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Managing Enterprise Systems for Enhancing Business Benefits

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Abstract

Enterprise systems (ESs) necessitate a substantial investment for most organisations and maximising benefits from this investment is a critical issue. This research utilises an ES data transformation model from existing literature to investigate how ES data were transformed into knowledge by a hi-tech manufacturing firm from an ES implementation, and how this knowledge was used to provide benefits for the company. Findings indicate that the ES data transformation process was the result of making knowledge-leveraging actions at both operational and executive levels. At the operational level, the ES data supported day-to-day running of business functions to provide an infrastructure for actions. At the executive level, various tools and methods were used for transforming ES data into knowledge including the use of data warehouses and business intelligence modules that helped in extraction and manipulation of data, and reporting on particular data objects. Cascades of balanced scorecards were used for knowledge sharing and to assess progress for achieving goals. The organisation continues to establish analytical and knowledge-leveraging processes to optimise and realise business value from its ES investment.

Keywords

Enterprise systems (ES), Enterprise Resource Planning (ERP), Business Benefits, Business Intelligence, Knowledge management

INTRODUCTION

Enterprise systems, also known as enterprise resource planning (ERP) systems, are packaged information systems software applications that integrate various disparate facets of business including planning, production, distribution, sales and marketing, finance and human resource management into one integrated business system. Firms such as SAP and Oracle offer these systems as standardised software packages which allow organisations to procure them off-the-shelf and align them to their individual needs (Allen et al. 2002). An ES is usually implemented to integrate functions, automate transactions, optimise processes and provide context-rich information to facilitate decision making (Davenport 2000). Enterprise systems enhance knowledge sharing within and across enterprises and assist in optimal utilisation of organisational resources. An ES can also be justified as a basic rationale for organisational expansion and extension (James and Wolf 2000; Shang and Seddon 2000). 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 et al. 2009). There have been quite a few studies to understand the critical success factors for ES implementations (e.g., Bancroft et al. 1998; Holland and Light 1999; Lui and Chan 2008) as well as many studies to establish the business benefits organisations obtain from ES implementations (e.g., Davenport et al. 2002; Deloitte Consulting 1999; Gattiker and Goodhue 2005). However, there has been very little research to understand how ES data are transformed into knowledge for decision-making, and how this leads to the benefits. "Very few studies have gone beyond looking at implementation to tackle issues related to longer-term usage and the impacts of these technologies on organisations" (Gosain 2004, p. 152). This makes it difficult to draw explicit conclusions on the impact of ES on organizational performance (Ifinedo and Nahar, 2006).

The purpose of this study is to explore (1) how ES data are transformed into knowledge and (2) how this knowledge is used to realise benefits. An ES data transformation model from existing literature is utilised to gain

insights from an organisational perspective via a case study in a hi-tech manufacturing company. The company has deployed an ES for more than three years and so is in a mature stage of implementation. The results of this study, especially the insight gained from user-practitioners through the application of the transformational model, are useful to both academia and industry practitioners, which is a distinctive contribution of this study.

The paper is organised as follows. This first section introduced the focus of this paper with a brief background on ES. The next two sections review related literature, beginning with an analysis of ES benefits followed by associated technologies such as knowledge management and business intelligence. The section concludes with the application of a model for ES data transformation into knowledge and results. The fourth section outlines the research methodology. The fifth section presents the empirical findings from a case study that applied the model in a hi-tech manufacturing organisation. The sixth section summarises and discusses the results of the findings. Finally, the results are summarised and suggestions for future research are offered.

ENTERPRISE SYSTEMS BENEFITS

The key benefits that can be expected from post-ES implementation apply to both strategic and operational areas (Jenson and Johnson 1999; Nicolaou 2004b). ES amalgamate a wider array of business automation tasks such as inventory management, sales order processing, financial accounting, production scheduling, materials planning, EDI and supply chain management. Some of the commonly recognised benefits comprise improved time-to-market cycles, competitive positioning ability, business process improvement, increased customer satisfaction, improvement in order-to-cash time, increased productivity, improved product quality, increased flexibility via shared services, standardisation of company processes, integration among business units, real-time access to relevant information and an optimised supply chain (Cooke and Peterson 1998; Hedman and Borell 2002).

Organisations have deployed enterprise systems to create data sources which provide valuable information to meet their business intelligence and knowledge requirements (Vitt et al. 2002). To achieve flexibility and adaptability within an enterprise, the rules underlying the business processes are applied to assess organisational performance so that the health of the organisation is ascertained and actions taken when required. Businesses gather data, analyse information and utilise knowledge to make well-informed strategic business decisions that affect a variety of organisational disciplines (Moncla and Consulting 2000).

KNOWLEDGE MANAGEMENT

Knowledge management (KM) technologies combine data management systems like enterprise systems with the World Wide Web to derive more value from textual information (Cody et al. 2002). 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 behaviours" (Bergeron 2003, p. 6). The rationale for KM is based on the understanding that the most valuable assets of an organisation are the skills and knowledge that the employees possess. To be able to utilise and share this expertise within the organization, management identify means of capturing and sharing that knowledge with other employees. KM theories have emerged from a broad range of research fields such as sciences, economics and management. The diversity of these fields enables knowledge to be abstracted at different functional levels, allowing many viewpoints for understanding organisational knowledge, which is key for maximising benefits from enterprise systems. KM helps in creating a collaborative work environment, encourages knowledge distribution and saves on duplicating effort, thus reducing cost and time spent (Berkman 2005).

BUSINESS INTELLIGENCE

For driving business collaboration, organisations necessitate data management and the intelligence to evaluate specific data objects and establish informed decisions. Business intelligence (BI) is an activity that supports transformation of data into valuable information, insightful analysis leading to knowledgeable action. It is described as a rational approach to management, which is fact-based and analysis-based, converting data into information and empowering organisations to "make better decisions faster" (Vitt et al. 2002, p. 14). BI supports collection, analysis and reporting on organisational data in all of the business activities supported by the system throughout the value chain (Nicolaou 2004a). BI focuses on extraction and analysis of structured enterprise data with distribution of results 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 organisational knowledge creation since it is the fundamental tool in the intelligent enterprise (Framinan et al. 2003).

A TRANSFORMATION MODEL FOR ASSESSMENT OF BENEFITS FROM AN ES IMPLEMENTATION

A model conceptualised by Davenport for evaluating the process of ES data transformation into knowledge and results is shown in Figure 1. The model comprises three major stages. The first is establishing the context. This includes the pre-existing factors – strategic, organisational and cultural, skills and knowledge, data and technology – that must be present to achieve successful transformation of ES data into knowledge and results. The second stage is the transformation of ES data into knowledge that takes place when the data are analysed and used to support a business decision. The final stage is the outcomes, which describe what changed as a result of implementation of the decisions.

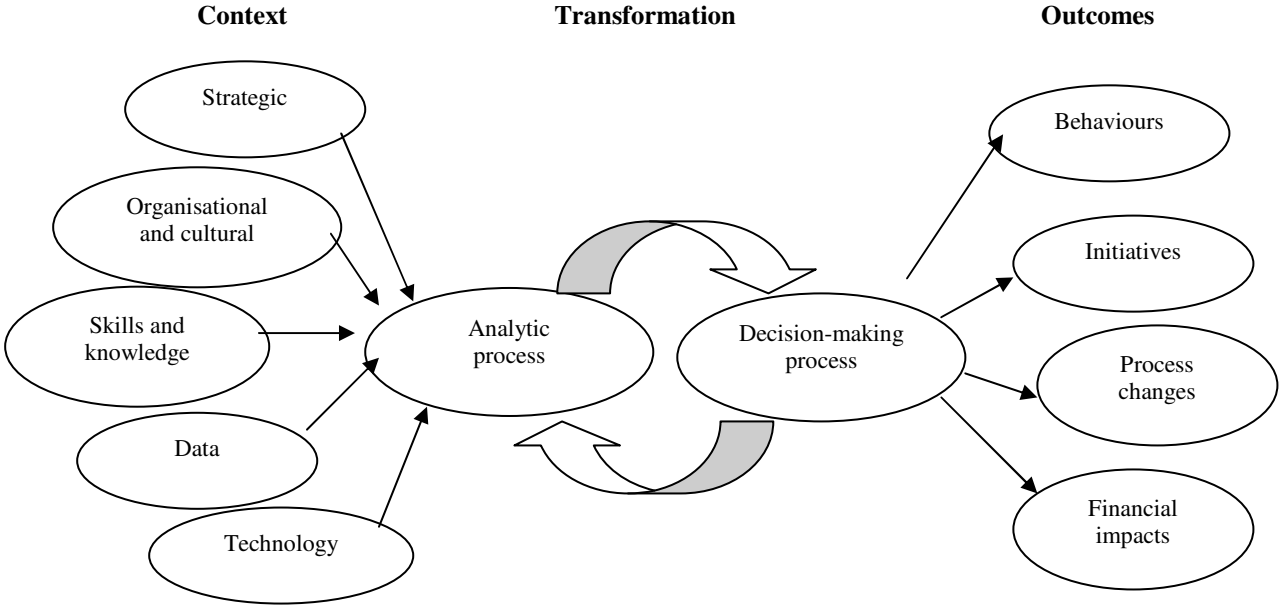

Figure 1: A model of how ES data are transformed into knowledge and results (Davenport 2000, p. 222)

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 organisation that invests effort and resources in ES data transformation". An examination of the transformation process would explain the ES impact to produce business benefits within an organisation and is the focus of this study.

RESEARCH METHODOLOGY

In this research, the assessment of business benefits from an ES is conceptualised as a series of steps that begin with goal seeking and conclude with realisation of benefits. The stages mirror the typical analytical and decision-making process. Using a qualitative research methodology, data were collected by way of semi-structured interviews with key respondents in an organisation that has implemented an ES. The case of ES implementation was selected with a predetermined criterion that the organisation should have implemented ES for at least three years and so is in the mature phase of realising benefits. The participants included senior executives, managers and operational staff in the organisation. Nine face-to-face meetings between 50 minutes and 3 hours each took place at the organisation. The positions of the participants included: manufacturing director, operations and supply chain (O&SC) manager, purchasing manager, IT manager, finance controller and quality manager.

A research information sheet and the interview questions were sent to the respondents prior to the interviews. In the interview, questions were asked to gain insights on how evolving ES data are extracted from structured database and converted into semantic information exchanges to make intelligent knowledgeable decisions for enhancing business benefits. The interviews were tape recorded and transcribed immediately after each interview. The Nvivo 7.0 qualitative software tool was used to code, categorise, and support evaluation of interview data. The software efficiently integrates and manages processes to search, index, and theorise unstructured and nonnumeric data. Davenport's model (Figure 1) provided the methodological guidance into the data collection and evaluation of the study. The empirical findings were analysed and the inferences reported.

CASE STUDY FINDINGS

Cevon (a pseudonym) is a successful high-tech manufacturing business based on global positioning system (GPS) technology. Specifically, Cevon is involved in the design and manufacture of electronic devices used in marine applications, personal in-car navigation and wireless fleet tracking at their manufacturing plant in Auckland, New Zealand (NZ). Established in 1987, by 2002 Cevon had grown from seven employees to 250 with annual revenue of more than NZ$100 million. In 2004, Cevon was sold to US Corporation (a pseudonym) who managed the business with substantial financial support. US Corporation grew Cevon to become a NZ$500 million business with 750 employees. The interviews took place in 2008-2009 when Cevon had become stable after the US Corporation takeover. The empirical findings are described using the format of the transformational model (Figure 1) to investigate the process of ES data transformation and benefit realisation at Cevon.

ES DATA TRANSFORMATION PROCESS

The ES data transformation process at Cevon is the result of making knowledge-leveraging actions at both executive and operational levels. At the executive level, Cevon has created the linkage between the metrics for achieving the company's 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 key performance indicator (KPI) against which major processes are aligned. These are communicated to all the team members and their specific key result areas are identified. The trends emerging from each indicator are evaluated to support inter-functional and overall business decisions. At the operational level, the ES data support day-to-day transactions in running of business functions such as sales and distribution, production planning, materials and financial management to provide the necessary infrastructure for decision making and actions.

ES DATA TRANSFORMATION INTO KNOWLEDGE

The IT manager explained that the ES implemented by them, namely SyteLine (also referred as SL7), has *"a lot of data in its database and it is not always presented in a user-friendly manner"*. Therefore, Cevon uses a bolt-on business intelligence application called Cognos Impromptu, which allows a more user-friendly way of drilling into specific data and presenting particular data objects with precise information the user might be interested in.

> *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.* (IT manager)

The IT manager further noted that the BI tool is good for generating ad-hoc reports by users. 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. This application is quite useful to users who need to create improvised reports based on the challenges they face in day-to-day business. The tool helps to get required data out of the system quickly and efficiently. The manager explained that when users have the ability to access the data easily they could quickly build a picture of relevant information and make better decisions. The BI tool insulates the user from the complexities of the embedded database, letting the user focus on high-level reports for analysing 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.

SL7 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 SL7, as well as some custom reports that have been built specifically for Cevon and added to existing SL7 reports. The data in SL7 are relatively easy to access, according to the IT manager. The operations and supply chain (O&SC) manager however opined that SL7 functionalities could have been further enhanced with some more reporting utilities (e.g., colourful graphs, more formulae applications) for better estimations. 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)

Cevon has also implemented a SL7 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, collated and the information is available to users who are permitted to log into the data warehouse. Additionally, Cevon staff also use a SyteLine Viewer application that provides a read-only view of SL7. To use the SyteLine Viewer application 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. Overall, the O&SC manager considered their current system effective for extracting and analysing data to create information for improved decision making.

UTILISATION OF KNOWLEDGE FOR DECISION MAKING TO ACHIEVE BENEFITS

Cevon has been utilising information from SL7 to provide a view of organisational performance as projected through cascades of balanced scorecards. The scorecards present the measurement of current status of functional performance areas, drilled at various levels of granularity. They highlight the company's objectives and provide a quantitative analysis through standard metrics, defined by the managers, to identify gaps or issues towards achieving those objectives. This includes benchmarking the KPIs and monitoring performance against the benchmark on an on-going basis. The scorecards also include 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. Keeping the scorecards relevant is an on-going task, especially as each business unit grows:

> *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 scorecards 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.* (manufacturing director)

Digital dashboards are another method for utilising information and knowledge sharing at Cevon. The dashboards are a graphical representation that the executive management team uses to track the performance indicators to evaluate which areas are performing well and which ones are not. Each component of the dashboard represents a different function of business activity, such as monitoring a revenue forecast. A digital dashboard helps management to view a detailed picture of the organisation's performance and to understand areas of deficit. According to the finance controller, 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 modelling is performed using external systems where the extracted data are transferred into spreadsheets for analysis. The 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 worthwhile. The scorecards can provide the reassurance that the kind of changes the company is doing are actually resulting in measurable benefits.* (finance controller)

At different times the SL7 administrator at Cevon has been asked to help produce information from the ES that is used for evaluation of some KPIs. It has only been a matter of establishing what that indicator is and what drives that indicator which really is the vital imperative. Once that is established, the required information is easily retrieved out of the system, measured and monitored.

The O&SC manager 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. The O&SC manager expressed that change in a particular process needs to be analysed to see whether it is having a positive or a negative effect on a range of KPIs.

DATA TRANSFORMATION BENEFITS

The result of data transformation and utilisation of ES information has led to improved outcomes at Cevon at both operational and executive levels. At the operational level, several outcomes in areas such as a) sales forecasting and operations planning and b) purchasing and inventory management are explained next. This is followed by some outcomes at the executive level.

Operational Level Benefits

Sales Forecasting and Operations Planning

Customer orders for Cevon are mainly made up of confirmed and forecasted orders received via subsidiaries. In the sales forecasting and operations planning process, the aim is to have all orders for the next three months firmed up and forecasts reviewed for the subsequent three months with the customers. The planners generate a six monthly forward order status report by region from SyteLine using BI. This is the founding point of Cevon's manufacturing rolling plan. The forward order status report is 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 is repeated each month using the BI system, which streamlines the demand planning with subsidiaries. As a result, the materials and capacity plans are updated regularly in SL7 and adjustments to the procurement and manufacturing plans are automated through the material requirements planning (MRP) module. This new planning process has not only improved inventories, but also the factory capacity and scheduling, leading to improved delivery performance and customer service.

The O&SC manager stated *"the use of APS (advanced planning and scheduling) 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 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 in improving customer service. 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, SyteLine 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 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. Production line, product family, work center and item group the requirements:

> *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 bill of materials (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 SyteLine, 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)

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. 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 SyteLine, 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 that provide an optimal plan. The new planning process through SL7 allocates resources. It indicates how much and when a resource is required. Based on this SL7 working 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/labour 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 analyse both historic and forward sales figures. The planners can review overdue customer orders, analyse the delivery performance and evaluate reasons for any delays.

Purchasing and Inventory Management

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 (vendor managed inventory) 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 SyteLine.* (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. The consignment stock inventory management program executed at Cevon has improved the cash flow substantially.

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. The Planners Workbench has made the purchase order (PO) 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 and item stock on-hand 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 SyteLine, the buyers now make these updates against the purchase order lines in SyteLine and do not need to maintain separate spreadsheets.* (purchasing manager)

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)

Executive Level Benefits

A value assessment model has been developed for the senior management through the use of balanced scorecards and digital dashboards. The model clearly defines the business activities that add value for its customers in each of the functional areas aligning company resources and future plans with strategy. For example, the system includes a review process that provides the means for a response through assessments supported by the underlying BI and data warehouse application. These assessments are performed in areas of (1) production yields and output, (2) cost and quality parameters, (3) manufacturing and test equipment utilisation, (4) planning and delivery targets, (5) inventory levels, (6) R&D plans and deliverables, and (7) financial results against benchmarks. A dashboard for each of these functional areas highlights KPI status reports. For example, an overview of quality measurements per production batch lists first time pass yields, acceptance/ reject rates, scrap and rework costs. Operational measures highlight metrics such as inventory stock turns, unplanned downtime, on-time delivery to customers and warranty returns. This has enabled the company to increase operational efficiencies, maintain high product quality, improve future versions of products, and achieve higher sales and customer services. Establishment of these analytical processes however, is a recent development at Cevon, to improve the company performance and realise business value from their ES investment.

RESULTS AND DISCUSSION

In answering the first research question, how are ES data transformed into knowledge in seeking benefits from an ES, the extensive use of ES functionalities and business tools have emerged from this study. The major methods include use of standard and custom ES reports, forms and user-friendly interfaces for writing queries. Additionally, data warehouses are used when data are brought in from various heterogeneous environments and the ES users utilise the relevant information on a regular basis. Tools such as SyteLine Viewer, which do not require a user license, are utilised so that more staff can access read-only data. Organisations also use special reports created through the Crystal Reports functionality for SL7. The BI module helps to perform user-friendly queries, execute formatting commands and report on particular data objects to provide a more informed view. Two-dimensional data objects are transferred to Excel spreadsheets where further data manipulation is performed. In this manner, the analytical processes enable ES data transformation into knowledge assisted by the different contexts – strategic, organisational and cultural, skills and knowledge, data, and technology – of the transformational model (Figure 1) driven by set benchmarks and key indicators in day-to-day operations. The knowledge extracted through the analytic process provides the background for making business decisions.

The second research question – how is ES knowledge utilised to make business decisions for the realisation of the benefits – emphasises that decision-making processes in organisations should be on the basis of well-analysed, high-quality current data that are aligned to achieving business goals. Cevon uses various knowledge-based processes to analyse ES data, apply human judgment and experience, and use the created knowledge for improved 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 detailed analyses whereby users can create graphs, pivot tables and other user-friendly representations. The business decisions are established on the basis of data analysis and other organisational factors. Cevon also uses benchmarking and KPI reporting supported with ES data for measuring and monitoring performance to achieve goals and targets. The performance review process leads to decision making that helps in achieving the overall business strategies. Additionally, business tools such as balanced scorecards and dashboards are used to track progress towards realising business benefits and to establish analytical decision making. The relevant information extracted through the ES business intelligence engine makes management aware of issues and gaps in different business activities as they arise within the value chain.

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). The findings from this study confirm the validity of Davenport’s model (Figure 1) in explaining the ES data

transformation process and linkage to the contextual factors – strategic, organisational and cultural, skills and knowledge, data and technology. The process outcomes lead to increased employee motivation enhancing new initiatives and process improvements that eventually lead to financial impacts. From this study, the model not only applies to large firms from Davenport's study but also to small and medium-sized firms such as Cevon.

CONCLUSIONS AND FUTURE RESEARCH DIRECTIONS

Several key findings have emerged from this study. The research has examined the effectiveness of ESs on organisational functions and processes for achieving benefits. The study has provided an increased understanding of the various knowledge-leveraging processes organisations adopt in use of ES and its information for realising benefits. The study has highlighted that results follow when the business strategy is clearly articulated and defined. A value creation process is developed identifying the critical areas that require attention and improvement. The business managers continually monitor the key performance drivers through ES reports and measure them against benchmarks. Management translates their business strategy into departmental or divisional strategies, know what targets to achieve, which data need further analytical application and expected outcomes. For achieving all of this, the organisation must possess the necessary expertise and skills in ES usability.

The main contribution of this research lies in providing methods used in ES data transformation processes and its implications for both research and practice with a focus on usability of an ES at both operational and executive levels. The implications for practitioners are 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. Also, tools for data extraction and analytical processing are essential to support the ES data transformation process. Using the transformational model in this study, the linkage between data transformation and business benefits has been established to offer rich insights on how ES data are used by management teams for improving effectiveness and realizing business objectives. The findings from this research are limited to the views of nine professionals interviewed in one organisation. However, the study's conclusions are drawn from interviews with a diverse set of professionals with considerable seniority and experience and positioned in a key firm in the hi-tech industry.

Based on the results of this study, it is suggested that this study be replicated using a diverse selection criteria of organisations such as selecting small organisations, or a different industry sector such as retail or service industry where ES implementations are realised. The perspectives of ES users in those organisations can be explored to understand their ES data transformation processes. Thus future research would analyse the critical effectiveness constructs used by other organisations in different sectors to investigate their perspectives and experiences and compare the findings with this study. Similar studies could also be conducted in other countries to better understand the management of enterprise system technology for enhancing business benefits.

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