The positions of the participants included: manufacturing director, operations and supply chain (O&SC) manager, purchasing manager, IT manager, finance controller (FC), and quality manager. The meetings took place in two rounds. In the first round, one meeting was conducted with each participant between June and August 2007. The second round repeated the meetings with the participants between April and July 2008. In the second round, the manufacturing director, finance controller, and quality manager were not interviewed due to their time and availability constraints. The details of the roles of the persons interviewed are shown in Table 21. Access was obtained to company reports, e-mail messages, minutes of meetings, and

organizational manuals. Promotional material and the Web sites of the organization were reviewed.

Table 21: Key respondents for the study at Cevon

Job Title	Number of meetings	Role in the company
Manufacturing director	1	Manufacturing management and overall in charge of all operations at the Cevon Auckland factory
Operations and supply chain manager	2	In charge of all operational activities including procurement, supply chain, manufacturing, and dispatch functions
Purchasing manager	2	In charge of purchasing and vendor development
IT manager	2	In charge of SyteLine and general IT administration
Finance controller	1	In charge of all finance related functions of Cevon
Quality manager	1	In charge of all quality functions in Cevon

7.2   Company Overview

Cevon was founded in 1987 in an Auckland, New Zealand garage by a group of seven people. The company was originally established for designing and manufacturing electronic devices used in marine applications. Cevon expanded to become an original equipment manufacturer (OEM) of several product applications using the core GPS technology for a variety of market segments. In 1997, Cevon diversified from marine electronics to global consumer markets and introduced personal car navigation products. Along side growth into consumer markets, Cevon diversified into business-to-business markets with the creation of a new Wireless Data division in 2003, to provide vehicle tracking and data transmission solutions to fleet owners. In 2004, Cevon further created a separate OEM division in Christchurch for supplying GPS modules and solutions to suit the needs of customers with their OEM specialization.

Cevon's head office, the R&D center, and the manufacturing plant are based in Auckland. It has main subsidiaries and sales and distribution centers based in the US, UK, Australia, and New Zealand. The raw materials are procured mainly from vendors based in China, Singapore, and Taiwan. The electronic devices are manufactured in the Auckland factory and shipped to the various subsidiaries across the globe. Cevon has four divisions based on their four distinct product lines and applications namely, Marine (with marine application products), PCN (personal in-car navigation products), Wireless (fleet tracking and data management products and services), and the OEM (GPS solutions and products to manufacturing customers).

From 1987 to 2002, the company grew from seven employees to 250 with annual revenue of more than $100 million and an expectation of $200 million by 2004. Cevon expanded their operations globally and established a presence in countries such as Spain, Germany, Denmark, and Chile. Cevon was also awarded the Trade NZ Supreme Exporter for 2002.

In 2004, Cevon was sold to US Corporation (a pseudonym) who managed the business for three years. During this time Cevon grew to become a $500 million business. In 2007, US Corporation split the business into three separate divisions and sold off each division to three different customers.

The interviews took place while Cevon was being divided and sold off. However, due to the retrospective nature of the questions, these events did not have any significant impact on the data collection for this case study.

7.3   Context

Insights gained from the Cevon participants through interview discussions on the contextual factors strategic, organizational and cultural, skills and knowledge, data, and technology are presented in this section.

7.3.1   Strategic context

In 2003, when Cevon's turnover was about $100M, the company divided its four groups of products into three separate business units (BUs) called the Marine, Consumer, and Commercial BUs. The Marine division formed the Marine BU, the PCN division became the Consumer BU, and the Wireless and OEM divisions together became the Commercial BU.

In 2004, when Cevon reached a turnover of $200M, the company was sold to US Corporation, a US-based large corporation. Cevon became part of and a wholly owned subsidiary of the global corporation. US Corporation is one of the world's biggest marine equipment and boat manufacturing companies, with sales revenue of US$3.7 billion annually. The sale of Cevon was completed ahead of schedule in June 2004, at a sale price of about $108 million. Though Cevon was owned 100 percent by US Corporation, Cevon still continued to operate from NZ and became a global company. Throughout the handover, Cevon carried on its trend of rapid expansion and won substantial new contracts for supply in global markets. US Corporation enabled commercialization of exports for Cevon through their worldwide distribution channels. After the sale, with the support of US Corporation, new distribution channels were created in France, Germany, Netherlands, Italy, Switzerland, and Hong Kong along with strengthening of the existing subsidiaries in the UK, US, Australia, and NZ.

US Corporation established a new target for Cevon to achieve $1 billion sales within five years. Cevon doubled its head count for achieving the growth objective set for the company. Three hundred positions were created in New Zealand to manage the high-tech job requirements in areas of software coding, chipset development, and electronics engineering. The company also doubled the space of its Auckland plant and planned to add another 100 employees in 2005 at their R&D centers in Christchurch and Auckland.

By 2005, Cevon had reached a sales turnover of $300M and continued to achieve its huge growth targets. Cevon by now had also developed additional manufacturing facilities with contract manufacturers based in China, Singapore, and Taiwan. Cevon also started an office at Singapore to manage the contract manufacturers and logistics locally.

Although Cevon was prospering in terms of financial growth, the company was facing many issues with line shortages, management of the factory, and the build process, areas related to the operational side of the business:

> we wanted to manufacture products with fewer problems, get on-time deliveries, achieve faster turnaround of products, control costs, and improve efficiencies in the manufacturing side. We wanted to tighten cash flow by ordering materials when required as per lead-time and improve utilization of working capital assets. We also wanted to make sure that the components are received on time, our factory produces products on time, and we buy parts only when required. (manufacturing director)

As the volumes and numbers in the factory went up, these issues became more and more important. There was a huge number of product SKU's[16] in the company that required better management. From the design side, Cevon wanted to make sure the engineers only designed parts using components that the company already had in the system:

> we wanted to ensure the engineers had the visibility and reviewed whether or not specific parts were available before creating a new one. New parts mean more code numbers, all of which add to more inventory (manufacturing director)

Since 1998 Cevon had been using SyteLine version 5 from Mapics as their business management system. However, as the company grew globally, the collaboration and communication between their subsidiaries and distribution centers in all major parts of the world required improvement. These subsidiaries used different systems and versions of

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[16] SKU – Stock keeping unit

SyteLine and there was no core system that was standard across the whole company. In the sales and operations planning process, the regions had their own forecasts in their standalone systems. Cevon had to go through the whole process of exporting the information into spreadsheets to collect regional information:

> the planners would then have to sit down and compare the regions spreadsheets with their own. The company realized that it would have been a lot easier if there had been some sort of compatibility between the various systems. The system could somehow make the comparisons to bring clarity into information such as what the demand and supply is, and to know whether the systems are aligned. The information could be controlled and managed centrally from one database instead of several. (O&SC manager)

In 2006 Cevon realized that it was time to upgrade their existing SyteLine 5 to SyteLine 7 in the NZ factory as well as roll out the platform to all its regions and subsidiaries worldwide. SyteLine 7 (SL7) was upgraded as a business strategy at Cevon and the new system went live in January 2007.

In April 2006, US Corporation's CEO had changed and so had the company's business policies. The new CEO wanted US Corporation to focus on its core competencies and decided to sell Cevon, which was a NZ$500M company by then with 750 employees. As US Corporation could not find a buyer to buy Cevon as one company, US Corporation decided to sell the three Cevon BUs separately. The moves were part of a review which began in 2006.

By February 2007, New Zealand high-tech company Cevon had been put up for sale by its US owner with analysts pricing the three divisions to be collectively worth between US$300M and US$500M. The technology division of US Corporation mainly comprising Cevon had annual sales of NZ$507M (US$317M) and reported a profit of NZ$127.2M in March 2007.

US Corporation sold the $160M marine electronics business to a Europe-based company with HQ in Norway that had manufacturing facilities at Norway and Mexico. The $240M consumer in-car navigation business was sold to a China-and-Taiwan-based company. Finally, the $100M Commercial BU dealing with the fleet tracking devices and the OEM Solutions group was sold to a US-based finance company. Some stake was also bought by the two members of US Corporation's top management team who were managing the Cevon business. The two members left US Corporation to take over the running of this company on a full-time basis.

7.3.2   Organizational and cultural context

The culture of Cevon has been congenial and friendly. Cevon's executive team managed the company professionally and communicated plans through regular company updates to its employees:

> we encourage the 'can do' attitude and recognize achievements by presenting 'employee of the month' awards at our monthly company updates. The yearly progression within the organization is achievement based. We have yearly and half yearly reviews for all employees against the goals identified for each individual. (manufacturing director)

Employees were encouraged to use a data-driven approach with formalized methods to capture information for day-to-day activities and monthly reports. The management believed in the utilization of modern technology tools including ES technology and BI tools, across different functional areas. Diverse groups utilized these common tools extensively, creating visibility and shared understanding of each other's functional tasks.

The organization structure at Cevon has been collaborative. Employees have been free to offer and express their views with a fairly open environment. Many people at Cevon operated as members of cross-functional teams. The organizational culture of Cevon evolved from the days of their earlier management and the way the founders ran the business:

> they created and gave a lot of visibility into how the processes are going to work and shared their ideas quite a lot. Whereas, over the last few years, after US Corporation has come in, it has become a lot more distanced in what the organization is doing and the employees having a part in it whatsoever. (quality manager)

The individual BUs at Cevon are smaller groups, less complex, and integrated together allowing sharing of responsibility and decision making across organizational levels. Recently, the structure at Cevon has "been a bit fluid" according to the quality manager, with some uncertainty among employees:

> some people prefer to have things loose in the organization chart whereas others prefer to have more structure for clarity and know exactly who people report to and where they fit in the organization. (quality manager)

The earlier management practiced more visibility regarding remuneration benefits to staff. Employees saw what was going to happen and understood what some of the conditions were and what was expected from them. But in 2006 and 2007 it has been far less visible and

understandable. According to one respondent, his BU head controlled the salary structure himself:

> he did not delegate any of the important activities to anyone. He individually set people's salaries with no input from any of his staff. (quality manager)

Cevon has gone through a change in overall and individual BU leaderships in the recent past. The employees are unaware of what to expect next. So, in 2007 the employees have concerns in "what the company is doing, where it is heading to go, what the specific objectives are, and what the remuneration plans are".

There had been very little staff turnover within the organization in the past. The company's excellent growth and "fun and work" attitude had always been an incentive for the employees to stay on. In 2005 Cevon moved its Auckland offices into a newly created multi-million-dollar building more in keeping with the polished high-tech image that has brought it success. The site has two cafeterias and a gym where the employees could relax, watch TV, play pool or table tennis, with a library for newspapers, books, and magazines. Social gatherings were hosted every Friday evening with drinks where the employees mingled in an informal and friendly environment.

However, the situation changed by October 2006. Jobs were being lost at Cevon as the US owner started cutting costs in an increasingly competitive market. In 2007, with the break-up of Cevon and takeover by the three different companies, more jobs were lost. From the 600 staff employed at Cevon offices in Christchurch and Auckland, 30 per cent of staff lost their jobs due to redundancy. Operations in Singapore and Germany as well as the entire division at the US corporate office were downsized. The Marine and the Commercial BU companies retained most of their employees, but the company that bought the Consumer BU made a majority of its employees redundant. The manufacturing director said Cevon opted to assist by exploring employment possibilities for the redundant staff. Several employees were transferred to new positions that were created as part of the restructuring, since many functions were now performed separately in each BUs:

> new organizational structures have been created. The people that had been working for specific business units have been transferred to the rolls of the new companies. All these changes left the employees with a sudden feeling of a let-down by the management. Many employees left the company and took alternate employment. The morale of the people suddenly went down with a feeling of uncertainty and regret set in. (quality manager)

Redundancy led to low morale of the employed people, and the staff turnover became high. Those who could move out from the company did not hesitate to do so. However, once "the dust settled down after the break-up", it was business-as-usual again. The three BUs now exist as three different companies.

7.3.3   Skills and knowledge context

Cevon has technically qualified design and development engineers, skilled operational workmen, and staff with expertise in commercial and managerial functions. Over the years Cevon has further developed their staff in specific skill sets by providing relevant training. For instance, training has been imparted in the use of SyteLine and business intelligence tools to manage business functions with the use of a centralized data repository. However, the respondent noted that the specialized training for SL7 was given only to people who used the system regularly, others who used the system occasionally were not trained:

> from an efficiency stand-point, if some more time had been invested up
> front to train all the users to use the system and all those shortcuts and
> specific reporting features, over the next couple of years the company
> could have saved a lot of those peoples time because they could have been
> able to do things better and faster. They did not have to learn from their
> neighbor who learnt from someone else. (quality manager)

According to the quality manager, SL7 training was very critical which was not done very well at Cevon and has hidden costs involved:

> it is hard to see on the bottom line, but its there. It is like the cost of poor
> quality which does not account very well in calculation but if individually it
> is wrapped up as to how much it costs on rework or how much it costs on
> returns, which are typically not reported on the management table, every
> month cost of poor quality could be a million dollars.

When the Cevon tie-up with US Corporation was announced, the deal began to boost Cevon's human resources with high quality engineers attracted to join the company. The acquisition also meant US Corporation was able to harness the considerable human talent within Cevon. Whilst US Corporation's ownership gave Cevon greater access to a global talent pool, finding skilled staff was a constant challenge due to the company's growth. A look at the Careers section of the Cevon Web site in early 2005 showed that the company was looking for about 30 software and hardware development positions. An engineering division had been set up in Germany, at the heart of Europe's automotive industry, since attracting talent to NZ was difficult. New Zealand

was a nice destination but the NZ industry did not pay as much. If people came to NZ, it was not for money, but mostly for lifestyle reasons.

7.3.4   Data context

Before the implementation of SyteLine, the transactions were recorded manually using a PC-based system and the data quality was historically questionable:

> the on-hand stock did not necessarily match the physical count. The reliability of data was poor. The reconciliation of the account receivable information with the customer invoices against the material supplies was a difficult task. Also, the account payables reconciliation with supplier invoices and the material received was not easy. (quality manager)

The situation changed after the implementation of SyteLine. Further controls such as regular cycle counts were introduced to enhance the accuracy of stocks:

> the system information has become current, accurate, and can be relied upon. With the BI solution it has become further possible to retrieve any relevant data quickly for decision making. (quality manager)

The quality of data is no longer a constraint in Cevon. The company has become a data-driven organization and has developed the skills to manage business with accurate centralized data to support managerial decisions.

7.3.5   Technology context

As Cevon grew, the company needed new ES technology to support their fast growth and the increasing operational needs to design, manufacture, and market their products. In 1998, the management team decided to implement Mapics SyteLine 5.0 (SL5) as the backbone to support their business processes and growth. Prior to that, the company processes were managed using a PC-based system that relied on spreadsheets and were difficult to manage. At that time there were issues with shortages of components due to a lack of visibility into the operational transactions:

> SyteLine 5 was selected by the new general manager who had previous experience with the system during his earlier tenure in another company in South Africa. He found this system cost effective and robust, satisfying the growth needs of the company. (IT manager)

The new SyteLine system was implemented in 1998 by a NZ-based consultant firm called EMDA at Cevon's Auckland site. The modules implemented were finance, sales and distribution, production planning, materials management, and production management. The implementation took around eight months and the system went live in early 1999:

> the cost of the SyteLine solution was much less compared to the other ES in the market from players such as SAP, BaaN, Oracle, and JD Edwards at that time. Our company quickly adopted the new system with top management involvement throughout the implementation process. (IT manager)

The SyteLine implementation was a success and the company started following the automated and integrated best business practices embedded in the system. Cevon now had the unprecedented visibility that they were looking for to achieve the operational efficiencies.

Soon after the SL5 implementation, the company implemented a business intelligence package from Cognos Impromptu which integrated with SyteLine. This further enhanced the visibility and information required by the Cevon management to make vital business decisions. This dramatically improved the organizational sales and operations planning process, inventory management, cash flow, and shipments to customers via their various distribution channels based in the US, UK, Australia, and New Zealand.

According to the IT manager, SL5 was very difficult to use and was not very friendly:

> it took a while for people to understand and learn the system. It was not a Windows-based system and therefore users had to learn all the shortcut keys and the usability tools.

As the company grew, so did the requirements. To keep up with the current and future growth, Cevon decided to upgrade SL5 to the newer version SL7. In 2006, SL7 from Infor was installed in the main manufacturing and R&D site in Auckland and was live by January 2007. The new SL7 system has a user-friendly GUI, Windows-type environment, and additional features such as Web-based access for better connectivity. Cevon also decided to implement SL7 at the other sales and distribution and subsidiary sites to have a common platform for the entire business.

The scope of the implementation included the standard SL7 with all existing functionality from SL5 plus a new chart of accounts, advanced planning and scheduling (APS), business intelligence Cognos Impromptu and Powerplay, workflow modules, and foreign exchange (FRx) reporter and forecaster. The scoping also included developing a number of workflow triggers during the implementation. The workflow feature managed the consignment stock

through a vendor-managed inventory (VMI) program. SL7 was also implemented at the new office in Singapore to manage Asian operations. The sites that were part of the SL7 upgrade along with their currencies were Cevon NZ Ltd. (USD), and subsidiaries Cevon Wireless NZ Ltd. (NZD), Cevon Australia (Pty) Ltd. (AUD), Cevon Europe Ltd. (USD), Cevon Wireless UK Ltd. (GBP), Cevon Singapore (SGD), and Cevon USA Inc. (USD):

> the main advantages with the upgrade to SL7 included ease of communication and data transfer from one site to another. On the operational side, the major change was in the multi-site structure that was set up as part of the upgrade. Manufacturing was another function where major changes occurred. This was mainly the result of the change in the planning model in SL7. (IT manager)

The capacity planning and "Analyzer" were part of the SL7 product suite. The use of Analyzer was encouraged but it had to fit the overall objectives of the planning and scheduling group. Cevon procured 130 user licenses at about US$3,000 each per year for the Auckland office, so there was a significant annual subscription to maintain. The implementation was executed by EMDA who were also Cevon's earlier implementation partners. EMDA charged $140 an hour for their time with a support guarantee:

> if there were any issues with recommendations that EMDA had made, and if anything went wrong, we had the guarantee that EMDA would come and fix it for no charge. (IT manager)

However, if Cevon had any new requirements and needed the services of the EMDA consultants, that would be at an extra cost.

SyteLine is a second tier ES package for SME companies. The packages from companies such as SAP or Oracle are the top tier and cost more. Usually bigger companies, more than 150 users, go for the top tier, according to the IT manager who was also the SyteLine champion at Cevon. For such systems the consultant time, application cost, and training cost are much higher than what Cevon paid for the SyteLine system:

> tier one systems are more complicated as well. The company would need more specialists in the organization to run such a system because each of the modules is much larger in terms of how these can be configured. (IT manager)

SyteLine was considered a good fit for Cevon's user base. "SyteLine delivered a good solution at a good cost and could be used with ease". Cevon had implemented SyteLine

when the employee strength was about 200 employees and since then the company has been growing well with this system and getting the benefits. Cevon's investment of $500,000 for the initial cost for this system has grown when the user numbers increased.

As per the IT manager, another area where Cevon could utilize the system better was the use of multi-site functionality. This functionality allows linking of several sites within a single instance of SyteLine, making global planning possible across multiple sites:

> transferring products from site-to-site is achieved by using a process called 'transfer orders' in SyteLine. If an organization uses multiple sites, there is some strong functionality within this area, such as reporting of information. Data can be retrieved in terms of the total product demand by using a function called an 'entity' that sits above a 'site'. An organization can have a number of sites reporting into an entity and then access their entity system to view aggregated data. (IT manager)

Cevon had used this functionality when the company initially split into the three BUs, aggregating their financial outlay into entity levels. Cevon had a NZ and an Australian entity and a common layer above them called Cevon entity which consolidated all the financial performance into a database so that the accountants could report the overall performance to US Corporation:

> the system is strong in this area. However, we have not really utilized this multi-site functionality since many of our sites have a separate instance of SyteLine. (IT manager)

Cevon had seven separate instances of SyteLine implementations at New Zealand, Australia (AU), US, UK, Singapore, China, and Hong Kong. Cevon implemented SL7 to achieve a common platform across all its regions and subsidiaries and establish the core processes that enable the businesses to operate efficiently and effectively. Some of the additional modules such as HR, CRM, and forecasting were not implemented. Some functions are covered by different applications which include the performance management system that US Corporation established and the external payroll system that had been implemented separately earlier. The core functions used out of SyteLine are the customer service, manufacturing, inventory, purchasing, finance, and RMA. Additionally, Cevon was quite keen to add the product development bolt-on and the product lifecycle management system. These bolt-ons interface the engineering functions with the operational functions within the organization:

> these applications keep the product development separate during the design phase, or the not-ready-for-production-yet phase, and provide a

way of automatically interfacing when the engineers have finished developing a product and sending it to the production environment. These functionalities would definitely be needed by the company. (IT manager)

The high-tech electronics and GPS industry of Cevon has products with relatively short life cycles. The time taken for bringing out new products to the market is constantly improving. Lead-time reduction is definitely a focus area for Cevon:

we have also been looking at some supply chain management type bolt-ons specifically the forecasting module, something to help us produce reliable forecasts and reduce lead-times. There are tools that the company could get benefit from, which are quite expensive, but once the dust settles from what is happening, these are the kind of areas the three companies [after the break-up] would be looking at for longer term improvements. (IT manager)

The role of SyteLine has been vital in the break-up of Cevon. Three systems were created out of one SyteLine system, one for each BU.

7.4   Transformation

The transformation process at Cevon is the result of making knowledge-leveraging actions operational:

the executive team has brought clarity into the organizational objectives by describing and explaining the value creation process and in guiding exploration of information to different dimensions of business. For example, business activities relating to operational areas that impact productivity, cost, and quality are identified and listed as goals for improvement measured by the functional heads. (O&SC manager)

Cevon has created the linkage between the metrics for achieving the company strategy and the key performance indicators for each functional area. The framework has been translated into team-based departmental plans leveraging improvements to achieve the business strategies and objectives. The plans identify metrics for each KPI against which key processes are aligned. These are communicated to all the team members and their specific key result areas are identified:

balanced scorecard and dashboard performance measuring tools have been put in place to monitor progress, translate information into visual presentations to show multiple results together, and facilitate decision

making. The indicators are benchmarked and the persons who are responsible ensure that these tasks are achieved. The progress is monitored and documented each month through regular reviews and updates. (O&SC manager)

ES data becomes knowledge at Cevon via the analytical process. The trends emerging from each indicator are evaluated to support business decisions. The processes for ES data transformation into knowledge and utilization of knowledge for decision making and results are areas discussed in depth with the Cevon participants. The findings are presented as follows.

7.4.1 ES data transformation into knowledge

The IT manager explained that SyteLine has "a lot of data in its database and it is not always presented in a user-friendly manner" such as through forms and reports. Therefore, Cevon uses a bolt-on business intelligence application called Cognos Impromptu:

> this is a more user-friendly way of drilling into the specific data and presenting particular data objects with precise information that the user might be interested in looking at. For example, the user may want specific information such as information relating to a particular customer, or may only want to know the products for a particular code range, or what the value of a specific sales order was. Through this application the user can retrieve just the information required rather than all the other pieces of information that might be available in a sales order such as the delivery terms or the ship-to address, or the GST code that makes all that data irrelevant for this particular user who does not want that information. Rather than using the system screen to get there and locate the relevant information which could be a tedious task, the user may use the Cognos tool to drill into the system and pull out the required information and transfer into spreadsheets where even further manipulation could be done that an ES application is not very good at. For example, summing the number of records and adding up the total values.

The IT manager further noted that the BI tool is very good for ad-hoc reports that a user might need, where there is no need for the user to go to a developer and request a new report layout because a particular column that the user wants in the report is not there. So, there is a cost saving as well, as per the IT manager. This application is quite useful to users who need to create ad-hoc reports based on the challenges they face at any time. The tool helps to get required data out of the system quickly and efficiently. The respondent opined that when users

have the ability to access the data easily they can quickly build a picture of the correct information and make better decisions from the data that they have managed to extract.

The IT manager further explained that the BI tool insulates the user from the complexities of the database, letting the user focus on analyzing the data that drives the business. It presents a business view of the information and controls the data access by users via the user permissions set. When the user requests information from the database, the BI tool generates a structured query language (SQL) query. Many ad-hoc queries can be made by the BI tool using its local SQL-based query engine. The query is executed and the output is seen through user reports.

These reports can be saved as a file and run again to retrieve the latest information and be refreshed periodically to retrieve real-time information. There are ways by which the performance of the BI tool can be optimized. The user can create efficient reports by applying filters and crosstabs, sorting the information, using if/then/else and lookup statements, using report formatting commands, and creating summaries. The user can further enhance performance of queries and reports as they learn from experience.

The IT manager explained the difference between queries and reports as follows:

> a query is a question that is defined and sent to the data source to retrieve the data. A report is an organized and formatted view of the data the query retrieved.

The report does not have to include all of the data items that were specified in the query. For example, a user may create a query that includes the data items Product, Product Price, Product Margin, and Total Sales Amount but the report may be created that only shows Product, Product Price, and Product Margin. Then a report may be created for the manager that shows only Product and Total Sales Amount by hiding the Product Price and Product Margin columns. According to the IT manager, the BI tool is very powerful and user-friendly; it can "retrieve, merge, and filter" almost any data from different modules.

SyteLine allows the recording of actions that are being taken throughout the organization in the form of various transactions such as customer order receipt, purchase ordering, order invoicing, stock movements, or payments to suppliers. This information is accessible by a range of users and it is fixed:

> there is no ambiguity, it is a record in the system and everybody sees it the same way. So, it is like an information provider that allows all the different functions to make whatever decisions they need to make to keep the business running. It does not make decisions for the people but it provides

the information for the people to make a decision and is consistent. It does not matter where the user looks at and how big the piece of data is. It is not realized often, just gets engrained in the culture of the company but many people use it as their source reference point for the daily business decisions that they make. (IT manager)

The BI is not the only reporting system at Cevon. There are a number of standard reports that are built in as part of SyteLine, as well as some custom reports that have been created for Cevon and put into SyteLine. The data in SL7 are relatively accessible, according to the IT manager:

SL5 was a different story since it was using 'Progress' database, where the reporting tools were not as good. But now SL7 is on a 'SQL server' platform so it is much easier to extract information.

The O&SC manager explained that when SL5 was upgraded to SL7, the custom reports had posed a huge problem because SL7 was on a different database technology and all those reports had to be re-written:

that was a big issue during the transition. There were emails sent out by the IT manager to the users asking for the reports that were being used because they would only transfer the ones that the users confirmed they used. Everything else would not be done, so that was a problem.

The O&SC manager however believed that SyteLine functionalities could have been enhanced with some more standard reports. Although, the respondent was appreciative of the current BI reporting methods:

everyone wants to see the data in a different way. It may never be possible to have enough reports built into the system that pleases everyone. As the people get more and more information, they look at it and then feel that it would be nice if they could look at it in a different manner and be able to slice and dice the information. With more and more information the knowledge is built up and people tend to want to view it differently because the people are learning something out of it. So, the report requirements keep constantly changing with time. This is where the BI helps. (O&SC manager)

However, the respondent further noted that although the information was accessible through the BI module, people had to depend on the few users with BI licenses, which was always a problem since those people always appeared to be quite busy:

getting a custom BI report would always involve a bit of a delay depending on who was asking for the report. It would help to have a person or a function where a BI person who knows the data structure can do the custom reports through BI for all users. Put it in a format that can be brought into Excel and then the users can do the manipulation themselves. Ideally, providing the training and the tools to users would be the best so that they have the ability to extract and create information themselves. (O&SC manager)

Cevon has also implemented a SyteLine data warehouse, wherein specific data related to customer orders, inventories, and finance are collected from the various subsidiary sites through file transfers each night. The data are mined, and the information is available to users who are permitted to log-into the data warehouse.

Overall, the operations and supply chain manager considered their current system good for extracting data and creating information for decision making.

7.4.2   Utilization of knowledge for decision making to achieve benefits

Cevon has been utilizing information from SyteLine to provide a view of organizational performance as projected through a balanced scorecard. The scorecard highlights the company's objectives and provides the metrics that direct the company towards achieving those objectives. This includes benchmarking the KPIs and monitoring performance against the benchmark on an ongoing basis. The scorecard also includes the specific names of the persons responsible for achieving the objectives with target dates. Decisions are then taken based on the analyses, interpretations, and the knowledge outcomes. According to the O&SC manager, a few years ago an earlier management team had set up the original scorecards that focused on the areas they wanted to monitor. The original scorecard was created from a core operations standpoint but has subsequently been extended to cover other areas of business. The scorecard had started to become effective but the respondent noted that by then the team had grown big as well. The operations team included the manufacturing and factory operations, along with the Marine, Consumer, and the Commercial BUs which had become too large an area to monitor in a single review meeting:

it would be nice to take what was happening then and apply it separately to the current business units. It would be very beneficial to have multi-scorecards for the business that track some of the key performance indicators for separate business units and make sure things are happening. The interesting features from the scorecard were to know what

the budget was for the next six months, what were the firm orders, the
planned orders, what were the gaps, where were the gaps coming from,
and from which regions. So that the gaps could be taken up with those
regions to ask for example, they had forecast for two million dollars and
already had firm orders of 1.6 million, so where was the balance four
hundred thousand going to come from. Those sorts of things, to make sure
that the budgets are being met and providing visibility to all concerned
especially the salespersons in the regions to make them aware of the
status. (O&SC manager)

Digital dashboard is another method for utilizing information and knowledge sharing at Cevon.
The dashboard is a graphical representation that the executive management team uses for
tracking the performance indicators to evaluate which areas are performing well and which ones
are not. Each component of the dashboard represents a different business activity for tracking
such as monitoring a revenue forecast. This would show what the revenue plan is for a period
and the cumulative revenue achieved against the plan. Such metrics could be selected from
sales, operations, project management or any other function the company wanted to monitor.
This would help to understand exactly how well an organization is performing and provide a
snapshot of the performance. However, what lacks in Cevon is accountability on such issues:

it is the NZ way that was a little bit lenient where people do not meet goals
and objectives and slip. People generally do not necessarily get a big
bullock and get told off in such a situation. There needs to be better
accountability in NZ business which is pretty lax about that sort of thing.
These are seen a lot more in other markets where if things are not met
then heads roll. Remuneration should be tied to that as well. (O&SC
manager)

Furthermore, the respondent implied that if the right data are retrieved and the noise eliminated
then correct decision making becomes a lot easier because the objects that are disrupting the
picture have been removed. This allows for clear and accurate decision-making. Analytic
modeling is performed using external systems where the extracted data are transferred into
spreadsheets for analysis. Cevon uses analytic outputs such as "list reports":

list customer orders that are overdue, list customers with account
receivables greater than sixty days, list overdue account payables to
vendors, list overdue purchase orders, or list the orders of forecasted sales
for next month are some of the list reports used for analytical decision
making to achieve results. (O&SC manager)

Furthermore, analytical assessments help to establish metrics using a number of different performance indicators:

> we're looking at KPIs from 'order-to-cash', so that KPIs from every business process between taking an order from a customer, delivering the goods and collecting the money can be clubbed together in a one page document which would really be a statement of how the business is performing at any point in time. The true benefits of this are not from knowing any one week's performance but from knowing week on week whether the performance is getting better or worse. This is where such analytical information gets beneficial if the effect of changes is evaluated to understand whether the changes have actually been worth while. The scorecards can provide the reassurance that the kind of changes the company is doing are actually resulting in measurable benefits. (O&SC manager)

At different times the SyteLine administrator at Cevon has been asked to help produce information from SyteLine that is used for some KPIs:

> it has only been a matter of establishing what that indicator is and what drives that indicator which really is the vital thing. Once that is established, the required information is easily retrieved out of the system, measured, and monitored. In reality, this is the area which is the most complex. Organizations fail to identify the areas which really need assessment. For example, portfolio management…In our PAC [program approval committee] review meeting, most of the times our team is not clear where the organization is creating value and where it is not. We then simply follow the usual market-pull, technology-push, or the cost reduction objectives of the organization without really a proper technical or financial assessment. (O&SC manager)

The O&SC manager further explained that different people are interested in different types of KPIs in different areas. But, what everybody wants to know are the results:

> the system is being used to be analytical in terms of being able to know whether the company is getting better in particular areas or worse. Or what is the result of making a process change. Maybe, change in a particular process needs to be analyzed to see whether it is having a positive effect on a range of KPIs or a negative effect.

7.5   Outcomes

"Outcomes are the events that change as a result of the analysis and decision making" by the utilization of ES and its data (Davenport, 2000, p. 224). These are the reasons for ES deployment through the use of ES functionalities and information. The outcomes were discussed in much detail with participants and the findings are presented in this section.

7.5.1   Changing behaviors

After the implementation of SyteLine, and as a result of the improved processes, improvement in stakeholder behaviors including those of suppliers, customers, and employees is a positive outcome at Cevon. As explained by the IT manager, over the years the stakeholders become accustomed to having and using the system in a certain way. But if the system functionality becomes unavailable due to any reason, then the realization of how beneficial the functionality was, is recognized:

> when people get used to having a particular report or screen, the improvement that brought it in is forgotten, but if they no longer have it, then its benefits are realized very quickly. Generally people are not worried about how good a system is as long as it is there. (IT manager)

According to the IT manager, when some processes are automated and the improvement is made, reducing the effort people have to put in to do a particular task, then people say "that is very good, thanks very much". An example cited by the respondent is when Cevon initiated the BU split:

> there were functionalities such as transfer orders, multi-site quantity moves that were used for transactions between the business units. But after the split, these functionalities could no more be used since the business unit SyteLine systems were separated as a result of the separate legal entities. People had to resort to creation and placement of purchase orders instead of being able to use the earlier automated transfer orders. At the receiving end, the purchase orders had to be received by the factory and customer orders created, shipped, and invoiced. These shipments again had to be received by the business units in their system to close the purchase order and complete the transaction. It was certainly realized how much more difficult it was doing in some ways to a more complicated process but the same people did not think or realize how good a transfer order mechanism was at first because it was just there. It allowed the planners to do their job.

The O&SC manager further explained that having such automated processes at Cevon together with the availability and sharing of data had streamlined the internal and external transactions between employees, customers, and suppliers:

> earlier, there use to be a constant tussle between the planners and the production staff, buyers and the vendors, customers and the ops team, regional sales people and the dispatch team over various transactions such as orders executed, stock transferred, item prices, and invoices. This has changed and that tussle does not exist any more. (O&SC manager)

The collaboration between stakeholders has improved with fewer disputes over transactions. This has significantly improved stakeholder relationships and behavior.

7.5.2 New initiatives

There have been several new initiatives at Cevon through the utilization of SyteLine and the result of data transformation. These findings are presented next.

Process efficiency improvements

Cevon has ventured into several new initiatives based on process efficiency improvements as a result of SyteLine implementation. Cevon has created complete bills-of-materials (BOM) with item cost break-ups for their various product families:

> the engineers can pull up the costed BOMs, look at the high value items, and provide the information that we're looking for to know the profitability of the various products and make pricing decisions. (O&SC manager)

Another new initiative resulted in the just-in-time procurement of material through the integrated order intake and manufacturing process. The operations team enters customer orders for specific products in alignment with the customers' request dates and establishes JIT planning and procurement actions through SyteLine MRP, reducing inventories, monitoring timely deliveries, and improving customer services:

> the MRP run through SyteLine prompts the procurement team to timely release purchase orders to vendors and procure materials just-in-time to match production schedules. SyteLine also prompts the timely scheduling and loading of jobs for production, assembly, and packaging until the final dispatch of products to end customers. (purchasing manager)

Cevon has also initiated value engineering and cost reduction exercises along with product profitability analysis. The company has targeted to achieve 7.5% BOM cost reduction during 2007-08. The purchasing manager confirmed that they were on-track to achieving the target with the support of their vendors. Also initiatives such as KPI monitoring of business activities through balanced scorecards and digital dashboards has helped Cevon to attain goals and targets set by the management team.

Vendor-managed inventory

Another new initiative at Cevon is the implementation of vendor-managed inventory (VMI) through a new consignment stock process. The managers at Cevon realized that they must hold inventory as "vendors owned" to reduce the liability until the stocks are depleted. In this process, Cevon's vendors stock materials in Cevon's warehouse and also have material reserved for Cevon stocked at their own site. This is done with the agreement that Cevon will sell or consume as much of these materials as they can. Only after Cevon has consumed the material will the vendor issue an invoice. If Cevon cannot consume or sell any more material, they must inform the vendor immediately:

> there was a lot of work done and data exchanged between SyteLine and the new consignment stock application which is an extension to the existing system. Using this application, the buyers, instead of procuring materials, provide a forecast to the vendors that are part of this program. The vendors supply the material as per the forecast, but the ownership including the management of the inventory remains the responsibility of the vendors. The vendors are paid as and when the inventory is back-flushed and consumed. This new initiative is a big success to the company and has made a huge difference to the cash flow. (purchasing manager)

SyteLine viewer application

The SyteLine Viewer is an application that provides a read-only view of SL7. The user does not log into the main system, therefore a user license is not required. The application has in-built queries that provide real-time information based on the user requirements as explained by the O&SC manager:

> there were always licensing issues with SyteLine earlier which was always a problem. The number of licenses available was limited but the numbers of users wanting to log-in and access data were more. Emails were sent around saying those who are not using SyteLine, to please log-off. So, as a new initiative an application called SyteLine Viewer was added as an

extension. Most people now use SyteLine Viewer regularly. The data are accessed from the system in a slightly different way using in-built queries, but has been a very clever thinking, and really helped the business.

Cost reduction initiatives

Cevon has started monitoring the cost of poor quality and has initiated cost reduction programs such as improving rework costs in the quality area:

> the engineers are not only required to complete the traditional rework of faulty production but also have to create rework jobs in SyteLine so that all the material and labor consumed for the rework is recorded and the cost is allocated to that job. This information is reviewed later pulling out all the rework jobs to evaluate how much is really spent doing rework. This was one of the things I found out that over a year we spend five hundred thousand dollars only on rework. (quality manager)

7.5.3 Process changes

There have been several process changes in different business functions at Cevon as a result of the SyteLine implementation and ES data transformation.

7.5.3.1 Sales, distribution, and customer services

The focus of sales and customer services is an outcome from processes covering customer order forecasting, sales and operations planning, order entry, customer order management, and the RMA (returned material authorization) that interfaces with customers. The resulting process changes with improvements in these functions are explained below.

Sales forecasting and operations planning

The sales order forecasting process begins at Cevon with a business plan. The executive management creates a budget in consultation with the regions and the operations team, and finalizes the business plan:

> a few years ago at one time, the factory had been receiving fewer orders than the regional forecasts and the company had not been meeting the budget. There was not a lot of visibility of that information. The ops team started pulling reports from SyteLine and realized there was no way they would be able to meet the budget because there were no orders in the system and the forecasts that existed were way too large. There was too much buffer in the system which was not being turned into firm orders.

> Therefore, what was happening, purchasing was ordering truck loads of materials for products that were not going to be built. The warehouse was just getting full of raw material and inventory which was not being transformed into finished product. There was a stage where the warehouse had to be extended and components had to be stored in the covered car park area across the road. Three hundred pallets of stock were sent to the BAX Global warehouse as well, who are the company freight forwarders, for storage at their facility near the airport incurring additional monthly storage cost. We resorted to a revised sales and operations planning process with the help of SyteLine and the situation changed. (O&SC manager)

How this happened is explained next. Orders for Cevon were mainly made up out of confirmed and forecasted orders received from subsidiaries. The aim was to have all orders for the next three months firmed up and forecasts reviewed for the subsequent three months with the customers. Cevon started generating a six monthly forward order status report by region from SyteLine using BI. This also became the founding point of the company's manufacturing rolling plan. The forward order status report was emailed to all the subsidiaries and regions with a request to firm up the next three months demand and review the following three months forecast based on the inventories and their market requirements. This process was repeated each month through the BI system which helped to streamline the demand planning with subsidiaries. As a result, the materials and capacity plans were updated regularly in SyteLine and adjustments to the procurement and manufacturing plans were automated through MRP. This new planning process has not only improved inventories, but also the factory capacity and production planning leading to improved delivery performance and customer service.

Customer order planning

The customer order planning process is much improved through SL7. The O&SC manager stated "the use of APS functionality has made a major change in achieving accuracy in the planning process". In the revised process, based on the demand quantity, an ATP (available-to-promise) is requested from the system. This is done while entering a customer order or a forecast with the customer's requested delivery date. As explained by the O&SC manager, an ATP executes a planning run for that specific order line and informs acceptance of the requested date or provides an alternate date with a report on the delay. The user can drill down to review the bottlenecks, and understand the reasons for the delay such as either component receipt dates are causing the problem or the availability of capacities or resources. This information is used to communicate with purchasing and manufacturing to review possibilities for improvement in meeting customer demand. Additionally, an automated order

verification report has been introduced which is emailed to the customer, confirming the delivery date with all the other relevant details of the order. Some of the new reports introduced in this area include order verification and customer overdue reports that have helped Cevon in providing and monitoring customer service.

Pricing

The pricing process is another notable area which has substantially improved at Cevon:

> earlier pricing structures were not very accurate and there were occasions when a different price was used for the same customer item. The price verification was done manually. In SL7, pricing is based on the customer item cross references maintained in the system. This means that the system only uses item prices fixed for specific customers and does not allow use of any different prices. The regions review the pricing once every year. (O&SC manager)

Through this process, any disputes in prices or terms of business that may have existed earlier have diminished as a result of the new process. A gross-profit report has been introduced to support the monitoring of gross profit against sales and the product pricing outcomes.

Returned material authorization

The quality manager explained that the returned material authorization (RMA) process that Cevon used was the standard SL7 process:

> the grid view gave the team an easier platform to find existing RMA lines and sort them easily for various queries. This option replaced the need for some of the query reports which the company wanted to customize in this area. Prior to the creation and processing of an RMA request from the customer, a credit authorization was required. A customized report was used as a verification report. This report was first dumped to an Excel spreadsheet, then manipulated and e-mailed to customers. The ability to print straight to Excel made this function smoother. The RMA products were tracked through serial numbers. The main inefficiency that still remained was the time it took to do returns of large quantities of serial numbered items. A 700 unit RMA would take a full day to process. Another issue was the inability to do the financial process of giving credits to customers for warranty returns.

To further improve this process, Cevon has put in another bolt-on service module called FS-Plus. This module is specifically helpful to organizations that have a regular service function to perform such as field servicing, where engineers go out to service or repair products that have failed at customer's site. This module also helps when products are returned for repairs and the ownership of those products still remains with the customer:

> in this system a record of the kind of repairs being performed is maintained that helps to find the root cause of problems and evaluate the type of faults that are causing failures to products and its related costs. This information, when fed back to the design engineers, helps them assess the issues and review how they can improve the design to try and eliminate warranty returns and its associated costs. This system is being used to track what the warranty expense rate is so that the company can recover the warranty costs in the cost of the products and also target to reduce this cost in the future product development. (quality manager)

Since this is a new system recently set up at Cevon, the service personnel are still new to its complete functionality. Within this system there are several areas that Cevon will look at using and developing further:

> it is expected from this tool to deliver some immediate benefits not only in terms of what the problems are with the company's products but to help the service function become a lot more efficient and proactive in the whole service area by providing preventive maintenance to installations at the customer sites. (quality manager)

Cevon can now schedule engineer visits to installations for preventive repairs before the products fail as well as plan the availability of service technicians through the system. Cevon has also achieved improvement in accessory sales, logistics, and inventory management with the integration of manufacturing, materials, and accounts systems through the new field service module.

7.5.3.2   Planning

The O&SC manager explained the planning process:

> the aim of the planning process is to provide input for the purchasing and production functions as to what products and parts are required by week and by quantity. In doing so, SL7 clusters the required production into similar families [product groups]. By grouping requirements it is expected that efficiency gains are achieved as the set up times between individual

items within each family is less than the set up times between items of different groups.

The outputs of the planning process at Cevon result in creation of a production plan, printed circuit board (PCB) manufacturing schedule, final assembly, packing, and outwork job schedules through SL7. The production plan specifies items required for production in the next four weeks. The supply quantity is indicated against the job numbers related to each item. The added value of the production plan is based on the daily production quantity and by week, that is based on customer requirements and line capacity. The requirements are grouped by Line/Family/Work Center and Item:

> the production plan is created by means of a BI report which is transferred into an Excel spreadsheet. The main issue with the earlier production plan was that it did not communicate any order priorities to the production units. Given its weekly buckets, it did happen regularly that the shortages occurred between levels, slowing down production. (O&SC manager)

The BOM was not always 100% accurate. Certain areas were flagged as being weak such as the final packing level BOM often contributing to stoppages in production:

> with SL7, the planning process improvements include a) the system plans and provides requirements per item/per time bucket based on demand, b) it is now possible to schedule certain parts of the business by minimizing the set up through grouping by family, and c) the planners are able to capacity plan forecasted orders and assess the need to add capacity from the feedback from regions. (O&SC manager)

Requirement planning

SL7 synchronizes production with available materials and customer demand to create planned orders. The planned orders are reviewed from the planning summary which show them in weekly time-buckets clustered according to three factors – order minimum, order multiple, and number of days supply – as configured by Cevon.

Each planner then reviews the generated planned orders to firm-up by means of generating job orders. This integrated planning process replaces the earlier approach and is more efficient to execute.

Scheduling

A new scheduling process is incorporated through SL7:

> the issue with the earlier process was its inability to sequence work minimizing set up time. But in SL7, we can link each item to a set up family. A matrix can be defined which indicates the set up times required when switching from one family to another. By combining this with the scheduling rule to 'minimize set up' time, scheduling can achieve a more optimal sequence of jobs than the planner was able to do earlier. (O&SC manager)

The jobs are created in SL7 from the Planner Workbench functionality with start and finish dates. The scheduler sequences these against the resources based on the rules set such as "minimize set up". The output of the scheduling is the allocation of resources against the jobs based on the schedule and sequencing rules and the current operations which provide an optimal plan.

Sales and operations planning

The new planning process through SL7 allocates resources. It indicates how much and when a resource is required. Based on this working of SL7 the O&SC manager explained:

> as soon as a salesperson enters a customer order, the order is planned after the next planning run and has allocated capacity according to the routing that has been set up. As the capacity is planned there are various options that are available to represent the data back to the user. This includes capacity graphs by resource and resource group for a chosen time period and bucket. Armed with this information, a call can be made whether additional shift/labor would be required for the forecasted work.

In summary, the SL7 planning process provides forward visibility of planned orders and the impact on capacity, assisting planners to analyze both historic and forward sales figures. The planners can review overdue customer orders, analyze the delivery performance to meet the customer commitments, and evaluate reasons for any delays.

7.5.3.3   *Purchasing*

Cevon's purchasing has two separate functional areas. The sourcing function, which is strategic, and the buying function, that is execution focused. In both of these areas there is a further split

into electronic and non-electronic parts. Purchased parts are managed through the new SL7 planning routines and the inventory management program (IMP):

> the IMP is a process which deals with consignment stock working towards a VMI system. The sourcing function identifies and negotiates with potential suppliers. Once the supplier has been established as a Cevon supplier and a vendor account opened in SyteLine, the buying function takes over. All of these processes are managed through SL7. (purchasing manager)

In light of the Sarbanes-Oxley (SOX) Act requirements, the authorization of users within SL7, particularly so, in the sourcing and buying function, is an important feature. This is part of the system's functionality.

A number of subsystems are used in the purchasing function at Cevon through SL7 such as consignment stock, lead-free database, tooling data, tracking of goods expected to arrive with tracking numbers, and amounts payable. Other sub-processes executed in the purchasing function as part of improvements through SL7 are the subcontracting, vendor creation and maintenance, and purchase order creation and maintenance. These subsystems are relevant to the purchasing function, but are also related to improvements in other areas of the business.

Purchasing subsystems

The consignment stock inventory management program executed at Cevon has improved the cash flow. This process discussed above is also explained as part of the new initiatives of Cevon in Section 7.5.2.

The newly created "lead-free" database maintained within SL7 provides specific information on parts to ensure compliance to the RoHS (lead-free) standards based on the RoHS regulation which restricts use of certain hazardous substances in electronic products. The database provides information from the manufacturer determining whether the part is RoHS compliant or not and establishing traceability. A new tools database is created as part of fixed asset register to track the company assets and depreciate them within the finance module. This forms part of resources which is linked to "assets" in the fixed assets register.

Another subsystem introduced in purchasing is the tracking of goods expected to arrive with tracking numbers. This forms part of the standard goods received note (GRN) functionality in SL7 executed in inwards goods. The revised "amounts payables" subsystem used in purchasing forms part of the accounts payable (AP) in the finance module. The AP subsystem provides the visibility of the amount due to vendors at any point in time.

Purchasing sub-processes

As per the O&SC manager, since 1993, the European Economic Community has required that certain additional information is tracked at the item level, including delivery terms, nature of transaction code (NOTC), commodity code, origin, unit weight in kilograms, and consignment number. These details are maintained in SL7.

The Planners Workbench has made the purchase order process more efficient and reduced the ability to "fiddle with dates". Relevant information is available to planners for decision making. Reports such as PO due report, PO cost variance report, order action report, item stock on-hand report, and PO freight report are available from SL7:

> earlier most buyers had their own spreadsheets by which they maintained the expected date of arrival for purchased items. With the new user interface and grid view in SL7, the buyers now make these updates against the purchase order lines in SyteLine and do not need to maintain separate spreadsheets. (purchasing manager)

In the subcontracting sub-process, a subcontracting item is defined as an assembly in the BOM for the support of the purchasing process. The items are listed on the bill to be sent to the subcontractor.

Finally, in the vendor management process, the vendor details are loaded into SyteLine for recurring retrieval. SyteLine also displays communication logs that display all communication with each vendor.

7.5.3.4   Inventory management

The processes for inventory management and maintenance at Cevon include inwards goods receipting, consumption in manufacturing, outwards goods, and stock accounting. Before SyteLine, Cevon used a PC-based system for warehousing that was ad-hoc and not integrated into the other parts of the business:

> the process was manual and prone to errors. The newly developed inventory management process focuses on the integrated stock control functions with the ease of having these operational controls through SyteLine. (O&SC manager)

The stock control function makes use of three subsystems including barcode labels, QA trackers (quality assurance tracking system), and freight watch (courier tracking number system). All

three subsystems have been implemented and are being used as part of the newly developed SL7 functionality.

Inwards goods

The inwards goods function at Cevon maintains the records for receipt of all materials within Cevon through SL7. As part of the SL7 functionality the process uses master files such as item master, purchase order master, and vendor master to receive and track supplies from vendors:

> a number of standard files are used to record receipt and issue transactions including stock adjustments and its reasons, or any miscellaneous issues and receipts. This helps in the reconciliation of stocks in case any mismatch or traceability issue arises. (O&SC manager)

Receipting

The new receipting process is standardized at Cevon through SL7. In this process receipting is done by "unit" to avoid problems with conversion factors. Upon arrival, the goods are booked into an arrival inspection location. The goods are seen in this usable inventory location through the SyteLine screen; the assumption is that the goods are fit for use, even though inspection is still to occur. From here the stock is moved to the relevant location depending on whether it is accepted for use:

> if the goods are accepted the stock is moved to its bin location in the warehouse from where it is brought to the factory based on factory kanbans. These processes are performed assisted by the SyteLine Data Collection module part of SL7. This module has integration points for all stock movements. Also, the use of the GRN (goods receipt note) functionality in SL7 registers information such as the freight forwarder, operator consignment information, and other pertinent details of the goods to arrive against specific vendors. This has made the receipting process quite smooth. (O&SC manager)

Stock consumption

The consumption of stock is triggered through the back flushing of materials after the stock is built in the factory and passed by quality assurance (QA). All the items consumed in production jobs are converted from material stock into finished goods. The kanban location where back flushing is executed relates to a production "Line" and is an automated process within SL7:

it does happen that the location sometimes is incorrect, not filled in, or does not have the back flush flag on due to kanban controllers' human error. This leads to wrong back flushing and incorrect stock accounting but such occurrences are rare and corrected as soon as observed. (O&SC manager)

Completed production

With the completion of a job order, the goods are sent for QA checking. After passing QA, the related job order is marked as completed and serial numbers are printed. Serial numbers are scanned using the barcode process enabled through SL7.

The inventory is moved to finished goods (FG) dispatch warehouse location from the QA location, both within SyteLine as well as physically. With SL7, the FG visibility and accuracy has improved and Cevon staff can confidently allocate stock to customer orders.

ABC analysis

The SL7 ABC classification functionality used by Cevon is defined around the standard 75%-20%-5% in terms of value and throughput. This classification is used for the automated cycle counting process through SL7 in the following counting frequency:

- A items: 90 days

- B items: 120 days

- C items: 360 days (yearly)

   the ability to review stockroom location and the inventory within these locations by means of queries in SL7 has largely helped the purchasing and warehousing staff. We operate with a 'stock-turn' of about 6. Using the SL7 ABC functionality to determine the A, B, and C class items and feeding this into the cycle count process has improved the process efficiency for cycle counts. The A items are counted 4 times a year, B items counted 3 times a year, and C items counted once a year controlling the inventory of A and B class items. (O&SC manager)

Cycle counting

Cycle counting is done as a daily activity at Cevon and the count values are entered into SyteLine. The process is regular and completed timely, which has led to an improved stock accuracy. The respondent explained that the factory inventory control function has been facing some specific challenges during cycle counting that Cevon has learned to work with:

the unpacked finished products and the tested PCB's [printed circuit boards] are managed by the inventory team, but with the counting of the finished goods in the packing area, which are not booked in as FG, the count needs to be broken down into individual components. Any stock variances are given to the production staff for signing off. The factory inventory goes through the same counting process… and the cycle count is a time consuming process. Recent analysis has shown that a full item count in all stock locations takes up to 33 minutes with SL7 support, although it used to take much more time earlier. (O&SC manager)

Inventory accuracy

Given the frequent counts, the inventory data in SyteLine is accurate at Cevon. Inventory inaccuracy can be contributed to a number of factors:

a) picking from the wrong location, inventory levels may be correct, but inventory by location is far from accurate, b) bill-of-materials on the job is different to one that is actually fabricated hence for each wrong BOM-line two items will have wrong inventory levels, c) people taking stock for other usage, and d) data-entry errors. (O&SC manager)

At Cevon, SL7 allows negative inventory. This is based upon the configuration setting approved by the Cevon management. The reason for allowing this is to avoid holding up a transaction if it creates a negative stock. A negative stock report is run separately, highlighting cases that are then investigated and corrected. The other reports used for managing inventories are the stock variance and average monthly usage report.

7.5.3.5   Manufacturing

Processes in the production management function include creation of jobs based on schedules (planning output), creation of production plan, job review (preparation for production), production review, post job review, and job closure.

Creation of jobs based on schedule

The manufacturing schedule for the week is created by planners through SL7 using the APS functionality:

a system-based check for the components to use and the supply situation is performed before a job order is created. We generate the schedule for the

week as a list of planned orders with a start date in the coming week. (O&SC manager)

The jobs are scheduled based on due date, available resources, and other criteria to generate an optimal plan. Based on the planning and scheduling review, job orders are firmed up for manufacture.

Create jobs

Earlier jobs were created by planners manually which were sent to the production staff for review. The production staff reviewed the material availability, BOM requirements, and production plan before they released the jobs. In SL7, this process is driven from the Planners' Workbench:

> the new process reduces the work of entering jobs and it avoids creating jobs that cannot be met due to lack of resources. The start date for such jobs is planned after the resources are available, as per SyteLine. (O&SC manager)

Now the jobs created have a firm status as the planners can check each job against pre-job information stored separately as production job traveler data. This has minimized any problems with the job once started.

Job review - preparation

In the job review process through SL7, a number of preproduction steps are taken. These steps include a review of ECN and comparing the job BOM with the current/standard BOM to see if any changes exist. An exception report is generated and documented:

> the check ensures that the product is being built according to the BOM allocated to the job and there are no errors in the build process. It also highlights any errors in the BOM if any. (O&SC manager)

The delayed firming of planned orders into firm job orders in SL7 has reduced the number of discrepancies between the current/standard BOM and the job BOM.

Production review

The production review process is focused on "what is happening". This includes on-line discussion through SyteLine, the review of job traveler, the set up of the production line, and

checking of the first sample against the reference called "gold sample unit". This stage is concluded with the initiation of the production run:

> this is a check prompted through the system to ensure correctness of the full production run. (O&SC manager)

Post job review

The post jobs review ensures that the specifics of the job are stored in the SL7 database for future review when the item needs to be run again. Also some standard SyteLine reports are run such as job material status report to check that the process is properly completed as stated by the O&SC manager.

Job closure

The process for closure of jobs in SL7 is automated:

> this is done by a utility which closes jobs automatically if the job quantity matches the produced quantity for the job or after 10 days, whichever is earlier. (O&SC manager)

Subsystems

The SL7 subsystems used for production are the manufacturing suite database, job traveler database, and the skills database to provide a production plan report. The report specifies "line schedule", "build plan", and "stage instructions" used by production engineering and QA. Another report used in this area is the job material status report:

> these integrated subsystems have improved the manufacturing process in our factory and provide the operational efficiencies and automation we were looking for. (O&SC manager)

7.5.3.6   Dispatch

The dispatch process involves a picking list detailing orders expected to be shipped in the coming week. This is followed by the manual picking of products. The O&SC manager explained that the main process step is the customer order shipping:

> here a very large number of serial numbers are involved. This was a tedious process with a lot of mismatch in the serial number processing earlier. After SL7, this process has become smooth with automated serial number control which resolved the earlier mismatch issues.

After the shipping is confirmed, the packing slip is generated by SL7. Other reports also generated include: (1) cover sheet (includes volume, weight, and number of cartons), which is e-mailed to the freight forwarder; (2) custom documents which describe the contents of each box in the shipment; (3) shipping instruction documents, this contains all the consigner/consignee and freight information; and (4) other documents which are normally filled out based on local requirements:

> the delivery orders functionality in SL7 has combined the earlier disparate dispatch information such as bill-of-lading, consignment note, and customer order with its related documentation into one integrated delivery order system for shipment purposes. This has helped the dispatch team to combine several customer orders into one shipment and produce delivery orders for freight forwarders with all the relevant information together which has reduced costs and improved efficiency... there are a number of sub-processes that were not recorded prior to putting in this process. Earlier, the dispatch staff use to create separate spreadsheets for providing shipment information and details. These were recorded separately using an Access database. The manual spreadsheets and databases together became another system that the dispatch staff had to maintain. There was also the chance of potential fraudulent behavior since the dispatch staff could send products using this external system out of the door. The delivery order functionality in SL7 has automated this process. During a Dun's audit [review by the Dun & Bradstreet auditors] to meet the SOX requirements, it was projected bringing all of this into SyteLine and eliminate the other systems that had to be maintained, and the costs associated with them. (O&SC manager)

Now, with the use of the delivery order functionality, Cevon has brought all of those disparate systems into a single system with better traceability for any future audit needs:

> if there is any concern of fraudulent activity such as a customer ringing up and complaining that they have not received full quantity, then that information is straightaway available from SyteLine. The information can be shared by 135 users rather than depend on any external system that could be manipulated and only shared by very few people. So, the data is retained, it is secure, it is available to many people. (O&SC manager)

Cevon believes that this will become better as they develop the process further and would be easier for the users as well. Cevon is getting the benefits from these systems and the new processes which are easy to maintain and better in terms of compliances. "This is certainly a

more efficient way of doing a logistics function", was the response from the O&SC manager.

7.5.3.7   Finance

The financial process changes at Cevon include changes to various finance functions such as accounts payables, accounts receivables, invoicing and transfer pricing, general ledger and reporting, and fixed assets.

Financial management - accounts payable

Cevon has made no subdivision for accounts payable (AP) processes through SL7 which include the vendor management, invoice registration, and vendor payments sub-processes together. The sub-processes within these functions include creation of a new vendor account, receiving an AP invoice with a PO number, vouchering an AP invoice from a PO number, and making a payment to a vendor:

> this integrated system has improved the accounts payable process reducing the time taken to clear payments, achieving speed and control in the function. (FC)

Creation of a new vendor account

Creation of a new vendor account process through SL7 integrates with other functions (e.g., purchasing). In the past, Cevon used only wire payments and standard checks as payment types. With SL7 more payment options are available and Cevon has started using an electronic funds transfer (EFT) payment process:

> in SL7 account payable replication is set up to have the vendor codes determined centrally, even though little vendor overlap exists between sites. This helps in paying vendors from a site different to the one owing the payment in the multi-site environment. (FC)

Receiving an AP invoice with a PO number

For non-stocked items the finance controller explained:

> the main problem we faced earlier was that in the receipting screen the GL account was not shown, the user had to check back into the purchase order to make sure the account used was correct. With the change, it has become possible for us to use the standard SL7 vouchers payable report.

> This has resolved the earlier challenges of the reconciliation that we faced
> and the process efficiency has improved. (FC)

Some other reports mentioned by the FC for this process were aged voucher payable and vouchers payable report.

Vouchering an AP invoice from a PO number

Earlier, the vouchering process was PO driven, but now it is vendor driven. The FC noted that "initially, the idea of not running this process by PO was a little strange". However, it was realized that any AP invoice would have vendor details and from there the purchase order could be selected. This eliminated the problem of creating negative amount vouchers for returns through SL7:

> all required data elements are supported in SL7. The only way the form
> and the voucher generation processes are executed is slightly different, but
> with better outcomes and control. (FC)

Making a payment to a vendor

The earlier process was based on the cash flow requirements. Decisions made on vendor payments required manual intervention and each decision was taken on a case-by-case basis. This process is replaced in SL7 and is driven by the "generate payments" functionality:

> the revised automated process has made the vendor payment much more
> efficient, reduced the number of steps involved, and removed the
> requirement for any manual intervention. The main reports used in this
> area are the purchase order report and the remittance advice report. We
> also have the multi-site functionality enabled in this function. The vendors
> are centrally defined with an option to be able to pay across multiple sites
> such as group subsidiary payments. (FC)

Financial management - accounts receivable

The earlier accounts receivable (AR) process used well defined specific procedures, therefore the new processes through SL7 were thoroughly reviewed to satisfy the demands before the change over. The processes that were changed through the use of SL7 for AR included customer maintenance enquiries, customer invoices statements, funds received allocations, and AR reconciliation reports:

> for the AR processes standard SL7 reports are used such as the 'tax
> invoice' and 'customer statement' reports. Some other reports such as
> 'credit note' and 'sales analyses' are part of the month-end reports.
> Another two reports that are used to help customer control are 'trade
> history' that explains the payment behavior by customers and 'credit
> analyst rating report' which provides information about the credit situation
> and the last time this was updated or approved. (FC)

In the enabling of multi-site functionality for AR, there are two categories which are centralized at Cevon, order entry and accounts receivable. Here the new customers are centrally defined and are able to receive a customer payment into another company that has raised the invoice.

Sarbanes-Oxley Act compliance

Earlier the Sarbanes-Oxley compliance was met by a number of off-line activities at Cevon. A number of user-defined fields were used on the customer master, which supported the SOX requirements. This was done through reporting outside SyteLine in Excel. This process has been made easier in SL7 through the query functionality. Monitoring of statutory requirements such as SOX and arising of alerts have been set up using "workflow" features.

Financial management – General Ledger (GL)/Financial Planning and Analysis (FP&A) accounting processes

The accounting processes within the GL and FP&A functions involve various financial events for a given accounting period at Cevon. These processes are executed on a weekly basis with support from SL7:

> earlier, we received data from other fledgling sites and subsidiaries by e-
> mails for finalization of accounts, and the data were loaded into a Hyperion
> system for US Corporation. In the SL7 set up, each of these subsidiary
> sites resides on the system and are accessible by authorized users. For a
> number of sites that earlier sent their financial records via Excel, this data
> are now loaded into SyteLine directly and are accessible from the various
> group entities and the individual sites. (FC)

The outputs in week one include cash flow reports such as AP, AR, Forex (foreign exchange), and their aging reports through SL7, whereas earlier an Excel spreadsheet was used for the cash impact analysis at Cevon.

In weeks two and three, sales reports prepared for US Corporation include group sales report and sales by individual BUs. Subsequently, the NZ factory variances and inventory adjustments

are reported. Some of these reports generated for transactions are specific to certain GL accounts such as stock and production variance report and bank reconciliation report. A summary of bank accounts reconciliation is produced and RMA reconciliations are executed to correct the sales figures.

In week four, the month-end financial processes include cut-off for sub-ledger by 16:00 on Friday. The system is then locked out until 12:00 next Monday. All the month-end utilities are run and balance sheet reconciliations are signed off by Tuesday for the month-end values for inventory, work-in-progress for the factory, work-in-progress for projects, accounts receivable, accounts payable and vouchers payable, and bank accounts. The group (multi-company) consolidation features also include BUs, and the subsidiaries for the finalization of accounts. The FC noted that "the accounts are closed in two working days which used to take weeks earlier".

7.5.3.8   *Systems*

The upgrade to SL7 was a move by Cevon to improve the systems management function including enabling ongoing version support from the vendor and moving to a SQL database platform. The identical systems are rolled out to all subsidiaries, BUs, and distribution offices of Cevon. The move from a PC-based system to SL5 and now to SL7 has proved beneficial to Cevon in terms of the speed of making mass changes and the ease of identifying pertinent data:

> there have certainly been some usability advantages. The SL5 version
> allowed users to work on one record at a time, but with SL7 it is possible
> to have the grid view which allows users to view multiple records at one
> time. It is possible for us to sort records by using filters and view customer
> or order details for specific dates. The data can be manipulated using the
> grid view, exported to spreadsheets and re-imported as required. (IT
> manager)

From a systems perspective, other SL7 process improvements have been use of an APS module to bring accuracy into the planning process (between promised customer delivery date and date of delivery), reduction in factory and regional inventories (making realistic delivery plans to aid planners), thus making substantial improvements to both factory operations and customer services:

> if plans are not created that are not achievable by the factory then some
> efficiency gains are obtained because the staff are not running around
> trying to satisfy the customer who is shouting the loudest since their
> orders are not met. (IT manager)

The IT manager explained the benefit of using an integrated SQL database platform:

> a coordinated and integrated set of data is accessible to users that allows all the functions of the business to work in an integrated manner rather than the standalone Excel spreadsheets used earlier. This provides the accuracy in what the company does. It allows the company to monitor costs and ensure being profitable. To know the sales, the costs, therefore know the profit and be confident that it is accurate... Being able to match demand with supply and delivering to customer expectations... Ensuring what the system says is what actually is such as inventory accuracy.

The system also supports additional areas such as reporting to the parent company or reporting to Inland Revenue. Extension to subsidiaries and distribution centers by providing identical systems has helped to redeploy staff across subsidiaries/distribution offices and the factory with minimal orientation and adaptation-time. The respondent, however, added that Cevon has realized several benefits "but have not gone as far as they would have wanted to due to the organizational changes". The sale of Cevon did not allow further exploration of SL7 functionalities due to the diverted company focus.

Change request system

The functionalities that are required for a robust approval system are not adequate through SyteLine and a separate change management system has been adopted through an extended bolt-on change request (CR) system. The new Web-based system helps to track changes by capturing all the relevant information, linked documentation, and communication at one place. The system maintains all this information in the database and provides a search engine through keywords. Automated workflows streamline the communication for pending CR approval through to implementation of the CR. Actions such as execution of BOM changes in SyteLine's bill-of-materials management system and transfer of relevant information into SyteLine to provide component revision histories, are directly performed.

For bill-of-materials changes, the CR system references the SyteLine item master to provide the list of parts and the correct part number. When a part is phased out or replaced by another part, it is linked to the CR number in the item master so that the subsequent users can identify the reason for the obsolescence and be able to trace the CR. The CR system is not only used for product changes but is also used for other system changes where decisions need to be recorded:

> if SyteLine configuration requires change to meet a business requirement or to allow users' access different screens, it is the company's method of recording the change. (IT manager)

The system records details of changes made (e.g., date of change, approved by whom), so that the changes are controlled. If there is any issue subsequently, the reason for the decision can be traced back and evaluated. This is a very robust method of monitoring changes and recording decisions whether these are permanent changes or one-off concessions.

7.5.3.9   *Product development*

The IT manager explained that SL7 functionality for product development includes the item master control, product definition, and item costing. The item master makes use of several master files specifying the product code, family code, commodity code, and price code. Except for the commodity code, all other master files are set up as part of the process improvement at Cevon. The product codes are set up from an engineering perspective to identify each product separately. Some of the product codes however, are now becoming obsolete due to the short product life cycles with Cevon's products. Groupings within products of similar variants have been created to define family code masters. The planning group uses the family code for reporting purposes. Finally, the price code automates the item pricing process for the various customers. The price matrices link customers to the item pricing. Through this process, when an item matches a customer, the pre-determined price is picked up and used by the system.

The coding system is based on a set of rules for each code, such as the length and the first two characters in the item code. Items are created by "configuration control" based on input from engineering. The engineering input is in the form of an Excel spreadsheet for the bill-of-materials information and a .pdf file for the drawing and specification of the main item. Standard copy functions from SyteLine are used to create new items. Although item revisions are an important aspect for version control, this field value is not used at Cevon, since it leads to additional master maintenance and requires some customization:

> if the revision field value is set to 'hold' the product definition routing in the BOM cannot be maintained and this requires some customization. Therefore, for version control, we use another system called Quma Version Control System (QVCS) through which the version of item revisions is controlled for traceability. (IT manager)

In SL7, the master files for product definition are linked to production "shifts" and "work centers" in the factory. Both of these are integrated to the job order system in SL7 and are used for the SL7 planning and scheduling processes.

Some of the reports regularly used in the product data management area are copy/move current materials lines, obsolete/effective dates on BOM, unit cost check report, change effective dates on BOMs, update of item, re-sequence BOM lines, and item where used report.

Product development - projects

The projects module in SyteLine is not fully operative at Cevon. The projects are not being closed in the system and are mainly used for "development" such as booking time against projects. The FC explained that as the project time did not have value against individual activities, hence nothing got capitalized or expensed automatically. The material costs accumulated through stock transfers and purchases, but the link from purchase to the project sometimes broke. The "project cost calculation was not run" therefore the costs are not calculated for the projects at Cevon. Since the subcontractors used in projects are booked straight to the GL hence those costs are not absorbed in the projects. To meet the project accounting requirements through SL7 some customized reports are needed. A column "available to spend" in project costing reports was required but this is something that Cevon was not willing to do. Therefore, the projects functionalities of SyteLine are not fully utilized and project costs are accounted separately by the finance control function:

> for the income side of the project, no form of project invoicing is used. Any capitalization happens manually. The projects are mainly used to make test equipment and special tooling which are expected to be capitalized. In SL7 the project reporting requirement against the GL is more difficult as the idea of using project is to have the detail on the project ledger and the GL is used for the compressed or aggregated financial data. (FC)

However, after the split of the company, the Commercial BU of Cevon has implemented a Web-based MS Project Server 2007 application for their project management. They have also recently implemented a Web-based product lifecycle management (PLM) system from Arena Solutions for their product development processes. The Commercial BU has moved their manufacturing operations from Auckland to Singapore and Indonesia and the BU currently has two development centers, in Auckland and in the US. Most recent findings suggest that the BU has now geared itself through the use of the PLM system and the project server to manage development of new products in its globally distributed environment. The O&SC manager explained the reason for the implementation of these systems:

> take for example Qube2 which is one of our core products, within the R&D environment. If you want to see the BOM you have to go to SyteLine or SyteLine Viewer, if you want to see the changes to the BOM then you have

> to go to the CR [change request] system, if you want to see a circuit diagram then you go to the master folder, and if you want to see the technical specifications then you have to go to QVCS [Quma Version Control System]. So, just for one product you have to go to five or six different systems to get the product related information on it. That's why we had been looking at these PLM systems which are becoming more popular and have been around for some time but now the costs are coming down so it makes them available for companies our size.

The Web-based software has enabled the extended product development teams to interact transparently with each other regardless of geographical or organizational boundaries. The solution provides three basic functionalities which are controlled centrally namely, the engineering, the program, and the team management functions.

The engineering functionality allows users to work with part information, drawings and specifications, BOM and product structures, quotations and vendor details, associated design, and manufacturing documentation from a central database. It facilitates concurrent engineering, strategic sourcing, and provides benefits such as parts management and standardization, visualization, and graphical analyses with integration to the CAD[17] tools.

The program functionality helps in complex project management across company's distributed development centers, suppliers, customers, and business partners specifically for new product development. The system creates budgets, allocates activities to the resource pool with work breakdown structures, tracks and approves tasks, and monitors progress and milestones in real-time until completion of the project.

The team management functionality offers a central virtual workspace for cross-functional and intra-enterprise teams of customers, suppliers, partners and employees. Virtual team management has become a necessity in Cevon's current global operations with distributed development centers, outsourced production, and shortened product life cycles. The PLM system has created a workplace for global collaboration across functions such as finance, sales, purchasing, production, engineering, and design. Online meetings are conducted such as design reviews to resolve technical or business problems including the viewing and approval of drawings. Participants can even opt for inclusion to notification of events.

The respondent explained that since the Commercial BU does not have a factory any more, their operations work differently:

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[17] Computer-aided design (CAD) is a computer technology that assists in the creation of designs by generating three dimensional control models or drawings (Ulrich & Eppinger, 2008).

the requirements are very different now. The company does not necessarily need the SyteLine system anymore. Manufacturing is a big part of the SyteLine system. With all the planning of the jobs through the factory, including materials planning and procurement, we do not do all that any more. So, the game has changed for the company. Therefore, we wanted something that is more focused on managing the product and the design of the product. The rest of it is just about the higher level parts or products which the company is placing orders on the contract manufacturer in Indonesia. Their system would look after the materials planning, managing of jobs, and the manufacturing. So, it depends on the business and what the company is actually doing. The PLM solution changes the focus more on managing product now, that's what we are as a company. As a design house we are really managing the IP [intellectual property]. Engineers in this company design products and what do they produce? They don't produce products, they produce documents and data. That's the business we're in now. Our contract manufacturers produce the products. We just have to give them the documents and the data that tells them how they're going to do it. They handle after that. So, there's been a change to the way we manage our business. (O&SC manager)

7.5.4   Financial impacts

Cevon has excelled in achieving their growth targets from 2004 onwards. Cevon's sales turnover has grown from $100M in 2003 to more than $500M by 2007 when the company was split and sold off by US Corporation to three different buyers. Cevon has also been successful in achieving their strategy of establishing a worldwide distribution network.

Cevon has achieved an increase in their cost efficiency by 15%, reduced their inventory by 65%, and improved their new product development time by reducing the time taken from the initial concept stage to market launch from 1.5 years earlier to eight months. Furthermore, Cevon has improved their delivery performance to 90% on-time. Their relationship management has improved with much better relations with customers and suppliers and their human resources have become highly motivated.

Cevon's improvement expectation in the bottom line, profit after tax, was about 30% and they have been quite on target achieving 34%. Their operating revenue has increased by 35% and EBITDA by 40%.

7.6   CSFs for the Transformational Process to Produce Benefits

Several critical success factors for the transformational process utilizing SyteLine and its data to produce benefits were cited by the respondents at Cevon. These include: (1) definition of overall measurable project objectives; (2) establishment of vision for project team consistent with management goals including the business plan; (3) senior management support including commitment of resources for the life of the project and assistance of senior management to remove barriers for project success; (4) dedicated project management including phased project plan and deliverables; (5) mandatory active involvement of all the regions and BUs; (6) appropriate use of technology including configuration; and (7) training.

According to the operations and supply chain manager, training was one of the most essential critical success factors:

> training is everything. SyteLine does all the stuff for you. People only have to know how it works. It is also important to have local support available. A dedicated SyteLine administrator would help, who understands the system, the core of the raw data and where that data are coming from. So that when any requests for pieces of data are received, the right questions are asked to first understand the requirement clearly, and then be able to deliver. The availability of the appropriate tools is important as well, to deliver. Sometimes there are a number of ways to deliver what people want so it is good to have somebody who has a good knowledge of business and works on the IT system as well. (O&SC manager)

The successful execution of the objectives greatly depends upon the management of the tasks and the quality of data:

> garbage in is garbage out, so it is important to make sure the data in the system are accurate and correct otherwise what you get out of the system is just bullocks. You have to trust the information in the system, that's very important. (quality manager)

The IT manager suggested appropriate technology as a factor, "it helps to have technologies such as the BI module that gives the ability to drill into the database and pull the data out".

The manufacturing director noted that the group project leaders' role who is managing the project is very important and the leader should be fully involved:

the project leader should be able to establish and maintain the implementation plan and reporting processes. Assign project tasks to team members and monitor progress. Schedule and facilitate project team meetings. Report project progress to the management and the project team. Acquire hands on knowledge of the SyteLine processes. Manage project deliverables to meet objectives and budgets. Resolve areas of conflict between functional areas. And, perform project reporting and budget tracking. (manufacturing director)

The quality manager concluded on the ES implementation success at Cevon with the following remarks:

in the past it has been very successful. Things have happened in the past with some of the data that have been pulled out and used to drive the business, there have been some successes in there. All along the way, things have not been the same. Businesses have changed and people have changed, so it's been varying up and down through the years. But, still at some points over the past six years that I have been with this company, I have certainly seen some great things coming out of this company and that's what has been successful. There have been some recent down sides as well, which is why it hasn't been so successful sometimes. So, it is a mix that's for sure. The SyteLine is there, the knowledge and information is there, and we have used it in the past and have achieved successes. The leadership changes and things like that have not gone so well. But when people take the time out to use the information to know what they are doing and they've got pre-goals to what they're doing I think it works very well.

A summary of the critical success factors for the transformational process utilizing SyteLine and its data to produce benefits at Cevon is presented in Table 22.

7.7   Summary

This chapter presented the conduct of the third case study and its findings. The study investigated the process of ES data transformation and results at Cevon using the format of the transformational model (Figure 10). The contextual constructs comprising the strategic, organizational and cultural, skills and knowledge, data, and technology factors were assessed. The methods and techniques for ES data transformation into knowledge and its utilization for decision making were explored.

Table 22: CSFs for the transformational process to produce benefits at Cevon

Critical success factors	Description
Definition of objectives	Definition of overall measurable project objectives and goals.
Vision for project team consistent to goals	A vision consistent with management goals and the business plan.
Senior management support	Senior management support including commitment of resources for the life of the project and assistance to remove any barriers for project success. Proactive and efficient decision makers must demonstrate their willingness to use ES and act.
Dedicated project management	Dedicated project management, phased project plan, and deliverables. The group project leaders' role in managing the project with full involvement is vital. The leader should establish and maintain the implementation plan and reporting processes. Assign project tasks to team members and monitor progress. Schedule and facilitate project team meetings. Report project progress to the management and the project team. Acquire hands on knowledge of the SyteLine processes. Resolve areas of conflict between functional areas. Perform project reporting and budget tracking.
Active involvement of all regions and BUs	Mandatory active involvement of all the regions and BUs towards achieving goals.
Training	Training is cited as the most important aspect in Cevon.
Local support	To have local support for any ES related issues is important.
Dedicated system administrator	A dedicated SyteLine administrator, who understands the architecture of the system, the core of the raw data, and where that data comes from. So that the right questions are asked to first, understand the requirement clearly, and then be able to deliver. It is good to have somebody who has a good knowledge of business and is able to work on the IT system as well.
Technology	The availability of the appropriate tools and technology including their configuration is important in order to deliver. It may help to have technologies such as BI that gives the ability to dig into the database and pull the data out.
Data quality	The successful execution of the objectives greatly depends upon the management of tasks and quality of data. It is important to make sure the data in the system are accurate and correct to be able to trust the information.

The outcomes comprising behavioral changes, new initiatives, process changes, and financial impacts were examined. An in-depth evaluation of the ES benefit realization events in the various functions and processes was conducted at Cevon. This was achieved with the more number of participants interviewed at Cevon and the multiple perspectives shared by the participants in the different functional areas.

The case study presented insights into Cevon's post ES implementation practices focusing on usability of ES and its information, and how the ES investment has impacted Cevon's functions and processes. It identified the areas that have either benefited the organization or need attention. Finally, the study examined the critical success factors for the transformational process to produce benefits at Cevon. The next chapter presents the cross-case analysis and discussion of the findings.

Chapter 8

CROSS-CASE ANALYSIS AND DISCUSSION

Chapter 8 provides the analytical cross-case comparisons of the three case studies, the case study results, and a narrative discussion of the findings. This chapter first presents an analysis of the financial impacts of ES implementation in the three case study organizations. Next, the chapter analyzes the critical effectiveness constructs of ES as identified through the transformational model (refer Figure 10) based on the three units of analysis – context, transformation, and outcomes. These are the three main phases of the transformational model for achieving results from an ES deployment through the process of ES data transformation into knowledge.

The fundamental focus of this research is to understand how organizations derive benefits from utilization of their enterprise system and its information, along with an evaluation of the CSFs for this process. By examining the current post-implementation ES practices in organizations through the transformational model, the impact of enterprise systems for business benefits is evaluated. The constructs within each of the units of analysis are analyzed and discussed from the three case studies through cross-case comparisons. The analysis combines the case study findings with the earlier preliminary study with ES vendors and consultants (Chapter 4). Finally, the case study findings and the business benefits realized by the case study organizations are summarized, to present the results of this research that explain the impact of ES for business benefits in organizations.

8.1   Financial Impacts and Key Results

Bevon and Cevon surpassed their growth targets from 2004 onwards. Cevon grew from a $100M sales turnover in 2003, to achieve a turnover in excess of $500M by 2007 when the company was split into three parts and sold-off by US Corporation to three different buyers. Cevon was also able to achieve their strategy of establishing a worldwide distribution network.

Bevon achieved a fast sales growth along with an excellent operational performance. From a $44M sales turnover in 2003, Bevon increased sales to $106M by 2007, achieving an EBITDA of 71% (see Table 23). Bevon also achieved an average unit shipment growth of more than 50%, as per their strategy. Volumes out of Auckland went up more than 50% in the 2008 fiscal year when compared to 2007. The NZ factory performed exceptionally well to keep up with the increased volumes, as per demand from the GPS manufacturers. Based on the significant effort by the production and engineering teams, Bevon has been able to meet all of their customer demand and remains very well positioned to ensure they can meet the expected 2009 demand.

Aevon however, has not fully achieved the anticipated objectives and results. In 2003, Aevon's sales turnover was $15M. Aevon has achieved sales of $24M by 2007 but this is short of expectations. They now have a new target of achieving $55M by 2011.

"Decisions lead to new behaviors, which lead to new initiatives and processes, which don't matter much unless they improve the bottom line and the return to the shareholders" (Davenport, 2000, p. 225). On the financial side, improvement expectation in the bottom line, profit after tax, was about 20% by Aevon, 40% by Bevon, and 30% by Cevon. An improvement of only 8% was achieved by Aevon whereas Bevon surpassed their target and achieved 64%. Cevon slightly exceeded their target achieving 34%. The financial outcomes of the three companies are presented in Table 23.

Table 23: Financial outcomes of Aevon, Bevon, and Cevon as on March 31, 2007

Financial outcomes	Aevon	Bevon	Cevon
Operating revenue	Increased 10%	Increased 42%	Increased 35%
EBITDA	Increased 12%	Increased 71%	Increased 40%
Profit after tax	8%	64%	34%

EBITDA – Earnings before interest, taxes, depreciation, and amortization.

It is essential to note that Bevon and Cevon are large organizations whereas Aevon falls under the small and medium-sized enterprise segment. Also, the financial impacts may not be solely as a result of ES implementation, but may also be the end result of a variety of behavioral, organizational, and environmental changes (Davenport, 2000).

Bevon continues to drive their costs down through new product designs, increased productivity, and material cost savings. Bevon ended 2008 with a sales turnover of $174M. Interestingly, Bevon's net profit was in the red by $2M in 2003. However, from 2004 onwards, their net profit has improved. It may be worth remembering Bevon went live with their SAP implementation on 1st April 2004.

Aevon expected that by 2007, cost efficiency would improve by 40-50% and the inventory levels would reduce by 60-70%. However, improvement in cost efficiency achieved was only 10% and reduction in inventory levels achieved was only 25%. Another expectation of Aevon was that the human resources would become highly motivated as an end result of ES implementation but this did not occur. Improvement in the areas of delivery performance and time taken for new product introduction has improved slightly. The key successes achieved by Aevon, Bevon, and Cevon are presented in Table 24.

Table 24: Key successes achieved by Aevon, Bevon, and Cevon

Key successes	Aevon	Bevon	Cevon
Cost efficiency	Increased by 10%	Increased by 20%	Increased by 15%
Inventory	Reduced by 25%	Reduced by 40%	Reduced by 65%
New product development time	Decreased to one year as compared to 1.5 years earlier; (closely matches industry benchmarks)	Decreased to eight months as compared to 1.5 years earlier; (closely matches industry benchmarks)	Decreased to eight months as compared to 1.5 years earlier; (closely matches industry benchmarks)
Delivery performance	Increased to 75% on-time	Increased to 85% on-time	Increased to 90% on-time
Human resources	Motivated	Highly motivated	Highly motivated
Relationship management	Some improvement in relations with stakeholders	Much improvement in relations with stakeholders	Much improvement in relations with stakeholders

8.2   Analytical Cross-case Comparisons

These case studies illustrated the transformational model (Figure 10) of how business benefits are realized from ES data transformation into knowledge, highlighting the effectiveness of enterprise systems in the three organizations. The overall business benefits including the financial results obtained in the Bevon and Cevon cases surpassed those of Aevon. The reasons attributed to this, including the overall comparisons of the three cases, are given below.

8.2.1   Company overviews

All three case studies were chosen from the hi-tech industry and all three specialize in the design, manufacture, and supply of high performance electronic products and devices. The three companies are the market leaders of their high quality products in their business segment within global markets. They have similar organization structures with HQs in New Zealand, the design, development, and manufacturing based in Auckland NZ, procurement of parts from Asia, and sales and distribution centers based in the various major regions of the world. All three companies are doing well in their respective business segment and have a track record of business growth in recent years. These three companies were chosen due to their similar nature of design, manufacturing, and global supply operations in the hi-tech electronics industry. This leads to a better comparison that brings rigor and relevance to the case study findings. Two of the companies, Bevon with a sales turnover of $106M and Cevon $507M at 2007 March year-end, are large firms with employee strength of about 750 each. The third company, Aevon, is a medium-sized company with $24M sales turnover in 2007 year-end and 90 employees. All three companies implemented ES more than three years ago therefore they are in the mature phase of realizing benefits from their ES investment.

8.2.2 Context

The strategic, organizational and cultural, skills and knowledge, data, and technology related contextual factors from the transformational model (Figure 10) for all three case study organizations are analyzed and presented next.

8.2.2.1 *Strategic context*

The three case study organizations have similar visions and business strategies. They want to achieve fast business growth, increase their sales turnover as fast as possible, and become the world leader in their business segments. In recent years all three companies embarked on a capacity expansion program increasing their manufacturing capacities as well as increasing the strength of their operational teams. Like many manufacturing organizations, all three companies were facing operational issues such as out-of-inventory events, production bottle-necks, quality failures, mismatch inventories, supply constraints, poor visibility of information, and lack of decision support. The companies wanted to overcome these issues and improve their process efficiencies and effectiveness. The strategic context specifies what questions are to be answered by the data, the critical business and management processes in which the data are to be applied, and the overall business value which is derived from the data transformation (Davenport, 2000).

All three companies wanted to reduce manufacturing and distribution costs, improve product prices and performance, reduce product development time and streamline inventories, improve information flow, and make better decisions. Additionally, they wanted to collaborate externally to their regions and subsidiaries around the globe with faster and better information flow. Table 25 provides the summary of the strategic contexts of the three companies.

Table 25: Strategic context in case studies

Case	Strategic context findings
Aevon	• Aevon had a growth strategy to achieve a sales turnover of $55M by 2011. • Aevon upgraded their ES to SyteLine 7 in 2004 to achieve operational efficiencies, better utilization of resources and information flow, and make better decisions.
Bevon	• Bevon wanted to achieve more than 50% growth. They wanted to optimize processes, market products at competitive prices, secure new customers, and retain market position. • Bevon decided to double their manufacturing capacity and implemented a major capacity expansion program. They also increased their global sales and business development teams. • Bevon implemented mySAP ES in 2004 to integrate and optimize business functions, achieve operational efficiencies, improve information flow, and realize business strategies.
Cevon	• Cevon wanted to become a $1 billion company and build a worldwide distribution network. • Cevon doubled their Auckland factory capacity and also their staff. Cevon was sold to a US Corporation to achieve growth. The Corporation on-sold Cevon splitting it into three parts. • Cevon wanted to improve their operational efficiencies and collaborate with subsidiaries and distribution centers. Cevon implemented SL5 in 1999 and upgraded to SL7 in 2006.

8.2.2.2 *Organizational and cultural context*

The organization culture of all three companies is professional with a congenial and friendly working atmosphere. The staff in all three companies is multi-cultural, self-motivated, and willing to accept changes. They eagerly use the implemented ES to improve work processes in their operational areas. In all of these companies, the organizational structure is collaborative and the employees participate in the decision-making process. The yearly progression in these organizations is performance based and the employees are encouraged to excel in their areas of business, achieve targets, share knowledge, and have a data-driven approach in managing the business. Organizational and cultural factors are difficult to measure and change, but without a positive context, successful data transformation is unlikely to occur on a regular basis (Davenport, 2000).

However, in the case of Cevon, with the sale of the company and its division into three different BUs, new organizational structures were created. Employees were transferred to specific BUs and many jobs were lost which became detrimental to the morale of the staff. The summary of the organizational and cultural context of the three companies is presented in Table 26.

Table 26: Organizational and cultural context in case studies

Case	Organizational and cultural context findings
Aevon	• Aevon's organization culture is self-motivated and the human relations are harmonious. The teams are culturally diverse and the organization structure is collaborative. • Employees participate in the decision-making process through cross-functional teams and group activities which fosters orientation towards achieving goals. • With the implementation of SL7, Aevon has adopted a knowledge-sharing culture.
Bevon	• Bevon follows the TQM culture for excellence and building customer relationships. • Their highly motivated employees have eagerly adopted SAP showing willingness to change. The communication within the firm is open, friendly, and interactive at all levels. • The SAP implementation has brought in a data-oriented culture encouraging employees to use data to support decisions.
Cevon	• The culture of Cevon has been congenial and professional. The structure has been collaborative and the people free to offer and express their views. • Cevon encouraged employees to have a data-driven approach in managing the business and believed in the utilization of modern technology tools for business. • The situation changed with the sale and break-up of Cevon. New organizational structures were created and jobs lost at Cevon damaged the morale of the staff.

8.2.2.3 *Skills and knowledge context*

All three organizations have highly technical, commercially qualified, and competent staff. The workforce includes software, hardware, electronic, and mechanical design and development engineers, skilled workmen, and international marketers with extensive managerial and

commercial expertise. These are human attributes that are often overlooked in efforts to use ES data effectively. "Not even the most sophisticated analytical software obviates the need for a high degree of skill and experience in the successful analysis and use of ES data" (Davenport, 2000, p. 223). There are many types of skills and knowledge that are relevant to this contextual objective, including analytical skills, technical skills, and business skills to understand the business and business processes. Since ESs are particularly complex systems, knowledge of the structure of available information across different functionalities is especially critical. Therefore, training played a very important role in effective utilization of ES to achieve benefits. Having US Corporation on board at Cevon created a confidence that helped attract management expertise from overseas. New engineers joined Cevon from across Europe. All three companies have been providing training to upgrade skills and knowledge of their employees including knowledge of the company's underlying business processes and training for ES administration and usability. Knowledge sharing is encouraged in all of these companies.

Although the three organizations imparted training to their employees, a systematic and on-going user-training strategy or implementation plan was not found in place. The staff did not undergo new training sessions when upgraded functionality or any changes were incorporated. Table 27 provides a summary of the skills and knowledge context in the case study companies.

Table 27: Skills and knowledge context in case studies

Case	Skills and knowledge context findings
Aevon	• Aevon staff is competent both technically and commercially. The team includes marketing professionals, industrial design, software, electronics, and manufacturing engineers. • Aevon provides training to upgrade and develop the skills and knowledge of their employees. The staff is encouraged to share their knowledge and skills.
Bevon	• Bevon has highly educated and technically skilled staff employed in the R&D, manufacturing, and commercial functions. All new staff undergo a comprehensive training program. • The workforce has the skills and capabilities to adopt and execute advanced manufacturing techniques using the latest technologies and machine tools. • The SAP specialists and analysts expertise also includes knowledge of the company's underpinning business processes.
Cevon	• Cevon has technically qualified design and development engineers, skilled operational workmen, and staff with immense commercial and managerial experience. • Cevon has been able to further develop their staff by providing relevant training and hiring staff from overseas destinations. • Specific training has been imparted to users in developing skill sets for using SyteLine and BI tools to run business functions and analyze information.

8.2.2.4 Data context

Prior to ES implementation, the quality of data were poor in both Aevon and Cevon. Maintenance of good data quality was not a focus area for these companies and the system data

were not current and reliable. There was a time lag between the physical transaction and its updating in the system and as a result the on-hand stock did not necessarily match the physical count. The availability of information and transactional data were an issue and the tools for data extraction were also inadequate. But in the case of Bevon the quality of data has been good historically since updating and monitoring of data has been a regular practice in the company. With the implementation of ES in the three companies the situation has changed. The new system has in-built processes to maintain integrity of information by timely and accurately capturing the transactional data. Cevon's data quality has improved dramatically. But due to the lack of discipline in updating records at Aevon, the data quality has not improved as much as expected. In comparison with most application software ESs have relatively better data quality. However, the data that emerge from an ES are generally intended to serve business transactions, not analysis and decision making. Davenport (2000) reiterates that creating an effective data context is difficult but necessary.

All three companies intended to become data-driven and developed skills to manage their business using data to improve management decision making. Bevon and Cevon moved ahead in this endeavor through the use of various data extraction and maintenance tools. However, Aevon is still in the phase of stabilizing their transactional data maintenance discipline to achieve integrity. The data context in the three organizations is summarized in Table 28.

Table 28: Data context in case studies

Case	Data context findings
Aevon	• Prior to SyteLine implementation, quality of data were not a focus area and availability of information and transactional data were an issue (i.e., non-current data with poor accuracy). Also, the tools for data extraction were inadequate. • The situation changed after ES implementation. The visibility and availability of data has improved. The new system has in-built processes to maintain integrity of information by accurately capturing the transactional data. But, due to lack of discipline in updating records, the data quality has not improved as much as expected.
Bevon	• The transactional data captured by the ES (SAP) are current and accurate based on the internal transactions recorded. • The transactional data are easily accessible and timely available to support business decisions. Updating and monitoring of data are routinely performed. • The SAP system provides the ability to drill down for information; change data views with grids, graphs and charts, and analyze data to create meaningful information.
Cevon	• The data quality was poor historically before the implementation of ES (SyteLine). The reliability and currency of data were poor. The on-hand stock did not necessarily match the physical count. The reconciliation of account receivable with customer invoices against the material supplies was difficult. • After ES implementation new controls such as regular cycle counts have been introduced to enhance accuracy of stocks. The information has become current, accurate, and reliable. • With the implementation of the BI solution it is possible to retrieve relevant data timely to support managerial decisions. The quality of data is no more a constraint. The company has become data-driven and has developed skills to manage business with accurate data.

8.2.2.5   Technology context

Historically all three case study companies had been using different types of disparate systems or home-grown PC-based legacy systems which were out-dated with limited functionality, and did not have a user-friendly interface or Web-enabled environment. These systems could not append and use external data, drawings, and documents, or collaborate with any external systems. The companies realized it would be expensive to integrate and maintain these systems, and decided to implement a new ES. Aevon and Cevon implemented SyteLine, which is primarily an enterprise system for the SME sector. Bevon decided to implement mySAP which comprised of SAP R/3 4.7. At that time the strategy of SAP was to price the package competitively with everyone else to increase their market share and grab more business. All three companies implemented the core modules of finance, manufacturing, and distribution first. They subsequently implemented the data warehouse and business intelligence module. The ES, modules, and functionality implemented are the technological factors that influence a company's capability of extracting value from ES data. "They might include the capabilities of the ES itself for reporting and analysis, software for data extraction and analysis, and the access that users have to the data over networks" (Davenport, 2000, p. 222).

Aevon bought 24 user licenses and their ES went live in 2004. The main system is implemented in Auckland comprising three sites, one each for NZ, US, and rest of world. With three different sites within one system Aevon has configured a single instance multi-site environment. The NZ site manages the Auckland manufacturing operations, the US site focuses on the US sales and distribution activities, and the ROW site transacts any other sales and distribution operations elsewhere. Access is allowed to individuals remotely through user logins into one or more sites. These systems interact with each other through the multi-site functionality such as situations where stock is moved between sites.

Bevon went live with SAP in 2004. The company initially bought 50 user licenses and that has now been extended to 130 in their Auckland site. The implementation is single instance multi-site. The main SAP software is implemented at the Auckland site however the system is extended and connected to the regional offices including sales and distribution centers at Taiwan, UK, and the US. As the system is Web-enabled, the users can log-in from any remote location through an Internet connection to use the system.

Cevon initially implemented SyteLine version 5 in 1998 when the company was smaller with around 200 employees. In 2006, SyteLine 5 was upgraded to version 7 with 130 user licenses in their Auckland plant. At the same time, SL7 was also implemented in subsidiaries and distribution sites to have a common platform for the entire business. The company implemented

multi-instances of the system with multi-site functionality. This enabled transfer of orders and stocks between sites through Web-based log-in environments.

Additionally, Aevon and Bevon have implemented a CRM module to improve their interface with customers. Likewise, Aevon and Cevon have implemented a field service module (FS-Plus) to manage customer service and field service requirements.

After the Cevon break-up, the Commercial BU has implemented a Web-based MS Project Server 2007 application for project management at their Auckland R&D center. They have also implemented another Web-based product lifecycle management (PLM) system from Arena Solutions to manage the development of products in the globally distributed environment. With another development centre established in the US, the PLM system and the Project Server are proving quite beneficial for this global environment. In the current company structure, the headquarters with one new R&D center and the top management are based in the United States, operations are managed from Singapore, manufacturing is contracted out in Indonesia, and the main R&D and product development center is based in Auckland, New Zealand. Table 29 summarizes the technology context in the case study organizations.

Table 29: Technology context in case studies

Case	Technology context findings
Aevon	• Aevon implemented SL7 from Infor in 2004. Their earlier system was an old Symix product which was not Windows or Web-based using a Progress database with limited functionality. • In phase 1, finance, sales, and manufacturing including purchasing, planning, warehousing, and production were implemented. In phase 2, BI, CRM, and FS-Plus were added. • Three sites have been created for different regions transacting in a single instance multi-site environment. Access is allowed remotely through user logins and passwords. • A Web portal enables distributors to load and configure orders.
Bevon	• SAP was implemented at Bevon in 2004. Historically, Bevon used a disparate home-grown legacy system without the Windows environment, nor could it provide relevant information. • Phase 1 implementation included finance, materials management, and sales and distribution modules. Phase 2 was production planning, production execution, and product classification. • The main SAP software is implemented at the Auckland site. The system is integrated to multiple sites (i.e., regional offices, sales and distribution centers in Taiwan, UK, and US). • To enhance functionality in CRM, manufacturing, data warehouse, and Web services Bevon has implemented BI7. They plan to upgrade BI7 to Business Objects, to enable them to produce better reports and achieve analytical decision making.
Cevon	• In 1998, Cevon implemented Mapics SL5 since their earlier PC-based system was difficult to manage. Cevon also implemented a BI solution from Cognos Impromptu that integrated with SyteLine. This enhanced the visibility of information to make business decisions. • In 2006, a version upgrade to SL7 with Windows-type environment was rolled out at the Auckland manufacturing and R&D site, and other subsidiaries and distribution sites. • Additional modules APS, Workflow, BI, FRx Reporter and Forecaster were implemented. • The Commercial BU has recently implemented a Project Server application for their project management along with a PLM system from Arena Solutions to manage distributed product development in the global environment.

8.2.3 Transformation

The transformation process at Bevon and Cevon focused on utilizing knowledge-based activities that leverages decision support from their ES. This process originates in these companies with the translation of organizational strategies into divisional or functional objectives. Bevon has implemented a KPI reporting system in which the organizational objectives have been categorized into functional goals and deliverables. These deliverables are benchmarked against the targets Bevon has set to achieve that are monitored through monthly review meetings. Cevon has established a KPI reporting system and has also identified the critical areas in their value creation process. The company has defined the business activities to achieve improvement in different dimensions of the business, aligning team and tactics with strategy. Team-specific programs have been created for leveraging innovations to achieve the business strategies and plans. Tools such as business intelligence, balanced scorecards and dashboards are used extensively for measuring and monitoring performance, and translating information into visual presentations that facilitates decision making. In this manner, both Bevon and Cevon have created the linkages between the metrics for achieving the company goals and the departmental KPIs. The key drivers have been analyzed to understand factors that influence these drivers and measure them. The achievement of goals is reviewed each month and the performance indicators are monitored on an on-going basis. This process keeps track of the business benefits the organizations want to achieve comprising the business context/objectives for which the ES data are analyzed and used. The objectives are communicated to the relevant team players and assigned as their personal result areas.

Aevon's managers have also identified their key business objectives, but the identification of critical areas and their detailed evaluation and monitoring process is missing. Aevon has not created the link between top management expectations for achieving the organizational goals and the individual departmental KPIs. Managers have the data from their ES investment, but have not been able to leverage it fully for realizing benefits. In the case of Aevon, the lack of discipline in updating transactions in the warehouse has led to data discrepancies and data integrity issues amongst employees. The data extracts also cannot be made in time to support decision making. Thus, the analytical and decision-making process is based on ES data which are unclean and inaccurate and the link between data, decisions, and actions is lacking.

The ES data transformation processes in the three cases are further analyzed below.

8.2.3.1   *ES data transformation into knowledge*

The use of standard reports, forms, and queries that are built into the ES is the most basic method of gathering information in all three case study organizations. The user drills down into a functional screen and retrieves information. This is also done by running generic query forms available within a functional module by selecting the parameters required for the query. Reports from the functional areas can be configured to generate relevant information. Standard generic ES reports provide the convenience of viewing information directly by selecting the criteria from drop-down menus such as date ranges, item-code ranges, value ranges or any other such parameters depending on the type of report. The data are manipulated to create meaningful information where human intuition, judgment, and experience are applied that convert data into knowledge. Numeral analyses and statistical evaluations from simple, straight forward reports further provides new insights on the work processes.

Bevon and Cevon have also implemented data warehouses wherein specific data are collected from their heterogeneous environments. The data are mined, and the information is presented back to the users permitted to access the data warehouse module. Aevon and Cevon have implemented the "SyteLine Viewer" application which has read-only functionality and a user license is not required for accessing this application. The application allows information retrieval without the possibility of recording any transactional changes. All three companies use some special reports that have either been created by their implementation partners on request or by their own programmers trained in the use of Crystal Reports (for SyteLine) and ABAP programming (for SAP). Although, all three companies have kept these special reports to a minimum, due to the costs involved in customization and future upgrade problems, special reports which are necessary to the business have been developed.

The BI module is specifically helpful in extracting and manipulating data in the required fashion, with the ability to perform user-friendly queries. Reports on particular data objects can be created and formatted as well as different report formats can be profiled. This application has been implemented by all three companies. The BI functionality is fully operative in Cevon and partially operative in Aevon and Bevon, who are still in the process of making this utility work. At Bevon, the SAP data output is transferred into a SQL database, manipulated, and then transferred into Excel spreadsheets for further reporting. Aevon has implemented a Web portal for their CRM module in which distributors can log in and use the system to load customer orders and retrieve related information.

The summary of ES data transformation into knowledge from the three cases is presented in Table 30.

Table 30: Transformation of ES data into knowledge

Method	Case	ES data transformation into knowledge findings
Standard reports, forms, and queries	Aevon	Data are retrieved and transformed through utilizing standard reports, forms, and queries that are part of the standard SL7 system.
	Bevon	Knowledge creation from SAP data is an on-going process. This happens by collecting, analyzing, and interpreting real-time information in the different SAP supported functions through use of standard reports, forms, and queries.
	Cevon	Numerous standard reports, forms, and queries that are built-in SyteLine are used regularly.
Data warehouse	Aevon	The standard SyteLine data warehouse is used.
	Bevon	SAP BW has been implemented through which data are extracted and transformed into knowledge by analysis of user requirements.
	Cevon	SL7 data warehouse has been implemented wherein specific data are collected from the subsidiary sites through file transfers each night. The data are mined and information is presented to users accessing data warehouse.
ES Viewer application	Aevon	SyteLine Viewer with a read-only functionality is implemented.
	Bevon	Such functionality is not used.
	Cevon	SyteLine Viewer functionality is implemented, same as Aevon.
Special custom reports	Aevon	Some special reports are created and customized specifically to the needs of Aevon. The Crystal Reports tool within SyteLine is used to modify existing reports or create new reports. Information from these reports can also be exported into spreadsheets.
	Bevon	There are some customized reports that were considered necessary to the business have been developed by the implementation partners. Bevon has also developed some internal capability to make changes to reports and customize, but creating a new customized report is mostly discouraged.
	Cevon	Some custom reports have been created and put into SyteLine for Cevon based on requirements. Crystal Reports is regularly used.
Business Intelligence	Aevon	Aevon uses BI to get reports that are not possible through Crystal Reports. When the data are required to be manipulated in a different way, a cube with different bits of information at different times is created. The BI is then used to drill into the data level and create a report. Aevon uses the bolt-on Symix BI but this is not fully operative yet.
	Bevon	Bevon has implemented BI7 for transformation of data and analytical processing. They are unable to utilize this functionality because the BI tool is unable to handle transactional data. However, Bevon uses a different method for doing this. The SAP data output is transferred into a SQL database, manipulated, and transferred into Excel spreadsheets for reporting.
	Cevon	SL7 has a large amount of data in its database, but it is not always presented in a user friendly manner just by accessing the various forms and reports within it. Cevon uses a bolt-on BI from Cognos Impromptu which is a more user friendly way of drilling into the specific data and presenting only the required data objects that the user wants.
Web portal	Aevon	Aevon uses a Web portal for their CRM, so that the distributors log in through the portal, use the system, and retrieve information.
	Bevon	Not implemented
	Cevon	Not implemented

8.2.3.2   *Utilization of knowledge to achieve business benefits*

Standard business analytics and ES reporting tools are used to extract information to which human judgment and experience is applied and decisions are made on a day-to-day basis. Further analyses are performed through user-friendly data manipulation techniques such as graphs, pivot tables, and data summaries. The decision making is based on properly analyzed data on a multitude of factors. The more the decision is based on knowledge, the better are the chances of achieving a successful outcome. In all three case study organizations, users transfer data from their ES into Excel spreadsheets to perform further manipulation.

Bevon and Cevon use KPI reporting as a method for measuring and monitoring organizational performance. The process leads to decision making directed towards achieving the overall business objectives. The KPI metrics are captured from enterprise systems and benchmarked against set targets. The targets are decided based on industry standards and are approved by the management as achievement goals. Once the goals have been defined, the executive team members monitor and control these goals through regular reviews.

All three companies have regular finance and sales reports that are run as standard reports through the ES, particularly at the month-end closing. The financial status is reviewed by the executive team and decisions taken. Additionally, Cevon has implemented the balanced scorecard and dashboard performance management system where the information extracted through their BI module is utilized for tracking progress of deliverables. Aevon and Bevon have yet not implemented such a performance management system. Bevon awaits their BI upgrade to Business Objects first. Aevon has future plans to extend their ES and integrate it with their business partners (distributors, customers, and suppliers). This will help Aevon share information and keep track of business across different time zones achieving better collaboration and decision making.

The knowledge utilization processes to achieve business benefits are summarized in Table 31.

Table 31: Utilization of knowledge to achieve benefits

Method	Case	Findings
Business analytics and standard ES reporting tools	Aevon	Most of the time, the information captured within SL7 is manipulated and used for decision making. This information is made available through the various SyteLine forms and queries on a day-to-day basis.
	Bevon	Bevon uses the standard SAP business analytics and reporting tools to create reports for their operational areas. KPIs are monitored and measured through trend analysis using graphical representations.
	Cevon	Analytic modeling is performed using external systems where the extracted data are transferred into spreadsheets for analysis. Analytic outputs such as list reports are used for analytical decision making.
Use of Excel spreadsheets	Aevon	Information from SL7 reports are exported into an Excel spreadsheet and manipulated as required to support decision making.
	Bevon	Many SAP reports are transferred into Excel spreadsheets to facilitate analyses through graphs, pivot tables, and user-friendly data manipulation techniques. The business decisions are based on accurately analyzed SAP data.
	Cevon	A BI person, who knows the data structure, does the custom reports through BI, exports into Excel, and then users apply data manipulation for decision making.
KPI reporting	Aevon	Aevon has recently initiated setting of KPIs for a few functional areas. The executive team has approved some targets for the functional lines. Once these have been set, the executive team will monitor KPIs for making decisions.
	Bevon	Bevon uses KPI reporting as a method for using knowledge for decision making. Useful information is created by identifying, extracting, and interpreting the SAP data for each indicator to monitor progress in realizing the business strategies.
	Cevon	Cevon wants to define KPIs from "order-to-cash" that include all business processes between taking an order from a customer, delivering goods, and collecting money. It is now a matter of establishing what those indicators are.
Bench-marking	Aevon	Aevon uses benchmarking as a tool for their day-to-day business activity, monitoring, and utilizing the ES data for establishing decisions.
	Bevon	The drivers that create value for each functional area are identified and defined. The managers have benchmarked some KPIs and review progress each month.
	Cevon	The scorecard defines company objectives and establishes their achievement criteria. This includes benchmarking KPIs and monitoring their performance.
Balanced scorecard	Aevon	Aevon plans to use a business scorecard. The process has just been initiated.
	Bevon	Bevon has not established the use of a balanced scorecard yet. Bevon is looking at having Business Objects first after which it will become easier to develop balanced scorecards and dashboards for tracking business performance.
	Cevon	Cevon uses a balanced scorecard, utilizing the information from SL7 to provide a view of the company performance in different functional areas.
Dashboards	Aevon	Aevon has created a roadmap for achieving strategic objectives. Dashboard is one of the exciting things Aevon wants to do once the BI is fully operative.
	Bevon	Bevon has not established the use of a dashboard yet. With the use of Business Objects it will become a lot easier for Bevon to develop balanced scorecards and dashboards for tracking business performance.
	Cevon	The executive management uses digital dashboards and graphical representations for tracking KPIs to evaluate performing and non-performing areas.
External collaboration	Aevon	Aevon's intention is to extend their ES and further integrate with stakeholders. This would help improve throughput and support in making decisions.
	Bevon	Bevon is focusing on a CRM module for future collaboration with customers.
	Cevon	The Commercial division has recently implemented a PLM system for future external collaboration with business partners to assist in product development.

8.2.4   Outcomes

The result of ES implementation and utilization of ES information in the three companies has led to various outcomes such as changing behaviors, new initiatives, process changes, and financial impacts. These are discussed next.

8.2.4.1   *Changing behaviors*

Better visibility and information sharing between employees and stakeholders may improve relations and behavior by all (Davenport, 2000). Improved attitudes and behaviors of stakeholders – including managers, employees, suppliers, and customers – were reported in all three case studies and as a result of their ES implementation. The reasons for this change are attributed to improved process control, automation, and currency of information that has further led to better collaboration between stakeholders. Improved information sharing, visibility, and openness between employees and stakeholders has resulted in improved interpersonal and business relationships. Disputes on prices and invoices are easily resolved due to availability of accurate information, therefore the customer and supplier relationships and behavior has improved.

In the cases of Bevon and Cevon, much improved relations with customers and suppliers were achieved. In Aevon, due to the persisting data integrity issues, the business relationships with suppliers and customers improved, but not to the extent expected. Their purchasing and production engineers also showed discontentment since they could not completely rely on the ES data for taking actions. Aevon's analytical and decision-making processes were based on ES data which were unclean and inaccurate, and the relationship between data, decisions, and actions was deficient. The out-of-inventory events reduced in Aevon with the visible supply and demand information to suppliers and customers, but the company did not achieve the reduction and streamlining of inventories anticipated.

The changing behaviors outcome from the three case study organizations is presented in Table 32.

Table 32: Changing behaviors from utilization of ES and its information

Function	Case	ES process change	Benefits
Process control and automation	Aevon	The process controls applied through SL7 and the realization that inventory accuracy is important has changed the attitude and behavior of warehouse staff towards how they stock material in the warehouse.	• Improved behavior and attitude by staff • Better process controls
	Bevon	An immediate improvement in behaviors of employees resulted from better availability, visibility, and accuracy of information. The inter-personal and business relations with customers and suppliers improved as a result of the transparency of information and better collaboration.	• Improved behaviors by all stake holders • More collaboration leading to improved relationships
	Cevon	Over the years, the stakeholders have become used to having the automated and controlled system. But, if some functionality becomes unavailable now, then the benefit of the functionality is realized and appreciated.	• Improved behaviors of all stake holders – customers, suppliers, and employees
Inventory management	Aevon	After SL7 the visibility and availability of system information has improved through reports, forms, and queries. The system inventory has improved, although some inaccuracies still exist.	• Improved availability of information • Better inventories
	Cevon	Improved SL7 data integrity has led to better relations between employees and with business partners.	• Improved relations between employees
Customer services	Aevon	With better communication and visibility of information, the business relationships with suppliers and customers have improved. But due to lack of discipline in updating transactions, this has not reached the levels expected.	• Better relations with business partners • Increased communication and cooperation
	Bevon	There has been a significant reduction in disputes on purchase orders and invoices relating to prices. With improved communication, customer and supplier relations have improved, achieving new levels of trust.	• Improved communication • Increased trust levels with stakeholders
	Cevon	The availability and sharing of data has led to better communication and collaboration between employees, customers, and suppliers. This has improved relationships between stakeholders, resulting in fewer disputes over transactions.	• Better availability and sharing of information with fewer disputes over transactions
Demand forecasting	Bevon	The earlier sudden demand changes are reduced with real-time visibility and sharing of information. Similarly, the requirement forecasts throughout the supply chain have improved. This has resulted in improved customer and supplier relationships and more streamlined supplies since Bevon has become more flexible and can respond better to change orders.	• Improved customer supplier relationships • More streamlined supplies, with better flexibility and demand forecasting
Systems management	Cevon	Functionalities such as transfer orders, multi-site quantity moves were used for transactions between the BUs. But after the split, these functionalities could no longer be used since the SL7 systems were separated into three BUs. The people realized how good the system was since the alternative was more frustrating and time consuming.	• Realization of functionality and system benefits by stakeholders • Improved behaviors by all concerned

8.2.4.2   New Initiatives

With the support of the ES, the ability to analyze data can lead to new initiatives in organizations. A decision based on the ES data transformation process may "result in a new initiative – a project to improve the business in some regard, or changes in an existing project" (Davenport, 2000, p. 224).

Aevon initiated lean manufacturing in their plant with the support of their ES functionalities. Aevon implemented a field service module (FS-Plus), as a new initiative that has improved their customer services and quality processes. Aevon also established a "LOOP network" for internal communication by installing seven large LCD displays at different places within their facilities and streaming information from their ES to the operational teams.

Bevon successfully undertook new Six Sigma process improvement projects with data support from their ES. Bevon also implemented a bar-code scanning system, established regular sales and operations planning meetings, and implemented new initiatives in the order receipt, planning, and execution processes. These new initiatives have led to improved customer services for the company.

Cevon implemented new initiatives by setting up just-in-time and vendor-managed-inventory systems in their manufacturing plant with the support of their ES. Cevon initiated cost reduction and value engineering programs, balanced scorecard and digital dashboards, and several process efficiency improvement initiatives that have improved the operations of the company.

The above findings confirm new initiatives taken by all three case study organizations as a result of ES deployment and data transformation which have led to process improvements and business benefits.

The new initiatives as a result of ES implementation in the three organizations are presented in Table 33.

Table 33: New initiatives as a result of ES implementation

Function	Case	ES process change	Benefits
Manufacturing	Aevon	Lean manufacturing principles have been implemented that involve the use of automated stock back flushing within SyteLine.	• Improved process efficiencies and cost reduction
	Bevon	The use of barcode labels on dispatch boxes has been introduced through SAP.	• Better process efficiency
		New initiatives towards implementing Six Sigma projects in critical areas have been implemented utilizing SAP data.	• Improved critical company processes through Six Sigma
	Cevon	Just-in-time planning and procurement of material through the integrated order intake and manufacturing process in SL7 are set up.	• Better planning and monitoring JIT deliveries
		The implementation of VMI using a new consignment stock process has been initiated through SL7.	• Implementation of VMI
		Cevon has started monitoring the cost of poor quality and initiated cost reduction programs (e.g., improving rework costs in the quality area).	• Increased visibility and reduced cost of quality
Supply chain	Bevon	Established demand, market and customer analysis, product classification, and requirement determination by market segment. Bevon has also initiated sales and operations planning meetings to review demand versus supply status.	• Improved supply chain processes • Better demand planning and on-time deliveries
Customer service	Aevon	Implementation of FS-Plus in SL7 has linked finance to customer service with the ability to issue credit notes against warranty returns. Also FS-Plus monitors product faults, its reasons, and associated costs.	• Improved finance integration • Better customer service and quality
Product design and development	Bevon	A new initiative in product costing has led to achieving visibility in cost accuracies and the ability to improve it. This has led to yet another initiative in value engineering. The design engineers strive to make the products more profitable.	• Improved product costing and value engineering • Increased profitability
	Cevon	New initiatives based on process efficiency improvements include creation of BOMs with item cost break-ups for various product families. The engineers know the profitability of the various products to make pricing decisions.	• Better BOM management and product costing • Improved pricing decision making
		Initiation of cost reduction and value engineering exercises. The engineers conduct product profitability analysis with available information.	• Improved analysis, reducing costs and improving profits
Executive information management	Cevon	Implementation of balanced scorecards, dashboards, and KPI performance monitoring processes to track accomplishment of goals and targets.	• Improved performance monitoring
Communication	Aevon	Established internal communication mode called the "LOOP network" by setting up to seven large LCD displays which show data picked-up directly from ES.	• Increased data visibility and communication

8.2.4.3   Process changes

All three companies have implemented several process changes as a result of utilizing their enterprise system functionalities and data transformation. The key functions where the changes

were incorporated include customer services, sales and distribution, planning, purchasing, inventory management, manufacturing, dispatch, finance, systems, and product development. These are the core operational areas where the major impact of the ES implementation is realized. "A determination that an existing process is not working effectively can lead to a new process design and its implementation" as an outcome of the ES data transformation process (Davenport, 2000, p. 225). All three companies streamlined their customer service processes. The field service module FS-Plus has improved customer services with faster turn around of repaired products to customers for Aevon and Cevon. The product faults are now better analyzed, improving future designs. All three companies have brought in key supply chain improvements and achieved a major change in customer and supply performance since the companies could respond faster to customer changes and improve their flexibility in manufacturing operations. Improvements in manufacturing processes have led to achieving operational efficiencies that the companies were looking for. Much improved process efficiencies are achieved in production planning, purchasing, inventory control, and dispatch functions reducing cost and improving throughput. Product costing process changes have improved the pricing policies, and resolved disputes in pricing. Improvements are also achieved in the financial and system management functions with modified processes achieving enhanced administration, data security, and control.

In the case of Aevon, the online visibility of demand from customers and supplies from vendors reduced the number of out-of-inventory events, but did not achieve the reduction and streamlining of inventories anticipated. The lead times could not be reduced substantially and delivery performance improved only marginally. Their data management was inconsistent, coupled with a lack of clarity on the information required to drive their strategy, which were the reasons they could not achieve their full potential and anticipated objectives. Aevon is now putting in steps to improve performance in these areas of shortfall.

A detailed list of process improvements identified in the three cases and the business benefits realized is presented in Table 41 (Appendix C). This table is placed in an appendix considering Patton's (1990) suggestion that researchers should maintain a balance between description and interpretation to keep the reader involved in the research study. Presenting all this information in this chapter would obscure readability due to the extensive attention to case data collected. Yin (1994) advises using tables or figures to show the chain of evidence for empirical findings and also not burden the reader with too much narrative detail and interpretations. However, a summary of the key process changes commonly occurring in the three cases (extracted from Table 41) is presented next in Table 34.

Table 34: Summary of key ES process improvements and benefits

Function	ES process changes commonly occurring in all three cases	Benefits
Sales and operations planning	Revised sales and operations planning process for management of orders, forecasts, and inventories. Teams forecast accurate requirements. The system assists in analyzing market trends that helps to decide on future sales strategies.	• More accurate deliveries to customers
Customer order planning	Improved customer ordering process with functionalities such as advanced planning and scheduling (APS) and available-to-promise (ATP) to achieve accurate deliveries and capacity utilization. In the revised process an ATP enquiry from the system is prompted against the customer's requested delivery date. ES returns the result in the form of an acceptance or an alternative date with reasons for delay. The user drills down to review issues and evaluate possibilities for improving deliveries by taking appropriate actions.	• Increased process efficiencies • Efficient customer order planning and enhanced delivery performance
Pricing	Revised pricing process through the costed BOM and item cross reference function. The prices for new products are established from the BOM cost available in the system which uses fixed item prices for specific customers. Through this new process, any disputes in prices that existed earlier have diminished.	• Better pricing process • Diminished pricing disputes
Production planning	The planning process entails a daily MRP run to review the latest product demand, stock on-hand and in the pipeline, availability of capacities and resources, providing a revised optimum plan for manufacturing. The system simulates constraint-based production planning scenarios for finalizing production plans and gearing up production to achieve it. Organizations are able to plan materials, production capacities, shop-floor manpower, and timely release purchase orders to the vendors to meet customer demand.	• More streamlined planning and improved process efficiencies • Constraint-based planning and scenario simulation
Purchasing	Revised purchasing process helps in timely and automated release of purchase orders, monitoring of supplies, and vendor evaluation. The ES provides information on various exceptions in the form of alerts, highlighting line shortages, pull-ins/push-outs, and areas of actions. Supports vendor communication and processes such as RoHS compliance.	• Improved information flow and visibility • Increased process efficiencies
Inventory management	Best practices in inwards goods receiving, quality assurance, and warehouse stock control processes are introduced. Global tracking of stock movement has led to better availability of stock in the regions and overall inventory control. Swift and accurate receipt of materials, efficient storage in the warehouse including first-in first-out process for shelf-life items, and on-time dispatch of finished goods to customers is established. Built-in checks to avoid data entry errors, triggering rule-based alerts such as transactions leading to a negative stock are launched.	• Enhanced inventory and asset management • Better management of shelf-life items • Improved on-time delivery
Manufacturing and production	Automated production schedules are created for released production jobs optimizing capacities and prioritizing production based on customer due dates and available material. This has improved achievement of production targets due to greater visibility of operations and instant exception alerts. The manufacturing process is driven by due dates and production schedules assigned by the APS and production optimizer in ES.	• Improved production targets • Increased productivity and performance
Dispatch	The dispatch process includes automated processing of shipment data through ES such as the packing list and the serial numbers that are timely sent to the customers with deliveries. Records are created to track shipment movements through freight forwarders.	• Improved deliveries, communication, and collaboration
Financial management	The ES outputs include cash flow reporting such as accounts payables, receivables, forex, and aging reports. The financial management process is automated through the ES functionalities providing tight funds controls and management reporting.	• Efficient and automated financial management
Systems management	ES provides built-in tools to monitor and administer the computer resources. System performance manager is available to the administrator to view the concurrent sessions and users, utilizing checkpoints, enforcing locking of user sessions, or enabling logging into the system. The system enables monitoring of the various applications and activities under processing providing optimum utilization of the system resources.	• Enhanced system administration • Better data security and storage
Product - BOM management	ES maintains different BOM versions, each with a distinct validity date. The separate yet integrated BOMs co-exist based on their specific requirements in different phases of development. ES supports on-going BOM updating with automated version control.	• Efficient BOM management
Product development – ECN process	The engineering change note (ECN) system provides a controlled creation, approval, and release of changes to products. ES provides the most feasible ECN implementation date based on stock on-hand, work-in-progress, stock-in-transit, purchase orders to vendors, ensuring a smooth transition of the change and avoiding stock obsolescence.	• Accurate ECN control • Reduced stock obsolescence

8.2.5 Case study findings compared to the preliminary study

In this section, a comparison of the key findings from the three case studies is made with the insights collected from ES vendors, ES consultants, and IT research firms in the preliminary study who are experts in this field. These comparisons establish triangulation and confirm the validity of the research findings to answer the four research questions: a) what key benefits do organizations seek through the utilization of ES and its information, b) how are ES data transformed into knowledge in relevance to the benefits sought, c) how is ES knowledge utilized to make decisions for the realization of the benefits, and d) what are the CSFs for the transformational process to produce benefits. These comparisons and insights are presented.

8.2.5.1 *Business benefits realized in the cases compared to the preliminary study*

All three case study organizations cited several business benefits that were realized through their ES implementations. These benefits are the basic reason for the ES deployment. Table 35 presents the business benefits realized in the three case studies compared to the benefits sought by organizations from the preliminary study.

Table 35: Benefits realized in the cases compared to the preliminary study

Business benefits organizations seek as per preliminary study	Benefits realized by Aevon	Benefits realized by Bevon	Benefits realized by Cevon
Improve information flow	√	√	√
Reduce inventory and reduce out-of-inventory events	+	√	√
Improve process efficiencies	√	√	√
Overall cost reduction by automating functions	√	√	√
Reduce head count	√	√	√
Increase information visibility	+	+	√
Supply chain operations reference (SCOR) model KPIs	●	√	√
Reduce month-end closure time	√	√	√
Process integration for seamless resource management	√	√	√
Increase productivity and throughput	√	√	√
Incorporate vendor-managed inventory	●	√	√
Become more agile and efficient	√	√	√
Drive efficiencies in the supply chain	√	√	√
Automate processes	√	√	√
Improve response time	√	√	√
Transparency in costing information	√	√	√
Reduce work-in-progress	+	√	√
Improve bill-of-materials management	√	√	√
Notes: √ = Realized; + = Partially realized; ● = Not realized			

It is evident from Table 35 that the business benefits expected from ES implementations as suggested by ES vendors/consultants are mostly realized by the three case study organizations. These are typical and generic ES benefits achieved from the various process improvements and information visibility in the organizational functions brought about through the ES deployment, as determined from the benefit realization findings in the three cases.

8.2.5.2 *ES data transformation in the cases compared to the preliminary study*

The respondents in the three case studies confirmed that creation of knowledge for decision making was a key motivation for ES implementation, especially in the second phase of implementation with modules such as business intelligence and data warehousing.

The ES data transformation processes for knowledge creation achieved by the three case studies are compared to the preliminary study insights. Table 36 presents the details.

Table 36: ES data transformation in the cases compared to the preliminary study

Conversion of ES data into knowledge as per preliminary study insights	Aevon	Bevon	Cevon
Use of data warehouse and business intelligence systems.	●	+	√
Clarity on information critical to the success of the organization and the data views needed to get valuable information.	●	√	√
ES products come with predefined reporting tools which provide a generic way of presenting data. To make this into useful business information to suit specific needs requires customization; effort by organizations to avoid customization because it drives up costs.	√	√	√
Organizations are looking to see what the system (especially at phase 2 implementation) is offering in terms of integrated reporting and whether the system has an inherent capability to give them the required information.	√	√	√
Extract and manipulate data from ES to present information in the form of a report, dashboard, scorecard, or KPI.	●	+	√
Creation of data warehouses to manipulate data into a format needed for management reporting.	●	√	√
Use of business analytics or reporting tools or a combination of both to extract information and create knowledge.	●	√	√
Enterprise portals through Web interfaces are used by senior managers to see financial trend analysis and a whole variety of other key requirements.	√	●	●
Initially organizations do not always see that they have information. What they see are data. They have to convert the data into a meaningful form to distil information using business intelligence tools.	●	+	√
Use of standard reports in the system such as aging or ABC analysis on inventory management, which also provides good information.	√	√	√
Notes: √ = Realized; + = Partially realized; ● = Not realized			

It is evident from Table 36 that Bevon and Cevon are more mature towards utilizing their enterprise systems investment for creating knowledge compared to Aevon. They have clarity on the information critical to the success of their organization and they have the means to achieve it. In contrast, Aevon has not yet set up KPIs for their approved goals. Aevon's management does not have clarity on the information critical to their success but they are working towards establishing these knowledge-driven processes.

8.2.5.3 *Knowledge utilization in the cases compared to the preliminary study*

Participants from all three case studies agreed that to realize benefits from an enterprise system, there should be no ambiguity on the objective to be achieved and clarity on the processes needed to accomplish it. Additionally, the company decision makers should be provided with the tools for establishing data-driven decisions. The utilization of knowledge-based processes to achieve benefits in the three case studies are compared with the preliminary study findings in Table 37.

Table 37: Knowledge utilization in the cases compared to the preliminary study

Utilization of knowledge to achieve benefits as per preliminary study insights	Aevon	Bevon	Cevon
Organizations use balanced scorecard techniques in conjunction with data mining capability to understand what the problem is and how managers should intervene.	●	●	√
Organizations also use business process simulation techniques and scenario planning when they want to analyze the problem by assessing different possible outcomes.	●	√	+
Information is transformed into knowledge by adding experience, context and interpretation so that it is used for decision making to achieve benefits.	√	√	√
There have been very few examples of a company using business intelligence tools strategically. The issue with balanced scorecards is that, firstly companies need to understand what the balanced scorecard is going to do for them.	●	+	√
Few NZ organizations are using a high level of strategic analytical tools, at least to the extent that might be expected.	●	+	√
Companies are now asking how to actually optimize and improve. Although, scorecards are as part of ES, few NZ companies are actually managing scorecards, others are just reporting KPIs.	●	+	√
Benchmarking is done by industry. The software vendors give clients a base line, with possibility to further build upon. Few NZ companies use benchmarking, others do not even know what it is they want to measure.	√	√	√
Notes: √ = Realized; **+** = Partially realized; ● = Not realized			

Table 37 shows that Cevon is the most mature towards utilizing knowledge for achieving business benefits. Cevon has worked out their value creation process and identified the critical areas that require attention and improvement in the different dimensions of business. Cevon utilizes strategic analytical tools and follows the business activity monitoring processes to achieve their business objectives. Cevon extensively uses ES tools such as business intelligence to extract information for decision making. Cevon has also established balanced scorecard and dashboard type of performance management systems for all their critical areas, translating information into visual presentations that facilitate decision making. These processes have been recently established after the take over of Cevon by US Corporation. This is in addition to the KPI reporting and the use of standard/special ES reports that Cevon had been using earlier.

Bevon and Aevon have not been able to create value assessments for tracking their business strategies, in part because the BI module is not operative in these two companies. Also, Aevon and Bevon have yet not implemented the balanced scorecard type of value assessment processes. Bevon uses the KPI reporting processes for monitoring their business strategies in addition to the use of standard/special ES reports. Aevon is in the very initial stages of establishing such analytical tools and business performance measurable towards achieving its business objectives. Aevon only uses the standard or special ES reports to manage its business currently. Aevon is planning to set up KPIs and would like to establish a scorecard in the future.

8.2.5.4   *CSFs for the transformational process compared to the preliminary study*

Given the significance and risk of ES projects, it is essential to examine and understand the factors which determine ES effectiveness and the influence of ES on the decision-making process for organizational benefits. The findings for critical success factors for the transformational process utilizing enterprise system and its data to produce organizational benefits in the three case studies are compared with the preliminary study insights.

These factors are further categorized and listed in alignment to the contextual factors in the transformational model (Figure 10) and presented in Table 38.

Table 38: CSFs for the transformational process compared to the preliminary study

Transfor-mational model contextual factors	CSFs for the transformational process to produce benefits as per preliminary study	Aevon	Bevon	Cevon
Strategic	Active executive commitment	Support from top management		Senior management support
	Business strategy is clearly defined, articulated, aligned		Alignment of ES strategy	Vision for team consistent to goals
	Translation into departmental strategies		Clarity on project plans and timelines	Definition of objectives
	Understand key drivers and influence the drivers	KPI management		Phased project plans and deliverables
	Clear definition of scope before implementation		Assessment of scope and budget	
Organizatio-nal and cultural	Effective change management process		Change management	
		Employee reward and recognition	Retaining key staff	
			Relationships within all stakeholders	Proactive, efficient decision makers
			Retain knowledge from legacy systems	
			Organization culture to promote creation and sharing of knowledge	Management must demonstrate the political will to use ES data and act
Skills and knowledge	Proper project management from both vendor and client		Relationships within all stakeholders	Dedicated project management and local support
	Training	Training	Training	Training
	User feedback, involvement and understanding of the process and expected outcomes		Involvement of key people and forum for discussions and feedback	Active involvement of all regions and BUs
	Managing client expectations		Timeline to achieve results	
	Design of information retrieval process appropriate to the business			
	Information gathering and application is seen as a technical project rather than a business project			Dedicated system administrator
Data	Data quality since unclean data can be very risky	Data integrity	Data quality	Data quality
	Consistent data management and clear data definitions			Management of technical tasks
Technology	Technology	ES usability, flexibility and scalability, support global transactions, and external collaboration, Web-based	Use of appropriate technologies	Use of appropriate tools and technology including their configuration

Firstly, Table 38 indicates that the critical success factors for the transformational process to produce organizational benefits cited by the three case study participants closely match the success factors cited by the ES vendors and consultants in the preliminary study. Secondly, these factors also closely match the contextual factors in the transformational model in the relevant category of the constructs comprising the strategic, organizational and cultural, skills and knowledge, data, and technology factors.

Factors such as senior management support, definition of objectives and translation into team goals, performance indicator management, and assessment of scope and budget, relate to the "strategic" construct in the transformational model.

Change management, retaining key staff, relationship within all stakeholders, employee reward and recognition, and culture to promote creation and sharing of knowledge cited in the case studies are factors in the "organizational and cultural" construct in the transformational model.

Training, involvement of key people and feedback, dedicated project management and system administrator, local support, and timeline to achieve results are part of the "skills and knowledge" construct of the contextual factors in the transformational model.

Data quality (i.e., accuracy, currency, timeliness) cited in all three case studies and also by the participants in the preliminary study relates to the "data" construct of the transformational model.

Finally, technology cited by all participants and its components such as ES usability, flexibility and scalability, support to global transactions and external collaboration, and Web-based functionality fall into the "technology" construct in the transformational model.

8.3   Results and Discussion

In answering the principal research question of how organizations are realizing the different types of business benefits from their ES investment and assessing the significance of these benefits in various functions and processes, four questions were posed (Section 1.3). These address how the process of ES data transformation affects knowledge creation, how knowledge utilization assists in decision making for achieving outcomes, how this leads to business benefits, and the critical success factors for the transformational process to produce benefits.

This section discusses the results of the research study. The section first discusses the summary of the key findings and cross-case comparisons identified in the earlier sections, applying the context, transformation, and outcomes approach to a wide range of evidence collected. The following subsections discuss the results in answering the research questions of this study. The

discussion uses the interpretive approach to collate business benefits from the findings and analyze how the process of ES data transformation has impacted knowledge creation. It then traces how the knowledge is utilized to achieve outcomes before discussing the critical success factors for the transformational process to produce benefits. This section begins with a summary of the major findings, which are presented next.

8.3.1 Summary of the major findings

The major findings from this study highlight that all three organizations sought business benefits from their ES investment with a strategy to achieve operational efficiencies and business growth through continuous improvement. The organizational culture is congenial and collaborative in the three organizations and they have a highly educated and skilled workforce. Bevon and Cevon have a more data-oriented culture with strict data discipline however data quality is not so good in Aevon. The reason attributed to Aevon's data quality problems is lack of organizational discipline, less respect for high quality data, lack of focus from the top management towards being more data-oriented, and, most importantly, insufficient attention to training. Rockart (2004) has noted that many companies impose less attention on improving the quality of data used by managers for business analysis, monitoring progress, and establishing decisions. These companies pay more attention to processes such as order intake or order execution which from their perspective and perception creates more value for the organization. Although all three companies have been providing training to their employees in different areas of business and in various forms, an important finding that has emerged from several respondents in this study is that end user ES training is one of the most critical elements for ES success. It may be vital for organizations to develop a user-training strategy as part of their business strategies, and not just a user-training delivery system which is not properly evaluated and controlled.

From the technology viewpoint, in addition to the core ES modules implemented by the three companies, Aevon has implemented a CRM module, Bevon and Cevon have implemented a bolt-on BI module, and Aevon and Cevon have implemented a field service module (FS-Plus) as an add-on. These modules provide additional support to the respective companies in those specific functions.

Standard reports, forms, and queries are used by all three companies for analyses, data transformation, and knowledge creation. Bevon and Cevon additionally use data warehouse and BI. To establish knowledgeable decisions, Aevon uses standard ES reports and Excel spreadsheets along with effective benchmarked comparisons. Bevon uses KPI reports to track organizational performance, whereas Cevon has additionally created a value assessment process

through the use of balanced scorecard and digital dashboards for monitoring performance and tracking benefits. Bevon and Cevon have translated their business strategy into quantifiable departmental goals and plans. Functional teams monitor and measure deliverables on an on-going basis and decide future actions for achieving set targets. Aevon has yet to establish such knowledge-leveraging processes but is considering implementation in the near future.

These findings clearly indicate that Bevon and Cevon are more mature and sophisticated organizations with higher-level business strategy analysis and knowledge-leveraging processes compared to Aevon. When implementing an ES, constraints in the transfer of knowledge has been identified as a key factor experienced by SMEs in comparison to large firms (Laukkanen et al., 2007; Light & Papazafeiropoulou, 2004; Van Stijn & Wensley, 2005). In the current study, Bevon and Cevon are large organizations whereas Aevon is a medium-sized organization. The findings from this study support earlier studies (Laukkanen et al., 2007; Light & Papazafeiropoulou, 2004; Van Stijn & Wensley, 2005) that SMEs fall behind large organizations with respect to establishing knowledge-leveraging processes for knowledge transfer and data transformation.

All three organizations have reported improved stakeholder's attitudes and relationships as a result of their ES deployment. The three companies have undertaken various new process initiatives within different functions such as manufacturing, supply chain, customer service, product design and development, and executive information management. Numerous process improvements have been realized in most of the operational functions of the three companies. All three organizations have reported improved financial performance, although the financial results of Bevon and Cevon demonstrate a superior performance compared to Aevon.

A summary of the key findings is presented in Table 39. This summary provides a comparative analysis of the three cases, highlighting the current practices and the critical effectiveness constructs of ES identified through the transformational model (Figure 10). The comparison is based on the three units of analysis – context, transformation, and outcomes – which are also the three main phases of the transformational model for achieving results from an ES deployment through the process of ES data transformation into knowledge. The constructs within each of the units of analysis are analyzed through cross-case comparisons and presented in Table 39.

Table 39: Summary of case study results from the three cases

Transformational model		Aevon	Bevon	Cevon
Context	Strategic	To achieve growth and operational efficiencies	To achieve growth and operational efficiencies	To achieve growth and operational efficiencies
	Organization and cultural	Congenial, and collaborative	Congenial, collaborative, and data oriented	Congenial, collaborative, and data oriented
	Skills and knowledge	Highly skilled and qualified workforce	Highly skilled and qualified workforce	Highly skilled and qualified workforce
	Data	Medium quality	High quality	High quality
	Technology	SL7, CRM, FS-Plus	SAP R/3, BI	SL7, BI, FS-Plus
Transformation	Analytical – knowledge creation	Reports, forms, queries, and alerts	Reports, forms, queries, alerts, data warehouse, and BI	Reports, forms, queries, alerts, data warehouse, and BI
	Decision making – knowledge utilization	Standard reporting, Excel, benchmarking	Standard reporting, Excel, KPI, benchmarking	Standard reporting, Excel, KPI, benchmarking, balanced scorecard, dashboards
Outcomes	Behavior change	Improved attitude and relationships	Much improved attitude and relationships	Much improved attitude and relationships
	New initiatives	Implemented in areas of manufacturing, customer service, and communication	Implemented in areas of manufacturing, supply chain, and product development	Implemented in product development, executive information management, and manufacturing
	Process changes	In all functions	In all functions	In all functions
	Financial impacts	Improved performance	Much improved performance	Much improved performance

The study has highlighted that business results follow in a culture where the business strategy is clearly articulated and defined; when organizational goals are aligned to overall business strategy; and when the key drivers are understood and the managers have the means to influence the drivers. Bevon and Cevon both had their organizational business strategy and goals aligned to their business activities. Cevon had further defined strategy to know exactly what had to be achieved, which data needed analysis, its area of application, and expected outcomes. Both Bevon and Cevon had a strong data-oriented culture. However, in the case of Aevon, the overall organizational strategy existed, but was not articulated and aligned into the day-to-day running of their business through departmental or divisional strategies. Aevon was not data-oriented and thus had not established adequate knowledge-leveraging processes.

Bevon and Cevon had a culture that supported decision makers who have the definition of the information critical to the success of the enterprise and the means to achieve it by aligning data, decisions, and actions. And, for achieving all of this, both Bevon and Cevon possessed the necessary expertise and skills in the usability of ES and its information. Quality of data played a vital role. The data quality was found quite good in Bevon and Cevon but not as good in Aevon.

Another key finding in this study is related to benefit expectation. New Zealand organizations are still weak in clearly defining and articulating their business objectives and translating them

into departmental goals and plans. An emphasis on the determination of clear goals and objectives at the outset of the project is one of the important factors for ES implementation success (Plant & Willcocks, 2006). This factor was found lacking in the case of Aevon. Management at Bevon had identified their key business objectives as performance indicators or deliverables, but had not sufficiently defined their value assessment framework. Cevon had created a value assessment model through the use of balanced scorecard and digital dashboards. The model clearly defined the business activities that added value for its customers in each of the functional areas aligning human resources and plans with strategy. For example, at Cevon the system included a review process that provided the means for a response through assessments supported by their underlying business intelligence and data warehouse application. These assessments were performed in areas of production yields and output, cost and quality parameters, manufacturing and test equipment utilization, planning and delivery targets, inventory levels, R&D plans and deliverables, and financial results. This enabled the company to increase operational efficiencies, maintain high product quality, improve future versions of products, and achieve higher sales and customer services. However, implementation of this review process was a recent development after Cevon's takeover by US Corporation. Specifically, as reported in the discussion of ES maturity in the preliminary study, the findings confirm that many NZ organizations produce little or no value assessments that often lead to weak business cases and insufficient benefit models which cannot be used for benefit tracking. Although some improvement is now seen, Aevon, Bevon, and Cevon have only recently started establishing analytical processes to optimize and realize business value from their ES investment.

Another finding from the case studies that matches the preliminary study findings is that many NZ organizations believe implementation of ES is a technology challenge. They think more in terms of the usability of the ES and the functionalities it provides. This is clear from the success factors identified by Aevon in which many factors cited are technology oriented. However the insights from the preliminary study suggest that implementation success is more about managing people and processes. This realization has been understood by larger and more mature organizations such as Bevon and Cevon, but not by smaller companies such as Aevon, as per findings of this study.

Cases of success are achieved when the executive team follows through in implementing and adopting the new possibilities and directions revealed by better ES data. An organizational culture that supports confident, knowledge-oriented decision-makers leads to achieving positive business results. It depends a lot on the leadership of the business.

8.3.2   Business benefits from ES implementation (research question 1)

In answering the first research question, what key benefits organizations sought through the utilization of ES and its information, a large number of business benefits realized by the three case study organizations emerged from this research. These benefits are reported across various different business functions and processes in the three organizations. The findings emphasize four major areas of benefit outcomes. These are categorized based on the outcomes phase in the transformational model comprising behavioral changes, new initiatives, process changes, and financial impacts. The benefits in these categories are listed by function and presented in Table 40.

The findings confirm the extension of the outcomes phase of Davenport's (2000) theoretical framework (Figure 9) to include the business benefits in the extended transformational model (Figure 10) resulting from changing behaviors, new initiatives, process changes, and financial impacts.

The results (shown in Table 40) are consistent with what is in the literature, but never has such a comprehensive list (Table 41 in Appendix C) been developed or with the multiple company perspective available from the case study organizations and the vendor/consultant community.

"Converting transaction data to knowledge is only effective if it produces business outcomes that improve financial performance, which usually happens as a result of new behaviors, new initiatives, or re-designed processes" Davenport (2000, p. 234).

The business benefits from this study that relate to benefits from the ES literature (e.g., Cooke & Peterson, 1998; Donovan, 1998; Gattiker & Goodhue, 2005; Hedman & Borell, 2002; Ragowsky & Gefen, 2008) include business process efficiency improvement, integration of business processes to achieve seamless resource management, improvement of information flow and access to data, increased productivity and throughput, an optimized supply chain, increase in production efficiency, inventory and cost reduction, and becoming more responsive with agility to change. These are generic benefits that most organizations seek and include all four major benefit areas of behavior changes, new initiatives, process improvements, and financial impacts summarized in Table 40.

Table 40: Business benefits realized by the case study organizations

Outcomes	Function	Business Benefits
Changing behaviors	Process control and automation	• Better collaboration and relationships between stakeholders • Improved behaviors of employees, customers, suppliers and all stakeholders
	Inventory management	• Improved availability of inventory information leading to better stakeholder attitudes • Better relationships between employees with fewer out-of-inventory events
	Customer services	• Enhanced communication, cooperation and relations with business partners • Increased trust levels with customers and suppliers • Improved availability, sharing of information, and customer responsiveness • Fewer disputes over transactions
	Demand forecasting	• Better customer supplier relationships • Streamlined supplies, with increased flexibility and improved demand forecasting
	Systems management	• Realization of various system functionality and benefits by stakeholders • Improvement in behaviors of all concerned due to the new system functionalities
New initiatives	Manufacturing	• Improved business processes and efficiencies • Better planning and monitoring through JIT deliveries • Implementation of VMI program and improved funds flow
	Supply chain	• Improved supply chain processes and SCOR model KPIs • Better demand planning and on-time deliveries
	Customer service	• Improved customer service and quality
	Product design and development	• Enhanced product costing and value engineering • Better BOM management • Superior pricing decision making
	Executive information management	• Effective performance monitoring and improved performance
	Communication	• Improved data visibility and communication
Process changes	Customer services (CRM)	• Fast and improved customer response process • Enhanced information visibility and process flow
	Returned material authorization	• Efficient customer service process • Better design process
	Sales operations planning	• More accurate delivery commitments to customers
	Customer order planning	• Increased process efficiencies • More accurate and improved delivery performance
	Pricing	• Transparent and accurate pricing process • Diminished pricing disputes
	Production planning	• More streamlined planning and improved process efficiencies • Constraint-based planning and scenario simulation
	Purchasing	• Efficient purchase ordering and monitoring processes • Increased information flow and visibility
	Inventory management	• Much improved inventory and asset management • Better management of shelf-life items • Accurate and improved on-time dispatch to customers
	Manufacturing- production	• Enhanced achievement of production targets • Increased productivity, production efficiencies, and performance • Better on-time deliveries
	Dispatch	• Faster deliveries, communication, and collaboration
	Financial management	• Enhanced finance integration with other functions
	Systems management	• Better system administration and integration of business processes • Enhanced data security and storage
	Product development - BOM management	• Accurate and efficient BOM management and control • Improved product data management and version control
	Product development – ECN process	• Tighter ECN control • Reduced stock obsolescence and better inventory control
Financial impacts	Finance	• Better visibility and reduced cost of quality • Increased revenue and growth • Improved analysis reducing costs, and improving profits • Much reduced warranty costs • Effective value engineering and cost reduction • Improved inventories and savings • Efficient working capital management and improved cash flow

ES benefits identified in this study but which are not evident in earlier studies include improvement in supply chain operations reference (SCOR) model KPIs, incorporation of a vendor-managed inventory (VMI) program, and improvement of bill-of-materials management. These are new and current development areas where the improvement in operational processes has a huge impact in achieving process efficiencies and cost savings by organizations. These findings indicate the new benefit areas of interest to organizations. These emerging benefit areas enable supply chain operational efficiencies and cost savings through the utilization of information technology. These new findings build upon the existing ES benefit literature.

Business benefits mentioned in earlier ES literature (e.g., Cooke & Peterson, 1998; Donovan, 1998; Gattiker & Goodhue, 2005; Hedman & Borell, 2002; Ragowsky & Gefen, 2008) but not cited in this study include shared services, competitive positioning ability, business growth, improved product quality, increased customer satisfaction, and standardization of company processes. This could be attributed to the intangible nature of these benefits that are difficult to recognize as resulting from ES utilization. Therefore, these were not offered by the case study organizations, although some of these outcomes are implicit in the resulting benefits (e.g., Table 40). These findings indicate the growing awareness of organizations towards seeking only those benefits that are tangible and can be quantified in terms of benefit. This insight contributes to the ES literature by explaining the growing ES maturity in organizations and identifying a new approach towards benefit expectations.

Even though several companies justify their ES implementation based on better process management and decision making, not many have taken full advantage of the information provided by the system (Davenport, 2000). Improvement of management and decision making with an ES may be a second or later phase of work with the system, after basic transactional processes have been put in place and substantially common information has been achieved.

Findings from this study have confirmed that now companies are designing new measurement and reporting systems around data from their ES and have begun to achieve measureable business improvements from better use of ES information. To achieve ES data transformation into knowledge and results, Davenport (2000) confirms the analytic and decision-making processes to be at the helm of the transformation process. The analytic process is the method by which ES data turns into knowledge.

8.3.3   ES data transformation into knowledge (research question 2)

In answering the second research question, how are ES data transformed into knowledge in relevance to the benefits sought, the use of ES business tools and their functionalities by the

three firms emerged from this study. The major tools and methods include use of standard ES reports, forms, and queries. Additionally, data warehouses are used when data are brought in from various heterogeneous environments and the relevant information is utilized by the users on a regular basis. Tools such as SyteLine Viewer, which do not require a user license for its usage, are utilized so that more staff can access data and gather information. Organizations also use special reports created through the Crystal Reports functionality for SyteLine and ABAP programming for SAP. The BI module is specifically helpful in extracting and manipulating data, with the ability to perform user-friendly queries and formatting commands and report on particular data objects. The information could further be transferred to Excel spreadsheets where even further manipulation could be performed. Organizations have created Web portals which are actively utilized by employees, customers, and distributors to collaborate and access real-time information. These findings specifically answer the second research question and confirm the analytic process in the transformation phase of the transformational model (Figure 10).

The decision-making process in organizations is on the basis of well-analyzed, high-quality data. According to Davenport (2000), some companies are beginning to link decisions to the data and knowledge used to assist them, but this linkage is not a common one. "If the results of ES data transformations are not used to inform decisions, then what is the point of the transformations in the first place?" (Davenport, 2000, p. 224).

8.3.4   Utilization of ES knowledge for decision making (research question 3)

In answering the third research question, how is ES knowledge utilized to make business decisions for the realization of the benefits, the use of various knowledge-based processes by the three firms emerged from this study. Organizations manipulate and analyze ES data, apply human judgment and experience, and use the created knowledge for decision making. The information is made available by the use of standard business analytics and ES reporting tools within the system. The ES data are transferred into Excel spreadsheets to facilitate analyses where the users create graphs, pivot tables, and other user-friendly representations. The business decisions are established on the basis of data analysis and other organizational factors. Organizations also use benchmarking and KPI reporting supported with ES data as a method for measuring and monitoring performance for achieving goals and targets. The performance review process leads to decision making that helps in achieving the overall business objectives. Additionally, business tools such as balanced scorecard and dashboards are used to track progress towards realizing business benefits and to establish analytical decision making. The relevant information is easily extracted by two of the three organizations through the use of their ES business intelligence engine. The third research question is answered from these findings

that confirm the decision-making process in the transformation phase of the transformational model.

Such aspects of ES data transformation and utilization through analytical decision making that lead to benefit realization have not been reported earlier in the ES literature. These new findings contribute to the existing ES literature.

Effective use of ES information to manage business requires a set of organizational factors to be present, in addition to the technological capabilities that most firms acknowledge (Davenport, 2000).

8.3.5 CSFs for the transformational process to produce benefits (research question 4)

In answering the fourth research question, what are the critical success factors for the transformational process to produce benefits, several critical success factors were identified by the various participants of the three firms who participated in this study. These factors are found across the five contextual constructs of the transformational model comprising the strategic, organizational and cultural, skills and knowledge, data, and technology factors, as summarized in Table 38.

These findings confirm the context framework of the transformational model (Figure 10). It may be noted that although the critical success factors for ES implementations have been widely explored and reported in the literature (Allen et al., 2002; Holland & Light, 1999; Parr, Shanks, & Darke, 1999; Yang & Seddon, 2004), the success factors for the transformational process to produce benefits through the utilization of ES, its functionalities, and its information have not been explored earlier. These findings contribute to the existing ES literature.

Collectively, the findings from this study reported in this section verify and confirm the success of the transformational model used in identifying the various phases, factors, and constructs for the process of ES data transformation into knowledge and benefits.

8.4 Summary

This chapter presented the analytical cross-case comparisons of the three case studies, the case study results, and a narrative discussion of the findings. First, an analysis of the financial outcomes and key results in the three case study organizations were presented. Next, the critical effectiveness constructs of ES as identified through the transformational model (refer Figure 10) based on the three units of analysis – context, transformation, and outcomes were analyzed. These are the three main phases of

the transformational model for achieving results from an ES deployment through the process of ES data transformation into knowledge. By the examination of the current post-implementation ES practices in the three case studies, the impact of enterprise systems on the various organizational functions and processes was evaluated and the business benefits achieved were summarized.

Comparisons were drawn with the earlier preliminary study with ES vendors and consultants (Chapter 4) and with what was found by previous researchers, verifying the validity of the research findings and establishing the generalization of the results in the New Zealand context. Finally, the results were discussed through analytical commentary and the major findings were summarized in answering the research questions of this study that explained the impact of enterprise systems for business benefits. The conclusion and future research directions for this study are presented in the next chapter.

Chapter 9

CONCLUSIONS AND FUTURE RESEARCH

9.1   Overview

The purpose of this study was to understand how organizations utilize their enterprise system and its information to realize business benefits. Insights were gained into the key business benefits organizations seek and have realized through their ES implementation, how organizations transform ES data into knowledge, how this knowledge is utilized to achieve business benefits, and the critical success factors for the transformational process to produce benefits. Understanding was achieved using the qualitative data from three case studies of ES implementations in the following ways:

a)   Providing a detailed description of the case study organizations utilizing the transformational model developed from the literature that includes the context, transformation, and outcomes phases. The context framework comprised the strategic, organizational and cultural, skills and knowledge, data, and the technology constructs. The transformation stage comprised the analytic and decision-making processes that explained how ES data are accessed, analyzed and transformed into knowledge, and how this knowledge is utilized through decision-making processes to achieve outcomes. The outcomes comprised the changing behaviors, new initiatives, process changes, and the financial impacts from the three case studies.

b)   Analyzing these findings within the cases and comparing them across the three cases using pattern matching and explanation building to show similarities and differences in the organizational practices for achieving business benefits.

c)   Further comparing these findings with the preliminary study insights from ES vendors, ES consultants, and IT research firms as well as addressing the rival explanations to conclude and generalize on the findings.

d)   Exploring and explaining the implicit relationship between the ES and knowledge-leveraging practices in organizations and the outcomes.

e)   Exploring and explaining the implicit relationship between the contextual factors present in organizations and the outcomes. In particular, focusing on the three success factors of clearly defining and articulating the business strategy, quality of

data and data discipline, and end-user training that have a major impact on the outcomes.

f)   Exploring and explaining the ES maturity attained by New Zealand organizations in their ability to realize business benefits from their ES investment.

This section explains the verification and confirmation of Davenport's extended transformational model (Figure 10) utilized in this study. Section 9.2 presents a further development of the transformational cycle model (Figure 18) and Section 9.3 introduces the model for ES data utilization in strategy (Figure 19) as two important outcomes from this study. Next after that, the key findings of this study are highlighted, the study implications are discussed, and study limitations are identified. Finally, directions for future research are proposed.

This study uses the dimensions and variables of the transformational model of how ES data are transformed into knowledge and results to guide the analysis to answer the four main research questions, which are summarized below.

The first research question "what key benefits do organizations seek through the utilization of ES and its information?" provided the focus for the research investigation in this study. The answer to this question was explored in the existing literature, further evaluated through the preliminary study with expert ES stakeholders through exploratory ES research (Mathrani et al., 2009a; Mathrani & Viehland, 2007a; Mathrani & Viehland, 2009; Mathrani et al., 2007, forthcoming 2010), and established through the description of the outcomes phase in the case studies using the transformational model.

The answer to the second and third research questions, "how are ES data transformed into knowledge?" and "how is this knowledge utilized to achieve benefits?", was explored in the existing literature, further evaluated through the preliminary study with expert ES stakeholders through exploratory ES research (Mathrani & Viehland, 2007a; Mathrani et al., forthcoming 2010), and provided through the description of the transformation phase in the case studies using the transformational model.

The fourth research question, "what are the critical success factors for the transformational process to produce benefits?" was explored in the existing literature, further evaluated through the preliminary study with expert ES stakeholders through exploratory ES research (Mathrani & Viehland, 2007a; Mathrani et al., forthcoming 2010), and established through the description of the contextual factors in the case studies using the transformational model.

Each case study in the main study reported a background of the company, the strategic, organizational and cultural, skills and knowledge, data, and technology dimensions of the organization. The analytical and decision-making processes were reported through ES data transformation into knowledge dimensions. The outcomes were reported through changing behaviors, new initiatives, process changes, and financial impacts dimensions leading to business benefits based on the transformational model. Through the construction of the cases, understanding is achieved about the key organizational and ES-related practices, achievements, and challenges.

Finally, the qualitative data that were collected and analyzed helped to evaluate how organizations realize business benefits from their ES investment. The rich empirical data gathered and results analyzed from the three case studies has helped in understanding the theoretical framework for this process and the model has been verified as an appropriate approach to understand the impact of enterprise systems for business benefits.

The research model that was used (Figure 10) evolved from Davenport's framework (Figure 9) and was found suitable for the purpose. The model's contextual constructs – strategic, organizational and cultural, skills and knowledge, data, and technology factors – confirm their role in transforming ES data into knowledge that lead to business benefits. The business benefits are realized as a result of analytical decisions and actions taken through the various organizational functions and processes with support from the ES and its functionalities. This study has utilized and verified the theoretical proposition in the transformational model (Figure 10) to confirm the process of ES data transformation for realizing business benefits in organizations.

It is clear from this study that software alone is not enough to make businesses run more smoothly and cost effectively. For software to deliver real value to the organization, end users must have the skills and understanding to use it accurately and intelligently. This study shows that the causes of failure to achieve expected results are more about the human performance, less about the technology.

9.2   The Transformational Cycle Model

One of the most critical conclusions from this study confirms that the process of ES data transformation is not a one-time activity starting from the context phase and ending with the business benefits. This is an on-going process of continuous improvement in organizations, a process which is cyclic in nature as organizations learn from experience. The process is also not an orderly sequence of events as some processes and events may exist concurrently. This

process is not strictly linear, as suggested in Figure 10. With this increased understanding, the transformational model is revised to depict the transformational cycle through a simplified model as shown in Figure 18. Recognizing that in a world of constant change, companies must recognize need for constant review and revision. This model establishes acceptance and understanding up front and maintains to develop the transformational process success in the long term.
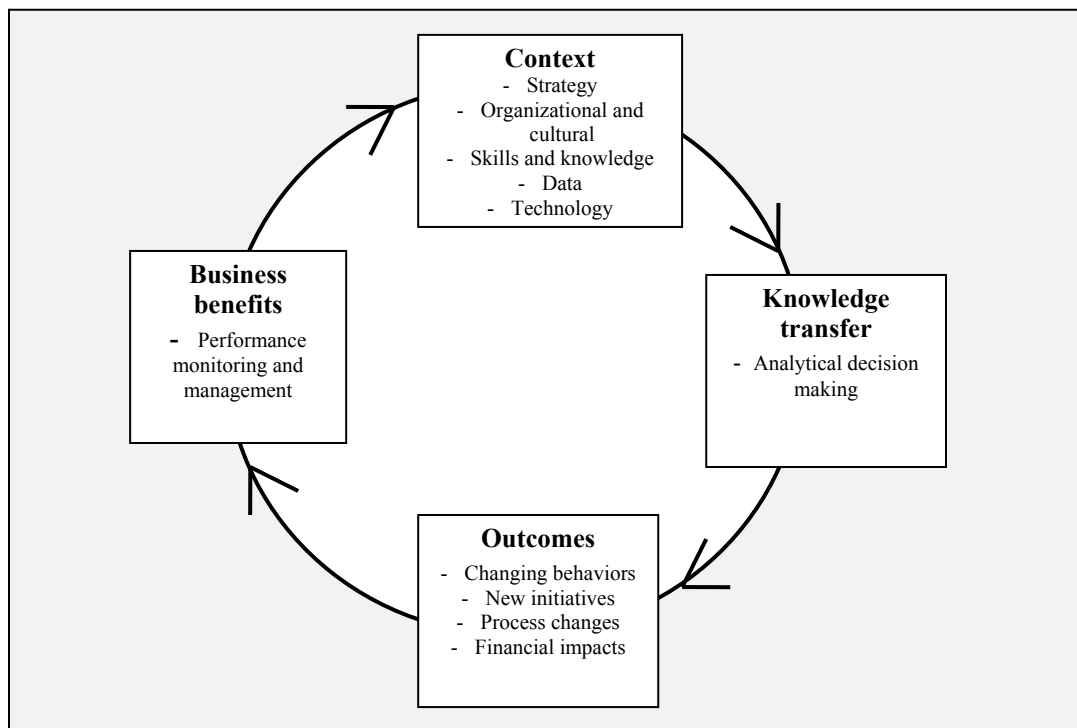

Figure 18: The transformational cycle model

9.3 Model for ES Data Utilization in Strategy

Another key conclusion from this study suggests the process organizations adopt for ES data utilization in strategy (see Figure 19). The process originates from the organizational strategy and targets. Once an organization's business objectives have been established, these objectives drive the organizational new initiatives and process changes in support of the accomplishment of those goals and objectives as depicted by the downward pointing arrows. These projects and actions establish and utilize the ES and business intelligence system which are the knowledge management enablers for the purpose of managing knowledge-related processes such as KPI reporting and balanced scorecard. This process utilizes the firm's knowledge assets, primarily, the ES data warehouse and its data. However, it is recognized that the existing technology can either deliver the identified requirement or might be limited by its ability to provide the precise information. This restriction could constraint the effectiveness and performance of the knowledge-related processes. This is represented by the dotted, upward pointing arrows.
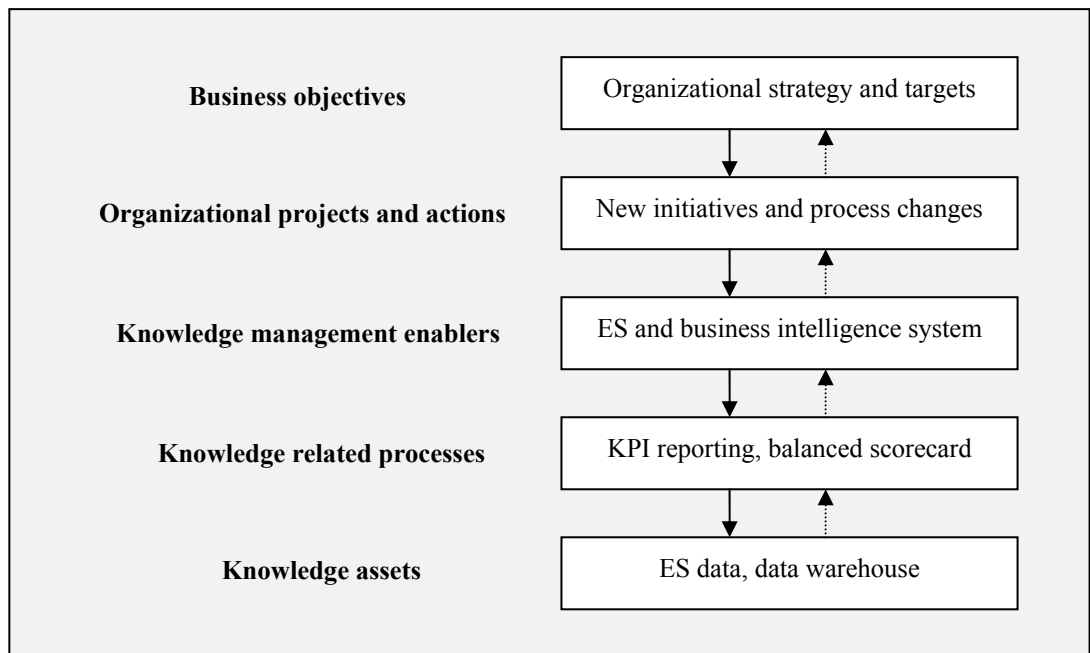
Business objectives	Organizational strategy and targets
Organizational projects and actions	New initiatives and process changes
Knowledge management enablers	ES and business intelligence system
Knowledge related processes	KPI reporting, balanced scorecard
Knowledge assets	ES data, data warehouse

Figure 19: Model for ES data utilization in strategy

The ES data are extracted and utilized, initiated through the knowledge-related processes for performance monitoring and management or a business function requirement that needs information for decision making. Knowledge management enablers such as the ES and business intelligence system assist in analyzing extracted data for strategic decision making. The analytical processes lead to knowledge utilization in various organizational projects and actions through new initiatives and process improvements to finally achieve the organizational goals and business benefits. This model is similar to (but not necessarily derived from) Ward and Peppard's (2002, p. 41) model that illustrates the relationship between business strategy and IT strategy (see Figure 7).

The above process of knowledge creation and conversion aligns with Nonaka et al.'s (2001) dynamic three-layered knowledge creation model (see Figure 6). Layer 1 – comprising the cyclic conversion of socialization, externalization, combination, and internalization – ensues from the on-going implementation of organizational projects and new initiatives which lead to individual, functional, organizational or inter-organizational process changes and actions. Layer 2 – comprising the contextual aspect, or the platform for knowledge creation – relates to the business objective or the strategic context for which the knowledge is shared, created, and utilized. Layer 3 involving knowledge assets (e.g., ES data and data warehouse), knowledge-related processes (e.g., KPI reporting and balanced scorecard), and knowledge management enablers (e.g., ES and BI system) interact with each other to generate new knowledge. This confirms Choo's (2006) argument suggesting that as new knowledge or knowledge assets are organized, shared, and made available to many groups in the organization through effective use

of information technology, these assets form the inputs, outputs, and the moderator to the knowledge creation process.

As an industry best-practice approach and framework for knowledge utilization and continuous improvement throughout the organization, the transformational cycle model (Figure 18) and the model for ES data utilization in strategy (Figure 19) maximize ES-related organizational performance and ensure the overall success and ROI of the ES implementation.

9.4   Key Findings from the Study

Several key findings have emerged from this study. First is the exploration of business benefits that organizations expect from an ES implementation. This study has examined the effectiveness of enterprise systems on organizational functions and processes for realizing business benefits. The study has evaluated the business benefits organizations seek and realize as a result of their ES investment. The key benefits (mentioned by more than one informant) include improving information flow and visibility, achieving process efficiencies, cost reductions by reducing inventory, fewer out-of-inventory events, automation of functions, and headcount reduction. A detailed list of business benefits achieved through ES-related process changes is available in Table 40.

This study also provides insights into the various knowledge-leveraging processes organizations adopt using ES and its information for realizing benefits. The most common processes for transforming ES data into knowledge include the use of standard ES forms, queries, and reports. Two of the three organizations in this study also use data warehousing and business intelligence systems for creation of knowledge from ES data. The processes for knowledge utilization and analytical decision making that lead to benefit realization include balanced scorecard type of performance evaluation techniques, KPI reporting, business process simulating techniques, scenario planning, what-if analysis, and digital dashboards. Organizations use such methods and techniques to identify problems and analyze potential solutions. Also, monitoring and measuring performance can help build the company's ROI. However, the use of such processes is limited to sophisticated and mature organizations with a high level of strategic thinking in place. For example, in this study Aevon has not ventured into the use of these processes yet. The reasons attributed to less adoption of knowledge-leveraging processes are the organizational size, ES maturity, and the top management vision and style of managing the organization.

The study has highlighted that business results follow in a culture in which the business strategy is clearly articulated and defined. The organization's managers work out their value creation process, identifying the critical areas that require attention and improvement. They understand

the key drivers and have the means to influence those drivers and measure them. Management translates their business strategy into departmental or divisional strategies, know what is to be achieved, which data need analysis, their areas of application, and expected outcomes. The organization has a culture that supports decision makers who have the definition of the information critical to the success of the enterprise and the means to achieve it by linking data, decisions, and actions. And, for achieving all of this, the organization must possess the necessary expertise and skills in the usability of ES and its information. Quality of data plays a vital role.

Another key finding related to benefit expectation is that New Zealand organizations are still weak in clearly defining and articulating their business objectives and translating them into departmental goals and plans. An emphasis on the determination of clear goals and objectives at the onset of the project is one of the important factors for ES implementation success (Plant & Willcocks, 2006). This factor was found lacking in the case of Aevon. Specifically, as reported in the discussion of ES maturity in the preliminary study, many NZ organizations produce few or no value assessments that often lead to weak business cases and insufficient benefit models which cannot be used for benefit tracking. This finding matches with the current status in Aevon. Aevon is an organization which is more typical of a SME organization in the NZ context, as referenced by the ES consultants. Although some improvement is now seen, Aevon has only recently started establishing analytical processes to optimize and realize business value from their ES investment.

Another finding from the case studies is that many NZ organizations still believe implementation of an ES is a technology challenge. Managers think more in terms of the usability of the ES and the functionalities it provides. This is clear from the success factors identified by Aevon in which many factors cited are technology oriented. These findings also match the preliminary study findings. The insights from this study, however, suggest that implementation success is more about managing people and processes. If people could not or would not use the software, the software simply would not deliver on its potential. This realization has been understood by more mature organizations such as Bevon and Cevon, but not by smaller companies such as Aevon.

Although all three companies have been providing training in various areas of business, including ES, an important finding that end-user training is one of the most vital elements for ES success emerged from several respondents in the study. It is important for organizations to develop a user-training strategy as part of their business strategies and not just a user-training delivery system that is not properly evaluated or controlled.

Finally, the results of this study can be generalized to a larger population of NZ companies since the findings mostly conform across the three cases and also conform to the preliminary study findings.

9.5   Contribution

To the author's knowledge, this study is the first attempt to: (1) extend Davenport's (2000) framework (Figure 9) on benefit realization and evaluate how organizations realize business benefits from utilization of ES and its information; (2) investigate the process for ES data transformation into knowledge and utilization of knowledge to achieve business benefits; (3) provide an in-depth analysis of the business benefits sought by organizations from their ES deployment and the benefits achieved; (4) examine the various methods of leveraging ES technology for business benefits; (5) investigate the critical success factors for the transformational process to produce benefits; (6) establish links between the adoption of ES, its impact on organizational functions and processes, and improved business practice; (7) identify strengths and challenges towards an organization's ability to extract value from their ES technology; (8) explain the ES maturity attained by NZ organizations; (9) provide insights on the business benefit realization practices in NZ organizations from an ES vendor/consultant perspective who are the most knowledgeable in this field; and (10) provide helpful guidance to organizational leaders to formulate a strategy for achieving organizational benefits through their ES investment.

There are several new insights this study provides to the ES benefit literature. First, the transformational model developed for exploring and understanding the benefit realization process from ES and its information in this study (see Figure 10). Second, the conceptual framework developed for the ES implementation determinants for ES adoption in this study (see Figure 16). These have been useful tools for examining ES benefit realization and can be used in future research. Third, never has such a comprehensive list of ES benefits been developed with multiple case studies (see Table 41 in Appendix C). Fourth, this study has categorized the comprehensive list of benefits into four major benefit areas (see Table 40) and identified new benefits that support cost savings and improvements in operational efficiency (e.g., vendor-managed inventory programs). Fifth, this study has found that organizations are principally seeking only tangible benefits from their ESs, benefits that can be quantified in terms of benefits sought.

This study provides new perspectives on the current ES implementation practices in New Zealand organizations. First, organizations are now installing a larger number of modules in the first phase of implementation. Second, not only are first phase implementations becoming more

ambitious, but they are also becoming more efficient in terms of time and cost of implementation. Third, ES implementations in all firms are becoming more vanilla – little or no customization – and across multiple sites. The vendor/consultant perspective is that this can be attributed to the availability of various system functions as pre-configured business process as ES technology architectures improve. These insights are new contributions to ES literature. Therefore, the study findings are believed to be extremely valuable to both academia and practitioners in the industry. This is further explained in the next section.

9.6   Study Implications

The main contribution of this research lies in providing a better understanding of what benefits can be sought from an ES implementation, its impact on the different organizational functions and processes, and implications for both research and practice with a focus on usability of an ES and its information.

These implications drawn from the study findings for both researchers and practitioners are discussed next.

9.6.1   Implications for researchers

As discussed earlier, there have been a number of research studies conducted to establish and understand the critical success factors for ES implementations (Allen et al., 2002; Holland & Light, 1999; Parr et al., 1999; Yang & Seddon, 2004). There have also been several studies on the business benefits organizations can expect from their ES implementations (Davenport et al., 2002; Gattiker & Goodhue, 2005; Hedman & Borell, 2002; Ittner & Larcker, 2003; Yang & Seddon, 2004). However, little research has been conducted to understand the affect of enterprise systems on organizational effectiveness in the post-implementation phase (Hedman & Borell, 2002; Ifinedo & Nahar, 2006) which makes it difficult to draw conclusions on the impact of ES on organizational performance (DeLone & McLean, 1992; Hedman & Borell, 2002; Ifinedo & Nahar, 2006). The current study addresses this research requirement and examines ES implementations in organizations to understand the impact of enterprise systems on the decision-making process for producing organizational benefits.

Yang and Seddon (2004) have stated that no previous study has found a theoretical link between ES benefits and critical success factors (CSFs). They found several studies that examined benefits from an ES implementation and also several studies which sought to identify the CSFs for enterprise systems, but none of the studies focused on both benefits and CSFs from an ES. In addition, Yang and Seddon (2004, unpaged) have reported that "the CSF studies have been criticized for lack of theoretical insight linking CSFs to benefits". Finally, most CSF studies

"lack a theoretical framework that adequately explains why the investigated project and business outcomes occur". Therefore, these studies contribute little to the understanding of ES implementations (Robey et al., 2002, p. 20 cited in Yang & Seddon, 2004).

The present study has bridged these gaps. In this study, extension of Davenport's (2000) theoretical model (Figure 9) into the transformational model (Figure 10) is a major achievement. Its further development into the transformational cycle model (Figure 18), as an outcome of this study, contributes to the ES literature. The transformational cycle for ES data transformation and results links key success factors to the analytical decision-making process leading to outcomes and business benefits as an ongoing and continuous learning and improvement cycle. Davenport (2000, p. 255) notes, "it may be difficult to draw a direct chain of influence from prerequisites to transformation to non-financial outcomes to financial results, but establishing that linkage should always be the objective of an organization that invests effort and resources in ES data transformation". Using the transformational model in this study, the linkage between the context variables, transformation, and business benefits has been established that evaluates the impact of enterprise systems and its data for realization of business benefits. The study further contributes to the ES literature through the development and confirmation of the model for ES data utilization in strategy (Figure 19) adopted in organizations as an outcome of this study. The focus of most ES research so far has been on "what an ES does" rather than "how an ES does it," which has been the contributing factor of this study.

In summary, the contributions to research include:

(1)   Extension and further development of Davenport's theoretical model by using empirical evidence from multiple case studies.

(2)   Exploration of the success factors, evaluation of the ES data transformation and decision-making processes, ES data impact on functional and business processes, and their outcomes.

(3)   The identification of business benefits organizations seek and have realized from an ES and its information.

(4)   The identification of methods for ES data transformation into knowledge.

(5)   The identification of methods for utilization of knowledge to achieve benefits.

(6)   The identification of outcomes as a result of ES data transformation and its impact on behaviors, initiatives, processes, and financial impacts.

(7)   The identification of critical success factors for the transformational process to produce benefits.

9.6.2   Implications for practitioners

For practitioners in business, the benefits of this study are significant and include the following:

(1)   Documenting and reporting the ES implementation and benefit realization experience of the three organizations participating in this study.

(2)   Understanding how ES data are transformed into knowledge and how this knowledge is utilized to achieve benefits, taking into account the different viewpoints of several functional stakeholders.

(3)   Understanding the influence of the contextual factors, ES data transformation methods, and knowledge utilization methods on the process outcomes.

(4)   Understanding the impact of ES implementation on various functions and processes and the possible benefits.

(5)   Gaining insights into current ES implementation practices in industry from the perspective of ES vendors, ES consultants, and IT research firms.

(6)   Understanding links between the adoption of ES, its impact on organizational functions and processes, and improved business practice.

(7)   Understanding strengths and challenges towards an organization's ability to extract value from its ES technology.

(8)   Understanding the ES maturity attained by NZ organizations towards their ability to achieve benefits from their ES implementation.

The practical lessons on the impact of ES for realizing business value that are learned from the three case studies include the following:

(1)   Clear identification of project goals and objectives helps bring clarity into the expected outcome, and then the ES data transformation process for achieving the objectives becomes easier to achieve.

(2)   Tools for data extraction and analytical processing are essential to support the ES data transformation process.

(3)   Quality of data plays a vital role in the ES data transformation process. The discipline for timely updating of transactional records and maintaining the accuracy of data has a major impact on the overall outcome.

(4)   The training of staff in the usability of the ES, its various technical functionality and built-in tools, knowledge of data structures, and the underlying business processes is a necessary factor for success.

(5)   It is important to note that successful cases may only be possible when management shows the willingness to act upon and implement the new opportunities and insights made available by better ES data. Positive organizational outcomes are most likely to follow "in a culture that supports bold, proactive decision makers" (Davenport, 2000, p. 235). It depends a lot on the leadership of the business.

The implications for business are clear. ES implementations necessitate significant investments, especially in software, consultant costs, and organizational resources. To ensure the investments are secure, it is in the organization's interest to prepare a business case that considers expected benefits for the money that is spent towards implementation. In order to successfully compete in the current global environment, organizations must focus on increasing effectiveness in business operations. Access to relevant information must be available through an integrated ES so that competent decisions can be established towards optimizing organizational performance, achieving business strategies, and providing value to customers. Knowledge is a key factor in this process.

Success or failure is often attributed to enterprise systems or their implementation process. However, it is evident from this study that enterprise systems provide a platform of functionalities and information to an organization. The ability of an organization to extract value from data, distribute results from analysis, apply knowledge, and establish effective decisions for strategic organizational benefits will guide the organization towards business success which would eventually emerge from the cyclic process of ongoing data transformations over a period of time.

9.7   Limitations of the Study

This section identifies the limitations of the research study. The limitations inform the need for future research, as an extension to this study, to further explore the process of benefit realization from the use of enterprise systems. It is also essential in order for ES evaluation research to continue having relevance to the organizational assessment procedures, whilst achieving

academic rigor. Explanations of these limitations and the implications on the study's findings are discussed.

(1) Restriction was imposed on the case selection due to the approach of selecting cases of ES implementation with a predetermined criteria based on common conditions. First, all three cases should belong to the same industrial segment (manufacturing) to capture the operational efficiencies improvements expected from ES implementation by this segment. Second, the cases should belong to the same industry class (high-tech electronics) with common conditions for comparison. Third, the cases should have implemented ESs for at least three years and so are in the mature phase of realizing benefits. No other organization in this sampling strategy was identified or agreed to participate. However, the restrictions on the sampling strategy have provided analytical descriptions using replication logic across similar "information-rich" cases.

(2) The in-depth nature of investigation for the case studies restricted the number of cases to three for this research study. The study involved a detailed examination of the organization's business processes across strategic, organizational and cultural, skills and knowledge, data, and technology factors. The study also entailed a comprehensive exploration of ES data transformational processes and the related success factors. A study using more cases would have provided a broader perspective on ES implementation practices, although three case studies are considered enough for this research due to the in-depth nature of the evaluation involved.

(3) The research dealt with both large and medium-sized organizations in the NZ context but did not include the small organization segment. The organizational size asymmetry precludes the evidence that the benefit realization process and its results in large and medium-sized would be available to smaller organizations. In this study the evidence of benefits realization reported by large organizations (Bevon and Cevon) were more prominent compared to the medium-sized firm (Aevon). Exploration of this aspect in the small enterprise segment would be of value.

(4) In this research, the specific time period under study was the recent past, comprising the last three years when the ES was implemented in the organization until the current period, with data collected through the events retrospectfully. The retrospective nature of this study could have limited or distorted the benefit realization events cited by the participants. Also, the findings are limited to the views of fifteen professionals interviewed in the three case study organizations and ten professionals from different ES vendor, ES consultant, and IT research organizations.

However, the study has achieved its exploratory purpose. This is achieved through the profile of the sample selected. The study's conclusions are drawn from interviews with a diverse set of professionals with considerable seniority and experience and positioned in key international firms in the NZ industry. Their rich real-life insights have been presented in this study.

9.8   Directions for Future Research

This study establishes the basis for understanding how organizations utilize their ES and its information to realize business benefits. The study has identified the critical effectiveness constructs to evaluate how organizations convert ES data into knowledge, how this knowledge is utilized to achieve outcomes, and how this leads to business benefits.

Based on the results of this study, it is suggested that this study be replicated in other countries, especially utilizing the perspectives of both ES vendors/consultants and the ES users in organizations in those countries. Most studies use only the organizational approach which focuses on the user's perspective. The user's viewpoints may be restricted to those of specific firms where the user is working with limited ES exposure or knowledge in the field. The users may not be utilizing the ES to the maximum, constrained by their functional knowledge. In contrast, the ES vendors/consultants are experienced individuals actively engaged with numerous organizations in a variety of industries who are purchasing and deploying enterprise systems. Thus future research would analyze the critical effectiveness constructs identified through the extended model in this study to investigate the perspectives of the consultants and vendors, and the real-life experiences of organizations in other countries where ES implementations are realized.

A longitudinal study to assess organizational transformation before, during, and after ES implementation is also suggested. This would overcome the retrospective nature of the current study.

Similar studies could also be conducted using a diverse selection criteria of organizations such as selecting small organizations, or a different industry sector such as retail or service industry to compare the findings with this study. These insights would be useful to better understand one of the most important areas of information system research and practice – the impact of enterprise system technology for business benefits.

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Appendix A

Preliminary Study Interview Sheet and Questions

Impact of Enterprise Systems for Business Benefits: Case Studies for Implementations in New Zealand

Purpose of the Study

This study looks at current enterprise system (ES) – also called enterprise resource planning (ERP) – implementation scenarios in New Zealand (NZ). This is a preliminary study which is part of a PhD study that explores the impact of ES for achieving business benefits.

The doctoral study investigates how organizations utilize their ES investment, functionalities and data to create knowledge and utilize the knowledge through decision-making processes to achieve business benefits. It does so by evaluating how ES data are transformed into knowledge and how that knowledge leads into business benefits in an organization. The study will evaluate the utilization of ES data for analysis and its use to support business decisions and examine the outcomes from this process on organizational functions and processes and the business benefits achieved. The main questions the doctoral study addresses are: **What key benefits do organizations seek through the utilization of ES and its information? How are ES data transformed into knowledge and utilized to make business decisions for the realization of benefits? And what are the critical success factors for the transformational process to produce benefits?**

The purpose of the current study is to better understand ES implementation scenarios in an NZ context and identify comparative case studies of at least three organizations that have implemented ES that satisfy the following criteria:

- Cases that **belong to the manufacturing sector**. This is significant because the characteristics of manufacturing organizations within the environmental, organizational, and technological context especially motivates ES adoption.

- The cases **belong to the same class of industry** allowing common condition for comparison. Specifically, all three cases must belong to the high-tech electronics manufacturing industry.

- The cases should have **implemented ES at least three years ago**, the system is stable, and the organization is in the phase of realizing the benefits. These conditions constrain variation due to differences among the firms.

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Preliminary Research Interview Questions

Impact of ICT for Business Benefits: Case Studies of Enterprise Systems Implementations in New Zealand

Questions

The following questions are offered for your consideration in advance of the interview. We may not have time to address all of them completely, but they all are pertinent for this study.

1. Could you please identify key business benefits that organizations generally seek and that are possible through the utilization of ES and its information?

2. Generally, how do organizations transform ES data into knowledge, and how is that knowledge applied to decision making to maximize benefit realization?

3. Are there any critical success factors – six or seven things that must go right – for the transformational process to produce benefits?

4. Could you please explain the current ES implementation scenario in New Zealand? Please elaborate using the following or more pointers
   - The number of users
   - The modules implemented and phases of implementation
   - The cost and time of implementation
   - The number of sites/locations where the ES is implemented
   - The type of industry– manufacturing/retailing/service
   - The size of the organization
   - The implementation partners/customization
   - New and upgrade implementations

5. Could you please identify three or more ES implementations that satisfy the following criteria?

   - Cases that belong to the manufacturing sector. This is significant because the characteristics of manufacturing organizations within the environmental, organizational, and technological context especially motivates ES adoption.

   - The cases belong to the same class of industry allowing common condition for comparison. Specifically, all three cases must belong to the high-tech electronics manufacturing industry.

   - The cases should have implemented ES at least three years ago, the system is stable, and the organization is in the phase of realizing the benefits. These conditions constrain variation due to differences among the firms.

Appendix B

Main Study Interview Sheet and Questions

Impact of Enterprise Systems for Business Benefits: Case Studies for Implementations in New Zealand

Purpose of the Study

This PhD study looks at current enterprise system (ES) – also called enterprise resource planning (ERP) – implementation scenarios in New Zealand (NZ) and explores the impact of ES for achieving business benefits.

This is a multiple comparative case study of two or more organizations which investigates utilization of ES and its information in organizations. The study explores the business benefits organizations seek, how ES data are transformed into knowledge and how this knowledge leads to business benefits in an organization. The study will evaluate the utilization of ES data to support business decisions and examine the outcomes from this process on organizational functions and processes and the business benefits achieved. The main questions the doctoral study addresses are: **What key benefits do organizations seek through the utilization of ES and its information? How are ES data transformed into knowledge and utilized to make business decisions for the realization of benefits? And what are the critical success factors for the transformational process to produce benefits?**

The purpose of this study is to better understand ES implementation scenarios in a NZ context and identify reasons for the varying results from an ES implementation. The organizations must have implemented ES at least three years ago, so that they are mature and stable with the system and are in the phase of realizing the benefits.

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Main Research Interview Questions

Case Studies to Understand Impact of Enterprise Systems for Business Benefits

This study uses a multiple case research approach that includes two or more ES implementation case studies that meet the following criteria:

- Cases that **belong to the manufacturing sector**. This is significant because the characteristics of manufacturing organizations within the environmental, organizational, and technological context especially motivates ES adoption.
- The cases **belong to the same class of industry** allowing common condition for comparison. Specifically, all three cases must belong to the high-tech electronics manufacturing industry.
- The cases should have **implemented ES at least three years ago**, the system is stable, and the organization is in the phase of realizing the benefits. These conditions constrain variation due to differences among the firms.

Questions

1. Could you please provide a descriptive background and overview of your organization with reference to the following: core business, products, sales turnover, technical collaboration if any, special technology used if any, stock market status and price movements, organizational structure, business units, divisions, HO, manufacturing plant details, divisional offices, sales and distribution network, customer profile, competitors, workforce (managerial, office, workmen etc.), major manufacturing facilities, plant and office locations, etc.?

2. Could you please provide a background and details of ES implementation in your organization with reference to when implemented, investment, number of users, locations, which modules and functionalities implemented and why - focusing on your role in the process?

3. Could you please identify key business benefits that your organization sought through the utilization of ES and its information?

4. How is ES data transformed into knowledge and how is the knowledge applied to the decision-making process to maximize benefit realization in your organization?

5. Please describe in detail some of the key instances where benefits and improvements were achieved through the process of ES data transformation into knowledge and the application of analytical decision-making processes within different organizational functions and processes. Please elaborate the outcomes of this process with specific reference to any improvement in stakeholders' behaviors, new organizational initiatives, business process changes/improvements, financial impacts or any other outcomes.

6. Are there any critical success factors – six or seven things that must go right – for the transformational process to produce benefits?

Appendix C

Table 41: ES Process Changes, Improvements, and Benefits in Case Studies

Customer services		
Case	**ES process change**	**Benefits**
Aevon	Customer orders are entered into SL7 by regional salespersons through a remote access using the Web portal. The products are offered to customers with firm delivery commitment. The regional salespersons can find out inventory of parts available, their costs, make commercial decisions, and commit deliveries to customers without having to wait for this information to come from the Auckland team. The regional time differences do not disrupt the transactions due to the Auckland office closing in the evenings.	• Improved customer responsiveness and relationship • Better information visibility and process efficiency • E-commerce enabled
Cevon	Salespersons can send automated order verifications to customers through e-mail with accurate delivery commitments cutting delays, effort, and cost.	• Increased process efficiencies
Returned material authorization		
Case	**ES process change**	**Benefits**
Aevon	A new process using the field service module (FS-Plus) is established to improve customer services with faster turn around of repaired products to customers. The returned material is promptly booked and RMA numbers issued to customers. This module manages the process of receiving and scheduling repair, and timely shipping of the product back to customer. The faults are analyzed for improving future designs.	• Improved customer service and RMA process • Faster information flow • Better future designs
Cevon	A bolt-on service module called FS-Plus has been added as the new RMA process. This module is helpful in performing field servicing where engineers go out to repair products failed in the field. This also helps when products are returned for repairs and the ownership remains with customers. A record of the kind of repairs being performed is maintained helping find the root cause with the related costs. The system is used to track warranty expense rates so that the company can improve the cost of the products. The system also helps the service function become more efficient and proactive by scheduling preventive maintenance to installations at the customer sites.	• Reduced warranty costs • Faster turnaround of service repairs • Improved preventive maintenance process at customers sites
Sales forecasting and operations planning		
Case	**ES process change**	**Benefits**
Aevon	A new sales and operation planning process is put in place in which orders and forecasts are updated through regular communication and reviews within regions. The process helps to accurately supply stock to regions and fulfill customer demand whilst continually monitor and minimize global inventories.	• Efficient information flow and visibility • Better supplies and reduced global inventories
Bevon	The operations team is able to plan and forecast accurate requirements utilizing the new sales and operations planning process through SAP. The process assists in improving customer services such as improving response time, supplying on-time, and providing better after-sales support. The system also has features for analyzing market trends that helps the salespersons decide on future sales strategies. By utilizing the critical data as well as the tools to analyze and interpret information, has led to improved business efficiencies and practices.	• More accurate delivery commitments to customers • Enhanced analytical processes and faster access to critical data • Improved business efficiencies and practices
Cevon	The revised sales and operations planning process helps planners generate a six monthly forward order rolling plan by region using BI and review with the regions on an ongoing basis. The new process has not only improved inventories but also the planning process, delivery performance, and customer service.	• Better sales and operations planning • Improved inventories, delivery performance and customer service
	With the new sales and operations planning process, changes to the demand becomes timely evident. SL7 responds instantly adjusting the procurement and manufacturing plans. The operations team can effectively respond to changes.	• Enhanced flexibility and agility to respond to changes

Pricing		
Case	**ES process change**	**Benefits**
Aevon/ Cevon	In SL7, pricing is based on the customer item cross references maintained in the system. SL7 only uses item prices fixed for specific customers and does not allow use of any different prices. The regions review the pricing once every year. Through this new process, any disputes in prices or terms of business that existed earlier have diminished. The integrated pricing process supports the salespersons for the order intake process, dispatch and accounts for invoicing, planners for valuation of plans, and designers for product valuation and pricing.	• Improved pricing process • Diminished pricing disputes • Increased information flow, visibility, and decision making • Cost reduction

Sales and distribution		
Case	**ES process change**	**Benefits**
Aevon	In the new process, the order intake details can be viewed by product, by date, or by customer. The salespersons run reports to review their forward order status monitoring expected sales against capacity utilization.	• Increased information flow, communication, and visibility
Bevon	With the improved sales and distribution process and by automating marketing support, an impressive average unit-shipment growth of more than 50% per annum over the past few years is achieved. Bevon has been able to supply quality products at very competitive prices.	• Improved sales and business growth • Optimization of processes
Cevon	The use of APS has build-in accuracy in the customer order planning process through SL7. In this process an ATP (available-to-promise) is requested from the system while entering a customer order with the customer's requested delivery date. SyteLine returns the result in the form of an acceptance or an alternative date with a report on the reasons for delay. The user drills down to review the bottlenecks. The information is used as communication points with purchasing and manufacturing to review possibilities for improving deliveries.	• Increased process efficiencies • Accurate customer order planning • Better delivery performance

Production planning		
Case	**ES process change**	**Benefits**
Aevon	A utility is created by which orders coming through the portal are automatically transferred as jobs into SL7. The automated creation of jobs eliminates possibility of human errors. This also eliminates issues such as faxed orders missing or fax machine under breakdown.	• Improved business process and efficiencies • Faster, more accurate transactions
	The MRP has enabled efficient material and manufacturing planning. The planners execute the automated MRP plans. The out-of-inventory events have reduced which was a regular feature earlier. The supply flexibility has improved and the supply time reduced thus reducing the overall costs.	• Increased productivity and supply flexibility • Improved inventories, throughput, and costs
	The use of Planners Workbench is an improved process for planning production. This is used for creation, opening, and closing of both the regular in-house production jobs and also outworks jobs where the material is given to an outside vendor for processing. The process includes execution and the material and labor cost allocation to jobs.	• Better production planning process • Efficient cost allocation and accounting
Bevon	SAP runs MRP daily reviewing the latest product demand, stock on-hand and in the pipeline, availability of capacities and resources, providing an optimum plan for manufacturing. The system also simulates constraint-based production planning scenarios which are useful for finalizing production plans and gearing up to achieve it. Powered with this information the planners can plan materials, production capacities, and shop-floor manpower to meet the demand, prompting purchasing to release purchase orders to vendors as and when required.	• More streamlined planning function • Better process efficiencies • Effective resource management • Constraint-based planning scenario simulation
	After the system finishes planning all the demands normally, according to order priority, it performs a second, time-phased planning run. The system prompts actions with exception messages such as "On Hand Below Safety Stock" with the date at which the on-hand first dipped below safety stock determines the due date. This provides the ability to view specific items comparing the on-hand quantity with its expected usage over time showing details of expected transactions based on the demand.	• Time-phased planning with exception messages • Enhanced planning function • Better throughput, utilization of resources and deliveries

	Production planning	
Case	**ES process change**	**Benefits**
Bevon	The MRP information is transferred into Excel spreadsheets and used by planners and buyers for further manipulation and actions. This information enables visibility into the in-house manufacturing and bought-out requirements prompting job order and purchase order release respectively based on the latest optimized plan.	• Increased information flow and visibility • Better analytical processes • Productivity improvement
	Different versions of production plan are maintained in SAP and the most suitable is activated by a single command. The planners are able to analyze the plans and assess the best possible outcomes as per needs.	• Optimized manufacturing plans and analytical processes
Cevon	SL7 clusters the required production into similar product groups. By grouping requirements efficiency gains are achieved as the set up times between individual items within each family is less than between items of different groups. The aim of the planning process through SL7 is to provide input to the purchasing and production functions as to what products and parts are required by week and by quantity to satisfy customer demand.	• Increased process efficiencies
	The outputs of the new planning process result in the creation of a production plan, PCB manufacturing schedule and assembly, packing, and outwork job schedules. The added value of the production plan is based on the production quantity by week that is set based on requirement and line capacity. The requirements are grouped by Line/Family/Work Center and Item.	• Effective planning process
	The process improvements incorporated include providing requirements per item/per time bucket based on demand. The main issue with the earlier production plan was that it did not communicate any order priorities to the production units. Given its weekly buckets, it did happen that shortages occurred slowing down production. The BOM was not always 100% accurate. Certain areas were flagged as being weaker such as the final packing level BOM. This was one of the contributing factors to stoppages in the production. It is now possible to schedule certain parts of the business by minimizing the set up through grouping by family and the planners are able to capacity plan forecasted orders and assess the need to add capacity from the feedback from regions.	• Increased process improvements • More accurate planning based on demand • Minimized set up times • Improved capacity planning
	The revised process synchronizes production with available materials and customer demand to create planned orders. The planned orders are reviewed from the planning summary which show them in the time-buckets set such as weekly. These are clustered by means of three factors – order minimum, order multiple, and days supply – as configured. If one or more of these fields are used, the planned production covers them in a single demand. This reduces the number of planned orders. Each planner then reviews the generated planned orders to firm-up by means of generating job orders. This integrated planning process replaces the earlier approach and is more efficient to execute.	• Improved and more efficient production planning process
	A new scheduling process is incorporated. The issue with the earlier process was the inability to sequence work minimizing set up time. In the new process, each item can be linked to a set up family. A matrix is defined which indicates the set up times required when switching from one family to another. By combining this with the scheduling rule to "minimize set up" time, scheduling can achieve a more optimal sequence of jobs than the planner was able to do earlier. The jobs are created from the Planner Workbench functionality with start and finish dates. The scheduler sequences these against the resources based on the rules set such as "minimize set up".	• Increased process efficiencies • Effective and accurate scheduling based on the rule "minimize set up" time.
	The new planning process allocates resources. It does not schedule multiple resources but it indicates how much and when a resource is required. Based on this working, as soon as a salesperson enters an order, it is planned after the next planning run and has allocated capacity according to the routing that has been set up. As the capacity is planned there are various options that are available to represent the data back to the user. This includes capacity graphs by resource and resource group for a chosen time period and bucket. Armed with this information, a call can be made whether additional shift/labor would be required for the forecasted work.	• Efficient planning process • Enhanced capacity planning including visibility through capacity graphs
	The planning functionality provides forward visibility of planned orders and the impact on capacity. With the available visibility, planners can analyze both historic and forward sales figures. Planners can review overdue customer orders and analyze the delivery performance which has helped in meeting the customer commitments and evaluating reasons for any delays.	• Better visibility and information flow • Increased analytical processes and delivery performance

Purchasing		
Case	**ES process change**	**Benefits**
Aevon	The purchasing functionality provides information on various exceptions in the form of alerts, highlights line shortages, pull-ins/push-outs, and identifies areas where actions are required.	• Improved information flow • Increased process efficiencies
	With the new system, buyers can analyze costs of items procured and examine cost variations over the last few years. A usage analysis of parts can bring an understanding into the changing trends in consumption with time.	• Cost reduction and savings • Effective analytical processes and purchasing
	The improved purchasing process assists better decision making. SyteLine information helps fixing more favorable payment terms with vendors and deciding share of business levels between vendors.	• Better information flow and decision making
	SL7 helps in accessing data. The reports can be processed in a grid form and transferred into an Excel spreadsheet. The purchasing team is dependent on SL7 and uses the system data almost all the time for analyzing information through manipulation of spreadsheets.	• Enhanced information flow, data access, and efficient analytical processes
	The buyers send automated PO to vendors via emails with precise requirements cutting delays, effort, and cost.	• Increased process efficiencies
	The Planners Workbench shows items required to be ordered that appear in a specific screen for ordering. All the buyers need to do is tick the lines that need to be ordered. Since the vendor cross-reference is already available against items, the system automatically creates the purchase orders.	• Enhanced process efficiencies • Better resource management
	A multi-level BOM is set up in SyteLine which provides all the item-level details of a product in the exploded BOM view. When customer orders are put in, the MRP engine drives purchasing actions to order material based on the BOM configuration, customer requirements and stock availability.	• Increased process efficiencies • Improved inventories and cost reduction
Bevon	Many different types of reports are run from where the functions are managed. For example, one of the features in SAP provides information on vendor quality. The buyers extract reports on supplies from vendors. These reports provide information on how many material lots have been received in the last one or two years and what has been the basis for acceptance or rejection of the parts. Such information helps to understand the reliability of the suppliers and decide on their share of business.	• Better vendor quality • Increased process efficiencies
	Manufacturing capacity has been augmented with subcontractors located in Asia to whom material is supplied for processing. The company vendors also supply parts directly to the subcontractors on request due to their proximity. All these transactions are managed through SAP and information on parts availability with subcontractors is system determined. The buyers assess where parts are expected to be consumed first and whether it is possible to divert some stock from one location to another optimizing inventory.	• Enhanced information flow and visibility • Improved inventory management • Effective vendor management
	Another process change is the method to review the terms and conditions of business with vendors for further negotiations and improvement. From the materials management module in SAP, buyers extract information on all of the suppliers and their different payment terms for review. They review payment terms such as how many suppliers are on advance payment terms where payments are made upfront. They also evaluate a vendor's frequency of supply, whether the vendor is a regular supplier or a slow moving supplier based on which decisions are taken.	• Enhanced analytical processes • Better decision making
	Vendor evaluation processes are put in place that allows seeing vendors who are pushing to give deliveries on-time with the right quality. Buyers can proactively identify and chase up vendors to give supplies that are over due date.	• Effective vendor evaluation • Increased process efficiencies
	Another process improvement is the method of receiving order acknowledgements from vendors based on the purchase orders sent. There is a regular report run through SAP that informs buyers on orders that have not been acknowledged and from which vendors. This information identifies the pending order confirmation from vendors for follow up.	• Superior order acknowledgement process
	BOMs are created quickly in SAP for any requirement. All the product details including the quantity of parts required, their specifications, and sourcing details become available for the buyers to take action. All the relevant data such as the vendors' details, the manufacturers' names and brands, specifications, type numbers, prices and all the required information becomes available for action.	• Efficient BOM function • Increased information flow and process efficiencies

Purchasing		
Case	**ES process change**	**Benefits**
Bevon	Some other process improvements are in the areas of vendor master creation and maintenance, purchasing item data creation and maintenance, vendor/item cross reference including price maintenance, and purchase order creation, its approval, release, and maintenance. Some of the analyses that are regularly assessed in the purchasing area include purchase ordering analysis by product group, buyer code, date, and vendor to evaluate the ordering pattern on vendors. These analyses help in establishing decisions to streamline material flow and avoid out-of-inventory events for both inventory and non-inventory items.	• Faster and accurate purchasing function • Improved analytical processes • Better decision making • Increased process efficiencies
Cevon	Purchased parts are managed through the new SL7 planning routines and the inventory management program (IMP). The IMP is a process which deals with consignment stock. The execution of consignment stock inventory management program/VMI system has improved the company's cash flow.	• Efficient VMI process • Better cash flow
	The newly created "Lead Free" database is maintained within SL7 which provides specific information on parts to ensure compliance to the RoHS (lead-free) standards. The database provides information such as manufacturer details, brand, manufacturers' item, and manufacturers' item description to the buyers. This helps in identifying the part is RoHS compliant providing its traceability.	• Accurate Lead-free (RoHS) database • Efficient purchasing process • Increased traceability
	A new tools database is created which is part of the fixed asset register that is used to track assets and depreciate them within the finance module. The tools database forms part of resources linked to "Assets" in the fixed assets register.	• Accurate tracking of assets linked to finance
	Another subsystem introduced in purchasing is the tracking of goods expected to arrive with tracking numbers. This forms part of the standard Goods Received Note (GRN) functionality executed in the inwards goods.	• Faster tracking of goods expected
	The revised "amounts payables" subsystem used in purchasing forms part of the accounts payable in the finance module. The accounts payable subsystem provides the visibility of the amount due to vendors at any point in time.	• Faster and accurate tracking of accounts payable
	In the subcontracting subsystem, a subcontracting item is defined in the BOM in SL7 for the support of the purchasing process. All other items on the bill are listed to be sent to the subcontractor.	• Enhanced subcontracting process
	In the subcontracting process after the vendors have been identified the vendor details are loaded into SL7 for recurring use. There is a communication log in the system which is used for frequent communication with vendor.	• Better vendor management and communication
	Since 1993, the European Economic community has required that certain additional information is tracked at the item level, including delivery terms, nature of transaction code (NOTC), commodity code, origin, supplemental units, unit weight in kilograms, and consignment number. Whilst not all of these fields are used, a number of these are still relevant for the various sites and tracked through SL7. Furthermore, SL7 has some additional fields currently not used but wanted for future use such as URL, internal and external e-mail, and attachment to SyteLine notes.	• Increased information flow, visibility, and traceability
	In the new planning tool, the process of purchase ordering by planner/buyer is done using the Planners Workbench. The new process has made the purchase order process more efficient and reduced ability to "fiddle with dates". The planner/buyer has access to all the required information fields from the Workbench to the planning detail as well as the item detail containing all the relevant information for decision making.	• Efficient purchase ordering process • Enhanced decision making
	Earlier most buyers had their own spreadsheets by which they maintained the expected date of arrival for purchased items. With the new user interface and grid view in SL7, the buyers now make these updates against the purchase order lines in SyteLine and do not need to maintain separate spreadsheets.	• Increased process efficiencies

Inventory management		
Case	**ES process change**	**Benefits**
Aevon	The inventories are monitored through the SL7 inventory management processes. The operations staff analyzes the inventory classifying into purchased, work-in-process, and finished goods.	• Effective inventory and asset management
	To improve the inventory accuracy, regular cycle count processes have been established in the warehouse for the various categories of items using the SyteLine functionality for this process. The warehousing staff conducts regular cycle counts to review and identify stock variances. This helps to keep the inventory accurate and evaluate reasons for mismatch. This also helps resolve stock discrepancies that may affect production.	• Increased inventory accuracy and control • Productivity improvement and cost reduction
	The ABC analysis report for inventory management from SyteLine is used in terms of value and throughput. The ABC analysis is executed for purchased, manufactured, and transferred items specifying percentages for the A, B, and C categories. This has helped to keep a close track of the inventory and improve the funds flow that could get blocked in slow moving inventories.	• Faster and accurate inventory management • Cost reduction with increased cash flow, revenue, and profit
Bevon	Best business practices in inwards goods receiving, quality assurance, and the warehouse stock control processes have been introduced. These processes have enabled swift and accurate receipt of materials, efficient storage in the warehouse including FIFO process for shelf-life items and on-time dispatch of finished goods to customers. SAP has enabled transactions with built-in checks to avoid data entry errors, triggering rule-based alerts such as transactions leading to a negative stock, and creating records to track stock movement. Regular cycle counts have improved stock accuracy.	• Enhanced inventory and asset management • Better management of shelf –life items • Increased process efficiencies
	All material is sourced with full traceability. The staff can track stock within the various locations in the factory The inventory is tracked by lot numbers and serial numbers. After the goods are dispatched these are tracked by serial numbers until they reach the final destination. With such controls in place, the accuracy and visibility of stock to all stakeholders has improved. In case of shipment errors or quality issues, the transactions are traced back to explore and resolve discrepancies and identify the production job the problem relates to.	• Increased accuracy and visibility of stock to all stakeholders • Reduced shipment errors and improved traceability of material
	SAP inventory management processes support the JIT inventory system. The raw material inventories range used to be 30-40 days and finished goods 15-20 days at material cost. A further reduction of 5 days each in both has been achieved as a result of the JIT system.	• Reduction in inventories
	Bevon has implemented a VMI program at their customers' end. The operation team at Bevon has been able to manage this very efficiently and effectively through SAP.	• Efficient and effective VMI process
Cevon	Cycle counting is done as a daily activity. Only after the count is completed the data are keyed into the SL7 cycle count. Since this process has been established the stock accuracy has dramatically improved. The factory inventory goes through the same cycle count process and is a time consuming process. Recent analysis has shown that a full item count (all locations) takes up to 33 minutes with SL7 support. Earlier it used to take more time.	• Efficient cycle counting process • Increased stock accuracy
	The SL7 ABC classification functionality is used. The ABC classes are defined around the standard 75%-20%-5% in terms of value and throughput. This classification is used for the automated cycle counting process in SL7. The ability to review stockroom location and inventory within these locations by means of queries in SL7 largely helps the purchase and warehouse staff. This system has improved the process efficiency for cycle counts.	• Improved process efficiency • Better procurement and inventory management
	A PC-based system was earlier used for warehousing that was ad-hoc and not integrated to the other parts of the business. The process was manual and prone to errors. The newly developed inventory management process focuses on the integrated stock control functions through SL7. This makes use of three subsystems including barcode labels, QA trackers (quality assurance tracking system), and freight watch (courier tracking number system) which are under use as part of the newly developed SL7 functionality.	• Enhanced stock control function
	The inwards goods function maintains records for receipt of all materials through SL7. The process uses master files such as item master, purchase order master, and vendor master to receive and track supplies from vendors. A number of standard files are used to record receipt and issue transactions including stock adjustments and its reasons, or any miscellaneous issues and receipts. This helps in the reconciliation of stocks in case any mismatch or traceability issue arises.	• Efficient and effective inwards goods function

Inventory management		
Case	**ES process change**	**Benefits**
Cevon	The new receipting process is standardized through SL7. In the new process receipting is done by "unit" to avoid problems with conversion factors. Upon arrival the goods are booked into an arrival inspection location. The goods are seen in this usable inventory location through the SyteLine screen; the assumption is that the goods will be fit for use, even though inspection is still to occur. From here the stock is moved to the relevant location depending on whether it is accepted for use. If the goods are accepted, the stock is moved to its bin location in the warehouse from where it is brought to the factory based on factory kanbans. These processes are performed assisted by the SyteLine Data Collection module part of SL7. This module has integration points for all stock movements. Also, the use of the GRN functionality in SL7 registers information such as the freight forwarder, operator consignment information, and other pertinent details of the goods to arrive against specific vendors, making the receipting process smooth.	• Faster and smooth receipting process
	The consumption of stock is triggered in SL7 through the back flushing of the materials once the stock is built in the factory and passed by QA. This functionality automatically posts all the items consumed in the production jobs based on their BOMs when the operations are confirmed, converting the material stock into finished goods. The kanban location from where the back flushing is executed, relates to a production "Line". This is a completely automated process within SL7. It does happen that the location sometimes is incorrect, not filled in, or does not have the back flush flag on due to kanban controllers' human error. This leads to wrong back flushing and incorrect stock accounting but such occurrences are rare and corrected as soon as observed.	• Effective accounting of stock consumption
	With the completion of the job order, the goods are sent to QA. After passing the QA check the related job order is completed and serial numbers are printed. In this process scanning is used for the serial numbers. This process is barcode enabled through SL7. From the QA location the inventory is moved to a FG (finished goods) location within SyteLine as well as physically to the dispatch warehouse. With SL7, the FG visibility and accuracy has improved. It is now possible for the Cevon staff to allocate stock to customer orders confidently.	• Better finished goods accounting including visibility and accuracy
Manufacturing and Production		
Case	**ES process change**	**Benefits**
Aevon	The manufacturing process is driven by the released jobs due date and the production schedules assigned by the advanced planning and scheduling system in SL7. Automated production schedules are created for all released jobs optimizing capacities, prioritizing production based on customer due dates and available material. The use of APS has improved achievement of production targets due to greater visibility of operations and instant exception alerts.	• Increased achievement of production targets • Improved productivity and enhanced on-time deliveries
	SL7 generates information and reports on the manufacturing costs. The manufacturing costs are associated with production of job orders, job material usage analysis and labor usage analysis. The general ledger production variance is analyzed to evaluate reasons for the production cost differences with the plan.	• Cost savings and increased revenue • Better resource utilization
Bevon	Despite close monitoring with customers, there are still changes to the demand pattern that are unforeseen based on the market conditions. In the event of a sudden increase or decrease in demand or revision in shipment dates, the order execution process responds to such changes positively and effectively. SAP provides the flexibility that is expected. The system responds with exception messages and reports on the actions that are required to meet the revised plan. It highlights areas for purchase order adjustments or changes to the manufacturing plans and schedules to the factory.	• Increased ability and agility to respond to any demand change • Improved process efficiencies • Enhanced resource management
	With better flow of materials, capacity planning, shop floor scheduling, and availability of resources, resulting from the manufacturing planning changes, improvement is achieved in production staff productivity. It is estimated that about 10% higher labor productivity could be achieved valued in practical terms of temporary labor deployment avoidance implied at a saving of about $50,000 per annum.	• Higher labor productivity

	Manufacturing and Production	
Case	ES process change	Benefits
Bevon	With the up-to-date and reliable costing available through SAP, the company has enhanced the factory contribution by reducing the non value adding costs such as reducing set up, change-over, transportation, and resource/material down times. The production line staff now receives better information to build product. The production staff gets a traveler (card) set out from SAP which has all the information about the job order for every sub-product or semi-finished product and they know exactly where it is along the process. It is now the same people in the production line who confirm they have done their job. Now their focus is on "doing right the first time".	• Increased information flow and visibility. • Enhanced factory contribution and cost reduction • Improved bill-of-materials structure and quality
	SAP provides information on BOM listing with vendor open PO details for individual items by warehouse/location to the planners to help finalize build plans for manufacturing products. SAP is also used to run material availability reports showing out-of-inventory items for one or several products. These reports highlight stock on-hand, quantity required and short, procurement lead times, and any open purchase orders on vendors with due dates for the items required in the build. This information is then used to procure the short items expeditiously and investigate the reasons for the out-of-inventory situations to avoid recurrence in future.	• Improved information flow and visibility • Reduction in out-of-inventory events and effective analytical processes for decision making
	The introduction of built-in process sheet system with multiple routings, integrated with the production planning has helped manufacturing in executing the production jobs as per production plan. The capacity planning process has improved with SAP showing peaks and troughs over time with graphical representations instantaneously. SAP provides an automated and optimized capacity improvement solution leveling out the graph with revised capacity plans. Graphical representations are displayed on the display panels at the end of production lines for monitoring production with information such as produced so far, line rejections, hourly updated target, and production asking rates.	• Enhanced capacity planning, resource management, and increased production throughput with achievement of targets • Faster and accurate analytical processes through graphical monitoring
	The "production optimizer" module has put into operation constraints-based dynamic machine loading. This has been especially useful for scheduling and loading the SMT machines used for manufacturing the PCBs, improving utilization, productivity, and execution of plan in the factory. With this process change, "order-to-invoice" time reduced from 3 months to 6 weeks.	• Reduced "order to invoice" cycle time with increased factory utilization and productivity
	With the introduction of barcode system through SAP has led to correct and efficient tracking/picking of goods through the wide spread use of barcode scanners in the factory. This process is managed by the production, warehouse, and dispatch personnel improving tracking/picking of goods.	• Faster tracking/ picking of goods • Improved process efficiencies
	The integrated manufacturing and marketing functions have enabled optimized supplies to the market place with better pricing increasing product sales. The company has been able to supply quality products at competitive prices by improving their manufacturing process and automating marketing support.	• Optimized manufacturing and marketing processes with better pricing increasing sales
Cevon	The manufacturing schedule for the week is created by planners through SL7 using the APS functionality. A system based check for the components to use and the supply situation is performed before a job order is created. SL7 generates the schedule for the week as a list of planned orders with start date in the coming week. The jobs are scheduled based on due date, available resources, and other criteria to generate an optimal plan. Based on the planning and scheduling review, job orders are firmed up for manufacturing.	• Faster and accurate job creation based on schedule and planning • Increased process efficiencies, better information flow, and visibility
	The SL7 subsystems used by production include production plan spreadsheet providing a "line schedule", build plan, stage instructions used by production engineering/QA, manufacturing suite database, job traveler database, and the skills database. These integrated subsystems have improved the manufacturing process and provide the operational efficiencies and automation Cevon wanted. The main report used in this area is the job material status report.	• Improved manufacturing process • Increased operational efficiencies • Better resource management
	The jobs were earlier created by manually keying the job orders. The planners used to earlier create jobs, but these were not released to production. The jobs were released by the production staff themselves after a job review in which the production staff reviewed the material availability, BOM requirements for the order and plan for production. In SL7, this process is driven from the Planners Workbench. The new process reduces the work of entering jobs and it avoids creating jobs that cannot be met due to lack of resources. The start date for such jobs is planned after the resources are available as per SyteLine. The jobs now created have the status firm. The planners do a large number of checks against the orders to minimize any problems with the job once started. The checks for these rely on "pre-job" information stored as production job traveler data.	• Efficient job creation process with increased process efficiencies • Better resource management • Effective production process • Increased information flow and visibility

Manufacturing and Production		
Case	ES process change	Benefits
Cevon	In the job review process through SL7, use is made from subsystems for a number of preproduction steps. These steps include a review of ECN, comparing the job BOM with the current/standard BOM to see if any changes exist. This generates an exception report through SL7 which is documented. The check ensures that the product is being built according to the BOM allocated to the job and there are no errors in the build process. It also highlights any errors in the BOM if any. The "delayed" firming in of planned job orders reduces the number of discrepancies between the standard BOM and the job BOM.	• Better job review preparation for production and efficient production process • Increased product quality and accurate BOM maintenance
	The production review process is focused on "what is happening". A number of elements of this process include on-line discussion through SL7, the review of the job traveler, the set up of the line, and the checking of the first sample against the reference or "gold sample unit". This stage is concluded with the initiation of the production run. This is a check prompted through SyteLine that ensures correctness of the full production run.	• Efficient Production and review process • Increased communication, improved quality, and effective analytical processes
	The post jobs review makes sure that the specifics of that job are stored in the SL7 database for future review when the item needs to be run again. Also some standard SyteLine reports are run such as job material status report to check that the process is properly completed.	• Enhanced post job review process, increased information flow, and visibility
	The process for closure of jobs in SL7 is automated. This is done by a utility in SL7 which closes jobs automatically if the job quantity matches the produced quantity for the job or after 10 days whichever is earlier.	• Automated job closure process
Outwork schedule		
Case	ES process change	Benefits
Aevon	The subcontractors get automated delivery instructions related to number of days supply configured in the system or even changes in balance days' delivery requirement, depending on the progress in the factory. Aevon has achieved full control on third party subcontracting with visibility of information. Aevon's operations team has the record and visibility on the various materials sent and available at their subcontractors end.	• Increased communication and collaboration • Improved information visibility • Inventory control
Quality management		
Case	ES process change	Benefits
Aevon	SL7 integrates the quality/sampling plans with purchase orders and schedules to suppliers. This has improved the quality of material receipts and reduced quality issues with suppliers smoothing the inwards goods receipt inspection function.	• Quality improvement • Better resource management
Bevon	The system is used to collect reject information from the production line. Production orders are reviewed for specific operations to examine the number of units lost in that operation and its reason. The data collected helps in gaining insights into the organizations biggest reject rate and its reasons, based on which actions are taken. Quality related real-time alarms are triggered, rather than just providing an MIS report, which is a proactive response reducing quality costs.	• Increased information flow and visibility • Improved quality • Reduced quality costs
Plant maintenance		
Case	ES process change	Benefits
Aevon	The SL7 preventive maintenance functionality is established that inter-relates production and maintenance plans. The maintenance plans optimize maintenance schedules and reduce factory down times. SyteLine provides features to make preventive plant maintenance more proactive and data based.	• Increased machine up-time, productivity, and automated preventive maintenance planning
Bevon	The facilities maintenance through the SAP system configures scheduling and monitoring of plant preventive maintenance, jigs and tools reconditioning, and gauges recalibration which are linked directly to production. The system is used for machine performance analysis by date, by department, and by work centre to achieve and maintain accuracy and quality of the products being manufactured.	• Enhanced preventive maintenance of plant and equipment as well as improved quality of products and throughput

	Dispatch	
Case	**ES process change**	**Benefits**
Aevon	The dispatch process through SL7 includes processing of shipment data such as the packing list with packaging details and the serial numbers generated through the system. With this process change, the dispatch team has achieved a much improved delivery performance. The automated processing of shipment data such as the packing list with packaging details and the serial numbers are timely sent to the customers.	• Better on-time deliveries • Faster communication and improved customer service
	FedEx, the shipping company has supplied a software application that is run through a utility in SL7. This utility exports the shipment data into the FedEx application through which the information is transmitted. With this process much better speed is achieved in passing the shipment information to customers along with visibility for tracking consignments. An extension to this process is being planned by having shipment information included in the CRM module so that the distributors can see the shipment status along with their order details.	• Efficient communication and collaboration with customers • Better customer service
	The SL7 process provides the facility by which the details of dispatches are e-mailed/e-faxed automatically to the regions and customers. This has reduced the time and cost that used to be incurred in collating information such as consignment and serial number details in separate spreadsheets and sending to customers.	• Increased process efficiencies and cost reduction • Better communication and customer service
Bevon	With the improved dispatch processes, the dispatch staff now knows the shipping priorities and has the visibility on the availability of goods for shipping. The dispatch team proactively plans and executes the picking and shipping function opposed to the earlier waiting for products to come and then finding out where these were to ship.	• Improved resource and manpower utilization • Increased dispatch process efficiencies
	The dispatch team now optimizes the product packaging with weight/volume considerations and consolidates destinations. This has improved the manpower utilization as well as produced cost savings in the dispatch area that Bevon has been looking for.	• Improved dispatch process efficiencies • Increased cost savings
	The management with the freight forwarders has become easy as all information and documentation is timely available for the shipping companies to arrange pick-ups. The customer invoicing process has also improved. The earlier process errors are eliminated such as mismatch in the physical dispatch quantity or serial numbers with the invoice data. The dispatch function has benefited with the improved processes including automated invoicing and improved customer services. These changes have also brought in accuracy to the shipment and invoicing process. The transmission of the shipment information to the customers has become a very simple process providing the visibility and accuracy required.	• Improved on-time deliveries • Increased communication and collaboration with customers • Better customer service
Cevon	The dispatch process is triggered by the printing of picking list through SL7 for orders expected to be shipped in the coming week. This is followed by the manual picking. The main process step is the customer order shipping. Here a very large number of serial numbers are processed. The processing of serial numbers was tedious earlier with a lot of mismatch in the serial numbers. After SL7 this process has smoothened with automated serial number control which resolved the earlier mismatch issues. After the shipping is confirmed the packing slip is created. This completes the shipping from a SL7 perspective.	• Effective and automated shipping process • Accurate serial number control • Increased process efficiencies
	The delivery orders functionality in SL7 has combined the earlier disparate dispatch information such as bill-of-lading, consignment note, and customer order with its related documentation into one integrated delivery order system for shipment purposes. This has immensely helped the dispatch team to combine several customer orders into one shipment and produce delivery orders for the freight forwarders with all relevant information put together which has reduced costs and improved efficiency.	• Improved process efficiencies • Reduced costs • Increased information flow and communication
	Earlier, the dispatch staff used to create separate spreadsheets for providing shipment information and details. These were recorded separately using an Access database. These manual spreadsheets and databases together became another system that the dispatch staff had to maintain. There was also the chance of potential fraudulent behavior since the dispatch staff could send products using this external system out of the door. The delivery order functionality in SL7 has automated this process. With the use of the delivery order functionality, all of those disparate systems are brought into SL7 which makes it a single system with better traceability for audits. If there is any concern of fraudulent activity, then that information is straightaway available from SL7 and can be shared by all the users rather than depend on an external system that could be manipulated and only shared by very few people. So, the data are retained, are secure, and available to many people.	• Better communication and collaboration • Increased availability of information • Improved process efficiencies • Integrated and automated processes with better regulatory compliance

Financial management		
Case	**ES process change**	**Benefits**
Aevon	The finance module through SL7 helps the finance function with various functionality, analysis and reports. The accounts payables are driven through the release of purchase orders and accounts receivables from invoices. The integrated accounts receivables control has led to improved working capital management through better and real-time debtors control and generation of exception reports. This has also helped in overview of enterprise-wide funds position.	• Improved debtors control, better working capital management and control • Inventory and cost reduction
	SL7 has improved the visibility into financial transactions such as posted transaction details and summary, vouchers and adjustments. With the ability to view information the finance team manages and controls the business better.	• Enhanced financial management and control
	SyteLine functionalities are used for general ledger, assets, liabilities, bank reconciliations, account balances, and cash impact. Fixed assets, depreciation, and transfers are also managed through SyteLine. All of these processes have improved the financial management and control. The use of automated electronic funds transfer through SyteLine has led to a reduction in the working capital for the company.	• Effective and improved financial management and control • Reduced working capital
Bevon	The most important process change is the integration of finance with the rest of the business. This change has enabled the company to have all the sales, customer, manufacturing, and finance related data in a single database which can be drilled-down to the transaction level. With the integration of financials, warehouse stocks, subsidiary stocks, and the receivables information, the company now has an instant overall view of the real exceptions such as "receivables exceeding a month's stock". SAP has built-in alarms on stock-piling, depletion, and provides aging information at the distribution center.	• Increased process efficiencies • Faster and more accurate transactions
	At the financial month end, accounts closing used to take weeks if not months, to finalize earlier. With the new processes and as a result of SAP, accounts can now be closed in 2 to 3 days. Any delay beyond that is a calculated business decision, not system limitation.	• Reduced month-end closure time
	SAP also provides an up-to-date and on tap financial obligations of the sales regions such as interest computation by defined rules and debit/credit note generation as and when required. The on-line cost related data with drill down facility has brought in focus and timely control on the various costs and expenses. Each financial/accounts figure can now be drilled-down to the transaction level leading to tighter expense control. The budgeting and commitment accounting feature has enabled budget and compliance control further strengthening of the finance control function.	• Effective budget and compliance control • Increased information visibility • Better financial control
Cevon	Only wire-payments and standard checks were used in the past, as payment types. With SL7 more payment options are available. The company has started using electronic fund transfer (EFT) payment method through SyteLine.	• Improved process efficiencies
	The SL7 outputs include cash flow reporting such as AP, AR, Forex, and the aging reports whereas earlier an Excel spreadsheet was used for the cash impact analysis. The financial management process is automated through the standard SL7 functionalities.	• Enhanced and automated financial management processes
	Group (multi-company) consolidation features from SL7 are used to include BUs, and the subsidiaries for the finalization of accounts. The accounts are closed in two working days which used to take weeks earlier.	• Reduced month-end closing time
Accounts receivable		
Case	**ES process change**	**Benefits**
Aevon	SL7 provides an on-line receivables check while accepting orders. The salespersons can timely review receivables with defaulted customers who have not made payments before executing their new order.	• Increased process efficiencies and resource management
	The accounts receivables process has improved with account receivable payment distribution analysis and pending receivable reports with aging analysis. Follow ups with customers for non-payment are regularly performed supported with relevant information. This has brought down the receivables status, improving funds flow.	• Improved receivables and funds flow
	Automated "credit hold" functionality is used which puts payment defaulted customers on credit hold. Through this system, the dispatch team is unable to process a shipment to customers on credit hold unless the hold is released through finance.	• Efficient debtors control as well as increased operational efficiencies

Accounts receivable		
Case	**ES process change**	**Benefits**
Cevon	For the AR processes standard SL7 reports are used such as tax invoice and customer statement reports. The credit note and sales analysis reports are part of the month-end reports. Another two reports that are used to help customer control are trade history – payment behavior by customer and credit analyst rating report which provides information about the credit situation and the last time this was updated or approved.	• Improved accounts receivable process
	In the enabling of multi-site functionality for AR, there are two categories which are centralized, order entry and accounts receivable. Here the new customers are centrally defined and are able to receive a customer payment into another company that has raised the invoice.	• Efficient multi-site accounts receivable process

Finance - customer management		
Case	**ES process change**	**Benefits**
Aevon	SyteLine provides the ability to view historical and open orders by customer, by currency, customer ship-to, and customer orders. The finance team can now perform an on-line customer profitability analysis. In case of any duty/tax structure changes by government, SL7 provides an instant all-round effect of changes in purchase orders, bills inward, customer invoices, and costing.	• Better financial management and control • Increased information flow and visibility
Cevon	Creation of a new vendor account process through SL7 integrates with other functions such as purchasing. Selecting vendors and retrieving information based on queries has become easier.	• Better vendor account management

Finance - costing		
Case	**ES process change**	**Benefits**
Bevon	Another area of improvement is the material costing. Earlier, the material costs could not be worked out due to the financial and the manufacturing systems being separate. With SAP the finance and manufacturing are integrated and now the costs are known. The company is now working towards further improving the accuracy with regular updates into their cost data.	• Accurate and faster material costing
	A costing run through SAP is carried out every month to re-cost all of the products and to review what the changes are since the last run. The variances are evaluated to review the reasons for product cost increases and its impact on product profitability.	• Enhanced product costing

Finance - cash flow and multi-currency management		
Case	**ES process change**	**Benefits**
Bevon	SAP provides facilities such as real-time cash flow projection and critical cash flow analysis. Fully on-screen supplier bill-passing/vouchering, and integrating purchase data and accounts for provisioning have sharply pruned manual work-load, without sacrificing controls.	• Superior financial processes and better resource management
	SAP has enabled multi-currency dealings with necessary built-in documentation that assists the regions to conduct business in the NZ offices using their country currency. The automated SAP multi-currency functionality converts the foreign currencies into local NZ dollars for parity and control reducing manual effort improving resource efficiency.	• Efficient multi-currency dealings

Accounts payable		
Case	**ES process change**	**Benefits**
Aevon	It has become possible to analyze accounts payable payment distribution that has improved the process for releasing funds to suppliers. This process has improved Aevon's funds flow and relations with suppliers who receive their payments timely and do not have to follow up.	• Improved funds flow • Better relations with suppliers
Cevon	The sub-processes within the SL7 accounts payable process include creation of a new vendor account, receiving an AP invoice with a PO number, vouchering an AP invoice from a PO number, and making a payment to a vendor. This integrated process has improved the accounts payable process reducing the time taken to clear payments, building accuracy and control in the function.	• Efficient, integrated, and automated accounts payable process with enhanced control and resource management

Accounts payable		
Case	**ES process change**	**Benefits**
Cevon	In SL7 account payable replication is set up to have the vendor codes determined centrally, even though little vendor overlap exists between sites. This helps in paying vendors from a site different to the one owing the payment in the multi-site environment.	• Increased vendor payment options and operational efficiencies
	Receiving an AP invoice with a PO number. The main problem faced earlier was that in the receipting screen the GL-account was not shown, the user had to check back to the PO to make sure the account used was correct. With the change to SL7, it has become possible to use the standard SL7 vouchers payable report. This has resolved the earlier challenges of the reconciliation faced and the process efficiency has improved.	• Improved process efficiency • Enhanced information flow and visibility
	Vouchering an AP invoice from a PO number. This was the most crucial process within accounts payable. The process went through some major changes. The earlier process was PO driven, but the new process is vendor driven. The company was earlier facing the creation of negative amount vouchers for returns in this process. This problem is overcome in SL7 with all required data elements supported in SL7. The way the form and the voucher generation are executed is slightly different, but with better outcomes and control.	• Effective vouchering an AP invoice process
	Making a payment to a vendor. The earlier process was driven by cash flow requirements. Based on the cash flow situation a decision was made as to which vendors would be paid. This process required manual intervention and decision was taken on a case by case basis. This process is replaced in SL7 and is driven by the "generate payments" functionality. The revised automated process has made the vendor payment much more efficient, reduced the number of steps involved, and removed the requirement for any manual intervention.	• Efficient and automated vendor payment process
	The multi-site functionality is enabled in the accounts payable function. The vendors are centrally defined with an option to pay across multiple sites (e.g., group subsidiary payments).	• Effective multi-site accounts payable process

Finance – regulatory compliance		
Case	**ES process change**	**Benefits**
Cevon	Earlier SOX compliance was met by a number of off-line activities. A number of user-defined fields were used on the customer master, which supported the SOX requirements. This was done through reporting outside SyteLine in Excel. This process has been made easier in SL7 through the query functionality. Monitoring of statutory requirements such as SOX and arising of alarms have been set up using "workflow" features.	• Enhanced and automated compliance and regulatory features through workflow.
	The accounting processes within the GL and FP&A functions involve various financial events for a given accounting period. Earlier, the financial accountant received data from all other sites and subsidiaries by emails for finalization of accounts, and the data were loaded into a Hyperion system. In the SL7 set up, each of the subsidiary sites resides on the system and is accessible by authorized users. For a number of sites that earlier sent their financial records via Excel, this data are now loaded into SyteLine directly and is accessible from the various group entities and/or the individual sites.	• Improved financial management, general ledger/financial planning and analysis processes • Better communication and collaboration

Systems management		
Case	**ES process change**	**Benefits**
Aevon	SL7 provides readily available and adaptable integrated systems covering all core business requirements implemented within months. A similar in-house development for integrating and automating the systems by the IT team would require years of effort and sustenance and would be a difficult task due to programmers' turnover.	• Increased IT infrastructure capability
	By implementing SL7 the system will cater to the company's business functionalities requirements for the next 15 years. This includes any diversification/ expansion, requiring incremental implementation support, minimal hardware and connectivity (LAN/WAN) upgrades, and pre-designed for ready integration of advanced application packages.	• Support to current and future business growth
	The benefits of SL7 in systems management include elimination of paperwork and stationery costs. This happens through elimination of intermediate documents, printed reports, copies, and memos. Also, a standard analytical decision support information system is built-in for each functional area.	• Cost reduction through automation • Better analytical decision support

Systems management		
Case	**ES process change**	**Benefits**
Aevon	SyteLine has enforced changes in work patterns and thinking from department to process-based. This has led to dismantling of departmental barriers with visibility and access to required information without waiting for "the other" department to provide it.	• Increased visibility, access to information, and efficient process-based management approach
Bevon	SAP provides built-in tools to monitor and administer the computer resources. System performance manager is available to the administrator to view the concurrent sessions and users, utilizing checkpoints, enforcing locking of user sessions, or enabling logging into the system. The system enables monitoring of the various applications, tasks, and activities under processing. Information on the pre-programmed activities scheduled to run are available confirming the processes that have run successfully and reporting any process that has failed to run including its reason. Facility for daily back-ups is used for information storage and data security.	• Better system administration • Improved data security and storage
	SAP provides database performance tuning opportunities comprising the administration of system parameters such as system memory utilization through system buffer monitoring. Additionally, the system monitors input/output and hard-disk utilization through partitioning versus free-space maintenance including monitoring of the processor speed. Tweaking any of these parameters potentially can improve performance.	• Enhanced system administration and monitoring
	The system has successfully been able to handle the increased work span on an on-going basis. SAP has supported the constant increase in the number of transactions and products over the last four years without correspondingly increasing staff strength.	• Support to current and future business growth
Cevon	The upgrade to SL7 was a move to improve the systems management function including enabling ongoing version support from the vendor and moving to SQL database platform. The identical systems are rolled-out to all subsidiaries and distribution offices. The upgrade to SL7 has achieved the various process improvements from a systems management perspective.	• Better processes from a systems management perspective
	There have been some usability advantages. The SL5 version allowed users to work on one record at a time. With SL7 it is possible to have the grid view which allows users to view multiple records at one time. It is possible to sort records by using filters and view customer or order details for specific dates. The data can be manipulated using the grid view, exported to spreadsheets and re-imported. The system supports when the user is not sure which record is required and helps find it.	• Faster and accurate speed to making mass changes • Increased information flow and visibility
	A coordinated and integrated set of data are accessible to users to allow all the functions of the business to work in an integrated manner. Improves accuracy in what the company does. Allows the company to monitor costs and ensure being profitable as well as to know the sales, the costs, therefore know the profit and be confident that it is accurate. These objectives are achieved through SL7. The system supports additional areas such as reporting to the parent company or reporting to Inland Revenue. Provides ability to match demand with supply, and deliver to customer expectations. Ensures what the system says is what actually is such as inventory accuracy. Connectivity and extension to the subsidiaries and main distribution centers, flexibility provided by identical systems to redeploy people across subsidiaries/ distribution offices and the factory with minimal orientation and adaptation-time. All of these requirements are achieved from SL7.	• Improved systems management function • Increased process efficiencies
	The change request (CR) system has been implemented as an extended bolt-on system that allows tracking changes to documents and processes such as changes to the configuration of the SL7, bill-of-materials, part specification changes, and engineering change management requirements for the products or procedures. The new Web-based system captures all the information such as the request for change, its reasons, allied documentation, and its approvals and communication at one place. This system has automated workflow in which the communication for a pending CR endorsement or approval moves through the e-mail system. After the approvals, the CR is implemented through actions such as execution of BOM changes through SyteLine's BOM system and transfer of the relevant information into SL7 so that the revision history of a component becomes available. The system records the change made on a specific date and approved by relevant functional approvals so that the changes are controlled. If there is any issue subsequently, the reason for the decision can be traced back and evaluated. It also provides a search engine through key words.	• Better and robust method of monitoring and controlling changes and recording decisions whether these are permanent changes or just one-off concessions.

Systems management - messaging		
Case	**ES process change**	**Benefits**
Bevon	It is now possible for the staff to mark some information on the SAP screen they are working in, append a message, and transmit to any colleague. The receiver can then see the drilled-down details if required and transmit a reply. Such messaging processes help in to-the-point communication, quick analysis, decision making, and fast reply to the sender. It is also possible for the sender to receive an alarm if the reply is not received within the specified period. This makes follow up and monitoring much easier.	• Increased information flow, communication, and collaboration • Accurate and faster decision making

Workflow controls		
Case	**ES process change**	**Benefits**
Bevon	Easy and instant enforcement of accountability are built-in features of the SAP system that are activated through work flow and alarm alerts, including instant highlighting of inaction to superior such as in case of a failure to timely release a PO. The system has eliminated many value added activities through electronic work flow setting features such as streamlining and accelerating the entire process from indent to PO approval to PO releasing eliminating hand filled purchase requisitions and approvals.	• Increased process efficiencies with automated work flows

Executive information management		
Case	**ES process change**	**Benefits**
Bevon	The executive team has monthly meetings in which KPI reports are presented. These KPIs lead to achieving the company goals. Built-in performance management tools are available in SAP for in-depth, enterprise-wide performance management. This enables real-time or near-time supervision of performance and analysis-based reporting. SAP provides the ability to drill down to particular performance elements, and adjust using automated alerts and triggers. SAP has specialized components to communicate with end users responding to particular process outcomes initiating actions for resolution.	• Effective analytical processes and KPI reporting. • Enhanced performance management to achieve organizational strategies
	Specific information requirements are easily and quickly achieved in SAP, through the drill down facility, without programming every time. The executive management members themselves extract different information that they need from the system data, carry out what-if analysis without the wait for someone to compile and provide the information.	• Better information flow with efficient analytical processes and resource management

Configuration control		
Case	**ES process change**	**Benefits**
Bevon	The system is configured to suit requirements through parameter settings. The condition technique is the single largest configuration within SAP. Through its operation the system responds to different scenarios. This technique is used in processes such as pricing, output determination, account determination, and material determination. It is used in any situation where a condition record exists to find a choice from among a number of alternatives. SAP makes the choice based on conditions.	• Increased process efficiencies and optimized results
	SAP provides the ability to configure items in their item master so that new part numbers can be assigned with a pre-configured logic. Before creation of new parts for use, the review of existing parts is facilitated to support standardization. SAP has the provision to assign alternate parts to existing part numbers for use whenever required. Alternate parts are used in an event of any supply issues to existing items. Parameters such as lead times, minimum order quantity, days supply, and lot sizes, are configured for each item that support MRP to plan requirements from vendors. The drawings and specifications of parts, along with vendor quotes and price agreements are appended to the SAP database against each item that helps in the sourcing of the parts.	• Improved product data management • Standardization of parts and cost control • Better information flow • Efficient sourcing of parts
Cevon	The item master in SL7 makes use of a number of standard files such as the product code, family code, commodity code, and price code. Except for the commodity codes, all other master files are set up as part of the process improvement through SL7. The product codes are set up mainly from an engineering perspective. The product codes identify each product separately and SyteLine has the provision to create groupings within products of similar variants. Some of the product codes are now becoming obsolete due to the short product life cycles with the company's products.	• Enhanced product identification processes

Configuration control		
Case	**ES process change**	**Benefits**
Cevon	The family code is added after the first set up of the item. This code is used to group similar item/product variants. This code identifies the family group that the product belongs to. This is added by the planning group, which uses this code for reporting purposes.	• Improved product grouping processes
	The price code has substantial use in automating the item pricing process for the various customers. The price matrices link customers to the item pricing. Through this process, when an item matches a customer, the pre-determined price is picked up and used by the system.	• Efficient pricing process
	The item master is maintained centrally in SL7. There are a set of rules for the length and the first two characters of the item code. Items are created by "configuration control" based on input from engineering. The engineering input is in the form of an Excel spreadsheet for the BOM information and a PDF file for the drawing and specification of the main item. Standard copy functions from SyteLine are used frequently when creating new items.	• Faster and accurate item master maintenance process
	Although item revisions are important for version control, this field is not used as such. The reason is that it leads to additional master maintenance and requires some customization through SL7. For version control, another Quma Version Control System (QVCS) through which the version of item revisions is controlled for traceability.	• Effective version control through QVCS and better traceability
	In SL7, the master files for product definition are linked to production "shifts" and "work centers" in the factory. Both of these are integrated to the job order system in SL7 and are used for the SL7 planning and scheduling processes.	• Enhanced and integrated planning and scheduling processes

Engineering change note management		
Case	**ES process change**	**Benefits**
Aevon	SL7 provides the facility to maintain a history of engineering change requests/notes (ECR)/(ECN). SL7 provides the information such as when and why an ECN was raised, when it was implemented, and who was the approver, tracking whether an ECN is producing the desired results.	• Efficient engineering change management
	The ECN system in SyteLine has enabled implementation of engineering changes optimally such as consuming existing stock before the change is introduced. The integration of ECN to bill-of-materials and inventories in SyteLine, relating ECN implementation date to interactively projected inventories, has led to a sharp reduction in inventory obsolescence helping the operation staff in this endeavor.	• Reduced inventory obsolescence • Cost reduction, improved cash flow, revenue, and profit
Bevon	The ECR/ECN system in SAP provides a controlled creation, approval, and release of engineering changes that are implemented to projects. SAP provides the most feasible ECN implementation date based on warehouse stocks, work-in-progress, stock-in-transit, purchase orders/schedules given to vendors, and projected consumption. This ensures a smooth transition of the change without impacting inventories or creating stock obsolescence. Such changes to the processes has smoothened the product development process expediting new innovations, utilizing the advantage of technological advances, and ensuring the company is well positioned for the future market growth.	• Enhanced ECN control • Reduced stock obsolescence and better inventory control • Smoothened product development process

Bill-of-materials management		
Case	**ES process change**	**Benefits**
Bevon	SAP has the ability to maintain different BOM versions, each with a distinct validity date. The separate yet integrated BOMs can co-exist based on their specific requirements in the different phases of development such as one version for the design phase, another for the purchasing phase, and yet another for production. A "design" BOM version is meant for "development only". A "purchasing" BOM version suggests that the design of the parts is finalized but subject to the verification and validation of the parts and the product. Finally, a "production" BOM confirms that the parts and the product have been validated and the BOM is released for regular production. SAP further supports on-going BOM updating with automated version control and release on pre-defined date.	• Increased information flow and visibility • Faster and accurate BOM management and control • Efficient product innovation and new product introduction process

	Product development	
Case	**ES process change**	**Benefits**
Aevon	SL7 is partially used for the product development cycle that records transactions providing information such as costs incurred against specific projects. When an order is released to a vendor to do the preproduction build against specific projects, this is processed through SL7. Aevon's project manager retrieves the information about the project's status from SL7.	• Increased information flow and visibility
	R&D engineers want to know where specific components are being used to be able to standardize parts. This can be performed quickly in SL7 through "Where Used" functionality. Through this process the R&D engineers find out if the parts are being used in any of the existing products so that when new items are set up, the parts that are currently in use are selected. This encourages standardization of parts.	• Effective standardization of parts • Cost control and reduced inventories
	SL7 helps in providing information on how the cost of the new product is coming through. The GL codes are linked to the various project codes. When parts are procured, the costs get booked directly to the GL. This provides the project costing details as the project progresses. The new BOM configured in SL7 provides information on the BOM cost break-down, costs spent on tool development, and one time non-recurring engineering charges. Such information is used by the project and product managers to analyze the project costs and compare with budget to contain costs and understand areas of cost overruns. Similarly, the GL codes are linked to various department codes or employee codes for cost allocation.	• Improved product cost analytical processes
	In the initial stage of product development, SyteLine provides details on component specifications. At the prototyping stage, information on inventory of parts is utilized for managing builds. In the growth phase information on forecasts to suppliers is used. At the end-of-life phase, SyteLine informs the liability with respect to the components that are in stock. As new component samples are procured and start coming in, SL7 starts to build historical data as to which supplier has been supplying parts at what price, which helps in developing costs for project planning and budgeting. In the growth phase SL7 highlights demand and order booking pattern, requirement to expedite orders, pull-ins, and push-out. In the end-of-life phase SL7 helps to plan last time builds and manage obsolescence of parts.	• Superior management support in all stages of product lifecycle – product development stage, growth stage, and end-of-life. • Increased information flow
Bevon	The product development time is slashed through the use of built-in multi-user project management and work flow features with instant projection of delays or hold-ups in project plans. SAP tracks project development cost on a real-time basis including an update by product, after an engineering change.	• Reduced development cycle time, increased information flow, and cost control
Cevon	After the company split, the Commercial division has implemented a Web-based MS Project Server 2007 application for project management. They have also implemented a Web-based PLM system from Arena Solutions for managing product development processes. The company has geared itself to manage development of new products in its globally distributed environment. The Web-based software has enabled the extended product development teams to interact transparently with each other regardless of geographical or organizational boundaries. The solution provides three basic functionalities which are controlled centrally namely, the engineering, the program, and the team management functions.	• Efficient and effective product design, development, and project management • Increased collaboration in a globally distributed environment
	The engineering functionality allows users to work with part information, drawings and specifications, BOM and product structures, quotations and vendor details, associated design, and manufacturing documentation from a central database. It facilitates concurrent engineering, strategic sourcing, and provides benefits such as parts management and standardization, visualization, and graphical analyses with integration to the CAD tools.	• Enhanced engineering data management • Improved design and reduced cycle times
	The program functionality helps in complex project management across company's distributed development centers, suppliers, customers, and business partners specifically for new product development. The system creates budgets, allocates activities to the resource pool with work breakdown structures, tracks and approves tasks, and monitors progress and milestones in real-time until completion of the project.	• Effective project management with increased visibility
	The team management functionality offers a central virtual workspace for cross-functional and intra-enterprise teams of customers, suppliers, partners and employees. Virtual team management has become a necessity in Cevon's current global operations with distributed development centers, outsourced production, and shortened product life cycles. The PLM system has created a workplace for global collaboration across functions such as finance, sales, purchasing, production, engineering, and design. Online meetings are conducted such as design reviews to resolve technical or business problems including the viewing and approval of drawings. Participants can even opt for inclusion to notification of events.	• Efficient and effective communication and collaboration • Reduced product development time with better designs and reduced design rework