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CRITICAL SUCCESS FACTORS FOR THE TRANSFORMATION PROCESS IN ENTERPRISE SYSTEM IMPLEMENTATION

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Abstract

Organizations continue to deploy enterprise systems (ESs) to improve information flow, reduce costs, and increase operational efficiencies. Realization of these benefits can be enhanced if more is known about the preceding factors that enable transformation of ES data into successful outcomes. This study identifies the critical success factors (CSFs) that influence the process for transforming ES data into knowledge, which leads to business benefits from ES implementation. A multiple case study approach is used to examine how three hi-tech manufacturing companies in New Zealand have deployed an ES and, specifically, the CSFs that contributed to business benefits. The 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 business strategy deployment, people and process management, and skills and competency development.

Keywords: Enterprise System (ES), Enterprise Resource Planning (ERP), Business Benefits, Critical Success Factor (CSF).

1   INTRODUCTION

Enterprise systems, also known as enterprise resource planning (ERP) systems, are packaged information systems 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 partners, human resources, and financial accounting to make up the value chain of the enterprise, enhancing an organization's flexibility and efficiency (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 to their individual needs, replacing earlier in-house legacy systems (Allen et al. 2002).

A number of research studies have been conducted to establish and understand the critical success factors for ES implementations (e.g., Chen et al. 2009; Daneva 2004; Holland & Light 1999; Sarker & Lee 2000; Scott & Vessey 2002). However, there has been little research to understand the effectiveness of enterprise systems in the post-implementation phase and, especially, to identify the factors that contribute towards realization of business benefits and organizational improvements from ES (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 preceding factors that impact on the decision-making process that produces organizational benefits. Hedman and Borell (2002) suggest future research should address "the critical effectiveness constructs of an organization, which can be mapped to enterprise systems" (p. 91).

The purpose of this study is to identify and better understand the critical success factors that influence how an enterprise system and its information leads to realization of organizational benefits. The results provide insight into how pre-existing contextual factors influence the transformation process of ES data into desirable outcomes, as per Davenport (2000). The study is conducted in three hi-tech manufacturing companies in New Zealand who have deployed an ES and reach maturity in its implementation. The results of this study and the specialist insight gained are shared with the reader which is a distinctive contribution of this study.

The paper is organized as follows. This first section introduced the focus of this paper with a brief background on ES. The next three sections comprise the literature review, concluding with the model that establishes the framework for this research. The fifth section outlines the research methodology, a multiple case study. The sixth section presents the empirical findings from the three NZ organizations who have implemented ES and are the focus of the research. The concluding section summarizes and discusses the findings.

2   ENTERPRISE SYSTEMS

Enterprise systems consist of a series of modules comprising different sets of functionalities that achieve integration through a common database and shared information. 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" (Gosain 2004, p. 153) in business processes.

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" (Davenport 2000, p. 203). 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).

3 CRITICAL SUCCESS FACTORS FOR ENTERPRISE SYSTEMS SUCCESS

Critical success factors (CSFs) are the few key areas where things must go right to achieve success (Rockart 1979). CSFs have been explored and widely published by a number of researchers in the ES implementation literature. 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 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 problems that should be addressed by these CSFs (e.g., Foster et al. 2004; Klaus et al. 2007; Lui & Chan 2008; Poon & Yu 2006).

Furthermore, very little is known about success factors for the process of transforming ES data into knowledge and results. In a working paper Davenport et al. (2001) presented a few critical success factors that must be present based on experience of over 20 companies that were successful in their data-to-knowledge-to-results efforts. The important factors emphasized in the paper are a suitable transaction data environment, alignment of business strategy into departmental or divisional strategies and visions, active senior executive commitment, and management of the organizational drivers.

The focus in this study is to identify the success factors that must go right for the transformation of ES data into knowledge to produce business benefits. Although these results are based on New Zealand organizations, we believe that the findings will be similar in other regions of the global ES experiences.

Except for Davenport et al. (2001), no study has examined critical success factors for ES success based on a set of contextual factors that precede the data transformation and benefit realization process in ES implementation. No study in the literature does this utilizing an in-depth multiple case study methodology, as is done in this study. The rich amount of data, with cross-case analysis across all three organizations, provides insight into the critical success factors that influence the data transformation process and is a distinctive contribution of this study.

4 TRANSFORMATION OF ES DATA INTO KNOWLEDGE AND RESULTS

A model (Davenport 2000) for transforming ES data into ES knowledge is shown in Figure 1. The model comprises three major 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 when the data are used to support a business decision. The final stage is the realization of the outcomes, which describe what changed as a result of the implementation of the decisions. In this model, the pursuit of business benefits from ES is conceptualized as a series of steps that begin with the contextual factors –

strategic, organizational and cultural, skills and knowledge, data, and technology – that must be present for the transformation of ES data to happen, and are the focus of this study.
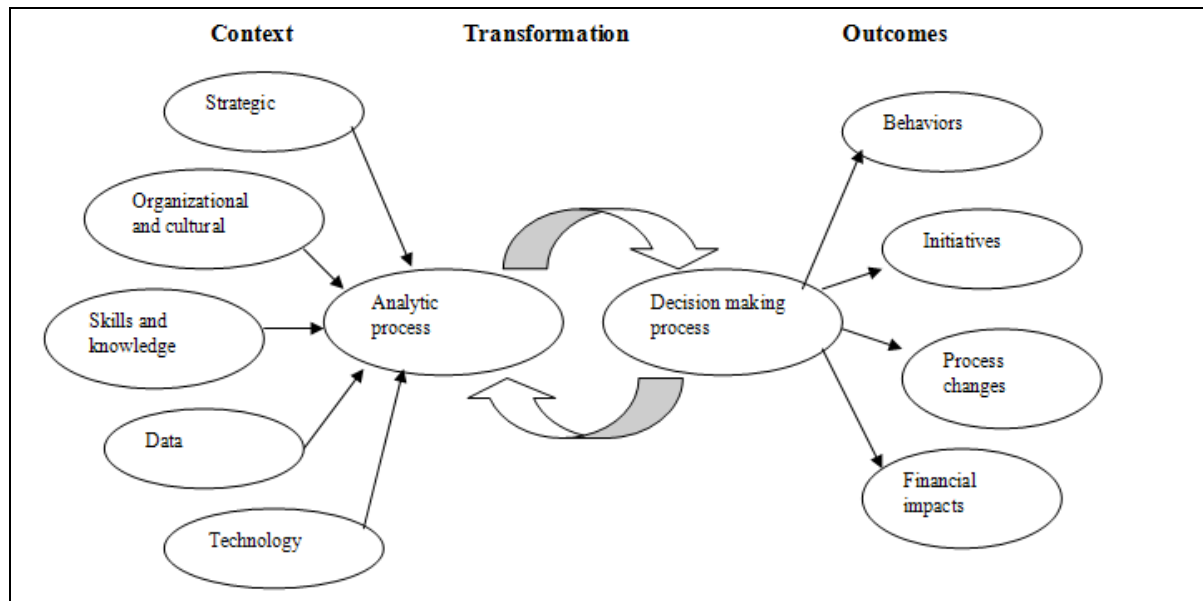

Figure 1. *A Model of How ES Data Are Transformed into Knowledge and Results (Davenport 2000)*

This model forms the basis for this study. 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".

Specifically, as described in the next section, the participants in this research were asked to identify and discuss what pre-existing factors contributed to realization of organizational benefits, implicitly through the transformation process in the middle of the model. The most critical factors are identified and organized into the contextual categories (left side of this model) by qualitative analysis, as described next.

5   RESEARCH METHODOLOGY

This study seeks insight from users of enterprise systems that are at a mature stage of development in order to better understand: What are the critical success factors that influence how an enterprise system and its information leads to realization of organizational benefits?

The underpinning epistemology uses a positivist approach for reliable and consistent findings to conduct semi-structured interviews with ES users in three organizations. The study utilizes Davenport's model (Figure 1) to evaluate the CSFs that influence realization of organizational benefits from an ES and its information. This assists in organizing the case study constructs to provide an orientation for finding the case study analysis which 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). The ontology assumption is based on the approach that the phenomena under study are singular, objective, and independent from the researcher. Rigor is attained with development of clear research questions, *a priori* specification of constructs, an explicit focus for the context of the study and its analysis. The *a priori* specification of constructs is utilized, based on the contextual and transformation phase in Davenport's model for turning ES data into knowledge and results, as shown in Figure 1.

The three case studies of ES implementation examined in this study were selected on the basis that the cases should have implemented ESs for at least three years and so are in the mature phase of realizing benefits. Twenty-three semi-structured interviews between 50 minutes and 3 hours each were carried out between June 2007 and July 2008. The positions of the participants included: manufacturing director, general manager, operations and supply chain (O&SC) manager, purchasing manager, IT manager, finance controller, quality manager, senior purchasing officer, and production engineer.

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

In the interview, questions were asked to extract information such as what are the critical success factors that influence how an enterprise system and its information leads to realization of organizational benefits. The interviews were tape recorded and transcribed immediately after each interview. The Nvivo 7.0 qualitative software tool was used for data analysis. The empirical findings were analyzed and are reported in the next section.

6   RESULTS AND DISCUSSION

The first three subsections of this section report the findings from the interviews with senior executives, managers, and operational staff at the three hi-tech electronics manufacturing organizations that are the case studies in this research. The final subsection provides a cross-case analysis of the findings.

6.1   CSFs for the Transformation Process to Produce Benefits from Aevon's Perspective

Aevon (a pseudonym) is an electronic weighing instruments design and manufacturing company based in Auckland, New Zealand. With about ninety employees, the company manufactures specialized measurement and control equipment for a wide range of industries including the mining, quarrying, and forestry sectors. Aevon's main markets are in the US, Australia, Europe, and China.

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 vision is to be the best in the class for design, manufacture, and supply of productivity solutions.

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 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. Table 1 summarizes the critical success factors for the transformational process to produce benefits at Aevon as cited by the respondents.

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.

Table 1.   CSFs for the Transformational Process to Produce Benefits at Aevon

6.2   CSFs for the Transformation Process to Produce Benefits from Bevon's Perspective

Bevon (a pseudonym) 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 of 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.

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.

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. The integration between the two systems was not adequate and the company had issues around costing of products. 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. With the implementation of mySAP ES 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 they thought would be useful later as the company grew. Table 2 summarizes the critical success factors for the transformational process to produce benefits at Bevon as cited by the participants.

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.

Table 2.   CSFs for the Transformational Process to Produce Benefits at Bevon

6.3   CSFs for the Transformation Process to Produce Benefits from Cevon's Perspective

Cevon (a pseudonym) was founded in 1987 in an Auckland, New Zealand garage by a group of seven people. Cevon became a successful high-tech business based on global positioning system (GPS) technology. Cevon was originally established for designing and manufacturing electronic devices used in marine applications. The company expanded to become the original equipment manufacturer (OEM) of several product applications using the core GPS technology for a variety of market segments. Cevon diversified from marine electronics to consumer markets by adding a range of new products to its portfolio.

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 customers).

By 2002, the company grew from seven employees to 250 with annual revenue of more than $100 million. In 2004, Cevon was sold to US Corporation (a pseudonym) who managed the business for three years. US Corporation grew Cevon 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.

Cevon had been using SyteLine version 5 from Mapics as their business management system since 1998. 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 SyteLine and there was no core system that was standard across the whole company. Cevon realized that it was time to upgrade their existing ES SyteLine 5 to SyteLine 7 in the NZ factory as well as roll-out the platform to all its regions and subsidiaries around the globe. SyteLine 7 (SL7) was upgraded as a business strategy at Cevon. The modules implemented were finance, sales and distribution, production planning, materials management, and production management and the new system went live in January 2007. The implementation at Cevon 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. Table 3 summarizes the critical success factors for the transformational process to produce benefits at Cevon as cited by the participants.

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 business units (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.

Table 3.   CSFs for the Transformational Process to Produce Benefits at Cevon

6.4   Cross-case Analysis of CSFs for the Transformation Process to Produce Benefits

A cross-case analysis of findings from the three case studies is presented in Table 4. Furthermore, the critical success factors are organized into the relevant category of the constructs comprising the

strategic, organizational and cultural, skills and knowledge, data, and technology factors in Davenport's transformational model (Figure 1).

Contextual factors	Aevon	Bevon	Cevon
Strategic	Support from top management		Senior management support
		Alignment of ES strategy	Vision for team consistent to goals
		Clarity on project plans and timelines	Definition of objectives
	KPI management		Phased project plans and deliverables
		Assessment of scope and budget	
Organizational and cultural		Change management	
	Employee reward and recognition	Retaining key staff	
		Relationships within all stakeholders	Bold, proactive 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		Relationships within all stakeholders	Dedicated project management and local support
	Training	Training	Training
		Involvement of key people and forum for discussions and feedback	Active involvement of all regions and business units
		Timeline to achieve results	
			Dedicated system administrator
Data	Data integrity	Data quality	Data quality
			Management of technical tasks
Technology	ES usability, flexibility and scalability, support global transactions, and external collaboration, Web-based	Use of appropriate technologies	Use of appropriate tools and technology such as BI including their configuration

Table 4.   Cross-case Analysis of CSFs for the Transformational Process to Produce Benefits

Factors such as senior management support, definition of objectives with alignment of ES strategy, and assessment of scope and budget, relate to the "strategic" construct in the transformational model. All three organizations are well-represented with several areas of synergy.

Change management, retaining key staff, involving stakeholders, and sharing knowledge are factors in the "organizational and cultural" construct in the transformational model. Bevon is especially strong in this area.

In "skills and knowledge" all three organizations emphasized training. The other critical success factor was involvement of key people throughout the organization.

Data quality and/or integrity (i.e., accuracy, currency, timeliness) was cited in all three case studies in the "data" construct of the transformational model.

Finally, technology critical success factors included ES usability, flexibility and scalability (Aevon) and use of appropriate technologies (Bevon and Cevon).

Overall, Bevon and Cevon both achieved strong placement of CSFs across all constructs, with Aevon identifying fewer CSFs. This is consistent with the reduced benefits Aevon realized from its ES

implementation, in comparison to Bevon and Cevon. Aevon has only recently started establishing analytical processes to optimize and realize business value from their ES investment.

7 CONCLUSIONS AND FUTURE RESEARCH DIRECTION

Interpreting the results reported in the previous section and with insight from the transformation model in Figure 1, business results follow in a culture in which the ES strategy is articulated and aligned. The organizational objectives are properly assessed and the scope and budget are clearly defined. The organization's managers work out their value creation process, identifying the critical areas that require attention and improvement. They understand the key success factors and have the means to influence those factors and measure them. The executive team is actively committed supporting the key staff within the organization. Knowledge sharing is highly encouraged involving all stakeholders. 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 tools for data extraction, its analysis, as well as the expertise in the usability of ES and its information. Quality of data plays a vital role.

The practical lessons on the impact of ES for realizing business value that are learned from the three case studies include: (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). Much of the success of ES implementation depends on the leadership of the business.

Although this study was conducted in New Zealand, the findings will be of interest to business organizations and ES vendors in many other regions of the world. There is no reason to expect that the results of this study are different from those that might be found in many countries with a large population of small businesses.

Further research is suggested by replicating this study in other countries, especially utilizing the perspectives of the ES users in organizations in those countries.

Research is currently underway to analyze the critical effectiveness constructs identified through an extension of Davenport's (2000) model shown in Figure 1.

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 critical success factors necessary for successful realization of benefits from enterprise systems implementation.

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