



The role of integrative technology in competitiveness

Integrative
technology

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423

Abstract

Purpose – The purpose of this paper is to investigate the relationship between integrative technologies and the corporation's ability to remain or gain a competitive advantage in today's fast-paced global economy.

Design/methodology/approach – The authors' professional experience, extensive literature review, and personal communications on the subject provided the foundation for this research.

Findings – The global business environment requires corporations to use a variety of information and communications technologies in order to coordinate and control all activities in its global operations. In order to be competitive, firms are implementing new technologies such as enterprise resource planning (ERP), ERP II, and radio frequency identification to reduce the cost of doing business by improving operational efficiencies, establish better relationship with their business partners, as well as effectiveness by quickly responding to changes in the marketplace. Challenges and benefits of implementing these technologies by both manufacturing and service organizations are explored and examined in this paper.

Practical implications – Low-cost and differentiation strategies require corporations to integrate information and communications technologies to streamline processes both within the firm and between business associates. A considerable amount of time and capital is required for acquisition and implementation of the new technology but the return on the investment is significant in the long run. Top management participation, change in management, and employee training are critical success factors in successful utilization of technology.

Originality/value – The paper provides useful information with regards to the importance of technology in sustaining or gaining a competitive advantage in the marketplace.

Keywords Supply chain management, Manufacturing resolve planning, Radio frequencies, Competitive strategy, Costs, Process efficiency

Paper type General review

Introduction

The uncertainties associated with the global business environment and the emergence of China and India as major players in the marketplace have pressured managers to look for ways of maintaining or increasing their competitive advantage. It is no longer practical to assume that today's business success will be enough to sustain the firm's competitive position tomorrow. The competitive advantage can be achieved if the organization is able to either develop an overall cost leadership or differentiate



itself from competition through exceptional service/products or a combination of differentiation and low-cost strategy.

The cost advantage enables the company to provide the same goods or services as their competitors but at a lower cost. A differentiation advantage is achieved when the consumer perceives that a company's products or services are more valuable than the competition's. The competitive advantage created by these strategies is that, even in strongly competitive markets, the firm will earn above average returns. Those returns can be reinvested into the firm and used to purchase new equipment and facilities that will help perpetuate the firm's cost position. However, the realities of the marketplace dictate that the long-term success, for the majority of businesses, is when a combination of these two advantages is sought by business executives.

Organizations produce products or provide services by performing a set of activities that create value. These activities form a value chain. Porter (1985, 2001) suggests that firms should analyze the value chain by dividing activities that form the value chain into support and primary activities. Support activities such as information technology, the internet, and human resource management are the activities that provide general support for the primary activities. Primary activities are the activities that are directly involved in the creation and distribution of goods and services such as operations, logistics, sales, and marketing.

The value activities, which include both primary and secondary activities, form the foundation of a competitive advantage. The way each activity is performed will determine whether or not the firm will gain a competitive advantage. In order to provide value for the customers and gain a cost advantage, a firm must perform these activities efficiently. Firms that use the value chain activities to separate themselves from their competition through the production of innovative products or exceptional service will enjoy a differentiation advantage.

However, in today's global and technology-based business environment the firm must look beyond the efficiency and effective performance of these activities and find ways to increase the value of the activities in the value chain that supply goods and services to consumers. The value chain must be analyzed as a system, from supplier to firm to distribution channel to customer. The system approach of value chain allows the organization to form alliances and partnerships throughout the supply chain in order to meet customer demand in a timely fashion (Christopher, 1998; Bendoly *et al.*, 2004).

Advances in information and communications technologies as well as the growth of integrative systems have created an opportunity for organizations to use these technologies to sustain or gain a competitive advantage in their industry. These technologies are used to streamline internal processes and provide timely information in order to improve efficiency within the firm and its supply chain. Businesses are using technology to improve the flow of materials and information among the supply chain partners. In this way, organizations can gain a competitive edge by reducing inventory levels, improve responsiveness, and lower cycle time. Effective management of the supply chain can be used as a tool for achieving short-term economic benefits and at the same time gaining a long-term competitive advantage. In recent years, enterprise-based technology systems have been used to connect all aspects of the enterprise into one common system. Having the enterprise connected in one common system will allow for increased supply chain efficiency, as well as the reduction of supply chain costs. The current trend for enterprise systems is to include web components for e-business

and international communications. Other technologies such as radio frequency identification (RFID) tags are being used to better manage inventory both in the manufacturing and distribution processes. These technologies are currently used by companies worldwide to provide information and improve relationships along the supply chain (Folinas *et al.*, 2004; Quinn, 2000; Stank *et al.*, 1999).

Enterprise resource planning

Enterprise resource planning (ERP) employs a multi-module software system for managing and controlling a broad set of corporate activities and functions such as product planning, parts purchasing, inventory control, order tracking, accounting, and human resource management. ERP implementation requires corporations to take a system view of their activities and processes to integrate all functions of an enterprise into a tightly connected system with a common platform for information processing and management.

According to Beheshti (2006), ERP systems are based on a value chain view of the business where functional departments coordinate their work, focus on value-adding activities, and eliminate redundancy. In order to implement an ERP system, a company may need to make changes to organizational structure, corporate culture, and business processes. ERP can be a valuable tool for managers to improve the operational as well as the financial performance of the firm. Long-term financial gains can be realized only when a company delivers increased customer value while simultaneously lowering the cost of delivering that value.

The largest passenger car manufacturer in China, Shanghai General Motors Company, uses an ERP system to enhance the quality of after-sales customer service. The firm uses an ERP module to focus on after-sales warranty analysis in order to address quality issues within the product line. The module reduced warranty costs by 34 percent per vehicle (Shanghai GM, 2007). Toro Company, a US based leader in the lawn and garden market, used an ERP system to control the inventory management process. As a result, Toro Co. achieved an annual savings of \$10 million due to the elimination of unnecessary inventory. The ERP system allows managers to view the flow of inventory in real time through the business. The access to real time information will also show the managers how a problem, such as a delayed order, could affect the business as a whole by holding up the manufacturing line until the delayed items arrive (Umble *et al.*, 2003).

ERP systems standardize business processes and store data in a single enterprise-wide database. The use of a common database and standardized business applications make it easier for the users to process and monitor information and generate reports in a timely fashion when needed. The ERP systems are beneficial to both manufacturing and service organizations.

A major benefit from ERP implementation in the service sector is the reduction of personnel. Since all business processes are linked together, data will be entered into the system once, thus eliminating repetitive data entry positions and reducing the level of human error involved with multiple data entries. Reducing the cost of personnel and human errors will result in lowering the cost and improving the quality of service to the customer. In an ERP environment when the customer calls the company/call center, a customer service representative will have access to all of the appropriate information on one computer screen. The needs of the customer can be correctly met and recorded

in real time. For example, a customer could call in and request information regarding a service (such as insurance), purchase the service, and receive any information regarding the details of the service. The customers could also call back to handle bill payments and/or cancellations of the service. This benefit is also prevalent at the service end of the manufacturing sector. Customer service representatives for the manufacturing firms have access to the ERP system so that they can provide information to the customers regarding their order or answer customer questions pertaining to the service of their products (Botta-Genoulaz and Millet, 2006; Ward, 2006; Umble *et al.*, 2003).

Challenges of ERP implementation

Implementation of an ERP system requires data format and processes to be standardized in order to provide uniformity of operations and to improve efficiency of business processes in the firm. In legacy systems, there is little or no integration between departments. This means that data have to be entered into each separate department of the organization, thus creating redundancies and at the same time making the retrieval of information more difficult. Deploying standard formats that allow information to be shared among all users throughout the organization is expensive and commitment from top management to change is essential to the success of ERP.

In order to minimize any possible problems with an ERP implementation and technology infrastructure upgrade, managers should establish an ERP implementation team and if necessary bring outside consultants into help the team. The team should establish a set of objectives, priorities, and benefits of ERP implementation. A list of features and functions should be developed to help in the selection of a vendor and proceed to conduct a study of various ERP vendors that match the company's strategic needs. At the completion of the study, the team should recommend a vendor who is the closest to the strategic needs of the company. Although price tends to be a major issue, the team should critically analyze each of the vendor options in order to find the best fit for the organization. A better fit means that the ERP system should directly align with the goals and objectives of the company's strategic plan. Flexibility, company/system fit, supplier support, and ease of implementation are extremely important factors to be considered in the decision (Beheshti, 2006; Umble *et al.*, 2003; Al-Mashari, 2001).

Athena Controls, a Pennsylvania-based firm that specializes in digital and analog temperature control instruments, implemented the WinMan ERP application in 2004. The WinMan ERP application controls the bill of materials, sales order management, and accounting. Athena Controls experienced a change in culture as it took on a lean focus to manufacturing. A near 70 percent decrease in inventory levels allowed the firm to utilize an additional \$2 million in cash that was previously tied up in inventory. Athena Controls also experienced a 30 percent drop in labor cost. The cycle time was reduced to less than two days from a maximum of nine weeks. The system also allowed for the machine change over time to be reduced from three hours to no time at all (Athena Controls Success Story, 2007).

Although there are many success stories, a few companies have experienced ERP failures. In July of 1999, Hershey Foods Corporation went live with its new SAP R/3 ERP software. The Hershey executives decided to reduce the projected four-year implementation timeframe to 30 months. For Hershey, July is when large orders are processed for Halloween and back-to-school candy sales. Hershey simultaneously

added two companion packages from two other vendors. The company failed to properly test the ERP system before going live, which resulted in increased inventories in warehouses instead of on the store shelves. Hershey reported that product inventory costs were about 30 percent higher than the previous year (Stedman, 1999). Hershey missed out on \$100 million worth of Kisses and Jolly Rancher sales for the Halloween candy season (Koch, 2002). Third quarter sales for 1999 were down 12.4 percent compared with the previous year. During this time period, Hershey experienced a great strain in its relationships with its customers as the typical delivery times increased from five to 12 days (Gallagher, 2005).

Radio frequency identification

Currently, the most popular method of tracking products and identifying the manufacturer of an item is the universal product code (UPC). The UPC system uses bar codes for identification purposes. Bar codes are read by an optical scanner with an infrared laser and must be in direct view of the scanner for it to be read. An alternative and a more effective technology to UPC is RFID, now in its second generation, that has many uses and is becoming more economical for widespread use. An RFID system has three basic parts which include an RFID tag (transponder), a reader (transceiver), and a computer database and processing system. The RFID reader will transmit data to and from the tag and the computer system will store and process the data for the company. The RFID tag is an etched integrated circuit on a silicon chip with a copper antenna that transmits the data to the reader. There are two types of tags: active and passive. Passive RFID tags do not have an internal power supply and will not transmit data until it is energized by a reader. Active RFID tags contain a battery that allows the tag to constantly send out a signal. Both active and passive tags communicate with a reader which communicates with the computer database system. The computer system will record and process data and make it available in real time for the user (Wu *et al.*, 2006; Toensmeier, 2005; Srivastava, 2004).

In December 2004, EPCglobal, a global organization that establishes international standards for electronic product codes, approved the standard for Generation-two (Gen-2) RFID technology. The first improvement over earlier Generation-one (Gen-1) tags is the elimination of tag classes. The Gen-1 tags have three classes: Class 0 (read-only) that are programmed by the manufacturer, Class 1 (read/write) where the end-user can code the tag once, and Class 2 (read-multiple write) that can be written on and erased several times. Gen-2 tags eliminate the class division and are classified as read-multiple write. In addition, Gen-2 tags use a standardized technology with the ability to be read by equipments in different countries. Previous Gen-1 tags failed to cross the language and frequency barriers of their international usage. Implementing the Generation-two RFID standards will allow one person to program a tag and have it successfully read anywhere in the world. RFID has multiple memory options that allow RFID tags to be used for a variety of applications such as improving the efficiencies and productivity along the supply chain or to monitor inventory throughout the production process in manufacturing. As the product moves through the process, information can be added to tags for use in quality and process improvement efforts (Roberti, 2004; Demetrakakes, 2005).

A major benefit of the RFID technology is that the supply chain will become more visible to management and that labor costs within the supply chain can be reduced.

Unlike bar codes, RFID tags do not need a direct line of sight reading method. RFID readers are able to communicate with the tags quickly and can simultaneously scan/read multiple tags. Removing the line-of-sight scanning enables firms to reduce the labor required to scan each individual item. As the products are moved throughout the supply chain, RFID tags will communicate with the readers and provide their exact locations. In doing so, a product will become more visible and thus easier to manage in the supply chain. Reducing the labor hours and increasing the visibility of a product along the supply chain will allow managers to better manage inventory, reduce the cost of products, and improve the accuracy of inventory forecasting. The tags also can be useful in theft prevention as the products will be monitored from its origin to the final purchase. RFID tags can facilitate product recall efforts by pinpointing exactly which products are affected by the recall instead of giving a broad range for the recall. Maintaining high levels of accuracy within an inventory management system will save the company both time and money.

RFID tags may travel through two or three different systems while moving through the supply chain. As the product moves through the supply chain, all systems must be operating by the same standards so that the data are interpreted correctly. For example, if a product traveled through three RFID software systems with different standards, the data may be interpreted incorrectly by one of the systems which could lead to incorrect information reception down the chain. Therefore, all integrated companies along the supply chain must have the same RFID system in order to accurately track the items.

Enterprise resource planning II

The intense global competition has created a need for businesses to go beyond the internal boundaries of the firm and to share information with business partners throughout the supply chain. Global availability of the internet and advances in web-based technologies have increased the visibility, availability, and accessibility of information across the globe regardless of the business partner's host country location with high speed and accuracy. These technologies have cleared a path for extended enterprise systems, commonly referred to as ERP II. ERP II systems have emerged as the latest wave of enterprise system technology.

The major difference between ERP and ERP II is that earlier ERP systems focused mainly on the linkages among the internal value chain activities of an enterprise, whereas ERP II expands the system to include linkages between the company and its buyers, customers, and business partners. In this way, ERP II extends the value chain to include any activity that deals with the supply chain from the supplier to the customer and all partners in between.

The supply chain consists of any business that comes into contact with a product or service from the supplier to the customer. ERP II systems extend product and business process related information throughout the supply chain via web-based communication technologies such as the internet-based extranets and intranets. Extranets and intranets can be used for communication within the enterprise, as well as with outside business partners along the supply chain via a secure connection. With ERP II, real time information can be used and disseminated throughout the supply chain providing managers with a holistic view of the supply chain. Information relating to the customer, production, and the actual order will become accessible by members of the supply chain. With the increased accessibility of customer, production,

and shipment information throughout the supply chain, the supply chain can become more agile in a fast-paced global economy.

Connecting all aspects of the supply chain through an ERP II system will allow for all transactions, including order placement, delivery, shipment, payment, etc. to be updated in real time. At any point, the customer or member of the supply chain could access desired information in real time. Information regarding a specific process, transaction, or product can be changed or updated if needed with relative ease. Integrating the buyers and suppliers throughout the supply chain will allow companies to become more agile and respond to changes quickly (Infor ERP, 2007; Srivastava, 2004; Weston, 2003). RFID is another addition to the original ERP systems. RFID tags are used along the supply chain to communicate data to the ERP II systems providing real time business transactions processing and monitoring.

Competitive advantage

Information and communications technologies are key ingredients of the value chain concept because they allow managers to make decisions over a broad range of activities in their business operations. ERP, ERP II, and RFID technologies are used to coordinate and control all activities in the supply chain from the raw materials purchased from one company to the sale of the finished product to another. Information is collected by these technologies and then organized, analyzed, and disseminated throughout the supply chain. In this way, managers are provided with a global view of the enterprise and a better understanding of the linkages that exist between business activities both within the firm and the supply chain. These technologies enable managers to create a competitive advantage by making decisions and monitoring the impact of their decisions on the supply chain online and in real time throughout the globe.

Aggreko, a Scotland-based global company specializing in short-term rental solutions of power, temperature control, and oil-free compressed air systems, combined RFID technology with their ERP system in order to achieve a faster and higher quality service for its customers. Aggreko technicians no longer have to return to the office to enter data on orders because they now have mobile devices connecting to the ERP system through the internet. RFID technology is also used to identify assets. The average turnaround time for checking equipment in and out has decreased from three days to just minutes. Important data that used to be written down and sometimes misplaced can now be entered into the system instantly. Instead of taking five or ten minutes to walk to the office to check on the status of an asset, technicians have access to the data immediately through their mobile devices. David Hanley, Systems Architect at Aggreko, believed that the company's competitive advantage was a product of its ability to maintain and manage its large fleet capacity from anywhere in the world (Aggreko Rental Firm, 2006).

Cost and differentiation advantages

The integration of technology in the supply chain can reduce the cost of doing business for organizations, especially those dealing with large quantities of standardized goods. Both the company and the consumer will benefit from this aspect of technology implementation. Global cost leaders have achieved much success in recent years by focusing on minimizing the supply chain costs and thus reducing distribution costs of products. Firms have used various tactics, such as cross-docking, for reducing

replenishment costs. Cross-docking is a replenishment system that avoids the traditional method of storing products in a warehouse between the supplier and the retail store or outlet. This process enables retailers to use technology to monitor the flow of products and manage inventory efficiently. Low-cost leaders, such as Wal-Mart, use integrative technologies such as ERP, ERP II, and RFID to reduce the replenishment costs of their products by using the cross-docking method at their distribution centers (Akan *et al.*, 2006).

Along with reducing distribution costs, current supply chain technologies are providing many other areas in which firms can reduce costs. As previously mentioned, ERP/ERP II systems reduce labor costs and supply chain costs by streamlining processes for a more efficient operational control. The use of RFID tags could reduce the overall supply chain costs by 3-5 percent (Srivastava, 2004). Firms can reinvest savings generated by reduced costs into the company for continuous improvement programs or pass the savings along to the customer in price reductions.

Over the years, corporations have adopted new technology to integrate business activities in order to achieve efficiency by lowering costs or to become more effective and differentiate themselves from competitors. Porter (2001) suggests that the internet is the most powerful tool available today for enhancing operational effectiveness and creating a competitive advantage by differentiation. The internet simplifies and speeds up the exchange of real time information throughout the enterprise. However, Smith and Flanagan (2006) warn that although technology can be used to differentiate, there is a risk that the advantage may not be sustainable for long because of imitation by other companies offering the same products and services. In this scenario, customers convert back to the low-cost provider which takes away from the original competitive advantage. When this occurs, firms must gain their strategic positioning by reducing cost and investing in leading edge technology in order to compete in a distinctive fashion.

Supporting interviews

Ms Jo Anne Short (personal communication, July, 2007), Document Control Specialist with JDSU's branch in Salem, Virginia, has seen a drastic increase in information visibility since the implementation of the company's Oracle-based MatrixOne ERP system. JDSU is a global provider of optical products, broadband test, and measurement solutions. The ERP system connects 21 US sites as well as numerous sites in Europe through the internet.

Connecting all locations via the web allows for management to monitor activities online and provide them with executive access to real time data whenever they need it. Prior to the MatrixOne system, the engineers would consistently call Ms Short to retrieve particular information. Depending on the information requested, it took from a few hours to a week to provide all the information. Currently, the engineers have access to real time data through the ERP system. Owing to the consolidation of multiple databases, managers at JDSU are able to create reports within 48 hours as compared to seven to ten business days under the old system. The web-based system has drastically increased the visibility of information within the company which has allowed for an increase in effective strategic decision making.

Ms Short also noted that the ERP system has eliminated the majority of paper handling because everything is stored electronically. Before the implementation of

the MatrixOne ERP system, Ms Short would have to make 18 copies of a 30-page change order to be distributed throughout the facility. A change order is an order that documents changes that need to be made to a product. Now, the paper has been eliminated as all information regarding the change orders are stored and updated in real time in the ERP system.

Ms Kristie Huntress, Business Process Manager with Dow Corning, explained (personal communication, June, 2007) how Dow Corning's ERP system was unique because it was the largest multi-site system on a single system. Dow Corning is a global leader in silicon-based technology and innovation and Dow Corning is a joint venture between the Dow Chemical Company and Corning Inc. Dow Corning uses the SAP ERP Central Component version 5.0 which is a web-enabled system. Dow Corning has experienced many improvements including increased visibility of transaction information as well as enhanced global selling capacities during the ten years the company has used an ERP system. Along with web-enabled modules, Dow Corning's ERP system has allowed the company to expand into the international market and become a global leader in its industry. Using both ERP and RFID technologies has been a learning experience for Dow Corning. The company is much farther along the learning curve for ERP than it is for RFID since the RFID technology is just in a pilot phase. These technologies have played a major role in the global competitiveness of the firm.

Conclusions

The rapid evolution of technology and globalization of the business environment have forced corporations to continuously search for strategies and tactics to stay competitive or gain advantage over their competitors. The integration of information and communications technologies has significantly changed the operational efficiency and effectiveness of companies and the competitive environment. The internet and web-based technologies allow managers and employees of corporations to conduct business and transfer data across the globe. Marketing and sales personnel are using technology to conduct market research and sell products around the world. Digital and mobile devices are used by business managers and employees to monitor business activities and communicate with business associates from the office or while on the road.

The applications of technologies presented in this paper create a unique opportunity for companies to avoid strategic jeopardy. Investments in technologies such as ERP, ERP II, and RFID have become a strategic necessity for many organizations. For example, suppliers and business partners of Wal-Mart must meet Wal-Mart's strict technology and supply chain requirements. The deployment of these technologies has allowed firms to gain a better control over the flow of information, as well as the movement of goods and services. Current economic trends are forcing companies to re-evaluate their supply chain management (SCM) processes and fine-tune them to be more efficient, deliver more cost savings, and to be more responsive to customer demands and market conditions. Cutting costs, being more responsive, and adding value through differentiation will lead to the formation of competitive advantages in the firm.

Currently, there are a large variety of modules available for ERP systems including customer relationship management, knowledge management, RFID, B2B, and SCM. Firms must have the ability to select the modules that will provide the most value-added benefit and focus on the modules that directly contribute to a gain in market share or major cost reductions.

There is no doubt that technology will continue to change the business environment both at the local and global levels. Successful utilization of technology requires organizations to conduct a careful analysis of changes brought by technology implementation and develop a plan for acquisition, implementation, and change management. Top management participation and support is critical in the success of new technology to the creation of competitive advantage.

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