APPLICATION OF MANAGEMENT CONCEPTS TO ERP IMPLEMENTATION

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Abstract

Many business faculty have expressed the idea that there is "nothing as practical as a good theory." And, while that statement is likely true, it is also important to demonstrate how the theories and concepts discussed in undergraduate business courses are applied in the business world. This paper presents the case of a successful ERP implementation in a small US manufacturing company. Its primary addition to the literature lies in the way it relates the case study to several established management and information systems concepts: the value chain, expectancy theory, change management principles, the capability maturity model and the systems development life cycle.

Application of Management Concepts to ERP Implementation

Enterprise resource planning (ERP) systems have become a common feature of life in organizations; the information they provide can "address the problem of fragmentation of information," (Muscatello and Parente 2006) allowing managers to make better, more timely decisions. Successful enterprise resource planning projects are rare; many of them end in frustration and wasted time, money and energy. Thus, when a project has a successful outcome, it is important to learn from it as much as possible.

Because ERP implementations are complex and multidisciplinary by nature, they can be viewed through various conceptual lenses; the paper therefore relates this case to the value chain, expectancy theory, change management principles, the capability maturity model and the systems development life cycle. Those concepts can pervade an undergraduate business curriculum; they can be presented and discussed in courses as diverse as principles of management, management information systems, organizational behavior, e-business, strategic management, marketing and accounting information systems. Likewise, ERP systems can be presented and discussed in those same courses.

This paper aims to marry the concepts to an actual case in an effort to provide business faculty an instructional resource for helping students master the concepts in a relevant, concrete case. The first section of the paper reviews some of the literature related to the study, while the second section describes the company used for this case study. The third section of the paper relates the company's experience to the management theories listed above.

Literature Review

This section of the paper contextualizes the study by examining: (a) the role and structure of ERP systems and (b) critical implementation factors for ERP systems.

Role and structure of ERP systems

ERP systems are large relational databases that capture a wide array of information needed for successfully managing organizations. Prior to the development of such systems, organizations

often had departmentally-based information systems which effectively treated the departments as separate organizations. The resulting functional stovepiping impaired organizations' ability to compete effectively, since such competition inherently relies on an interdisciplinary perspective (Porter, 1980). Senge (1990) used the term "learning organization" to refer to the need for organizations to be dynamic to compete successfully. His classic work enumerated five disciplines, each of which "provides a vital dimension in building organizations that can truly 'learn,' that can continually enhance their capacity to realize their highest aspirations": systems thinking, personal mastery, mental models, building shared vision and team learning. Because they are inherently relational databases, ERP systems can help organizations think and learn in a cross-functional way.

A typical ERP system is organized in modules. McGaughey and Gunasekaran (2007) demonstrated that modules cut across all functions of the organization, including such items as:

- Customer and supplier relationships
- Sales, often including e-commerce
- Asset and financial management
- Facilities and maintenance
- Inventory management and order processing
- Logistics and distribution
- Analytics and reporting
- Human resources

The typical system's modular organization offers many advantages, including the ability to see how activities in one area affect other areas of the business. Relational database files can cut down on repetitive data entry; ERP systems can also promote strong internal control via identity management, centralized file backup and inherited rights masks.

Critical implementation factors

Several authors have examined the "prerequisites" for a successful ERP project (Umble and Umble 2002; Barker and Frolich 2003; Stapleton and Rezak 2004; Plant and Willcocks 2007). Muscatello and Chen (2008) completed an extensive review of both scholarly and practitioner literature which yielded factors such as:

- **Strategic initiatives**: Managers need to articulate clearly how an ERP system will assist in implementing organizational strategy. Framing the matter in terms of Porter's **value chain** (1985), ERP systems can enhance a firm's ability to compete in at least the following ways:
  - Infrastructure: The ERP system provides comprehensive, integrated data for managing enterprise value creation.
  - Human resource management: People are an organization's most important asset, though they do not appear on any financial statement as such. The ERP system can assist in managing virtually every major HR related task, including hiring and recruitment, training and compensation, benefits management and retirement.
  - Procurement: Purchasing staff can make notes on supplier performance; they can also cut down on paper by using electronic purchase orders and other documents. A properly implemented ERP system can also

strengthen internal controls over procurement via strong separation of duties and inherited rights masks.

- Inbound logistics: Inbound shipments can be tracked electronically in the system. In addition, communication between the receiving department, the purchasing department and operating departments can flow more easily and quickly.
- Operations: Data from the manufacturing function can be tied more clearly and directly to the accounting information system, thus facilitating real-time financial reporting. In addition, sales staff can track product availability.
- Outbound logistics: Advantages similar to those for inbound logistics apply to outbound logistics.
- Marketing and sales: In an era when personal service and relationship marketing are increasingly important, an ERP system can help marketing and sales staff stay in contact with clients. In addition, the ERP system can provide market segmentation and consumer behavior data to assist in planning marketing strategy.
- Service: Clients' service records can be tracked, thus eliminating the need for repetitive data entry every time service is required. In addition, in the event of product recalls or other broad-based systemic issues, a well-maintained ERP system can expedite quick, direct communication to a targeted population of clients.

- **Human resources**: Employees who will use the ERP system often must acquire new skills; in addition, they must "unlearn" old ways of doing business. Employees unequipped to make such changes can behave in very dysfunctional ways which may lead to poor project results. Vroom's **expectancy theory** (1967) suggests that motivation depends on three factors: valence, instrumentality and expectancy. Valence refers to the value the employee places on the potential outcome; with respect to ERP systems, employees need to appreciate system benefits such as stronger communication throughout the organization. Instrumentality is associated with an employee's belief that they have the necessary skills to achieve the desired outcome; instrumentality can be a challenge in ERP systems, particularly for employees unaccustomed to working with sophisticated information technology. The final element of Vroom's theory, expectancy, is the probability that, if an outcome is achieved (i.e., learning how to use an ERP system), the desired reward will be provided. For an ERP project, rewards can include increased job satisfaction and performance. According to expectancy theory, motivation is the **product** of the three factors (valence X instrumentality X expectancy); so, if any one of the factors is "zero," resulting motivation will be "zero."
- **Project management**: ERP implementation is inherently a team effort, requiring involvement from information technology, operations, marketing, accounting / finance, human resources and other areas of the business. In

addition, given the scope and length of most ERP projects, "the ultimate product is almost always shaped by unanticipated and late breaking circumstances." (Crawford and Nahmias 2010) Thus, the interdisciplinary team needs to be prepared to manage change.

Crawford and Nahmias (2010) summarized eight competencies required for successful **change management** based on both case studies and a literature review; they also described specific change activities associated with each competency. The table below reiterates their work; the paragraphs afterward relate each competency specifically to ERP projects.

Table 1: Change Management Competencies

Competency	Change activity
Leadership	Changing behaviors and organizational culture to achieve goals
Stakeholder management	Preparation of users
Planning	Organizational structure
Team selection / team development	Political diffusion
Communication	Impact analysis
Decision-making and problem-solving	Selling the change
Cultural awareness / skills	Champion schemes
Project management skills	Involvement in process analysis work; training and education to affected staff

With respect to **leadership**, ERP project managers must motivate employees on the team to approach their duties with alacrity, professionalism and skill. Such motivation may require explicit discussions of the elements of organizational culture (behaviors, values and assumptions) so that conflicts and issues can be addressed early in the project.

Regarding **stakeholder management**, the ERP implementation team must communicate with potential users of the system. They must prepare them by talking about the purpose of the ERP system and how it will be incorporated in their job responsibilities. **Planning** is an essential element of stakeholder management in an ERP project, since the system will affect most (if not all) business functions. While ERP implementation does not necessitate major changes in organization structure, management may consider making such changes in concert with the ERP project.

Selecting and developing the **ERP implementation team** carefully is crucial to the project's success. Project leaders must ensure that most / all organizational functions and levels are represented on the team; doing so will not only result in a more robust project, but will also "buy a lot of political clout" throughout the organization. **Communication** throughout the project is vital. Team members should keep in mind that they are representatives of their various constituencies; communication must therefore flow both ways (team to organization **and** organization to team).

Many employees will be resistant to the changes required by the ERP system. Thus, team members need to prepare to "sell" the change throughout the organization—to **make decisions and solve problems** clearly, honestly and directly. They must also demonstrate deep and fundamental **awareness of organizational culture** by consistently championing the project. Finally, regarding **project management skills**, the ERP project team must be involved in analyzing and potentially redesigning business processes to promote optimal use of the ERP system.

- **Business processes**: ERP implementations provide an excellent opportunity to consider the ways business is done in an organization. Muscatello and Chen (2008) stated: "Using re-engineering techniques to develop a homogeneous vision depicting the company's processes after the ERP implementation, a firm is more likely to minimize uncertainty and achieve success."

  Humphrey (1989) developed the Capability Maturity Model (CMM) as a way of classifying business processes; although his original work was focused on government contractors, the model has since been applied in a variety of organizational contexts. The CMM comprises five levels:

  - Chaotic: As the name implies, business processes at this level are largely disorganized; they may also suffer from lack of good (or any) documentation. Organizations with chaotic business processes are unlikely to complete an ERP project successfully.
  - Repeatable: At this level, a business process begins to become standardized, although the standardization is not widespread. An individual or a very small group of people may have developed a repeatable way to accomplish a specific task that yields consistent results, but their knowledge is not widely disseminated.
  - Defined: A process moves from repeatable to defined when two major events occur: documentation development and consistency across the entity. When an organization's business processes become defined, it is more likely to benefit from an ERP project.
  - Managed: Standardized, defined processes are a good beginning, but organizations need to be able to adapt their processes to specific situations. They also need metrics to determine if business processes

are working as intended. Once those milestones have been achieved, processes reach the managed level of the CMM.

- Optimized: At the highest level of Humphrey's model, an attitude of continuous process improvement is ingrained in organizational culture. Staff throughout the organization consistently seek ways to improve business processes, both incrementally and systemically.

ERP projects have a higher probability of success when business processes are more mature; at a minimum, an organization's business processes should be defined before commencing the project.

- **Software selection and support**: Every organization has nuances in its business processes and environment; a generic ERP system seldom is an "exact fit." Therefore, managers should use a well-structured systems analysis and design process to select and support appropriate ERP modules, modifying them as necessary for their particular needs.
  - The classic systems development life cycle (Haag 2008) has stood the test of time across a variety of organizational and project contexts. Its six phases offer a disciplined approach for implementing an ERP system:
  - Initiation / planning: The organization recognizes a gap in its information infrastructure and begins searching for a way to close it.
  - Requirements analysis: A team determines what information and decision needs must be filled.
  - Design: Based on the requirements analysis, the team develops a detailed structure for the proposed information system. The structure will likely include database specifications, screen layouts and forms design.
  - Build: If the new information system is to be developed "from scratch," coding begins during the build phase. If the organization chooses not to build, they use this phase to search for appropriate software tools based on the design specifications.
  - Test: Organizations may use a modular approach, testing subsets of the information system individually over time. Alternatively, they may test the new system side by side with the old system until the new system is ready to run on its own.
  - Operations and maintenance: After sufficient testing, the system is deployed throughout the organization. Ongoing maintenance (such as software upgrades, database modifications and changes to screen layouts) is an essential, though often neglected, part of the SDLC.

Summarizing their study, Muscatello and Chen (2008) concluded: "Firms are realizing that ERP implementations are a long journey and that results may not be readily apparent until well into the future." The present study acknowledges their assertion by examining the second phase of that journey: the period immediately following an initial installation of an ERP system.

Company Description

The company involved in this study manufactures two main products: metal transport cases and boat accessories. The cases can be used for handguns / rifles, ammunition, cameras and wine, while the boat accessories include heating units and shower systems, along with their related replacement parts. At the time of the research, the firm had about 70 employees, with annual sales of $10 - $12 million. The two product lines are seasonal: cases are the emphasis from October through January, while boating accessories are from September to June. Both product lines are material dominated, with direct materials comprising 45 – 50% of total cost.

The company's physical plant comprises two buildings totaling 40,000 square feet: one for production and the other for administrative and sales functions. In the company's own words: "Our products began in the "marine" industry. They are not complex. They are simply designed for assembly and performance. It is the fit and finish of our products that sets us apart. The stainless steel fasteners and powder-coated exterior have become our world-renowned trademarks."

Relationship to Capability Maturity Model

Looking through the lens of the CMM, the company's business processes prior to the ERP system were **defined**. Procedures were standardized throughout the organization—both on the production side and the administrative side. Processes were documented, but normally did not incorporate measurement metrics because of information asymmetry issues described below.

Prior to the implementation of its ERP system, the firm experienced numerous information problems:

- Lack of integration between sales and production. The company operates a hybrid production system in which basic units are mass produced (process costing), then tailored as needed to a specific client's order (job costing). The lack of integration between sales and production meant that neither function had sufficient information for completing essential tasks.
- Insufficient detail about product components. The company did not have a complete standard components list for many of its products. Thus, assembly knowledge tended to be fragmented, resulting in both delayed orders and inefficient use of labor.
- Weak inventory controls, including a "free-for-all" stockroom. The company began as a small operation, so inventory controls were not a high priority. But, as the company grew, inventory controls failed to develop. Secured storage areas, periodic inventory counts, and adequate separation of duties were all missing from the information system.
- Inability to get information about production except by visiting the production floor. Given the physical layout of the company and the lack of information integration noted above, the only way to be certain about production status was to visit the actual production floor.

The firm ran two parallel accounting systems: MAS 90 and Microsoft Office Accounting. But, the two systems regularly gave radically different financial results. Management had no ability to drill down to product line profitability, and the accounting information system frequently reported negative quantities of finished goods on hand—despite continual increases in work in process inventory.

The firm was poised and ready to move forward with an ERP implementation. Table 2 below reiterates Muscatello and Chen's "ERP prerequisites," along with specific examples for the case study organization.

Relationship to Systems Development Life Cycle

In August 2008, through an Internet search, the corporate controller contacted an ERP consultant to address those issues; the consulting firm was vendor independent. The project began by creating and installing a work order system that would address some of the most pressing problems: integration between sales and production, component detail and inventory control and reporting. The ERP consultant used a modified version of the systems development life cycle for the project, organized in five steps:

1. Education. Management learned about the structure, operation and value of ERP systems. In addition, they learned about methodologies for selecting an appropriate system. Staff training and knowledge transfer: Both administrative and production staff received similar conceptual training; once the system was selected, they received more specific training about using the software.
2. Software selection. The consultant conducted an operational review / needs assessment, including an assessment of the company's technical proficiencies in accounting, operations and technology. With those results in mind, the consultant recommended and demonstrated products from several ERP vendors; the consultant also estimated costs for each product to help the client develop a budget.
3. Network / virtualization. Once the client selected a product, the consultant worked to create the necessary IT network. The network followed the principles of "cloud computing" to allow for maximum scalability and ease of use.
4. Implementation. After the network was sufficiently robust, the system was installed. Hands-on training included knowledge transfer, migration to the new system and additional systems architecture and design services.
5. Assessment and review. The system was used to develop metrics for present processes and forecasts based on projected information needs. The development of metrics moved the company up one level on the Capability Maturity Model: from **defined** to **managed**.

The interviews for this research focused on three main areas: human factors, technology and operations. Participants in the interviews included the ERP consultant, the director of supply chain management, the chief financial officer and the production scheduler.

Table 2: ERP prerequisites and examples

Prerequisite	Example
Strategic initiatives	The company operates in relatively small, highly specialized markets. Management was looking for ways to promote its competitive advantage, and concluded an ERP system would be one important element of its overall strategic plan.
Human resources	Nearly everyone in the organization was highly motivated to address the problems noted above. With strong executive commitment and tangible support for the ERP system, employees embraced the idea without much resistance.
Project management	The ERP consultant was broadly trained and experienced in accounting, information technology, strategy and process management. In addition, the company assembled an interdisciplinary team to manage the ERP project.
Business processes	The company had been in the process of realigning its business processes leading up to the implementation of the work order system.
Software selection and support	Working together, the ERP consultant and organization employees followed the systems development life cycle to implement the ERP system.

The last section of this paper relates the company's experience to the value chain, expectancy theory, change management principles, the capability maturity model and the systems development life cycle.

Application

By their very nature, ERP projects must consider at least three macro-level issues: human factors, information technology factors and operations factors. While any of the previously discussed management concepts can be involved in virtually any of the three areas, this section of the paper relates the concepts to the factors based on the company's actual experience.

With respect to ***human factors***, interviewees focused on training and development issues. Even a year after the initial ERP installation, employees were still in "learning curve" mode. Production employees were unaccustomed to having computers on the production floor, as well as to working directly with them. The company was engaged in ongoing training, but was trying to choose between an online / self-training format and a dedicated / on-site format. Considering the totality of the ERP project, training and development falls under the "operations and maintenance" phase of the systems development life cycle. But, if one considers the training and development process in isolation from the rest of the project, applying the systems development life cycle to that one activity only, management had completed the first three phases (initiation,

requirements analysis and design), and was in the "build" stage of the SDLC. In other words, they were attempting to choose an appropriate format for training. At the time of this writing, they had elected to pursue the "online / self-training" format, leaving open the possibility of dedicated, on-site training if the need arises.

The training and development post-implementation issue relates directly to several of Crawford and Nahmias' competencies for successful change management. The project team was carefully selected for their knowledge of the organization, its processes and the employees. They had used good project management skills in narrowing the potential training modalities to two choices, and were engaged in vigorous debate about the costs and benefits of each choice (decision-making and problem-solving).

The ***technology*** itself pointed out the need for ongoing assessment of technical and functional capabilities. Almost no form of information technology works exactly as a firm desires "right out of the box," and this case was no exception. Interviewees noted two ongoing technology issues: the inability to delete part numbers from the database when no longer in use and needed modifications in database design. For the latter, interviewees specifically pointed out issues with parent / child relationships; that is, when importing data from flat files, the relationships were cumbersome to establish, leading to some inaccuracies in the database. Those problems are primarily focused on technology development (a support activity in the value chain) and operations and maintenance (the last phase of the systems development life cycle).

In the ***operations*** area, the firm made changes to its business processes to promote more seamless integration between sales, purchasing and production. From the point of view of Porter's value chain, some of those changes included:

- Procurement. The company initiated some paperless transactions with its vendors.
- Operations. Financial and operational data flowed through a single information system, thus eliminating the problem of inconsistent data reporting. In addition, the firm was able to develop standardized components lists for its products.
- Marketing and sales. Sales staff could access customers' order history more easily. They could also determine inventory levels and product availability in real time.

Both line employees and management initiated more inquiries after the ERP system implementation simply because more information was available to them. In addition, the firm was able to maintain greater control over all types of inventories (raw materials, work in process and finished goods) after the system was implemented.

Interactions across the corporation were strengthened and employee morale improved after the ERP implementation; the firm started using integrated purchasing teams, and their strategic and tactical value increased as a result. From the standpoint of expectancy theory, employees' valence was fairly constant; that is, they had long seen the potential value of more integrated

operations. Prior to the ERP project, however, they had low instrumentality, since few of them believed they had the skills necessary to achieve the desired outcome. However, as a result of the ERP project, instrumentality improved considerably. Expectancy (the probability that they would be rewarded if the desired outcome was achieved) also improved, though not as much as instrumentality. Thus, employees' motivation to work more productively increased substantially after system implementation.

Conclusion

The goal of this paper was to relate an enterprise resource planning system implementation to various management concepts based on a case study of a small, US-based manufacturing firm. The project touched several elements of Porter's value chain: technology development, procurement, operations, and marketing and sales. It also looked at employee motivation via Vroom's expectancy theory. Employees' motivation to embrace the ERP system and work productively increased due to constant valence, significantly increased instrumentality and moderately increased expectancy.

The case also demonstrated strong change management, particularly in the areas of team selection and development, decision-making and problem-solving and project management skills. The organization moved its business processes up one level in the capability maturity model: from defined to managed. Finally, the entire project, and some individual components of it, was structured according to the phases of the systems development life cycle.

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