Association for Information Systems
AIS Electronic Library (AISeL)

ICDSS 2007 Proceedings

International Conference on Decision Support Systems

2007

Leveraging Knowledge-Driven Technologies for Business Success

Sanjay Mathrani
Navman New Zealand Limited, Sanjay.Mathrani@navman.com

Dennis Viehland
Massey University, d.viehland@massey.ac.nz

Leveraging Knowledge-Driven Technologies for Business Success

Sanjay Mathrani[1], and Dennis Viehland[2]

[1] Navman New Zealand Limited, Auckland, New Zealand
[2]Massey University, Auckland, New Zealand
[1]Sanjay.Mathrani@navman.com , [2]D.Viehland @massey.ac.nz

Abstract. A significant investment in resources is required for implementation of integrated enterprise systems as technology solutions while the effectiveness of these systems to achieve business benefits remains unclear and empirically largely unexplored. Unarguably, the business benefits can be achieved from improvements through transformation of enterprise system data into knowledge by applying analytic and decision making processes. This study explores a model of transforming ES data into knowledge and results by comparing two case studies that examine the impact of enterprise systems information on organizational functions and processes leading to business benefits.

Keywords: Enterprise systems (ES), enterprise resource planning (ERP), effectiveness, data, knowledge creation, knowledge management (KM), business benefits

1 Introduction

The implementation of enterprise systems (ES), also called enterprise resource planning systems (ERP), has been considered the most important development in corporate use of information technology [1],[2],[3],[4]. However, despite a few dramatic successes, many organizations still fail to realize the benefits while incurring huge costs and schedule overruns [5]. It has been estimated that half of all ES implementations fail to achieve the desired results [6].

In most cases enterprise systems are implemented to improve organizational effectiveness [4],[7],[8]. These software applications connect and manage information flows across complex organizations, allowing managers to make decisions based on information that accurately reflects the current state of their business [9].

These systems are implemented to bring about definite business benefits that justify the investment. Truly significant return on investment (ROI) comes from the process improvements that ES supports and not just from improved information access. In most implementations, ES software alone makes marginal improvement in business performance. If organizations continue to follow the same pre-ES business processes after implementation, they can expect the same or possibly worse performance. ES software can, however, enable and support many new and improved

processes, but not without the organization deciding what those processes are and committing to them. Positive ROI can come from changing the way business was performed in the past to more streamlined, faster and lower cost processes that better serve the needs of the customer and, if that is done well, the organization will be a winner [10].

The focus of this paper is to better understand the effectiveness of enterprise systems technology in an organizational setting. A qualitative research methodology is used to explore the application of knowledge processes on ES data and how firms can leverage knowledge-driven technologies to realize improved business benefits.

Field studies were conducted in two large manufacturing organizations in India that have implemented ESs, in order to understand their experience in achieving growth by leveraging data from their ES investment. Semi structured interviews were conducted with senior managers of the two organizations. The empirical data were integrated and analyzed to formulate inferences presented in this paper. Both organizations had aggressive growth plans with an objective to achieve better penetration capability into the competitive market by improving their operations. Both organizations had implemented ES for at least three years and so were in their mature phase of implementation. One organization had achieved considerable success from their ES implementation and the other had achieved little success. The two cases are compared to identify reasons for their levels of success.

2 Enterprise System Benefits

The justification for adopting ES centers on anticipated business benefits from the ES. To receive benefit from an ES, there must be no misunderstanding of what it is about, its usability, and, even more importantly, organizational decision makers must have the background and temperament for this type of decision making coupled with the right quality of information [11].

Many researchers have evaluated benefits from ES investments [2],[8],[9], [11],[12],[13],[14],[15],[16],[17],[18],[19],[20],[21]. These studies have found that ES's are designed to help manage organizational resources in an integrated manner. Furthermore, the level of integration that is promoted across functions in an enterprise closely relates to the primary benefits that are expected as a result of their implementation. After adoption, improved business performance should produce both operational and strategic benefits [17],[22],[23].

A study of 85 global companies [2] found tangible benefits (e.g. cost savings, faster processing) and intangible benefits (e.g. improved information visibility, new/improved processes, and improved customer responsiveness) from ES implementation. In a survey of 163 large firms [9] key benefits realized by organizations adopting enterprise systems included better management decision making, improved customer service and retention, ease of expansion/growth, increased flexibility, faster and more accurate transactions, cost reduction, and increased revenue.

There have also been some studies on organizational benefits resulting from overlapping implementation of knowledge management (KM) and enterprise systems in organizational settings. A study by [24] pertaining to interaction between KM and ES as separate systems, examined their combined influence on improving organizational efficiency and flexibility. Another study [25] explained how enterprise systems produce effects that make business knowledge become more convergent from the organization perspective and divergent from the individual perspective in relation to technology and business processes. Bendoly [26] examined the knowledge discovery and data mining process from enterprise systems for attaining sufficient domain-specific knowledge for use in strategic planning. However, this paper focuses on creation and utilization of ES knowledge through the process of ES data transformation, by applying analytic and decision-making processes to achieve business benefits. This study attempts to establish the link between data, decisions, and actions, its impact on functional and business processes, and their outcomes.

3 Turning ES Data into ES Knowledge

A model conceptualized and used by Davenport (2000) and his team of researchers for turning ES data into ES knowledge is shown in Figure 1. The model comprises three major steps. The first is the context. This includes the factors that must be present for transformation of ES data into knowledge and results. The second is transformation of ES data into knowledge which takes place when the data are actually analyzed and then used to support a business decision. The third are the outcomes which are the events that change as a result of the analysis and implementation of the decisions made.

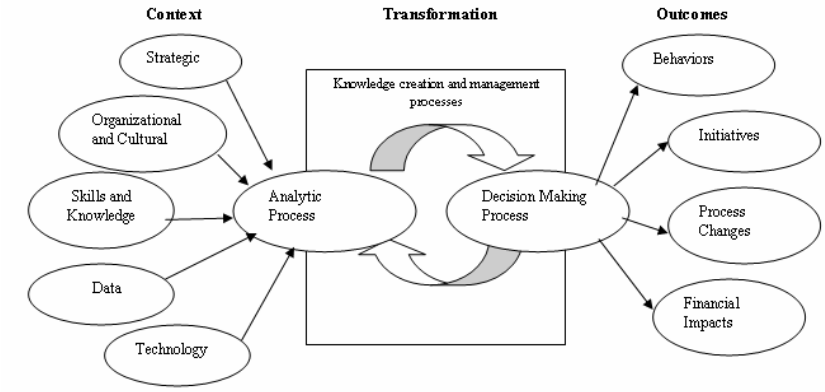

Figure 1. A Model of How ES Data are Transformed into Knowledge and Results

As Davenport's model shows, the process of ES data transformation into knowledge leads into organizational changes. The most basic potential outcome of this process is the changes in behaviors of individual managers, employees,

customers, suppliers, and all stakeholders in the value chain. Another outcome from the decisions or the behavioral changes may be new initiatives to bring about improvements in business or make changes in existing projects. The results of decisions can also include process changes – determining that an existing process is not working effectively can lead to changes in the existing process or design and implementation of an entirely new process. The ultimate results of all these activities are the business benefits which lead to positive financial impacts for the organization. "Decisions lead to new behaviors, new initiatives, and processes, which do not matter unless they improve the bottom line and the return to share holders" [7] (p. 225).

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 be the objective of an organization that invests effort and resources in ES data transformation [7] and is the focus of this study.

4 Case Study 1

4.1 Company Overview

Growel Limited[1] is a US$1 billion forging manufacturing company and is one of the world's largest manufacturers and exporters of automotive engine and suspension components. It has the world's largest single-location forging capacity and one of the most technologically advanced commercial forge shops in the world. Growel has been a publicly traded company whose stock has appreciated more than 200 percent since March 2004. With manufacturing facilities in India and Germany, the company manufactures a wide range of forgings and machined components for the automotive, diesel engine, railway, earthmoving, cement, sugar, steel, coal, ship building, and oilfield industries. An ISO 9001:2000, ISO/TS 16949:2002 accredited company, Growel is internationally reputed for its cutting edge technology, established quality processes, and capabilities to meet the exacting standards of the most demanding customers in the world. Growel Limited is a global corporation with world class engineering capabilities, state-of-the-art manufacturing facilities, and a global customer base that includes General Motors, Toyota, Ford, Daimler Chrysler, Honda, Renault, Volvo, Caterpillar – Perkins, and several others. It is the largest manufacturer of axle components for heavy trucks and has a 35% global market share, with a 10% global market share in engine components. The following sections discuss how Growel leveraged knowledge-driven technologies to improve business dynamics with considerable success. The discussion follows Davenport's model – context, transformation, outcomes – as shown in Figure 1.

[1] A pseudonym. The name was chosen to symbolize growth.

4.2 Context

Strategic Context

Growel's journey towards becoming an international e-business began in the late 1990's. The company wanted to grow exports, widen its global footprint, secure new customers, become the world's largest manufacturer of axle components, and be a key global provider of engine components. To achieve these goals, Growel planned to double its manufacturing capacity by implementing a major capacity expansion program. However, this involved large investments and risks. The company had to resort to major cost controls, improve operational efficiencies and optimize its business processes to counter the adverse financial effects of the major investments. Senior managers in the company decided to pursue a strategy of operational excellence. The company historically lacked integration between its order-to-cash, shipping, and accounts receivable processes. There were disputes on invoices and purchase orders relating to price and terms of business. There was a lack of visibility into finished goods inventory and overall accuracy of inventory was poor. Visibility of material requirements and inventory throughout the value chain was inadequate and did not provide decision support at all stages of operations.

The company had not integrated the design and development practices with the operational systems; therefore the time lag between development and marketing of products was large and resulted in poor customer service and dissatisfaction. The pre-production approval process was another aspect which required attention. The company needed the ability to interactively participate with its customers at the early stages of product development and avoid rework at a later stage. The product forecasting process also required improvements. Managers only discovered that they had a shortage of manufacturing capacity when the line ran out. On the sales side, management had limited visibility of who its most and least profitable customers and products were. They also did not have information on whether they were buying in the most cost effective manner. The management team recognized what types of decisions had to be made to support their strategic objectives but could not utilize the available operational data.

Organizational and Cultural Context

A company is as good as its people and Growel has the advantage of having a highly qualified and motivated manpower base. Since its inception, Growel has attached great significance to "people power" and considers its employees as important assets. With interactive communications at all levels, Growel continues to provide a congenial and peaceful working atmosphere to its employees. In the process of ES implementation, the organizational and cultural elements were aligned to support the use of transaction data at Growel. The compensation system was also changed to reward sales people for sales volume and profit to include a fixed and variable component of pay. The company created a friendly atmosphere within the organization which fostered orientation to change. The organization also adopted a data-oriented culture and encouraged employees to use data to support any business decision.

Skills and Knowledge
Growel has always had a high quality, motivated work force. The company employs about two thousand workmen of which over four hundred are engineers with a high ability to learn and implement modern manufacturing methods using high tech equipment. The company provides extensive training both in house and externally, including overseas exposure. Within the group of knowledge workers and analysts, the skills include detailed knowledge of the organization's underlying business processes. They possess extensive skills for interpreting the SAP data, including understanding how key elements relate and their limitations for analysis. They also have a thorough working knowledge of several analytic and data presentation software packages, along with strong interpersonal skills to train and support end users.

Data Context
Issues of data quality were less at Growel, where transaction data captured in the SAP system were created internally based on all transactions from sales orders to shipping invoices. Monitoring and updating of data was a regular feature at Growel and the transaction data was made available in a timely fashion to support decision making.

Technology Context
Growel had historically been using a home-grown legacy system which provided disparate information which lacked proper integration and utilization. However, this lack of operational data to support decision making changed with the implementation of SAP's R/3 in 2000-01. The modules implemented were finance, sales and distribution, materials management, production management, and human resources. The company now had unprecedented visibility into its operations and customer base. SAP business intelligence tools were extensively used to extract, analyse, and develop adhoc reports.

4.3 Transformation

The transformation process at Growel was a result of putting knowledge-leveraging activities into action. How this happened is explained next. The value creation process was initially described in detail to gain an in-depth understanding of where and how Growel adds value for its customers. A critical success factor framework for each functional area was developed and a strong linkage between departmental performance indicators and top-level metrics for gauging the effectiveness of company strategy was put in place. Task groups within each functional area translated the general framework into team-specific programs to leverage innovations for achieving strategic goals and plans.

The model was shared with all the relevant team players. Descriptive indicators of the improvement and corrective-action plans were identified to facilitate decision making. The implementation plans for these decisions to achieve the desired results along with the steps to create the results were identified. Forms were designed to describe these plans and their measures. The indicators were documented choosing the reference for benchmarking and external validation along the time-line. The

analytical process was the means by which ES data became knowledge. The SAP data, required for each of the indicators were identified, extracted, and interpreted, to create useful information for monitoring the progress for achieving the objectives. The signals and messages coming from each indicator were analysed and evaluated to support decision-making. The decision-making process was based on high-quality, well-analysed ES data on a multitude of factors. Some key areas where ES data were utilized for improvements were customer and product profitability analysis, price/volume analysis, market and customer segment analysis, sales forecasting and operations planning analysis. All actions likely to improve the likelihood that the result will be coherent with the strategic intent were identified, evaluated, and implemented.

4.4 Outcomes

Changing Behaviors

One of the major outcomes from the initiatives described above was changing behaviours. Improved information sharing, transparency, and openness with customers, suppliers, employees, and all stakeholders resulted in improved inter-personal and business relations. Having easy access to invoice and purchase order data enabled Growel to improve price synchronization with customers and suppliers. The earlier disputes on invoices and purchase orders relating to price and terms of business diminished. The online visibility of demand and supplies with customers and suppliers through the integrated supply chain management (SCM) system led to less volatility in sudden spurts of demand which existed earlier. This resulted in more streamlined supplies and a dramatic change in customer and supplier behaviour since Growel could react better to change orders now and was able to be more flexible in the manufacturing environment.

New Initiatives

The ability to analyse customer and product profitability lead to a new initiative of value engineering to improve or change the design to make the product more profitable. Unprofitable products and customers were identified and the division's existing unprofitable product lines were replaced by more profitable new product lines. New initiatives towards implementing just-in-time inventory systems were undertaken, which decreased inventory costs substantially.

Process Changes

Growel recognized that the SAP data created opportunities for redesigning some business processes which could create entirely new sets of decisions. Growel is moving at full speed to re-design some business processes and build e-commerce applications with SAP as a backbone for their legacy systems and other collaborative software like SCM (Supply Chain Management) and PLM (Product Lifecycle Management). SAP provides capabilities such as CRP (Capacity Resource Planning), and BPR (Business Process Re-engineering) which offer powerful links within the entire value chain from customers to suppliers. The company has set up an integrated supply chain management system which enables real-time visibility of material

requirements and inventory throughout the value chain and provides decision support at all stages of operations. With a majority of the company's suppliers receiving supply chain data, the company has a real-time total demand management system in place. A virtual private marketplace has been created for Growel through which the company engages in e-procurement and reverse auctions. The company has already started selling scrap online.

In a development that will substantially reduce product development time and bring the company closer to its customer, Growel is in the process of implementing a Collaborative Product Commerce (CPC) module. CPC will enable the company to work online with its customers to design and develop products and share information and knowledge with the customers. This will reduce product development time and costs and, more importantly, forge close ties with the customers from early stages of product development.

5 Case Study 2

5.1 Company Overview

Primemover[2] is a multi-faceted engineering enterprise. Established in 1859, Primemover is one of India's leading and well-diversified engineering companies with a US$500 million turnover. The company's core competencies are in diesel/petrol engines, power generating sets (gensets), agricultural and construction equipment. The business operations of the company are divided into various business groups strategically structured to ensure maximum focus on each business area and yet retain a unique synergy in the operations. The business groups are power generation, agricultural equipment, light engines, and infrastructure equipment. Primemover has six manufacturing plants located at several locations in India. The company has an extensive sales and service network manned by a highly skilled and dedicated workforce.

The power generation group of Primemover designs and manufactures diesel engines and gensets for industry sectors such as power, oil and gas, construction, earthmoving, and transportation and supplies to various countries all over the world. The unit employs about 1,200 people. Originally Primemover only manufactured diesel engines. In 1993 the company collaborated with a German company to include gensets in order to extend its range of products, to develop a more complete supply capability to the engine manufacturing industry, and to position the company for long-term growth. Both product ranges served as solution providers for their customers, provided products with a large-range of kva and hp ratings. The synergies created by the integration of the two product ranges enabled better designs and product offerings. Specifically, customers had more effective, one-stop access to a comprehensive range of products as well as simplified commercial relationships. By enabling improved

[2] A pseudonym. The name was chosen to symbolize power.

service to customers, the integration of the two product lines enhanced the market position of the power generation group of Primemover. However, the company realized that it would face challenges to ensure its profitable growth in the long term.

5.2 Context

Strategic Context

Primemover was one of the few companies that were full-line supplier of the entire product range in industry markets however; the company was facing growing challenges. Despite increased demand resulting from a healthy growing market, greater competition in its core markets and high operating costs could inhibit the achievement of financial returns expected from its operations. Primemover had to overcome the competition, and leverage the new opportunities to ensure profitable growth for the future. To compete effectively, Primemover needed to improve its supply chain performance and cost; the business processes of the two product lines were not performing at the levels necessary to grow profitably in the emerging competitive environment. The time frames required to commit to delivery of finished goods to customers were not competitive; customer order handling and service processes were complex; operations were not sufficiently flexible to enable rapid response to shifting demand; market share was not growing rapidly; and inventory-carrying costs and other expenses inhibited achievement of adequate financial returns. These challenges were compounded by the fact that 60% of Primemover diesel engine and genset parts were externally sourced and there were long lead times for products such as pistons from Germany and turbochargers from UK. Forecast accuracy was low, inventory data and related information were inaccurate. Thus, key goals for Primemover included enhancing its ability to respond to customer requirements, improving market share, and reducing costs throughout the operation. Primemover determined that it must improve its supply chain planning and execution capabilities to improve its operations in order to achieve better penetration capability into the competitive market, which was their prime objective.

Organizational and Cultural Context

Primemover has an overall employee base of about three thousand employees and has a change-oriented organizational culture. Primemover enjoys the enviable reputation of being one of the few corporates that has successfully maintained harmonious human relations year after year and the credit for this goes to all its employees who have always been open to and welcomed change. The organization structure is collaborative and the compensation system is aligned to achieving goals.

Skills and Knowledge

Out of the three thousand workmen Primemover employs, over five hundred are qualified engineers having technical and commercial expertise. The company has hired mostly skilled workmen in the last fifteen years. The company has been providing on-going training and development to upgrade the skills and knowledge of its employees including knowledge of the organization’s underlying business processes.

Data Context
Quality of data was not an area of focus for Primemover prior to ES implementation. The maintenance of data records was not consistent and discrepancies were often encountered in the data records. There was a lack of discipline in updating transactions in the warehouse which would lead to stock and other data discrepancies. This lack of accuracy and currency of information led to data integrity issues amongst employees. The tools for data extraction were also inadequate. Availability of transactional data and information was an issue. Data extracts could not be made easily available and in time to support decision making.

Technology Context
Primemover realized a need to couple its execution systems with a new class of supply chain planning software to address its requirements in the future. After considering various software solutions and determining the business strategy, the company selected SAP R/3 to be the foundation of the planning system for its integrated operations. Primemover had historically been using an internally-developed system which provided disparate information that lacked proper integration and utilization. However, the situation changed with the implementation of SAP's R/3 in 2000-01. The company implemented financial, sales and distribution, production management, human resources along with Web-enabled supply chain management systems. Primemover now had better visibility into its operations and customer base. Standard reports from SAP and Microsoft's Excel were used to analyse and report data.

5.3 Transformation

The transformation process at Primemover was based on the information from the SAP system. The available SAP data were utilized, interpreted, and analysed in various areas of operations to support decision-making for achieving the company's strategic objectives. Standard reports from the SAP system were used and evaluated on a regular basis to support decision-making. Many of these reports were transformed into Excel spreadsheets to facilitate application of analytical processes. The decision-making process was based on well-analysed ES data on a multitude of factors.

However the organization's business strategy needed more alignment into departmental and divisional strategies. The definition of information critical to the success of the organization was missing. This was evident by a remark from one of the interviewees when he said "there was a lot of confusion on what is to be achieved, which data needs to be analysed, where it is to be applied and to achieve what results". The analytical and decision-making process was based on ES data which were not very accurate. There was a lack of timely availability of data extracts to support analytical decision making and the link between data, decisions, and actions was missing. Some key areas where ES data were utilized for improvements were market and sales forecasting and operations planning analysis, theory of constraints in

manufacturing analysis, raw material cost analysis, inventory analysis, activity-based costing, and process efficiency analysis.

5.4 Outcomes

Changing Behaviors
As a result of implementing an ES, the attitude of customers, suppliers, employees, and all stakeholders improved but did not reach the levels expected since inaccuracies were still present in the historical data. The online visibility of demand and supplies with customers and suppliers through the integrated SCM system 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 marginally. The supply issues from vendors and customers continued and dramatic overall improvement in behaviours was not achieved.

New Initiatives
With some ability to analyse demand and with the information now visible, the company implemented the following changes to its supply chain processes. Primemover analysed its various market and customer segments, determined the service requirements for these segments, and classified products according to volume and variability of demand. Primemover established monthly sales-forecasting and operations-planning meetings where the supply-and-demand plans were formally reviewed; performance of locally produced and imported product was considered; exceptions and unique requirements were brought up for discussion; and market intelligence and longer-term constraints in material and production were factored into plans.

Process Changes
In order to shorten lead times, reduce inventory, and increase throughput, Primemover employed a “theory of constraints” model, establishing processes to identify critical material and capacity constraints – and to optimize these constraints in its manufacturing operations on an ongoing basis. As operations of the two product lines were unified, customer account numbers were merged; SKUs were combined; and the number of warehouses was reduced from five to three. These consolidations required considerable revamping of numbering schemes and physical storage strategies. Warehouse consolidation was coupled with improved policies associated with material movement, virtually eliminating the need to transfer material between locations once received. Due to better tracking of material and a substantial reduction of the need to move material multiple times, costs for damaged and lost material declined from 1.60% to 0.78% of sales. Also, strategically significant and measurable improvements to inventory, cost, and customer service were achieved.

Forecast accuracy improved as the company gained experience with sales forecasting and operations planning. The new processes also gave visibility into material requirements for scheduled orders and further facilitated procurement planning. Primemover had earlier been placing large, irregular orders monthly or

bimonthly with its suppliers but is now placing regular weekly orders, improving its suppliers' abilities to plan and thereby improving Primemover's negotiating position. The store manager at Primemover remarked that the suppliers and customers were now giving "fewer headaches" with the new system. Primemover's customers are also able to plan better due to the company's improved forecasts. Resolution of manufacturing constraints has improved production throughput by 20%. Daily cycle counting has enabled inventory accuracy to advance from 52% to more than 80%, which has facilitated a reduction in the levels of raw materials and finished goods. Finally, many employees are undertaking what-if analyses with the range of available data, further improving planning and execution across the supply chain. Primemover has chosen to integrate related product lines, establish supply chain channels to match supply-and-demand streams, and resolve constraints in its manufacturing network. The company recognizes that its process designs are not static and that its business and enabling systems will continue to evolve in line with market demands. Ongoing achievements in cost reductions and customer service improvements have enabled Primemover to make continual improvements in market position, premium pricing opportunities, and financial return.

6 Results and Financial Impacts

Table 1. Key Successes Achieved by Growel and Primemover

Growel	Primemover
1.Product development time - Decreased to around three weeks as compared to six months earlier; this closely matches industry benchmarks	**1.Product development time** - Decreased to around two months compared to three months earlier; this closely matches industry benchmarks
2.On-time delivery - Increased to 98% on-time	**2.On-time delivery** - Increased to 85% on-time
3. Inventory - Reduced by 80%	**3. Inventory** - Reduced by 40%
4. Cost efficiency - Increased by 60%	**4. Cost efficiency** - Increased by 20%
5. Relationship management - Much improved relations with customers and suppliers	**5. Relationship management** - Some improved relations with customers and suppliers
6. Human resources - Highly motivated	**6. Human resources** - Motivated

Table 2. Last year's financial outcomes of Growel and Primemover as on March 31, 2005

Growel	Primemover
1.Total revenues - Increased by 47%	**1.Total revenues** - Increased by 24%
2.Exports - Increased by 76%; contributes 48% of total revenue	**2.On-time delivery** - Increased by 15%; contributes 38% of total revenue
3. Profit before tax - Increased by 37%	**3. Profit before tax** - Increased by 15%
4. Profit after tax - Increased by 26%	**4. Profit after tax** - Increased by 9%

Growel has surpassed the last full year's total revenue and exports in the first nine months. Today, Growel has achieved the distinguished position as the largest manufacturer of axle components for heavy trucks world wide and one of the key global players for engine components. Primemover has improved over last year's total revenue and exports (as shown in table 2). However, Primemover has not fully achieved the anticipated objectives and results. Primemover had an expectation that the inventory levels would reduce by 50% and cost efficiency would also improve by 50% however, reduction in inventory levels achieved was only 40% and improvement in cost efficiency also was only 20%. Another expectation of Primemover was that the human resources would become highly motivated as an end result but the motivation expected was not seen. Although, improvement in the areas of on-time delivery and time taken for new product development, was achieved as anticipated. On the financial side, improvement expectation in the bottom line, profit after tax, was 20% by both Growel and Primemover. An improvement of only 9% was finally achieved by Primemover whereas Growel achieved 26%.

7 Discussions

These cases illustrated Davenport's conceptual framework (Figure 1) of how business benefits are achieved from ES data transformation into ES knowledge highlighting the effectiveness of enterprise systems in the two organizations. The overall business benefits including the financial results obtained in Growel's case surpassed those of Primemover. The reasons attributed to this are given in the following section.

Growel and Primemover both had a business strategy and had identified their business objectives however; the business strategy in Growel's case was clearly articulated and aligned. Growel worked out their value creation process and identified the critical areas that required attention and improvement. They understood the key drivers and had the means to influence those drivers and measure them. Growel were able to translate their business strategy into departmental or divisional strategies. They knew what was to be achieved, which data needed analysis, its area of application, and expected outcomes. Primemover had identified their key business objectives however, the definition of information critical to the success of the

organization was lacking. Primemover could not create the link between departmental performance indicators and top-level metrics for gauging the effectiveness of the company strategy. Managers had data from their ES investment but could not leverage it to maximise realization of benefits and achieve their business strategies.

Growel understood the complexity of problems requiring analytic support. More complex issues, requiring sophisticated modelling and data analysis, are better served when analysts and decision makers are closely linked which was the case in Growel. The quality of management reviews also improved at Growel because executives became much more reliant on numbers in explaining their performance. Issues of data quality did not exist at Growel. Monitoring and updating of data was a regular feature and the transaction data was made available in a timely fashion to support decision making. In the case of Primemover, the lack of discipline in updating transactions in the warehouse led to data discrepancies and data integrity issues amongst employees. Data extracts could not be made in time to support decision making. The analytical and decision-making process was based on ES data which were unclean and inaccurate and the link between data, decisions, and actions was lacking.

Growel had streamlined their supply chain and achieved a major change in customer and supplier behaviour since Growel could react better to change orders and was able to be more flexible in the manufacturing environment. However, in case of Primemover the online visibility of demand and supplies with customers and suppliers 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 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.

8 Conclusions and Further Research

This study has examined the effectiveness of enterprise systems for leveraging knowledge-driven technologies for realizing business success. It has highlighted that business results follow only in 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. Quality of data plays an important role. In order to succeed in today's competitive world, businesses must shift their focus from improving efficiencies to increasing effectiveness. Integrated access to pertinent information captured by ES must be available so that effective decisions can be made towards successfully implementing strategies, optimizing business performance, and adding value for 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 decisions for strategic organizational benefits will lead the

path towards business success which would eventually emerge from the process of ongoing transformations over a period of time.

A logical continuation of the research would evaluate and prioritize the critical effectiveness constructs of an organization that will benefit the long term development of the organization.

References

1. Davenport, T.H., SAP: Big Change Comes in Big Packages, 1995. http://www.cio.com/archive/101595_davenpor.html.
2. Deloitte, C., ERP's Second Wave-Maximizing the Value of ERP-Enabled Processes. 1998: New York: Deloitte Consulting, ISBN 1-892383-42-X.
3. Davenport, T.H. and L. Prusak, Working Knowledge. Boston, Harvard Business School Press, 1998.
4. Davenport, T.H., Putting the enterprise into the enterprise system. Sloan Management Review, 1998. July-August: p. 121-131.
5. Dalal, N. P., Kamath, M., Kolarik, W. J., and Sivaraman, E., Toward an integrated approach for modeling Enterprise processes. Communications of the ACM, 2004. 47: p. 83-87.
6. Jarra, Y.F., A. Al-Mudimigh, and M. Zairi, ERP Implementation Critical Success Factors - The Role and Impact of Business Process Management. IEEE & ICMIT, 2000. 02/2000: p. 122-127.
7. Davenport, T.H., Transforming the Practice of Management with Enterprise Systems, in Mission Critical. 2000, Harvard Business School Press: Boston. p. 203-235.
8. Marcus, M. and C. Tanis, The Enterprise Systems Experience - From Adoption to Success, in In Framing the Domains of IT Research Glimpsing the Future Through the Past, R.W. Zmud, Editor. 2000, Pinnaflex Educational Resources, Cincinnati, USA: Cincinnati. p. 173-207.
9. Davenport, T.H., J.G. Harris, and S. Cantrell, The Return of Enterprise Systems: The Director's Cut. 2002: Accenture Institute for Strategic Change.
10. Donovan, M., Why the Controversy over ROI from ERP?, in The CEO Refresher Archives - Logistics and Supply Chain. 2003.
11. Donovan, M., There is no magic in ERP software: It's in preparation of the process and people, in Midrange ERP. 1998, R. Michael Donovan & Co., http://wwwrmdonovan.com/pdf/perfor_98_9.pdf.
12. Shanks, G., Parr, A., Hu, B., Corbitt, B., Thanasankit, T., and Seddon, P., Differences in Critical Success Factors in ERP Implementation in Australia and China: A Cultural Analysis. in Proceedings of the European Conference on Information Systems. 2000. Vienna, Austria.
13. Cooke, D.P. and W.J. Peterson, SAP implementation: Strategies and Results, in Research Report, T.C. Board, Editor. 1998: New York.
14. Shang, S. and P. Seddon., A Comprehensive Framework for Classifying the Benefits of ERP Systems. in 6th America's Conference on Information Systems. 2000. Long Beach, California.
15. Soh, C., S.S. Kien, and J. Tay-Yap, Cultural Fits and Misfits: Is ERP a Universal Solution. Communications of ACM, 2000. April 2000(Vol 43, No. 4): p. 47-51.
16. Donovan, M., Successful ERP Implementation the first time. 2001. www.mdonovan.com/pdf/perfor8.pdf July 25, 2001.
17. Jenson, R.L. and R.I. Johnson, The Enterprise Resource Planning System as a Strategic Solution. Information Strategy, 2002. 15(Summer): p. 28-33.

18. Robey, D., J.W. Ross, and M.-C. Boudreau, Learning to Implement Enterprise Systems: An Exploratory Study of the Dialects of Change. Journal of MIS, 2002. 19(1, Summer 2002): p. 17-46.
19. Hedman, J. and A. Borell, The impact of Enterprise Resource Planning Systems on Organizational Effectiveness: An Artifact Evaluation, in Enterprise Resource Planning Solutions & Management, F.F.-H. Nah, Editor. 2002, IRM Press: Hershey, London. p. 125-142.
20. Ittner, C.D. and D.F. Larcker, Coming Up Short on Nonfinancial Performance Measurement. Harvard Business Review, 2003. 81(Number 11): p. 88-95.
21. Yang, S. and P.B. Seddon., Benefits and Key Success Factors from Enterprise Systems Implementations: Lessons from Sapphire 2003. in 35th Australasian Conference in Information Systems. 2004. Hobart, Australia.
22. Irving, S., Managing ERP, Post-implementation. Manufacturing Systems, 1999. 17(February): p. p. 24.
23. Nicolaou, A.I., ERP Systems Implementation: Drivers of Post Implementation Success. in Decision Support in an Uncertain and Complex World: The IFIP TC8/WG8.3 International Conference. 2004.
24. Newell, S., Huang, J. C., Galliers, R. D., and Pan, S. L., Implementing enterprise resource planning and knowledge management systems in tandem: fostering efficiency and innovation complementarity. Information and Organization, 2003. p. 25-52.
25. Baskerville, R., S. Pawlowski, and E. McLean., Enterprise resource planning and organizational knowledge: patterns of convergence and divergence. in International Conference on Information Systems, Proceedings of the 21st International Conference on Information Systems. 2000. Brisbane, Australia, p. 396-406.
26. Bendoly, Theory and Support for Process Frameworks of Knowledge Discovery and Data Mining from ERP Systems. Information and Management, 2002. 40(7): p. August 2002.