A Thesis

entitled

Critical Success Factors of ERP Implementation

by

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This study examines what factors facilitate or inhibit the success of ERP projects. The study proposes that worked with functionality, maintained scope, project team, management support, consultants, internal readiness, training, planning, and adequate testing are critical to a successful ERP project implementation and also dealing with organizational diversity, development, and budgeting are other important factors that are contributing to a successful implementation.
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List of Abbreviations

ERP – Enterprise Resource Planning
MIS – Management Information Systems
IOS – Inter Organizational System
MRP – Materials Requirements Planning
RDBMS – Relational Database Management Systems
JIT – Just In Time
TQM – Total Quality Management
ES – Enterprise Systems
BPR – Business Process Reengineering
IT – Information Technology
NOV – National Oilwell Varco
AIM – Application Implementation Methodology
CEO – Chief Executive Officer
SCM – Supply Chain Management
HR – Human Resources
ANOVA – Analysis of Variance
CSF – Critical Success Factor
Chapter 1

Introduction

Every aspect of management in the modern age relies heavily on information to thrive. In today’s competitive market, organizations have to adapt themselves into the continuously changing and evolving conditions in order to survive and develop. Therefore, during the adaptation process the organization’s decisions are critical. During that process, in order to take appropriate decisions, the organization should have a good understanding of its own system dynamics, its current place and state in the market as well as ever changing dynamics which impact and affect the world, the country, the sector and finally the organization itself.

This paper will explain information systems ideas in general and then will focus on Enterprise Resource Planning (ERP) as most sophisticated Information Systems, implementation and critical success factors for ERP implementation.

An MIS is an integrated user machine system for providing information to support operations management and decision making functions in an organization (Davis and Olsen, 1985). Information system is a system using formalized procedures to provide management at all levels in all functions with appropriate information based on data from both internal and external sources, to enable them to make timely
and effective decisions for planning, directing and controlling the activities for which they are responsible (Argyris, 1991). O’Brien (2002) states that “a system is a group of interrelated components working towards the attainment of a common goal by accepting inputs and producing outputs in an organized transformation process”.

O’Brien (2002) divides information systems in two types according to their supporting objectives:

- Operations support systems
- Management support systems

![Image of information systems types](image)

Figure 1-0-1. Information systems types, Source: (O’Brien, 2001)

Functional information systems divide into four types according to business function they support: (Laudon and Laudon, 2006)
• Sales and Marketing
• Manufacturing and Production
• Finance and Accounting
• Human Resources

Each business function has its own specialized information systems at each level. This can be seen in Figure 1-2 with their examples.

Figure 1-2. Information systems from a functional perspective, Source: (Laudon and Laudon, 2006)

According to Laudon and Laudon (2006) many processes are larger than one division and so they divide cross functional information systems to two types:
• If goes across enterprise, is called an “Enterprise System” (ERP)
• If across multiple firms is “Inter-Organizational System” (IOS).

Enterprise Resource Planning (ERP) system software packages are highly integrated complex systems for businesses and thousands of businesses are running them successfully worldwide (Koch, 1996).

1.1 Evolution of ERP

Wallace and Kremzar (2001) described ERP as an enterprise wide set of management tools that balances demand and supply, containing the ability to link customers and suppliers into a complete supply chain, employing proven business processes for decision making, and providing high degrees of cross functional integration among sales, marketing, manufacturing, operations, logistics, purchasing, finance, new product development and human resources, thereby enabling people to run their business to run their business with high levels of customer service and productivity, and simultaneously lower costs and inventories by providing the foundation for effective e-commerce.

ERP evolution started with MRP (Material Requirements Planning) as universal manufacturing equation (Wallace and Kremzar, 2001). Its logic applies wherever things are being manufactured whether they are aeroplanes, tin cans, tools, cosmetics or dinner and so on. MRP linked to closed loop MRP. Further, tools were developed such as Sales and Operations Planning, Master Scheduling, Demand Management and Rough cut capacity Planning (Wallace and Kremzar, 2001).

The fundamentals of ERP are the same as with MRP II. However, enterprise software, ERP as a set of business processes is broader in scope and more effective in dealing with multiple business units. Financial integration is even stronger. Supply
Chain tools, supporting business across the company are more robust. In order to understand the attraction of enterprise systems, as well as their potential dangers, the organization first need to understand the problem they are designed to solve: “the fragmentation of information in large business organizations” (Davenport, 1998). At its core is a single comprehensive database. The database collects data from and feeds data into modular applications supporting virtually all of a company’s business activities across functions, business units and across the world. Maintaining many different computer systems leads to enormous costs for storing and rationalizing redundant data, for reformatting data from one system for use in another, for updating and debugging obsolete software code, for programming communication links between systems to automate the transfer of data (Davenport, 1998).

1.1.1 Step One – Material Requirements Planning Systems (MRP)

Before the introduction of computer systems in organizations, the most popular approach towards materials management was counting inventory and cost of each item once a year (Guamer 1996). MRP systems sought to replace this reactive approach towards production planning via the utilization of a master schedule, bill of materials and an inventory record to determine accurately the future requirements and production capacity (Wallace and Kremzar 2001).

1.1.2 Step Two – Closed-loop MRP Systems

Closed-loop MRP system further enhanced on the existing MRP system by adding two key features known as priority planning and capacity planning (Wallace and Kremzar 2001). These features gave suppliers and manufacturers the ability to
develop priority and capacity in production planning. It also provided support in the planning and execution of orders sent and received via the closed-loop MRP system.

1.1.3 Step Three – MRP II Systems

Since the 1980’s tens of thousands of manufacturers have implemented MRP II systems (Guamer 1996) and with good reason too. The next generation of MRP system, MRP II offered businesses the ability to manage key functional areas such as shop floor & distribution management, project management, finance, human resource & business process engineering (Rashid, Hossain et al. 2002). At the same time offering all the features and functionality of a closed-loop MRP system, MRP II’s evolution coincided with developments in computing technology, such as computerised relational database management systems (RDBMS) and fourth generation computer languages such as UNIX and C. This gave organizations using MRP II the ability to simulate future forecasts in supply & demand using external variables. This step also saw companies utilising dynamic management methodologies such as Just-In-Time (JIT), Kanban & Total Quality Management (TQM) (Raman and Diwan 2000).

1.1.4 Step Four – ERP Systems

Heralded by some as the ‘holy grail’ of information systems (Kumar and Hillegersberg 2000), ERP systems are fundamentally the same as MRP II systems, however they are seen as a set of business processes with a much broader organisation-wide scope (Wallace and Kremzar 2001). Another feature which evolved with ERP systems is their modular structure, which allows organisations to implement
them incrementally thus gradually setup a complete system (Cooper 2008).

The adoption of ERP systems by organizations has been nothing short of phenomenal. Research estimates that the worldwide market for ERP systems was $16.67 billion in 2005 and is forecast to exceed $21 billion in 2012 (Hawking 2007). Many believe that this rapid adoption of ERP is due to the ‘integrative’ nature of the system (Hammer 1999; Raman and Diwan 2000; Koch 2001). Coupled with rapid advances in computing technology, ERP systems provide organizations with the ability to capture information from various locations and sources, and streamline business process to increase efficiency and reduce costs.

An enterprise system streamlines a company’s data flows and provides management with direct access to a wealth of real time operating information. For many companies, these benefits have translated into dramatic gains in productivity and speed.

ERP goals include high levels of customer service, productivity, cost reduction and inventory turnover. It provides the foundation for effective supply chain management. It does this by developing plans and schedules so that the right resources – manpower, materials, machinery and money are available in the right amount when needed (Wallace and Kremzar, 2001). It is a direct outgrowth and extension of Manufacturing Resource Planning and, as such, includes all of MRP II’s capabilities. ERP is more powerful in that it:

- Applies a single set of resource planning tools across the enterprise
- Provides real time integration of sales, operating and financial data
- Connects resource planning approaches to the extended supply chain of customers and suppliers (Wallace and Kremzar, 2001).
The primary purpose of implementing Enterprise Resource Planning is to run the business in a rapidly changing and highly competitive environment, far better than before.

ERP implementation throughout the organization would help them to better cope with the issues by the help of business intelligence and decision support systems. Within this scope, in order to implement the ERP, it is necessary to establish a common information system infrastructure and to integrate the corporation business workflows to this system. The ERP is the software providing infrastructure for Management Information Systems (MIS)

Main aims of an ERP application can be summarized as:
1. To expedite, integrate and maintain the standardization of business workflows.
2. To provide the coordination, cooperation and integration among the functional units.
3. To interfere the repetitive data entry within the organization.

The organizations which implement an ERP system also accept main aims as stated above. ERP has a distinction from other software systems, because modules (application domains) in ERP packages are free from the implemented organizations. Thus, customizations are inevitable through the implementation. For example, an important step in implementation is to compare business processes embedded in the ERP package with organization’s business processes. In order to manage this change, by bringing business processes to the same platform, organization should become aware of the organizational change and needs. Such a change leads customization. The short and not fitting aspects in the ERP package may increase risks in the success of implementation. Accordingly, risk management is an important factor for the success of such a project. Especially for the ERP package, risk management
concentrates on the solutions and business processes that are available in the package but disregarded by the organizations. In that context, the stated items below are vital for an ERP package in order to manage the risk:

- Flexibility (allowing additional and new data entry not included in the package)
- Extendibility (localization programs not included in the standard package)

In order to increase the flexibility and extendibility of an ERP package, one should increase the flexibility available at the interface design and the conceptual design of the system. From the software engineering point of view, an ERP package should consist of two main components:

- Programs units that constitute the business intelligence
- Database that holds the setup and transaction information specific to the organization

Since the conceptual design of a system is the state of an information system where early implementation decisions are made, it is important to meet the requirements of a flexible implementation in that stage. Within this context, the database design which the ERP package is built on, should consider the employment of the package modules (application domains) considering requirements of different implementation domains.

As there is a need for building a flexible ERP application, thus flexible database design, it is clear that, we need new ideas for constructing database design in a flexible manner. The focus of this study is discussing the critical success factors of ERP implementation and analyzing the benefits of ERP in an organization once it is successfully implemented.
1.2 Problem Discussion

An effective business strategy centers on an aggressive, efficient use of information technology; for this reason the ERP systems have emerged as the core of successful information management, and the enterprise backbone of the organization (Nash, 2000). A successful ERP system will streamline processes within a company and improve its overall effectiveness, while providing a means to externally enhance competitive performance, increase responsiveness to customers, and support strategic initiatives (Sandoe, 2001).

ERP implementation is a socio technical challenge that requires a fundamentally different outlook from technologically driven innovation, and will depend on a balanced perspective where the organization as a total system is considered. ERP implementation is considered to rely on behavioural processes and actions (Al Mudimigh et al, 2001).

Lucas (1981) defined implementation as the whole process of introducing a system into an organization, from conception of an idea, to analysis, design, installation and operation. Olson and Davis (1984) define implementation as preparing an organization to receive an information system for its effective use. Other conceptions of implementation have included implementation as a process of influence (Gibson, 1975), implementation as an interaction between designer and user (Lucas 1981), implementation as problem solving (Mitroff, 1975). Sauer (1993) sees implementation in terms of reducing the uncertainty around the problematic relationships amongst the information system, the project organization responsible for delivering the system, and the system’s supporters.
ERP implementation is a process that involves macro implementation at the strategic level and micro implementation at the operational level. This therefore means that implementation in the context of ERP systems is not possible through an ON/OFF approach whereby deployment of the new systems will necessarily yield the desired and expected results. Understanding the implementation process through a balanced perspective will therefore prevent any unpleasant surprises, and will ensure and guide the change process to be embedded in a painless fashion (Al-Mudimigh et al, 2001).

ERP systems are highly integrated and complex packages that bring information visibility across companies. The systems are capable of functioning as advertised; however, companies run into costly and sometimes fatal difficulties with the implementation and subsequent maintenance of the packages (Gargeya and Brady, 2005).

According to The Gartner Group, 70 percent of all ERP projects fail to be fully implemented even after three years (Gillooly, 1998). There is no single responsible or individual reason for failure or success of ERP implementation. According to Gargeya and Brady (2005), there are two levels of failure

1. Complete failures
2. Partial failures

In complete failure, project was stopped before implementation or cause serious financial and functional damages to the company. In partial company will gain some thin adjustments processes but it will have some disruptions in daily works (Gargeya and Brady, 2005).

Gargeya and Brady (2005) state that an ERP success can be a complete success—one in which everything goes off without a hitch, or one in which there are few
alignment problems, resulting in minor inconvenience or downtime. Frequently these situational circumstances that have to be ironed out in the weeks and months after the “Go-Live” date are not severe enough to disrupt the daily operations. Some of the blame for failures in ERP implementation lies with the enormous technical challenges of rolling out enterprise systems. These systems are profoundly complex pieces of software and installing them requires large investments of money, time and expertise. But the technical challenges, however great, are not the main reason enterprise systems failed. The biggest problems are business problems. Companies failed to reconcile the technological imperatives of the enterprise system with the business needs of the enterprise itself (Davenport 1998).

Simply putting ERP is not intended for every business (Gargeya and Brady, 2005). When considering the decision to invest in an ERP system, a business case must be developed to provide an understanding of ERP, and to formally assess the benefits that the company as an individual entity apart from its competitors can expect to achieve. The analysis must consider not only the obvious cost/benefit analysis but also the non financial factors. It includes information visibility and flexibility (Sandoe, 2001). ERP implementation costs are incurred in three areas: software, hardware and personnel. The human resources cost is by far the largest and most expensive, but at the same time has been the area given the least amount of consideration. The software and hardware costs are often easily quantifiable; however the human cost is not (Davenport, 2000).

ERP implementation can reap enormous benefits for successful companies or it can be disastrous for organizations that fail to manage the implementation process.

The two critical questions should be,
1. How can ERP systems be implemented successfully?

2. What are the critical success factors of ERP implementation? (Holland and Light, 1999).
Chapter 2

Literature Review

The purpose of this chapter is to present theoretical framework of this study. This chapter presents different success factor models from researchers and one model is selected as base. Finally sub factors in this model will present.

2.1 ERP Implementation Critical Success Factors

Holland and Light (1999) consider strategic and tactical factors for implementing ERP and purpose a critical success factor model.

Dong (2001) proposed a conceptual model exploring the impact of top management on enterprise systems (ES) implementation. Aladwani (2001) described an integrated, process-orientated approach for facing the complex social problem of workers’ resistance to ERP systems. Huang and Palvia (2001) proposed ten factors (at the national/environmental and organizational level) concerning ERP implementation by making a comparison of advanced and developing countries. The national/environmental factors identified by them are economy and economic growth, infrastructure, regional environment, government regulations, and manufacturing strengths. They also noted that information technology maturity, computer culture,
business size, business process re-engineering experience, and management commitment are the organizational level factors. This model can be seen in figure 2.1.

Figure 2-0-1. Framework for ERP Implementation, Source: (Huang and Palvia, 2001)

In other papers Fitzgerald (1998) observes the limitation of the conventional evaluation methodology and proposes a multidimensional approach for evaluating information systems projects. The eight steps of this approach are: (a) identification of costs, (b) the contribution to business strategy (c) analysis of benefits, (d) second-order effects (e) flexibility (f) implement ability, (g) risk and (h) testing the business idea.

Shankumarayanan (1999) recommends the following criteria for evaluating ERP software: (a) functional fit with the Company’s business processes, (b) degree of integration between the various components of the ERP system, (c) flexibility and
scalability, (d) complexity, (e) quick implementation; shortened ROI period, (f) ability to support multi-site planning and control, (g) technology; client/server capabilities, database independence, security (h) availability of regular upgrades, (i) amount of customization required, (j) local support infrastructure, (k) availability of reference sites, (l) total costs, including cost of license, training, implementation, maintenance, customization and hardware requirements.

Umble et al. (2003) identified 9 factors for implementing ERP.

1. Clear understanding of strategic goals
2. Commitment by top management
3. Excellent project management
4. Organizational change management
5. A great implementation team
6. Data accuracy
7. Extensive education and training
8. Focused performance measures
9. Multi-site issues

Nah et al. (2001) identified 11 factors that were critical to ERP implementation success. The 11 factors noted by them are:

1. ERP teamwork and composition;
2. Change management program and culture;
3. Top management support;
4. Business plan and vision;
5. Business process re-engineering and minimum customization;
6. Effective communication;
7. Project management;
8. Software development, testing, and troubleshooting;
9. Monitoring and evaluation of performance;
10. Project champion; and
11. Appropriate business and information technology legacy systems.

Themistocleous (2001), based on a survey of 50 respondents, underscored the need for integration of existing systems with ERP applications in ERP implementation. Stratman and Roth (2002) through a questionnaire survey of 79 North American manufacturing users of ERP systems identified eight generic constructs (strategic information technology planning, executive commitment, project management, information technology skills, business process skills, ERP training, learning, and change readiness) that are hypothesized to be associated with successful ERP adoption. Gargeya and Brady (2005) by using a content analysis model and searching more than 100 articles and books propose following critical success factors for implementing ERP:

1. Worked with functionality / Maintained Scope
2. Project Team / Management Support / Consultants
3. Internal Readiness / Training
4. Deal with Organizational Diversity
5. Planning / Development / Budgeting
6. Adequate testing
Gargeya and Brady (2005) proposed model seems the most complete model. So the model is selected for explanation in this study.

2.2 Factors Discussion

2.2.1 Factor 1: Worked with Functionality/Maintained Scope

A crucial part of working with the ERP functionality is the ability to streamline operations. When implementing a system, many organizations fail to specify their organizational objectives. Job skills are raised by the requirements of the new, post-implementation company. Idiosyncratic ways of doing business, which were manageable, although most likely inefficient, under the “old system”, are no longer tolerated. Companies that do not understand these issues early on will face serious problems (Davenport, 2000). Even though the so-called “vanilla” approach is adopted by two-thirds of implementing companies, some customization will always be required in order to meet individual needs (Themistocleous et al., 2001). The key, it appears, is to know just how much to customize.

The ability to implement ERP with minimal customization requires assistance from several other factors, primarily streamlining operations and re-engineering the business - both of which will help the organization to run in a more straightforward manner. Thorough planning is also a close partner, as it is threaded through the plans from scope to budgets (Gargeya and Brady, 2005).

Important factor that begins at the project phase is BPR and minimum customization. It is inevitable that business processes are moulded to fit the new system (Bingi et al., 1999). Aligning the business process to the software implementation is critical (Holland et al., 1999; Sumner, 1999). Organizations should
be willing to change the business to fit the software with minimal customization (Holland et al., 1999; Roberts and Barrar, 1992). Software should not be modified, as far as possible (Sumner, 1999).

Modifications should be avoided to reduce errors and to take advantage of newer versions and releases (Rosario, 2000). Process modelling tools help aid customizing business processes without changing software code (Holland et al. 1999). Broad reengineering should begin before choosing a system. In conjunction with configuration, a large amount of reengineering should take place iteratively to take advantage of improvements from the new system. Then when the system is in use reengineering should be carried out with new ideas (Wee, 2000). Quality of business process review and redesign is important (Rosario, 2000). In choosing the package, vendor support and the number of previous implementers should be taken into account (Roberts and Barrar, 1992).

Scope is the initial “blueprint” of an implementation plan. Within this original plan, budgetary and resource needs are established. During the course of the project, it can be easy, often transparently so, to become so involved in details that additional responsibilities or requirements are added or affected. Suddenly, but often too late, the realization comes that the project is a victim of “scope creep”. The ability to maintain scope is closely related to planning, and it is possible to achieve for companies both large and small (Gargeya and Brady, 2005).

Maintaining scope is just as important for small companies as it is for large organizations. The approach for “rolling out” their implementation is another very important consideration.
There is no evidence that any one way of implementation is better than another as a whole; however, one approach will be better for companies on an individual basis.

There have been many widely publicized “big bang” successes, and many failures. The same is true for gradual (phased) rollouts, although these generally are not headline-grabbers (Gargeya and Brady, 2005).

The phased rollouts take longer to complete, and are more expensive due to the additional time commitment; however, the approach does offer reduced business risk (Davenport, 2000).

So the following characteristics for these factors can be identified:

**Worked with functionality:**

1. Doing BPR and aligning the business processes with software.
2. Doing minimal customization to the software.
3. Considering vendor support and the number of previous implementations for choosing the package.

**Maintained scope:**

1. Maintaining the initial scope.
2. Choosing best way of implementation on individual basis (big bang method or phased method).

**2.2.2 Factor 2: Project Team/Management Support/Consultants**

The ERP team should consist of the best people in the organization (Buckhout et al., 1999; Bingi et al., 1999; Rosario, 2000; Wee, 2000; Nah et al., 2001). Building a cross-functional team is also critical. The team should have a mix of consultants and
internal staff so the internal staff can develop the necessary technical skills for design and implementation (Sumner, 1999). Both business and technical knowledge are essential for success (Bingi et al., 1999; Sumner, 1999). The ERP project should be their top and only priority and their workload should be manageable (Wee, 2000). Team members need to be assigned full time to the implementation (Wee, 2000). As far as possible, the team should be co-located together at an assigned location to facilitate working together (Wee, 2000).

The team should be given compensation and incentives for successfully implementing the system on time and within the assigned budget (Wee, 2000). The team should be familiar with the business functions and products so they know what needs to be done to support major business processes (Rosario, 2000).

A successful implementation is only achievable when high-level executives have a strong commitment to the project (Davenport, 2000). The attitude of senior managers will affect not only the flow of funds and information to the project, but also the subordinates view the project, its future impact upon the company as a whole, and its impact upon the employees as valued and capable individuals. Top management support is needed throughout the implementation. The project must receive approval from top management (Bingi, 1999; Buckhout, 1999; Sumner, 1999) and align with strategic business goals (Sumner, 1999). This can be achieved by tying management bonuses to project success (Wee, 2000).

Top management needs to publicly and explicitly identify the project as a top priority (Wee, 2000). Senior management must be committed with its own involvement and willingness to allocate valuable resources to the implementation effort (Holland et al., 1999). This involves providing the needed people for the implementation and giving appropriate amount of time to get the job done (Roberts
and Barrar, 1992). Managers should legitimize new goals and objectives. A shared vision of the organization and the role of the new system and structures should be communicated to employees (Nah et al., 2001). New organizational structures, roles and responsibilities should be established and approved. Policies should be set by top management to establish new systems in the company. In times of conflict, managers should mediate between parties (Roberts and Barrar, 1992).

Due to the complexities of implementing an ERP system, most companies choose to hire consultants to help them select, configure, and implement the system. Welti (1999) argues that the success of a project depends on the capabilities of the consultants, because they have in-depth knowledge of the software. Somers and Nelson (2001) point out that consultants should be involved in different stages of the ERP project implementation.

There are hundreds of companies that provide such ERP services. Those services may include all or a combination of the following offerings (Computer Technology Research Corporation, 1999):

- ERP selection
- Business process planning or reengineering
- ERP implementation
- End-user training
- ERP maintenance and support.

However, one of the challenges with ERP implementation is that it demands multiple skills covering functional, technical, and interpersonal areas. If these skills are found in a consulting firm, it is another challenge for an organization to manage such a consultant (Bingi et al, 1999).
IT research firm Gartner Group (Computer Technology Research Corporation, 1999) argued that the ratio of consulting costs to software costs could reach up to 3:1. Thus, the cost of hiring consultants and all that goes with it is very high, and can consume more than 30 percent of the overall budget for the implementation (Bingi et al, 1999). Clearly, it is a critical success factor, and has to be managed and monitored very carefully.

Following characteristics for these factors in this category can be identified:

**Project Team:**

1. ERP team should be cross functional, mix of consultants and internal staff.
2. Team should have both business (familiar with business functions and products) and technical knowledge.
3. The team should be dedicated to ERP implementation.
4. ERP team should be given compensation and incentives.

**Management Support:**

1. Highly support and approval from top management is required during implementation.
2. Senior management must be committed with its own involvement and allocating valuable resources.
3. New organizational structure should be established and communicated to employees.
4. Top management should set policies to establish new system.
5. In time of conflict between previous and new system managers should be in middle.

**Consultants:**

1. Consultants should have in-depth knowledge of software.
2. Should be involved in different stages of implementation.

3. Consultants should have multiple skills covering functional, technical, and interpersonal areas.

4. Company should be able to manage well these consultants.

2.2.3 Factor 3: Internal Readiness/Training

The “people element” and training aspect of an ERP implementation have historically received the least amount of attention. The paradox of this is that when this factor is ignored or downplayed, primarily because it does not have the largest quantifiable benefit, expenses are greatly increased in the long run. By treating resource training with little regard and financial support, it is not hard to realize the reality of delay, confusion and financial ruin that may result. Some companies insist on assigning a fixed cost or percentage to the training effort, regardless of need or variable conditions (Gargeya and Brady, 2005).

This mistake has certainly been the root cause of many failed implementation attempts. Fortunately, it has also been a source for others to learn from such experiences and avoid repeating the mistake (Gargeya and Brady, 2005).

Gargeya and Brady (2005) state that people element must be handled on two levels. At one level, employees must be trained on the new system in order to use it to continue day-to-day operations. The second level is educational exposure. Managers must know and understand the implications of the system, and must come to a consensus about the changes that will take place. If they agree that change is necessary and possible, they can be charged with disseminating this information to their subordinates. If managers are not in agreement or collaboration, then there will
be no “enthusiasm”, or buy-in, and there may even be active resistance (Davenport, 2000). The reinforcement of a “team environment” is critical to the overall success of an ERP implementation. Members of the project team should be encouraged to support each other and work toward common goals. This also leads to a “cross-pollination” effect, resulting in a more collaborative and self-sufficient mix of talent and responsibilities (Gargeya and Brady, 2005).

Change management is important, starting at the project phase and continuing throughout the entire life cycle. Enterprise wide culture and structure change should be managed (Falkowski et al., 1998), which include people; organization and culture change (Rosario, 2000).

Not unexpectedly, the most common failure factor reported was that of “readiness for change”. Implementing an ERP system completely changes the culture within an organization, and many companies have found themselves hard pressed to accomplish this successfully (Gargeya and Brady, 2005).

Many companies have been guilty of making simplistic assumptions of how an implementation will affect the culture within their organization. Culture changes do not occur magically, and must be handled with the utmost care and precision (Davenport, 2000). These changes directly relate to the human cost element, or human psyche. If people are not ready or willing to change, change simply will not occur. All managers must be charged with the responsibility of controlling worker anxiety and resistance to the ERP system (Aladwani, 2001).

A culture with shared values and common aims is conducive to success. Organizations should have a strong corporate identity that is open to change. An emphasis on quality, a strong computing ability, and a strong willingness to accept new technology would aid in implementation efforts (Nah et al., 2001).
Management should also have a strong commitment to use the system for achieving business aims (Roberts and Barrar, 1992). Users must be trained, and concerns must be addressed through regular communication, working with change agents, leveraging corporate culture and identifying job aids for different users (Rosario, 2000).

As part of the change management efforts, users should be involved in design and implementation of business processes and the ERP system, and formal education and training should be provided to help them do so (Bingi et al., 1999; Holland et al., 1999). Education should be a priority from the beginning of the project, and money and time should be spent on various forms of education and training (Roberts and Barrar, 1992).

Training, re-skilling and professional development of the IT workforce is critical. User training should be emphasized, with heavy investment in training and re-skilling of developers in software design and methodology (Sumner, 1999). Employees need training to understand how the system will change business processes. There should be extra training and on-site support for staff as well as managers during implementation. A support organization (e.g. help desk, online user manual) is also critical to meet user’s needs after installation (Wee, 2000).

Internal readiness success factor is too broad that contains many of other factors such as management support, budgeting, business process reengineering. So for to avoidance of repeating these factors internal readiness will be considered as readiness for change.

So factors for this category are:

**Internal Readiness:**

1. Organization and people should be ready for changes.
2. Users should be involved in design and implementation of business processes.

3. Education should be a priority from the beginning of the project, and money and time should be spent on various forms of education and training.

4. Training, re-skilling and professional development of the IT workforce is critical.

**Training:**

1. Heavy investment in training and re-skilling of developers in software design and methodology.

2. A support organization meets user’s needs after installation.

3. Employees must be trained on the new system in order to use it to continue day-to-day operations.

2.2.4 Factor 4: Deal with Organizational Diversity

Organizations have many cultures. Individual branches of the same organization have their own ways of doing things, and each function/department operates with different procedures and business requirements. Not unexpectedly, the larger, more global companies cite their diversity as an obstacle to success (Gargeya and Brady, 2005). Individual units and groups are often companies of their own right, and do not wish to be assimilated into one corporate culture. “Re-engineering” of the business is required here, both on the “people” level, and on the operational level. This organizational diversity differs from factor #1 (worked with functionality/maintained scope) in that the company changes its culture, not just its processes.

In addition to having important strategic implications, enterprise systems also have a direct, and often paradoxical, impact on a company's organization and culture.
On the one hand, by providing universal, real-time access to operating and financial data, the systems allow companies to streamline their management structures, creating flatter, more flexible, and more democratic organizations. On the other hand, they also involve the centralization of control over information and the standardization of processes, which are qualities more consistent with hierarchical, command-and-control organizations with uniform cultures (Davenport, 1998).

Davenport (1998) argues that for a multinational corporation, enterprise systems raise another important organizational question: How much uniformity should exist in the way it does business in different regions or countries?

Some large manufacturers have been even more ambitious, using the systems as the basis for introducing a global lean-production model. By imposing common operating processes on all units, they are able to achieve tight coordination throughout their businesses. They can rapidly shift sourcing, manufacturing, and distribution functions worldwide in response to changing patterns of supply and demand. This capability allows them to minimize excess manufacturing capacity and reduce both component and finished-goods inventory (Davenport, 1998).

For most companies, however, differences in regional markets remain so profound that strict process uniformity would be counterproductive. If companies in such circumstances don't allow their regional units to tailor their operations to local customer requirements and regulatory strictures, the risk sacrificing key markets to more flexible competitors (Davenport, 1998).

Davenport (1998) state that “to preserve local autonomy while maintaining a degree of corporate control-what might be called a federalist operating model - a very different approach to enterprise systems needs to be taken. Rather than implementing a single, global Enterprise System (ES), these companies need to roll out different...
versions of the same system in each regional unit, tailored to support local operating practices.”

The federalist model rises what is perhaps the most difficult challenge for a manager implementing an Enterprise System: determining what should be common throughout the organization and what should be allowed to vary (Davenport, 1998). Corporate and business-unit managers will need to sit down together-well before system implementation begins-to think through each major type of information and each major process in the company. Difficult questions need to be raised: How important is it for the company to process orders in a consistent manner worldwide? Does the term "customer" mean the same thing in every business unit? Answering such questions is essential to making an ES successful (Davenport, 1998).

Identified factors for dealing with organizational diversity are:
1. Reengineering in both people and operational level in different business units.
2. Determining level of uniformity and choosing appropriate model (Single, global ES vs. Federalist model).

2.2.5 Factor 5: Planning/Development/Budgeting

Planning a sophisticated ERP project should not be taken lightly or with little forethought. As mentioned before, there are enormous potential costs associated with such an undertaking. In addition to the high costs paid out before the go-live date, there can and have been major expenses incurred by companies that were unable to fully develop a comprehensive plan. Planning should be closely identified with maintaining scope during an implementation. Cost overruns and developmental delays are costly, sometimes fatal results of ineffective planning (Gargeya and Brady, 2005).
A clear business plan and vision to steer the direction of the project is needed throughout the ERP life cycle (Buckhout et al., 1999). A business plan that outlines proposed strategic and tangible benefits, resources, costs, risks and timeline is critical (Wee, 2000). This will help keep focus on business benefits.

There should be a clear business model of how the organization should operate after the implementation effort (Holland et al., 1999). There should be a justification for the investment based on a problem and the change tied directly to the direction of the company (Falkowski et al., 1998). Project mission should be related to business needs and should be clearly stated (Roberts and Barrar, 1992). Goals and benefits should be identified and tracked (Holland et al., 1999). The business plan would make work easier and impact on work (Rosario, 2000).

Software development, testing and troubleshooting is essential, beginning in the project phase (Nah et al., 2001). The overall ERP architecture should be established before deployment, taking into account the most important requirements of the implementation. This prevents reconfiguration at every stage of implementation (Wee, 2000).

There is a choice to be made on the level of functionality and approach to link the system to legacy systems. In addition, to best meet business needs, companies may integrate other specialized software products with the ERP suite. Interfaces for commercial software applications or legacy systems may need to be developed in-house if they are not available in the market (Bingi et al., 1999).

Implementations can become very costly, despite all efforts at developing a solid plan. Many projects, especially failed ones, find themselves over budget, some by as much as 189 percent (Gargeya and Brady, 2005). Only one-sixth of projects are completed on time and within budget (May, 1998).
Identified factors for this category are,

**Planning:**

1. A clear business plan and vision to steer the direction of the project.
2. Business plan should outlines proposed strategic and tangible benefits, resources, costs, risks and timeline.
3. A clear business model and justification for the investment based on a problem and the change tied directly to the direction of the company.

**Development:**

1. Interfaces for commercial software applications or legacy systems may need to be developed.

**2.2.6 Factor 6: Adequate Testing**

System testing has proven to be the key element of success for some companies and a direct cause of failure for others (Gargeya and Brady, 2005). Gargeya and Brady, (2005) argue that “after months or years of development, it may be feasible to assume that both team members as well as executive management are tired of dealing with the project and just want it to be completed. The result of this myopic thinking, however, is that testing is reduced or ignored, and “red flags” are disregarded.”

Troubleshooting errors is critical (Holland et al., 1999). The organization implementing ERP should work well with vendors and consultants to resolve software problems. Quick response, patience, perseverance, problem solving and fire fighting capabilities are important (Rosario, 2000). Vigorous and sophisticated software testing eases implementation (Rosario, 2000).
Scheer and Habermann (2000) indicate that modelling methods, architecture and tools are critical. Requirements definition can be created and system requirements definition can be documented. There should be a plan for migrating and cleaning up data (Rosario, 2000). Proper tools and techniques and skill to use those tools will aid in ERP success (Rosario, 2000).

This also proves the importance of another success factor - top management support. Unrealistic fears of delaying the “go-live” dead line indicated that senior executives were not completely “in tune” to the importance of completely testing the implementation; even that resulted in a slight delay.

So important factors for testing are:

1. Vigorous and sophisticated software testing before go-live date is essential.
2. Troubleshooting errors is critical.
3. There should be a plan for migrating and cleaning up data.
Chapter 3

Research Methodology

This chapter should give the reader detailed and sufficient information in order to make an estimate of the reliability and validity of the methods used. This chapter will explain and justify the choices of methodology approaches adapted in order to answer the research question posed.

3.1 Purpose of Study

According to Yin (2003), the purpose of an academic study can be exploratory descriptive, or explanatory.

- Exploratory studies are practical if one wish to clarify his/her understanding of a problem (Saunders, Lewis & Thornhill, 2000). Robson (1993, cited by Saunders, Lewis & Thornhill, 2000) describes exploratory studies as a method of finding out “what is happening; to seek new insights; to ask questions and to assess phenomena in a new light”

- Descriptive studies are appropriate when one wish to portray phenomenon such as events, situations or process. Furthermore, a descriptive is also appropriate when problem is clearly structured, but the intention is not to conduct research about the connections between causes and symptoms.
- Explanatory studies are useful when one wish to establish causal relationships between variables. The emphasis in this sort of study is to examine a situation or a problem in order to explain the relationships between variables (Saunders, Lewis & Thornhill, 2000).

The purpose of this study is somewhat exploratory since the study is to assess and ERP implementation in light of critical success factors and understand what is happening in an ERP implementation case. The study is partly descriptive because it is necessary to have clear picture of the phenomena. Also it is somehow explanatory, because sometimes it examines a situation or a problem in order to explain the relationships between variables. But it is mostly descriptive.

3.2 Research Approach

The aim of this study is to recognize ERP implementation critical success factors and compare them with theory. Without making generalization, this study could investigate certain variables in depth and thus, provide a better understanding in this area.

3.3 Research Strategy

Robson (1993) defines case study as the ‘development of detailed, intensive knowledge about a single “case”, or a small number of related “cases”.’ This strategy will be of particular interest to anyone if they wish to gain a rich understanding of the context of the research and the process being enacted (Morris and Wood, 1991). Case studies further contribute uniquely to our knowledge of individual, organizational, social and political occurrence and it allows an investigator to retain the holistic and meaningful characteristics of real-life events, such as individual life cycles and
organizational and managerial processes. The case study approach also has considerable ability to generate answers to the question ‘why’ as well as ‘what’ and ‘how’ questions (Robson, 1993). Case study can be very worthwhile way of exploring existing theory. The design of case study can be either a single-case study or a multiple case study. A single case study investigates a single entity in form of one industry, company, or district in depth. However, a multiple case study allows the researcher two or more entities to be studied and compared, which increases the validity of the study. Each case within a multiple case study will however not be investigated in the same depth. The purpose of this study is to find information to answer “how” and “what” questions. The study did not require control over behavioural events. The data were collected, analyzed; and compared it with existing theories.

3.4 Data Collection Method

According to Yin (2003) no source of information is better than others. In fact they should be considered complementary, and therefore a good case study will rely on as many sources as possible. When gathering information for case studies a major strength is the opportunity to use many different sources of evidence. The use of several sources of evidence means that the researcher has the opportunity to obtain multiple measures of the same phenomenon that adds validity to the scientific study. According to Yin (2003) interviews are the most important sources for case study information.

Telephone interview and personal interview can be used as potential techniques. The use of interviews can help the researcher to gather valid and reliable data that are relevant to research question(s) and objectives (Saunders, Lewis & Thornhill, 2000).
Structured interviews use questionnaires based on a predetermined and standardized or identical set of questions. Unstructured interviews are informal. There is no predetermined list of questions to work through in this situation, although the researcher needs to have a clear idea about the aspects he/she want to explore (Saunders, Lewis & Thornhill, 2000).

The study had a certain set of questions that needed to be answered in order to obtain relevant data for this study. Furthermore, interview was kept open ended to some extent. This in order to preserve the flexibility of the interview and to make room for additional information not thought of.

3.5 Sample Selection

Sampling techniques provide a range of methods that enable the researcher to reduce the amount of data need to collect by considering only data from a sub-group rather than all possible cases or elements (Saunders and Thornhill, 2000). Non-probability sampling is done without chance selection procedures. Purposive sampling or judgmental sampling is a non-probability sampling method that basically allows a researcher to select a case that seems to be best suited to answer the research questions. The company is selected as a case which completed their implementation in one year ago.

The organization is National Oilwell Varco (NOV). After investigation it was known that this company has implemented its ERP system about three years ago. After searching for finding best persons for interview, NOV’s Information Technology Deputy ERP Project Manager was selected to do interview with and the request was fortunately accepted. Two telephone interviews were done for collecting data for this case.
3.6 Data Analysis

The data analysis was a continuous iterative process (Figure 3-1) where each component entered successively as the study continued. The analysis was developed based on procedures for analyzing qualitative data suggested by Miles and Huberman (1994). Data collection and analysis have overlapped to reveal useful adjustments to data collection (Eisenhardt 1989), even though most of the analysis was done after finishing data collection.

When analyzing the data collected, the intentions were to find answers on the previously stated objectives. Miles and Huberman (1994) present the following three parallel flows of activity to explain the analysis (Figure 3-1).

![Figure 3-1. Components of data analysis: Interactive Model (Miles and Huberman 1994)]
- Data reduction: The process of selecting, focusing, simplifying, abstracting, and transforming the data. The purpose is to organize the data so that the final conclusion can be drawn and verified. Data reduction actually occurs throughout the entirety of any project involving qualitative data: during basic project design, during data collection itself, and during preliminary and final analysis.
- Data display: Taking the reduced data and displaying it in an organized compressed way so that conclusions can be more easily drawn.
- Conclusion drawing/verification: Deciding what things mean, noting regularities, patterns, explanations, possible configurations, casual flows, and propositions.

The interviews have been analyzed by categorizing, clustering based on an approach suggested by Miles and Huberman (1994). The same sentences in an interview could be given several different codes since the same information could shed light upon different aspects.

3.6.1 Hypothesis Testing

A statistical hypothesis test is a method of making decisions using data, whether from a controlled experiment or an observational study (not controlled). In statistics, a result is called statistically significant if it is unlikely to have occurred by chance alone, according to a pre-determined threshold probability, the significance level. In this study, “Is the mean scores from the survey about benefits of ERP systems are equal”? is the research question developed and conducted the hypothesis testing for the same by developing null and alternate hypothesis. The purpose of this
testing is to measure and analyze the statistical data collected from employees and to know how the ERP implementation affects their day to day activities in a positive or in a negative manner. And also F – Test is conducted for the same scheme of hypothesis to support the results. The T – Test is performed by assuming hypothesized mean equals 4 and results were interpreted.

3.6.2. Cronbach Alpha

Cronbach coefficient Alpha is a measure of squared correlation between observed scores and true scores. The theory behind it is that the observed score is equal to the true score plus the measurement error (Y = T + E). It is assumed that a reliable test should minimize the measurement error so that the error is not highly correlated with the true score. On the other hand, the relationship between true score and observed score should be strong. In addition, it is assumed that the mean of the measurement error should be zero. In this Cronbach alpha is used to measure the internal consistency or Reliability of respondent’s feedback about the benefits of ERP implementation in their organization.
Chapter 4

Empirical Data

This chapter will present the empirical data from the selected companies. To begin with, will present a background of the company and thereafter the data collected will be presented.

4.1 Case: National Oilwell Varco

4.1.1 Background

NOV is a multinational corporation which manufactures land based and off shore oil drilling rigs as well as all the major mechanical components for such rigs. The company also performs a number of services for the oil industry such as well and pipeline inspections and is one of the market leaders in Supply Chain Management through their distribution network of over 200 locations. The company has the revenue of 13 billion USD and 40000 employees.

ERP implementation in NOV started in September 2005 and finished in October
Two companies, Freudenberg IT and IBM, cooperated with NOV during implementation. Following modules from Oracle e-Business Suite have selected and implemented:

- **Financial Modules**
  - Oracle General Ledger and Budgeting
  - Oracle Fixed Assets
  - Oracle Accounts Payable
  - Oracle Accounts Receivable
  - Oracle Cash Management

- **Supply chain Management**
  - Oracle Purchasing
  - Oracle Order Management
  - Oracle Inventory

- **Oracle Human Resource**
  - Oracle Human Resource
  - Oracle Payroll
  - Oracle Time and Labour

- **Manufacturing**
  - Material Requirements Planning/ Master Production Scheduling
  - Work In Process
  - Bill of Material
  - Quality Management
- Cost Management Maintenance
- Enterprise Asset Management

Project team was consisted of 15 persons from IBM, 17 persons from Freudenberg IT, 11 persons in project management team, 110 NOV specialists and 35 persons as operators for inputting information.

4.1.2 Factor 1: Worked with Functionality/Maintained Scope

About worked with functionality factor, NOV tried to align its business processes to best practices that are most suitable for Oracle E-Business. One of the points that respondents mentioned was that business process reengineering was the most difficult part of the job. Although best practices were chosen, many people used to do their jobs in traditional ways. Respondents said that they think the most important factor and the hardest job in ERP implementation is business process reengineering. Resistance against changes and using traditional ways of doing jobs created most problems in ERP implementation in NOV.

The package selection in NOV was based on opportunities to buy software from a well known brand. In NOV there was familiarity with Oracle database, they tried to contact Oracle. Oracle proposed them a way to buy its E-Business Suite. Finally they bought Oracle package with complete support from an official partner of Oracle.

NOV started its implementation according to AIM methodology, Oracle's software for Application Implementation Methodology (AIM). They used it as their initial blueprint and scope and defined their plan, resources and budget according to
it. During implementation NOV tried to maintain initial scope and avoid scope creep by aligning all phases to Oracle’s AIM.

In implementation methodology, respondents said that although the selected method was big bang method but somehow they can call it phased approach, because the go-live date for different departments and modules was different but their main approach was big bang.

4.1.3 Factor 2: Project Team/Management Support/Consultants

In NOV, they tried to select the best persons who were familiar with NOV’s business. Some NOV personnel selected and other team members were selected from Freudenberg IT, which in many projects had cooperated with NOV and some from IBM that had technical knowledge of Oracle system and the experience of implementing ERP.

Respondents believed that this team was the best that they could select according to company and its situation. However they believe that if they could select a team that had more knowledge in their business and oracle system they could achieve better results. Respondent said that team members should have following characteristics:

- Be experienced
- Have ability to accept changes
- Have business and technical knowledge

All project team members should dedicate all their time to ERP implementation project. But some persons in team had various responsibilities that reduced their time that they can work on project and they were not able to dedicate their time to project.
Respondent told that although compensations can motivate team members to do their responsibilities better and complete project phases in promised time; they didn’t use compensation system at all because they fear from some problems because of this system.

To do the jobs better, a special committee was created from different managers that CEO was on top of this committee. Management approved and supported implementation before and during implementation. Management committed with its own involvement and allocating valuable resources. Management had middle role in times of conflicts.

NOV tried to select consultants that have both knowledge of business and software. So Freudenberg IT Company selected because of its experience with NOV and IBM because of its experience in implementing Oracle E-Business Suite. According to respondent, consultants involved in all stages of implementation and management of project consultants was completely by NOV.

4.1.4 Factor 3: Internal Readiness/Training

In order to make organization ready for changes, NOV has started an extended campaign that included trainings, advertisements and seminars. NOV took more efforts to ready people and organization to accept changes. The respondent said that some people and departments have been doing their jobs traditionally and some have accepted changes very well and are doing their jobs according to new system.

In order to involve users in implementation process and business process reengineering, from each target department that they wanted to do implementation,
NOV selected several persons and a leader among themselves and called them power users. These users selected from most knowledgeable and authoritative personnel. Power users were trained and prepared for doing BPR and implementing ERP modules. For training and education, NOV has started from first days of implementation by publishing articles in internal magazine. Then they had several seminars for different levels of employees, used Oracle Demo vision and started using application by only simple data. Also NOV has an independent education department that has responsibility of training in all fields in NOV and also ERP training. There were not a specified budget for training, but training was done from beginning of project and during it.

IT department have responsibility of supporting users. Department is doing tasks of support in several levels and if there is need to support from vendor, the Oracle partner company that sold the package to NOV will provide support for them.

4.1.5 Factor 4: Deal with Organizational Diversity

NOV is a diverse organization that has more than 40000 employees in different departments and business units. Respondent believe that this diversity has an important effect on their implementation. Doing business process reengineering in every department, managing changes, and training employees to use new system were the most difficult parts of implementation process.

In NOV the single model for sharing information is used. A large database with more than 18000 tables that shares all information in organization. It was a challenge to determine what should be common throughout the organization and what should be
allowed to vary, noticing that responsibilities of department and business units are so tight to each other.

4.1.6 Factor 5: Planning/Development/Budgeting

ERP project manager said that there was a clear plan for implementing ERP which includes resources, costs, risks and timeline, clear business model and justification for the investment. NOV decided to have an MIS and it seems that because of ERP buzz in that time they became interest in ERP implementation.

There were some needs to develop interfaces, especially in finance department, to be able to communicate with commercial software applications and other suppliers and customer’s systems. These interfaces were developed in NOV and respondent said that they think this interfaces were working properly and not only have no negative effect on systems performance, but also are well developed and are so aligned to systems.

About budgeting, although ERP implementation in NOV has not completed within budget, but the amount of over budget was not as much as have a negative effect on implementation outcome or company performance. They tried to keep the project within budget and also in specified time frame, but there were some additional costs for project, and it finished about three month later than specified time.

4.1.7 Factor 6: Adequate Testing

AIM methodology is Oracle's software for Application Implementation Methodology (AIM). It contains several templates to be used for documentation
during the full implementation life cycle, such as sample test script or business process templates. The templates are crucial for an implementation team during an upgrade for sure. NOV has done everything according to AIM.

In NOV the test phase started by using ERP system in parallel with legacy systems to test and compare the output of two systems. Also integration test was performed in NOV to ensure that communication between different modules and systems is working properly. Integration test was performed by Oracle professionals and NOV again asked a similar test from Freudenberg IT.
Chapter 5

Data Analysis

In this chapter each factor with its sub-factors are analyzed according to acquired data.

5.1 Factor 1: Worked with Functionality/Maintained Scope

According to interviews and theoretical framework and recognized factors coded tables are derived to help better analysis. The following coded table 5.1 will present a summary of key findings in regards to worked with functionality/maintained scope.
Table 5.0.1. Factor 1: Worked with Functionality/Maintained Scope

+/+ = stated as a factor  
-/+ = Not stated as a factor, but considered important  
-/ = Not stated as a factor

<table>
<thead>
<tr>
<th>Worked with functionality</th>
<th>NOV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doing BPR and aligning the business processes with software</td>
<td>+/+</td>
</tr>
<tr>
<td>Doing minimal customization to the software</td>
<td>+/+</td>
</tr>
<tr>
<td>Considering vendor support and the number of previous implementitations for choosing the package</td>
<td>-/+</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Maintaining Scope</th>
<th>NOV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintaining the initial scope</td>
<td>-/+</td>
</tr>
<tr>
<td>Choosing best way of implementation on individual basis (big bang method or phased method)</td>
<td>-/+</td>
</tr>
</tbody>
</table>

A crucial part of working with the ERP functionality is the ability to streamline operations. The ability to implement ERP with minimal customization requires assistance from several other factors, primarily streamlining operations and re-engineering the business - both of which will help the organization to run in a more straightforward manner. Thorough planning is also a close partner, as it is threaded through the plans from scope to budgets (Gargeya and Brady, 2005). Important factor that begins at the project phase is BPR and minimum customization. It is inevitable that business processes are moulded to fit the new system (Bingi et al., 1999). In NOV business process reengineering started from beginning of project. Target processes selected to be reengineered to best practices that are designed for Oracle e-Business suite.
In NOV doing business process reengineering identified as one of the most important critical success factors. They tried to keep software code as much as possible unchanged. They have only some customization in software code, that only did it to be able to use with other systems, and in most of the system they tried to do mostly business process reengineering to align business processes with new system.

In choosing the package, vendor support and the number of previous implementers should be taken into account (Roberts and Barrar, 1992). In NOV, package was selected with regard to its situation. They wanted one of the best systems in the world and they think that although system selection is important, is not a critical factor in implementation.

Scope is the initial “blueprint” of an implementation plan. Within this original plan, budgetary and resource needs are established. The ability to maintain scope is closely related to planning, and it is possible to achieve for companies both large and small (Gargeya and Brady, 2005). NOV started its implementation according to AIM methodology, Oracle's software for Application Implementation Methodology (AIM). During implementation, they tried to maintain initial scope and avoid scope creep by aligning all phases to Oracle’s AIM. They think this factor as a necessary factor for every project and so know it as an important factor.

There is no evidence that any one way of implementation is better than another as a whole; however, one approach will be better for companies on an individual basis.

There have been many widely publicized “big bang” successes, and many failures. The same is true for gradual (phased) rollouts, although these generally are not headline-grabbers (Gargeya and Brady, 2005). The phased rollouts take longer to complete, and are more expensive due to the additional time commitment; however,
the approach does offer reduced business risk (Davenport, 2000). NOV used big bang approach, and think that may be phased approach were successful for them. However they didn’t know this approach as critical success factor but know it is important.

5.2 Factor 2: Project Team/Management Support/Consultants

The following coded table 5.2 will present a summary of key findings in regards to project team/management support/consultants factors.

The ERP team should consist of the best people in the organization (Buckhout et al., 1999; Bingi et al., 1999; Rosario, 2000; Wee, 2000; Nah et al., 2001). Building a cross-functional team is also critical. The team should have a mix of consultants and internal staff so the internal staff can develop the necessary technical skills for design and implementation (Sumner, 1999). In NOV the team was selected from users in the company and mixed with consultant’s team. Both consultants had experience in Oil industry and so the team was familiar with business. NOV believe that project team is one of the most important critical success factors in ERP implementation. About giving compensations to team members, NOV thinks that it was a project that should be completed with its budget and there was no need for compensation for team members.
### Table 5.2: Factor 2: Project Team/Management Support/Consultants

+/- = stated as a factor  
-/+= Not stated as a factor, but considered important  
-/- = Not stated as a factor  

<table>
<thead>
<tr>
<th>Project team</th>
<th>NOV</th>
</tr>
</thead>
<tbody>
<tr>
<td>ERP team should be cross functional, mix of consultants and internal staff</td>
<td>+/-</td>
</tr>
<tr>
<td>Team should have both business (familiar with business functions and products) and technical knowledge</td>
<td>+/-</td>
</tr>
<tr>
<td>The team should be dedicated to ERP implementation</td>
<td>+/-</td>
</tr>
<tr>
<td>ERP team should be given compensation and incentives</td>
<td>-/+</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Management support</th>
<th>NOV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly support and approval from top management is required during implementation</td>
<td>+/-</td>
</tr>
<tr>
<td>Senior management must be committed with its own involvement and allocating valuable resources</td>
<td>+/-</td>
</tr>
<tr>
<td>New organizational structure should be established and communicated to employees</td>
<td>-/+</td>
</tr>
<tr>
<td>Top management should set policies to establish new system</td>
<td>-/+</td>
</tr>
<tr>
<td>In time of conflict between previous and new system managers should be in middle</td>
<td>+/-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Consultants</th>
<th>NOV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consultants should have in-depth knowledge of software</td>
<td>+/-</td>
</tr>
<tr>
<td>Should be involved in different stages of implementation</td>
<td>+/-</td>
</tr>
<tr>
<td>Consultants should have multiple skills covering functional, technical, and interpersonal areas</td>
<td>+/-</td>
</tr>
<tr>
<td>Company should be able to manage well these consultants</td>
<td>+/-</td>
</tr>
</tbody>
</table>
A successful implementation is only achievable when high-level executives have a strong commitment to the project (Davenport, 2000). In NOV there was high management approval and support and management committed with its own involvement with participating in all project stages. Management established new policies and new organizational structures. Also in times of conflicts always management stay in the middle. So NOV mention the management support one of the critical success factors.

Welti (1999) argues that the success of a project depends on the capabilities of the consultants, because they have in-depth knowledge of the software. Somers and Nelson (2001) point out that consultants should be involved in different stages of the ERP project implementation. In NOV, consultant had software knowledge. And also they had experience in implementation. Also they involved in all stages of implementation. As implementation started they started their job until go-live date.

The company was aware of the role of consultants and tried to select the best that have multiple skills covering functional, technical, and interpersonal areas.

5.3 Factor 3: Internal Readiness/Training

The table 5.3 will present a summary of key findings in regards to internal readiness/training.
Table 5.3: Factor 3: Internal Readiness/Training

+/+= stated as a factor  
-/+ = Not stated as a factor, but considered important  
/- = Not stated as a factor

<table>
<thead>
<tr>
<th>Internal Readiness</th>
<th>NOV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organization and people should be ready for changes</td>
<td>+/-</td>
</tr>
<tr>
<td>Users should be involved in design and implementation of business processes</td>
<td>+/-</td>
</tr>
<tr>
<td>Education should be a priority from the beginning of the project, and money and time should be spent on various forms of education and training</td>
<td>+/-</td>
</tr>
<tr>
<td>Training, re-skilling and professional development of the IT workforce is critical</td>
<td>+/-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Training</th>
<th>NOV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heavy investment in training and re-skilling of developers in software design and methodology</td>
<td>+/-</td>
</tr>
<tr>
<td>A support organization meets user’s needs after installation</td>
<td>+/-</td>
</tr>
<tr>
<td>Employees must be trained on the new system in order to use it to continue day-to-day operations</td>
<td>+/-</td>
</tr>
</tbody>
</table>

Organizations should have a strong corporate identity that is open to change. An emphasis on quality, a strong computing ability, and a strong willingness to accept new technology would aid in implementation efforts (Nah et al., 2001). In NOV, the most difficult problem in implementation is mentioned as unwillingness to accept changes. Although there was campaigns and trainings for making users familiar with new system and encourage them to use this system, there are some problems yet.

As part of the change management efforts, users should be involved in design and implementation of business processes and the ERP system, and formal education and training should be provided to help them do so (Bingi et al., 1999; Holland et al., 1999). In NOV the main body of project team was from company itself. Also some
skilled and influenced users selected as power users to be involved in design and implementation of new processes. The company knows this involvement of users in project is very important.

Education should be a priority from the beginning of the project, and money and time should be spent on various forms of education and training (Roberts and Barrar, 1992). Training, re-skilling and professional development of the IT workforce is critical.

User training should be emphasized, with heavy investment in training and re-skilling of developers in software design and methodology (Sumner, 1999). In NOV, the training and re-skilling of IT workforce started from first day and they say that their ability to do many of support jobs after project completion is one of critical factors.

There should be extra training and on-site support for staff as well as managers during implementation. A support organization (e.g. help desk, online user manual) is also critical to meet user’s needs after installation (Wee, 2000). In NOV, training was done in different level and different approaches. They used demos and on-site training.

Separate department in NOV that has responsibility of all educations, also accepts responsibility of trainings for new system. NOV knows this factor is so critical, because they say that some problems that they have yet is because of some users that cannot work properly with new system. They have trainings yet to educate these users to use new systems properly and without errors.
5.4 Factor 4: Deal with Organizational Diversity

The table 5.4 will present a summary of key findings in regards to deal with organizational diversity.

**Table 5.4:**

<table>
<thead>
<tr>
<th>Deal with organizational diversity</th>
<th>NOV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reengineering in both people and operational level in different business units</td>
<td>+++</td>
</tr>
</tbody>
</table>

Organizations have many cultures. Individual branches of the same organization have their own ways of doing things, and each function/department operates with different procedures and business requirements. Not unexpectedly, the larger, more global companies cite their diversity as an obstacle to success (Gargeya and Brady, 2005). NOV think that this diversity and doing business process reengineering in each business unit is a critical factor that had strong influence on their implementation project.

5.5 Factor 5: Planning/Development/Budgeting

The table 5.5 will present a summary of key findings in regards to deal with organizational diversity.

A clear business plan and vision to steer the direction of the project is needed throughout the ERP life cycle (Buckhout et al., 1999). A business plan that outlines
proposed strategic and tangible benefits, resources, costs, risks and timeline is critical (Wee, 2000). NOV provided plan for to outline proposed strategic and tangible benefits, resources, costs, risks and timeline. It kept the project aligns to this plan.

Table 5.5: Factor 5: Planning/Development/Budgeting

+/- = Stated as a factor  
-/+ = Not stated as a factor, but considered important  
-/- = Not stated as a factor

<table>
<thead>
<tr>
<th>Planning</th>
<th>NOV</th>
</tr>
</thead>
<tbody>
<tr>
<td>A clear business plan and vision to steer the direction of the project</td>
<td>+/-</td>
</tr>
<tr>
<td>Business plan should outlines proposed strategic and tangible benefits, resources, costs, risks and timeline</td>
<td>+/-</td>
</tr>
<tr>
<td>A clear business model and justification for the investment based on a problem and the change tied directly to the direction of the company</td>
<td>+/-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Development</th>
<th>NOV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interfaces for commercial software applications or legacy systems may need to be developed</td>
<td>-/+</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Budgeting</th>
<th>NOV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keep the project as much as possible within budget</td>
<td>-/+</td>
</tr>
</tbody>
</table>

There is a choice to be made on the level of functionality and approach to link the system to legacy systems. In addition, to best meet business needs, companies may integrate other specialized software products with the ERP suite. Interfaces for commercial software applications or legacy systems may need to be developed in-house if they are not available in the market (Bingi et al., 1999). NOV developed some interfaces and customized some codes in order to be able to communicate with some legacy and external systems.
Implementations can become very costly, despite all efforts at developing a solid plan. Many projects, especially failed ones, find themselves over budget, some by as much as 189 percent (Gargeya and Brady, 2005). Only one-sixth of projects are completed on time and within budget (May, 1998). NOV tried to keep the project within budget and they say that they were partially successful. They consider this as an important factor but say that it cannot say that a project that is not within budget is completely unsuccessful project.

5.6 Factor 6: Adequate Testing

The table 5.6 will present a summary of key findings in regards to adequate testing factor.

Table 5.6: Factor 6: Deal with organizational diversity

+/- = Stated as a factor
-/+ = Not stated as a factor, but considered important
-/+ = Not stated as a factor

<table>
<thead>
<tr>
<th>Adequate testing</th>
<th>NOV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vigorous and sophisticated software testing before go-live date is essential</td>
<td>+/-</td>
</tr>
<tr>
<td>Troubleshooting errors is critical</td>
<td>+/-</td>
</tr>
<tr>
<td>There should be a plan for migrating and cleaning up data</td>
<td>-/+</td>
</tr>
</tbody>
</table>

System testing has proven to be the key element of success for some companies and a direct cause of failure for others (Gargeya and Brady, 2005). NOV started its testing phase after before go-live date. They did their testing in according to Oracle
Application Implementation Methodology (AIM) and once again with consultants to be sure about communication and that the system is working properly. They have had several phases of troubleshooting.

There should be a plan for migrating and cleaning up data (Rosario, 2000). Proper tools and techniques and skill to use those tools will aid in ERP success (Rosario, 2000). In NOV first system started working parallel with legacy systems to compare the outputs. After finalizing, implementation cleaning up phases started. Also they have trainings to teach users skills to use proper tools and techniques.

5.7 Hypotheses Testing

The purpose of the first hypothesis test was to evaluate the differences in the mean scores which is calculated from the result of survey conducted among 25 respondents. In this study it is chosen to focus in this question on one of the qualitative aspects developed. The survey instrument, Likert type scale used for the survey and respondent’s feedback were attached in Appendix section. To address this question we propose first to test the following hypothesis

**Scheme:**

H0: The mean scores are not equal.

Ha: The mean scores are equal.

The satisfaction variable corresponds to the average for all ERP modules (finance, SCM, HR, inventory, production). This variable is expressed in a scale, with 1 being the weakest value and 5 being the strongest value.
The statistical test employed in this study is to analyse this hypothesis is to compare means of satisfaction. In a general manner, one can notice that the satisfaction is on average quite high. Practically, ANOVA (Analysis of Variance) was conducted for the size case, which is the method for comparing means of samples.

The significance level of 5% is retained that is the first-type error (or the risk to reject the null hypothesis when it is actually correct).

The p-value of 0.006 for the size case indicates that the null hypothesis can be rejected at the significance level of 5%. So it is concluded that the mean scores for each level of implementation success were equal. So the overall satisfaction related to the use of ERP systems is generally good in NOV.

Statistical tests can be conducted, that are typically suited for dealing with variables defined upon nominal scales. Below table presents descriptive statistics about value different “attributes” of value added provided by ERP systems.

**Table 5.7: Collected data for Hypothesis testing**

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Improved information</td>
<td>25</td>
<td>4.32</td>
<td>0.45</td>
</tr>
<tr>
<td>2</td>
<td>Cost savings</td>
<td>25</td>
<td>4.24</td>
<td>0.60</td>
</tr>
<tr>
<td>3</td>
<td>Time saved</td>
<td>25</td>
<td>4.6</td>
<td>0.43</td>
</tr>
<tr>
<td>4</td>
<td>Improved quality of work</td>
<td>25</td>
<td>4.64</td>
<td>0.39</td>
</tr>
</tbody>
</table>
The Minitab results are:

**One-way ANOVA: C2 versus C1**

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implementation success</td>
<td>3</td>
<td>2.990</td>
<td>0.997</td>
<td>4.40</td>
<td>0.006</td>
</tr>
<tr>
<td>Error</td>
<td>96</td>
<td>21.760</td>
<td>0.227</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>99</td>
<td>24.750</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ S = 0.4761 \quad \text{R-Sq} = 12.08\% \quad \text{R-Sq(adj)} = 9.33\% \]

Individual 95% CIs For Mean Based on Pooled StDev

| Level | N  | Mean  | StDev  | -------+---------+---------+---------+-- |
|-------|----|-------|--------|-------+---------+---------+---------+-- |
| 1     | 25| 4.3200| 0.4537 | (--------*--------) |
| 2     | 25| 4.2400| 0.5972 | (--------*--------) |
| 3     | 25| 4.6000| 0.4330 |                    |
| 4     | 25| 4.6400| 0.3958 | (--------*--------) |

\[ \text{Pooled StDev} = 0.4761 \]

Figure 5-1. Minitab Box plot for collected data
5.8 T – Test

The test statistic in the t-test is known as the t-statistic. The t-test looks at the t-statistic, t-distribution and degrees of freedom to determine a p value (probability) that can be used to determine whether the population means differ. The t-test is one of a number of hypothesis tests. When analyzing data, it need to be decided whether a sample mean is different from a hypothesized population mean. In order to accomplish this measurement data, calculated mean and standard deviation of a sample, and hypothesized mean are needed.

For this testing, the hypothesized mean is selected to be 4. The reason is from the survey questionnaire Likert scale measure 4 represents the respondents is “agree” with the level of implementation success.

The respondent’s scores were attached in Appendix section. The proposed hypothesis to perform T – Test is,

H0: μ < 4

Ha: μ ≥ 4

The T – Test was conducted for each independent samples and the Minitab results are shown in the below table:
Table 5.8: Minitab results for T – Test

<table>
<thead>
<tr>
<th>Measure</th>
<th>N</th>
<th>Mean</th>
<th>StDev</th>
<th>SE Mean</th>
<th>95% CI</th>
<th>T</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved information</td>
<td>25</td>
<td>4.3200</td>
<td>0.4500</td>
<td>0.0900</td>
<td>(4.1342, 4.5058)</td>
<td>3.56</td>
<td>0.002</td>
</tr>
<tr>
<td>Cost savings</td>
<td>25</td>
<td>4.240</td>
<td>0.600</td>
<td>0.120</td>
<td>(3.992, 4.488)</td>
<td>2.00</td>
<td>0.057</td>
</tr>
<tr>
<td>Time saved</td>
<td>25</td>
<td>4.6000</td>
<td>0.4300</td>
<td>0.0860</td>
<td>(4.4225, 4.7775)</td>
<td>6.98</td>
<td>0.000</td>
</tr>
<tr>
<td>Improved quality of work</td>
<td>25</td>
<td>4.6400</td>
<td>0.3900</td>
<td>0.0780</td>
<td>(4.4790, 4.8010)</td>
<td>8.21</td>
<td>0.000</td>
</tr>
</tbody>
</table>

From the above results, it can be observed that in all levels of factor except cost savings the null hypothesis can be rejected. The null hypothesis is accepted if the critical value (table value) is greater than the statistic value. In this case the table value is 2.06 (for $\alpha = 0.05$). The statistic value for each sample is more than 2.06 except cost savings. The statistic value for cost savings is 2.00 which is lower than table value. So it is concluded that the the mean score is greater than or equals 4 for all these three factors at 95% confidence interval and the mean score is less than 4 for the factor cost savings at 95% confidence interval when the hypothesized mean equals 4.
5.9 F–Test

An F-test is any statistical test in which the test statistic has an F-distribution under the null hypothesis. It is most often used when comparing statistical models that have been fit to a data set, in order to identify the model that best fits the population from which the data were sampled. F-tests arise by considering a decomposition of the variability in a collection of data in terms of sums of squares. The test statistic in an F-test is the ratio of two scaled sums of squares reflecting different sources of variability. These sums of squares are constructed so that the statistic tends to be greater when the null hypothesis is not true.

The scheme of hypothesis used for F–Test is,

\[ H_0: \text{The mean scores are not equal} \]
\[ H_a: \text{The mean scores are equal} \]

The F–Test is performed by using the formula and the F-value is 4.397. The results were interpreted in the next section.

5.10 Interpretation of statistical testing

From hypothesis testing, the P-value is significantly low \( P = 0.006 \), the null hypothesis can be rejected. It means that the alternative hypothesis is true, The benefits provided by the ERP system is satisfied.

For the t-test, as in all hypotheses testing, the computations are done assuming the null hypothesis is true. And also the p – value for the other factors such as improved information, Time saved and improved quality of work is negligible, the alternate hypothesis can be rejected. At the same time null hypothesis can be accepted for cost savings since the table value is higher than the statistical value. By
interpreting the T – Test results, the ranking of the levels must be in the order of improved quality of work, time saved, improved information and Cost savings.

The critical value is the number that the test statistic must exceed to reject the test. In this case, \( F (3, 96) = 2.70 \) (approx.) at \( \alpha = 0.05 \). Since \( F = 4.397 > 2.70 \), the results are significant at the 5% significance level. So the null hypothesis can be rejected and concluded that there is strong evidence that the means are equal.

5.11 Cronbach Alpha

Reliability is the accuracy or precision of a measuring instrument that is the extent to which the respondent can answer the same or approximately the same questions the same way each time. The internal consistence reliability was assessed by calculating Cronbach’s alpha values. The reliability results of the constructs are summarized in the Table. The internal consistency (Cronbach’s alpha) of the construct is 0.350497 for implementation success. Given the exploratory nature of the study, the result seems acceptable.

Table 5.8: Summary of Reliability measurement

<table>
<thead>
<tr>
<th>Measure</th>
<th>Items</th>
<th>Mean</th>
<th>S.D.</th>
<th>Reliability (Cronbach’s alpha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implementation success</td>
<td>4</td>
<td>4.45</td>
<td>0.4675</td>
<td>0.350497</td>
</tr>
</tbody>
</table>
Chapter 6

Findings and Conclusions

Based on the previous chapter, this chapter will provide the answer to the study. First it will provide the findings and then the conclusions have drawn based on the analyzed data followed by the implications for management.

6.1 Findings

This chapter completes the study by summarizing the key findings of the project along with an evaluation of the study.

As indicated in introduction of this study ERP implementation can reap enormous benefits for successful companies - or it can be disastrous for organizations that fail to manage the implementation process. This research intends to answer the question,

“What are the critical success factors for ERP implementation?”

Key findings of this interpretive study were derived from interviewee’s perceptions, literature review and secondary data review.

For doing this research a study case were selected and interviews along with a secondary data review were conducted. Through a case study of a successful ERP implementation, it was found that 9 of 12 identified CSF’s from literature were
mentioned as critical and others as important with regards to the interviewee’s perceptions.

The following factors are mentioned as critical:

- Worked with functionality
- Maintained scope
- Project team
- Management support
- Consultants
- Internal readiness
- Training
- Planning
- Adequate testing

Following factors are mentioned as important, but not critical, mainly because control of them is very hard.

- Deal with organizational diversity
- Development
- Budgeting

6.2 Discussion of the Method

The purpose of this research is to study a case about an organization and conduct interviews with IT-manager or project manager who have been involved in the ERP implementation projects. The respondent who involved in this study is showed to be an excellent choice since the respondent were well involved in the organizations and could answer all questions needed for this study. The method of interview is
telephonic interviews and reviewed some secondary data. Therefore the answers have been correctly interpreted.

6.3 Implication and Recommendations

In this final section, the implications and recommendations based on the findings and conclusions of this study were presented in order to address managers.

6.3.1 Implications for Managers

A crucial part of working with the ERP functionality is the ability to streamline operations. Doing business process reengineering and doing minimal customization in software code is very important.

Broad reengineering should begin before choosing a system. In conjunction with configuration, a large amount of reengineering should take place iteratively to take advantage of improvements from the new system.

Maintaining scope is just as important for small companies as it is for large organizations. The approach for “rolling out” their implementation is another very important consideration.

The ERP team should consist of the best people in the organization. It is important that ERP be implemented by organizations themselves.

Top management needs to publicly and explicitly identify the project as a top priority and managers should legitimize new goals and objectives.

Consultants should have in-depth knowledge of software and company should be able to manage well these consultants.
The “people element” and training aspect of an ERP implementation is one the most important factors and companies should avoid to insist on assigning a fixed cost or percentage to the training effort.

Change management is starting at the project phase and continuing throughout the entire life cycle. Enterprise wide culture and structure change which include people; organization and culture change should be managed.

Planning a sophisticated ERP project should not be taken lightly or with little forethought. Planning should be closely identified with maintaining scope during an implementation.

Troubleshooting errors is critical. Both team members as well as executive management should not be tired after months or years of project.
References


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Wallace, T.F., Kremzar M. H. (2001), Making it happen (John Wiley & Sons, Inc.).


Appendix – A

Survey instrument:

The different opinions are indicated by the numbers.

Table A.1: Likert Scale used in the survey questionnaire

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Disagree very strongly</td>
</tr>
<tr>
<td>1.5</td>
<td>Disagree strongly</td>
</tr>
<tr>
<td>2.0</td>
<td>Disagree</td>
</tr>
<tr>
<td>2.5</td>
<td>Tend to disagree</td>
</tr>
<tr>
<td>3.0</td>
<td>Neutral</td>
</tr>
<tr>
<td>3.5</td>
<td>Tend to agree</td>
</tr>
<tr>
<td>4.0</td>
<td>Agree</td>
</tr>
<tr>
<td>4.5</td>
<td>Agree strongly</td>
</tr>
<tr>
<td>5.0</td>
<td>Agree very strongly</td>
</tr>
</tbody>
</table>
Implementation success (9 point Likert type scale):

1. The transparency of information between the departments is improved, so that effective communication between various departments is possible than before ERP implementation.

2. The company is able to save costs in its regular activities and it reflects in subsequent Quarter results after ERP implementation.

3. There is reduction in time while performing day to day operations comparing to working with legacy systems.

4. The quality of work is greatly enhanced when doing with ERP.
Appendix – B

The response to the survey questionnaire:

<table>
<thead>
<tr>
<th>Respondent</th>
<th>Improved Information</th>
<th>Costs saved</th>
<th>Time saved</th>
<th>Improved quality of work</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>4.5</td>
<td>3.5</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>4.5</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>3</td>
<td>4.5</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>4.5</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>4.5</td>
<td>4.5</td>
<td>4.5</td>
<td>5</td>
</tr>
<tr>
<td>7</td>
<td>5</td>
<td>4</td>
<td>4.5</td>
<td>5</td>
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