SUCCESSFUL ERP IMPLEMENTATION:
HOW TO REACH THE OPTIMAL ACHIEVEMENT
FOR MANUFACTURING BUSINESSES

ARMORNTAPE SINTHORNTHAM

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE GRADUATE SCHOOL
MASTER OF BUSINESS ADMINISTRATION
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Title: Successful ERP Implementation: How to Reach the Optimal

Achievement for Manufacturing Businesses

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Thesis title: Successful ERP Implementation: How to Reach the Optimal Achievement for Manufacturing Businesses

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ABSTRACT

The objectives of this study are (1) To investigate the critical success factors of ERP implementation that are described in many academic journals and find supporting evidence from actual ERP implementations to justify which critical success factors can confidently be applied to help increase the success rate of ERP implementation. (2) To construct a basic framework that manufacturing businesses can use as guidelines to achieve successful ERP implementation and improve business operations and bottom line. The expected benefit of this research is to give researchers, business owners, executives, and managers practical advice when making decisions on ERP implementation.

Questionnaires were used in this research to collect data from the survey sample. The survey sample consisted of 15 respondents from various manufacturing companies within the Bangkok Metropolitan Region. The questionnaire was purposely designed to ask open-ended questions from pre- to post-implementation.

This research focused on these success factors: planning before implementation, realistic expectation of benefits, scalable and integrable software package, IT infrastructure of business, competent support team, user adaptation, effective training and leadership from the executive level. After all the collected data was dissected, grouped, ranked and calculated, the final result confirmed that four critical success factors of ERP implementation which this research focused on, were common in both literature journals and actual ERP implementations: leadership from the executive level, realistic expectation of benefits, competent support team, and effective training. Therefore, the final basic framework was constructed based on these four critical success factors.

Keywords: ERP, Enterprise Resource Planning, ERP implementation, critical success factors, manufacturing, ERP framework, critical failure factors, mobile ERP, cloud-based ERP.

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LIST OF ABBREVIATIONS

Abbreviation	Full Term
BOM	Bill of Material
BPA	Business Process Automation
BI	Business Intelligence
BYOD	Bring Your Own Device
CRM	Customer Resource Management
ERP	Enterprise Resource Planning
IoE	Internet of Everything
IT	Information Technology
MRP	Material Requirements Planning
MRP-II	Material Resource Planning
OLAP	Online Analytical Processing
PC	Personal Computer
RDBMS	Relational Database Management Systems
Y2K	Year 2000

CHAPTER 1

INTRODUCTION

1.1 Statement of the Problems

The advancement of Information Technology (IT) has continuously reshaped the way people do business. From the early years of the personal computer (PC) to the upcoming age of the Internet of Everything (IoE). More and more, business expects to get information faster, more easily, as comprehensive as possible, and virtually anywhere and anytime. Since people (i.e. business owners, employees, suppliers and customers) are the main stakeholders in most business environments, business must constantly change to align itself with the interests of the people involved in the business.

Business Process Automation (BPA), therefore, has become more and more vital in the business environment. Business can no longer compete in today's fast-paced and competitive global environment without the help of some sort of business process automation. One of the key reasons to introduce BPA is to get information quickly at the time when it is needed in order to make the best business decisions. That is where Enterprise Resource Planning (ERP) comes in.

An ERP system typically stores business transactions and data from various functions of a business. An ERP system can cover many business functions such as Human Resources, Supply Chain Management, Customer Relations Management, Financial Management, Manufacturing functions, and Warehouse Management functions (Singh, 2011). With sophisticated features that accompany the ERP system, a business can gain insights, trends, forecast, and reports at the click of a mouse.

There are literally hundreds of ERP software packages available today both commercial and open-source. Once an ERP software package is selected and purchased, a common problem that all businesses must face is how to optimally implement the purchased ERP system to get the most out of the system to improve the business operation and bottom line.

1.2 Research Objectives

The objectives of this research are as follows:

(1) To investigate the critical success factors of ERP implementation that are described in many academic journals and find supporting evidence from actual ERP implementations to justify which critical success factors can confidently be applied to help increase the success rate of ERP implementation.

(2) To construct a basic framework that manufacturing businesses can use as guidelines to achieve successful ERP implementation and improve business operations and bottom line.

1.3 Significance of the Study

This research contributes to the body of knowledge by giving researchers, business owners, executives, managers practical advice when making decisions on ERP implementation. For people in business, this research can be useful as a starter guide for new ERP implementation or it can be used as a guideline on how to get back on track for ERP implementations that might not have reached their desired success level. Businesses that are trying to improve their business operation in hope to improve their business bottom line can find this research useful and informative.

For those researchers who are also investigating about ERP systems, they can use this research to see which critical success factors can be applied to many different ERP solutions. This research can also be beneficial to new students in business, accounting, finance, operation management, or computer related curriculums to learn more about what leads to a successful ERP implementation. It can be used as a supplementary study material.

1.4 Scope of Research

This research focuses only on manufacturing-related businesses; however, the information and the findings of this research can certainly be applied to other types of businesses. The research will concentrate on critical success factors that are relevant to the modern business environment, roughly after the Year 2000 problem (Y2K). This research concentrates on ERP implementations after the Y2K because many new

critical success factors had emerged due to changes in technology and business environment since then.

There are many critical success factors described in published literature journals. This research is not intended to investigate all of those published critical success factors. Only eight critical success factors are selected for investigation. Also, due to many constraints (e.g. time, number of manufacturing companies), samples for this research are selected from manufacturing companies that are physically located within the Bangkok Metropolitan Region.

1.5 Conceptual Framework

The dependent variable of the research is the successful ERP implementation for a business. The independent variables are determined to be: (1) planning before implementation, (2) realistic expectation of benefits, (3) scalable and integrable software package, (4) IT Infrastructure of business, (5) user adaptation to the system, (6) effective training, (7) competent support team, (8) leadership from the executive level
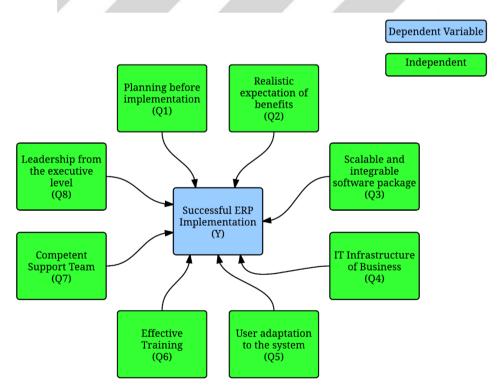
Figure 1.1 Conceptual framework for successful ERP implementation

1.6 Research Questions

   This research attempts to find evidence from literature journals, other secondary data, and data from the test samples to answer these research questions:

Table 1.1 List of research questions

Alias	Research Question
Q1	The success of an ERP implementation depends on thorough planning before the implementation.
Q2	The success of an ERP implementation depends on having realistic expectation of benefits.
Q3	The success of an ERP implementation depends on having a scalable and integrable software package.
Q4	The success of an ERP implementation depends on having adequate IT Infrastructure.
Q5	The success of an ERP implementation depends on having the users adapt to the system.
Q6	The success of an ERP implementation depends on having effective training.
Q7	The success of an ERP implementation depends on having competent supporting team.
Q8	The success of an ERP implementation depends on the leadership from the executive level.

CHAPTER 2
LITERATURE REVIEWS

This chapter provides the overview of information from academic researches and other secondary data used to conduct this research. The literature review focuses on the critical success factors and critical failure factors of ERP implementation. The review starts out with the overview of the ERP system to pave way for the discussions about the ERP system and to understand the typical characteristics of the ERP system. Since an ERP system is a software package that tends to change rapidly with the advances of Information Technology, the key trends related to ERP system are also studied in order to see the road ahead and help make better decisions on ERP implementation.

After the overview of the ERP system, the next section is divided into three parts to match the typical phases of lifecycle of an ERP implementation. There are three phases of lifecycle that most ERP systems have to go through: selection, implementation, and operation. The operation phase can also be further broken down into two stages: stabilization stage and routine stage (Sternad, Gradisar, & Bobek, 2011). This research uses the term pre-implementation to map the selection phase, In-process implementation to map the implementation phase, and post-implementation to map the operation phase.

2.1 Overview of the ERP System

As business starts to grow, things could get unorganized very easily. Sales transactions, account receivables, account payables, and inventory will require more manpower to keep track of these data. Generally, using paper-based system or spreadsheet-based system would still suffice in recording these data. However, the speed to collect, to report, and to analyze these data for business decision making are often not fast enough, especially in the modern days. The results could be late payments, missed sales opportunities because of incorrect sales forecast, or undiscovered loss and stolen inventory. This is when the business owners, executives or the managers start to think of solutions that can solve and prevent such results. Most often times, nowadays, that leads to the implementation of an ERP system.

An ERP system is an integrated set of software modules linked to a centralized database. It is a software solution that addresses the enterprise's needs. The system tightly integrates all functions of a business in order to meet the business goals (Garg & Agarwal, 2014). By nature, an ERP system is a very complex system. The task to implement the ERP system is never straightforward (Christofi, Nunes, Peng, & Lin, 2013). The implementation is a lengthy and costly process that can face serious failure (Moalagh & Ravasan, 2013). Many publicized failures of ERP implementation reveal the frustration and even total meltdowns of the business (Kim, Lee, & Gosain, 2005).

Businesses generally do not have an IT expert on ERP system available in-house. The decision makers of these companies often have to deal with the daily business problems and are more concerned about how to make sales and manage the cash flow. Therefore, when it comes time to implement an ERP system, they normally do not have all the facts and guidelines to help them select the most optimal ERP solution and implementation plan for their businesses. Often times, they would search for a few ERP software vendors, which normally have an ERP consultant available as a part of the total implementation package, to explain and demo the ERP systems. However, these vendors tend to be biased towards their own offered solution, making comparing the pros and cons of these various ERP systems even more difficult. Therefore, understanding a little bit of the background, the technology behind the ERP system, the common features of the ERP system, and the future trends of the ERP system should be the first step prior to ERP implementation.
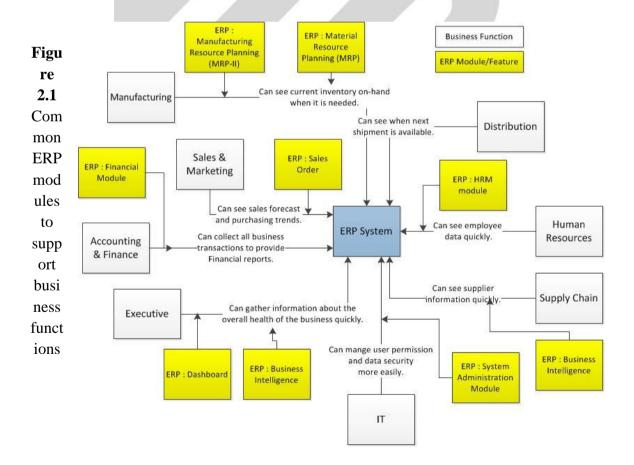
2.1.1 Background

The development of the ERP system could be traced back to the 1960-1970s. The early ERP system was developed based on the specifications of the Material Requirements Planning (MRP). With joint effort by J.I. Case, a number of construction machinery companies, and IBM, the MRP was created. In 1979, relational database technology was introduced. In 1980, the Manufacturing Resource Planning (MRP-II) was created to expand the use of MRP and backed by the power of relation database technology (ERP and More!, n.d.). The primary tasks of an MRP and an MRP-II were to manage the transactions occurred within the production

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department, inventory movement, and transactions occurred within the accounting department.

With advances in business methodologies and technologies, the scope of the MRP and MRP-II has increased. Distribution, supply chain, marketing, sales, and human resources were added to the original specifications of MRP and MRP-II. The modern ERP system was born. The ERP system has become the de facto system for providing information for the whole enterprise. It can store and manage all the information related to the business. In addition to the typical modules available in MRP and MRP-II (e.g. BOM and shop-floor transactions), the modern ERP system also included information about customers, suppliers, employees, products and financial data.

2.1.2 Common Features of ERP System for Manufacturing Business

Figure 2.1 Common ERP modules to support business functions

Financial Management

The finance module of an ERP system is the heart of the system. Just about everything that goes on in a business involves money, this module is considered to be the standard module of all ERP systems regardless of the brand and cost of the ERP systems. Typically, this module includes general ledger, fixed asset, account receivables and account payables, cash management and financial consolidation ("Enterprise resource planning," 2014).

Manufacturing Operation Management

As mentioned in the background section in this chapter, ERP started as MRP and MRP-II. Therefore, manufacturing module is another core element of typical ERP systems. This module normally consists of bill of materials (BOM), work orders, scheduling, quality control, and capacity management ("Enterprise resource planning," 2014).

Sales Management

Although, finance is the core module of the ERP system, the majority of the data and transactions will come from the Sales module. This is where most business transactions begin. This module generally includes order entry, credit checking, pricing, available to promise, sales commissioning, and sales analysis ("Enterprise resource planning," 2014).

Business Intelligence

Business Intelligence (BI) is a feature that is commonly integrated with the commercial Relational Database Management Systems (RDBMS) that the ERP systems use to store data. The main objective of BI is to turn large and raw data into business insights or business performance indicators. The information computed by the BI system can then be used for forecasting and planning. BI architecture largely depends on the size and the business goals of the company.

"The core of BI technologies is based on data analysis" (Xia & Gong, 2014). Cost-Benefit Analysis (CBA) is one of the common tasks that can be performed using Business Intelligence (BI). "CBA is the systematic identification of policy

consequences followed by valuation of benefits and costs according to the appropriate decision criteria" (Xia & Gong, 2014). "Cost-Benefit Analysis (CBA) can be used to assess whether decisions or choices that affect the use of scarce resources promote efficiency" (Xia & Gong, 2014).

Data mining, data warehouse, data mart, Online Analytical Processing (OLAP) are all common Business Intelligence technologies. In order to understand the power of Business Intelligence, it is necessary to understand different technologies of Business Intelligence.

1) Data Mining (DM) – Statistical and artificial intelligence techniques are used in data mining process to extract insights and information from large sets of data. Data mining can be used for many purposes. It can be used to financial forecasting, inventory management, or customer segmentation. Data mining tends to be in tabular format, but non-tabular format do exist as well. Text mining, web mining and multimedia mining are examples of data mining. Data mining can be divided into two different techniques. First, the Cross-Industry Standard Process (CRISP-DM). This technique is a mature technique and is widely used. Another technique is the Sample, Explore, Modify, Model and Assess (SEMMA).

2) Data Warehouse (DW) – "Data warehouse is a database used for reporting (1) and data analysis (2). Integrating data from one or more disparate sources creates a central repository of data, a data warehouse (DW). Data warehouse stores current as well as historical data and are used for creating trending reports for senior management reporting such as annual and quarterly comparisons" ("Data warehouse," 2014).

3) Data Mart – "Data mart is a subset of data warehouse that typically focuses on a single subject area. A data mart can be dependent or independent. A dependent data mart is a subset created directly from the data warehouse and uses data models to provide quality data" (Xia & Gong, 2014).

4) Online Analytical Processing (OLAP) – Similar to Data Mining. Xia and Gong (2014) also explained in their research that OLAP is a software technology that allows system users to gain business insights from the data that has been transformed from raw data to useful information. (Xia & Gong, 2014) What makes OLAP different from DM is that DM supports data-driven analysis, while OLAP supports

model-driven analysis. What OLAP cannot do is make future predictions. It also cannot explain the reasons behind the events.

Business Intelligence (BI) has its drawback, too. Because of its power to generate in-depth information that can be critical to a business, Business Intelligence system tends to be very expensive. "The high cost of integrating BI technologies is always a financial challenge especially for small and medium sized companies. Additional costs are accrued from hardware standards and business transactions" (Xia & Gong, 2014). Implementing a Business Intelligence system is a complicated task. Highly trained and experienced consultant is normally required to install, setup, and configure the system. Perhaps because of these drawbacks, SMEs tend to think that Business Intelligence (BI) is unnecessary to their daily operations.

As mentioned earlier, BI capability often comes built-in with a commercial Relational Database Management System (RDBMS). Some the most well-known RDBMSs are Oracle and Microsoft SQL. Regardless of the brand, BI system typically includes these basic features:

1) The data warehouse that processes the data source.
2) BI analytic tool to manipulate the data.
3) Business Performance Management to monitor the business performance.

2.1.3 Key Trends

This research was conducted during 2014 to 2015. Many promising new technologies had been introduced and were ready to change what most people describe as the typical modern ERP system. Many experts in the field of ERP implementation confirmed that these key trends would definitely impact the ERP implementation.

According to the article from Forbes (Trefis Team, 2014), cloud-based ERP is the trend that would eventually change the ERP landscape. Users would want not only fast and accurate information, but they also would want to access the information from anywhere. Large ERP providers such as SAP, Oracle and Microsoft have to rapidly create ERP systems that are cloud-ready to support the growth of acceptance of cloud computing.

Based on the research conducted by Gartner (Gartner, Inc., 2013), the public cloud services market was expected to grow 18.5 percent during 2013 to total $131 billion worldwide, which was an increase from $111 back in 2012. Software-as-a-Service (SaaS) was expected to reach 14.7% of the estimated $131 billion revenue obtained from cloud services. According to an article by Rob Drew ("Top 8 ERP Trends for 2014 - Enterprise Apps Today," n.d.), the acceptance of cloud-based ERP had increased gradually. Many companies were still reluctant to put the company's data into the cloud. However, that trend would change after those companies understand the benefits of the cloud. Fesak, Duan, Faker, & Stuart (2012) stated in their research that cloud-based ERP systems are more suitable for small and medium-sized companies because of the subscription based pricing schemes. The cloud-based ERP solutions generally require lower upfront investments.

Another trend that was heating up during the time of this research was conducted was mobile ERP. Users of ERP systems wanted more than just sitting in front of a computer to access the information from the ERP system, they wanted to be able to access the information from any device that was capable of connecting to the ERP system. During the past few years, the uses of mobile phones and tablets have become the norm for most people in the world. These devices have entered the enterprises by the phenomenon known as BYOD (Bring Your Own Device). Therefore, the users would want to be able to connect to the ERP system via these devices. Whether the companies would allow such access from BYOD devices or not depends on the security system they have in place within the organizations. According to an article by Schmitz from SAP (Schmitz, 2013), mobile application for business intelligence, a big part of modern ERP systems, would play a large role in the future of ERP systems. Decision makers wanted to be able to retrieve business KPIs and analyses when they are outside the company.

2.2 Pre-ERP Implementation

There are many factors, both obvious and not so obvious, that can determine the success and failure of the ERP implementation. In order to minimize the risk of unsuccessful implementation of the ERP system, business must perform thorough assessment of what it expects an ERP system to be able to do for the business and

what features of the ERP system should exist in order to cover the company's necessary business functions (Chung, Skibniewski, Lucas, & Kwak, 2008). Companies should gather the information about the impacts that may occur after the implementation of the ERP system. It should also go through the process of selecting the most appropriate ERP package for the business.

Generally, it is recommended that business should try to improve its business processes even before the start of an ERP implementation. Improvements on non-technical areas can be performed right away. This helps single out the technical tasks that must be performed by the ERP system. At the same time, it allows business to see what features that do not readily exist in the current system and would be nice if the new ERP system can provide such features. This makes system analysis and requirement gathering easier when the implementation starts.

It is during this phase of the implementation that user resistance may occur. According to Alballaa & Al-Mudimigh, one of the key challenges of ERP implementation is user resistance. Top management of the company must determine the sources of resistance and find adequate strategies to offset the resistance. This process typically is known as Change Management. Change management managers must understand the culture and values of the company because they will have impact whether the change will be accepted or rejected. The authors also explained that user resistance generally occurred due to fear of loss of power and status, unclear strategic vision, and long working hours, no evident benefit of financial gain (Alballaa & Al-Mudimigh, 2011).

Impacts on different departments should also be studied before the implementation of the ERP system. Knowing the general impacts or outcomes of implementing an ERP system before it even starts can help the business avoid the pitfalls early. For example, Chen, Huang, Chiu, and Pai (2012) explained that based on their research, operations and roles of accountants change significantly after ERP implementation. The workload of traditional data input, data compilation, filing and preparation for financial statements decreases because of ERP implementation (Chen et al., 2012). Knowing this information, business can predict that the routine tasks that the accountants had to perform prior to the implementation of the ERP system will either be eliminated or they will be transferred to other departments. If the

former is the case, business can hire less accountants. If the latter is the case, business can prepare to hire more staff for the other departments that will have to take more workloads.

Once the gathering of technical requirements and expectations of what an ERP system should provide are complete, the next step is to study the available options of the ERP packages in the market. Selecting the right ERP package that is a fit for the business is crucial in the long run. The system should provide enough features and capabilities and within the budget set for the ERP implementation project. As illustrated in figure 2.1, the large ERP systems can provide modules that support many different business functions. It is critical to understand what each module can do and how they interact with other modules.

For most companies, budget is one of the main obstacles to implement an ERP system. Since these ERP systems do not come cheap, business must find alternatives. Business can choose to go with a lesser known ERP packages or open-source systems. These types of ERP packages tend to be less expensive, but also less features. However, if those features are really what the business basically needs, these lesser known packages or open-source can save the business quite a lot of money. This research tries to find evidence to support this notion. See Chapter 4 of this research for the result.

2.3 In-Process ERP Implementation

During the implementation phase, the most common task is the customization of the ERP system. Because different businesses work differently, the ERP system must be customized to tailor the system to the business. Therefore, it is important to understand success factors of customization and the pitfalls of customizing as well.

2.3.1 ERP customization

One of the decisions that companies implementing an ERP system will certainly have to make is whether to abide by the way the default ERP system works or customize the ERP system to conform to the current business process. For those companies opting to customize the ERP system, they must understand that this might lead to more difficulties, longer implementation period, and higher cost.

Most of the time, it is recommended that companies adhere to the standard, or vanilla, package of the ERP system. However, there will be times when that are not possible. Most SMEs have a special process that is their competitive advantage within the industry they are in. The special process would normally not fit with the standard ERP package. Thus, a customization is required to change the way the ERP system work.

Zach and Munkvold (2012) stated that there are primarily seven possible reasons leading to ERP customization. According to their research, there were five reasons before going live and two reasons after going live. For those that are not familiar with software project management, the term "Go Live" simply means putting a software system into use in a real business setting. The five reasons before going live are as follows:

1) Resistance to change – "If it ain't broke, don't fix it" way of thinking.

2) Unique business processes – special business processes that no commercial ERP software packages can provide right off the shelf.

3) Functional misfit – business process that must be performed the way it has always been done.

4) Ownership type – SMEs owners have a lot of power in their companies.

5) Technical motivation – Current system may be too outdated. A new system is desired.

The other two reasons for ERP customization after going live are as follows:

1) Stage of growth – SMEs must constantly grow. Their ERP systems must grow, too.

2) Maturity of the ERP system – Early implementation of certain features may need to be updated and modified to meet the current requirements.

2.4 Post-ERP Implementation

There is no guarantee that implementing an ERP system will be successful. The research by Federici (2009) concludes that ERP systems can improve the work process of business of any size and in every sector. The same benefits that large companies gain from using an ERP, smaller SMEs can expect to gain the same benefits. However, to measure the success and benefits that the business receives

from the ERP implementation, the business must perform an assessment. The success assessment is an essential step at the post-implementation stage of an ERP implementation. This is the step that will evaluate how much the system has succeeded in achieving its predetermined objectives (Moalagh & Ravasan, 2013). Nonetheless, the assessor must keep in mind that the term success can have different meanings depending on the viewpoint of the assessor. Based on the research by Markus and Tanis (2000) (as cited in Garg and Agarwal, 2014), the success of ERP implementation can be viewed as technically successful, economically successful, financially successful, strategically successful, operationally successful (i.e. accepted by manages and employees), and externally successful (i.e. accepted by customers, suppliers, and investors) (Markus & Tanis, 2000).

Many post-implementation assessment models had been created by researchers to systemically evaluate the success ERP implementation. As depicted in figure 2.2, each new model typically is based on selected previous model. The newer model tries to solve the missing aspects of previous model.
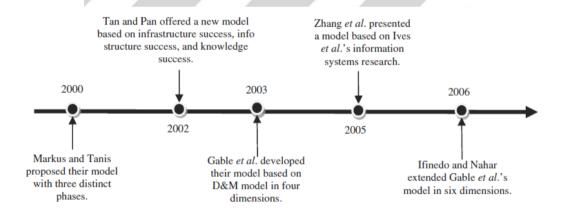
Figure 2.2 Timeline of ERP post-implementation success models
Source: Moalagh & Ravasan, 2013: 1239

Based on their study, Stenad et al. stated that the post-implementation phase (a.k.a the operation phase) could commonly be divided into two stages; stabilization stage and routine stage. In the stabilization stage, the ERP system could be considered as technically successful, because the system provided all the requested features. However, much of the success of ERP implementation depended on the users' attitudes toward and actual use of the system delivered to them in the routine

stage. The benefit that organizations would receive from the ERP system was limited to how frequently and extensively the users utilize the system and how much they accept the system. Therefore, to improve the efficiency and effectiveness of ERP systems in the operation phase, the user satisfaction must be attained by attending the factors that impacted it (Sternad et al., 2011).

Boudreau (2002) added that the way the users use the ERP system could be classified into two groups: limited use and extended use. The users in the limited use group tend to use the ERP system because "they had to" and they would only concern about the features that they are responsible for. On the other hand, the users in the extended use group demonstrated a deeper understanding of the system. These were the users that would eventually learn how to tweak the ERP system so the system would work the way they preferred. These users would also become the informal trainer of the ERP system (Boudreau, 2002). Boudreau (2002) also explained that the training of the ERP system could be categorized into two channels: formal training and informal training (Boudreau, 2002).

Stanciu & Tinca (2013) also confirmed the importance of the post-implementation analysis by stating that it gives useful information about errors occurred during the implementation process. The lessons learned from the errors can help practitioners avoid similar errors in the future.

2.5 Critical Factors Based on Literature Reviews

After reviewing a number of literature journals and software vendor information materials, critical success factors and critical failure factors were identified. These factors will later be used to construct questions in the questionnaire. The list of these factors is depicted in Table 2.1.

Table 2.1 Some critical success factors and critical failure factors based on literature journals

Critical success factors (Not Ranked)	Critical failure factors (Not Ranked)
Top management support and involvement	Lack of top management support

Table 2.1   Some critical success factors and critical failure factors based on literature journals (Cont.)

Critical success factors (Not Ranked)	Critical failure factors (Not Ranked)
User involvement	Lack of user input
Business process reengineering	Incomplete requirements
Good project management	Changing requirements
Have clear desired results	Unrealistic expectations
Planning before implementation	Unrealistic timeframes
Right data entering into the system	Unclear objectives
IT legacy system	Technology incompetence
Effective communication	Lack of disciplined project management
Minimal customization	Turnover of key team members
Competent members of ERP team	Viewed ERP implementation as "IT" project only
Make user training a high priority	Unrecognized small problems escalated

2.6 Proposed Success Framework

As part of the objectives of this research, a basic framework will be constructed to be used as a guideline for ERP implementation. Based on the literature reviewed, the following framework is proposed: Eliminate or minimize the causes of failure + Do the success factors = Successful ERP implementation. The framework is designed to be common and simple so businesses of all sizes can easily adapt.
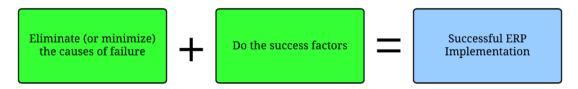
Figure 2.3 Proposed basic framework

In order to determine that the ERP implementation is a success, the term success must be clearly defined. Otherwise, there is no way to know that success is achieved. This research will base the term "success" using the ANP framework for ERP success implementation (See Figure 2.4) since it is a recent model and seems to make sense in today's business environment. It is not expected that the proposed basic framework will achieve all of the success elements described in the ANP framework. A few success elements should be achieved by using the framework.
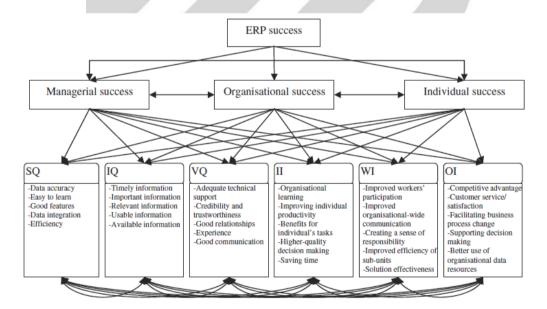
Figure 2.4 ANP framework for ERP success implementation
Source: Moalagh & Ravasan, 2013: 1244

CHAPTER 3
RESEARCH METHODOLOGY

3.1 Research Framework

This research is a pure research based on empirical testing and secondary data. Qualitative research approach was selected to conduct this research. Qualitative data were collected and used to find supporting evidence for the research questions of this research. Many literature journals were used to find supporting evidence for the research questions. Many of the literature journals used for this research also used qualitative research approach.

Qualitative research is the common method of research regarding the topic of ERP system. This is due to the fact that it is very difficult to get quantitative data. Other constraints also make qualitative research method a better choice. It may be possible to get quantitative data for the performance aspect of an ERP system by using performance benchmark software, but most of the time, respondents for this topic do not have such quantitative data on hand. Their answers are mostly based on their own judgment, knowledge, and experience, not actual numbers. This research uses non-paramedic statistics to display the result of the data collected.

3.2 Research Procedures

1) Topic of the research was selected based on personal interest and work experience of the researcher.

2) Relevant data were searched and collected from various sources such as the online databases of published literature journals, ERP vendor and consultancy websites, IT forums and printed publications.

3) Collected data from step two were dissected to find key success and failure factors. The number of times that those factors were mentioned in the data sources were recorded to determine the rankings of those factors (grouped by success and failure). The most mentioned factor would have the highest ranking. The least mentioned factor would have the lowest ranking. Spreadsheet software was used to record the factors, sum the number of times the factors were mentioned, and rank the factors.

4) Using the success and failure factors found in the previous step, a questionnaire was then constructed. See the detailed explanation about the questionnaire construction in section 3.5 of this chapter.

5) Copies of the questionnaire were sent out to selected companies disregarding the size, industry, and nationality of those companies. See the detailed explanation of the selection process in section 3.4 of this chapter.

6) The responses from the questionnaires were collected and dissected. The dissected responses were analyzed and compared to the success and failure factors described in the literature journals to test hypotheses.

7) Conclusions based on the findings were explained to wrap up the research.

3.3 Data Privacy

Due to the promise to the respondents that the data collected in the questionnaire are kept confidential, this research will not disclose the names of the companies or the names of the respondents anywhere in the research. Assigned code, such as "C001", is used instead to represent the respondent.

3.4 Sample Size and Population

The survey was intended to collect qualitative data from individuals from manufacturing companies within the Bangkok Metropolitan Region (ie. Nakhon Pathom, Pathum Thani, Nonthaburi, Samut Prakan, and Samut Sakhon (Wikipedia, n.d.) regarding different elements of an ERP implementation. Therefore, the unit of analysis was person. The final sample size of the research was 15 individuals from 10 participating companies.

3.5 Sample Selection

A total of 56 companies, which operated within the Bangkok Metropolitan Area, were contacted by email and traditional postage mail to participate in the research by filling out the questionnaire; however, only ten companies actually participated. Half of the information about the contacted companies was obtained through the website of the Department of Industrial Works of Thailand (Department of Industrial Works of Thailand, 2014). The department of Industrial Works of Thailand is a Thai government body that oversees the industrial business operation activities in Thailand. It serves as the national information center for industrial works, machines, chemical substances, hazardous substances and volatile substances. The other half was obtained through the website of the American Chamber of Commerce in Thailand (The American Chamber of Commerce in Thailand, 2015). The American Chamber of Commerce in Thailand is an organization that provides a point of exchange and coordination of efforts to improve business conditions and opportunities for American and American affiliated organizations.

The size of the companies was disregarded when selecting the companies to participate in the research. The goal was to have responses from small, medium, and large companies. The selection process also disregarded whether these companies were privately held companies or publicly traded companies. The only criterion in the selection process was that the selected companies must be a manufacturer.

The persons that were contacted were managers, executives, or owners of the companies. They did not have to be in the IT department to complete the questionnaire. Basically, anyone within the specified organization levels can complete the questionnaire as long as they have a good knowledge about the ERP implementation within their respective companies.

3.6 Questionnaire Construction

The questionnaire was constructed based on the success and failure factors mentioned in the literature journals. See Table 2.1. Most questions in the questionnaire were open-ended questions. Most of them were mapped to a particular independent variable of the conceptual framework in hope of getting focused answers to that variable. Other questions were general questions to know more about the

respondent. The mapping of the questions to the independent variables is illustrated below:

Table 3.1 Mapping of questions in the questionnaire to independent variables of the conceptual framework

Question in the Questionnaire	Independent Variable
Name of the company	None
Type of business	None
Number of employees	None
Nationality of the company	None
Name of respondent	None
Job title	None
What is the name of the ERP system your company is using?	None
How long has your company been using your current ERP system?	None
How did your company plan for the ERP implementation?	Planning before implementation
What were the expectations or benefits your company would gain from the ERP system?	Realistic expectation of benefits
Were there any resistance from the users before the ERP system was introduced? How did your company resolve the issue?	Users adaptation to the system
How have the users adapted to the ERP system?	Users adaptation to the system
Did you have any legacy systems that the ERP system must integrate with? Please explain.	Scalable and integrable software package
Can your ERP system be deployed in the Cloud or be integrated with mobile devices?	Scalable and integrable software package
How did your company train users when the ERP system was introduced?	Effective training
How does your company provide on-going training for the ERP system currently?	Effective training
How does your company provide on-going technical support or improvement of the ERP system currently?	Competent support team
None.	IT infrastructure of the business.
How much have the owners or the executives of the company been involved in the ERP implementation?	Leadership from the executive level
Are the owners or the executives satisfied with the results and benefits of the current ERP system? Please explain.	Leadership from the executive level

The number of employees were grouped as follows: 1-50, 51-200, 201-500, 501 – 1000, and more than 1000. The grouping was based on the classification of business size described in Thai law issued in year 2000. See Appendix B for detail.

There was no question that directly mapped with the independent variable "IT Infrastructure of the business". It could be assumed that if the company had an ERP system, the company must have an adequate IT infrastructure to support such system.

3.7 Data Collection

Data were collected from November 2014 to January 2015. Data were collected by using online questionnaire and paper-based questionnaire. The questionnaire was given to manufacturing companies via email and typical postage mail. Responses from the online questionnaire would be recorded instantly in a formatted spreadsheet upon submission of the questionnaire. As for the responses from the paper-based questionnaire, they were collected and then manually entered into the formatted spreadsheet.

3.8 Data Analysis

Statistical software package and spreadsheet were used to calculate the results. Non-parametric statistic (i.e. descriptive statistic) was applied to understand the collected data. The descriptive statistic was applied to understand the general information about the collected data, for example the type of software packages used by the companies. The results of the descriptive statistic are displayed and analyzed in the next chapter.

CHAPTER 4

RESEARCH FINDINGS

This chapter shows the findings from the questionnaire and the result from the spreadsheet software and statistic software.

4.1 Data Analysis

The first part of this section shows the descriptive statistics. The second part shows the inferential statistics. Calculated statistics are displayed in tables. These are calculations from either the spreadsheet software or the statistical software. Analysis of each statistic is provided below each table. Independent variable from the conceptual model, which the question was based on, is listed below the analysis for easy reference. The question from the questionnaire which the calculated statistic was derived from is also listed.

Table 4.1 Frequency and percentage of respondents grouped by type of business

Type of business	Frequency	Percentage
Electronics Equipment	1	6.67
Food and Beverages	3	20.00
Tire	1	6.67
Networking Equipment	5	33.33
Animal Feed Additive	1	6.67
Chemical	3	20.00
Footwear and Apparels	1	6.67
Total	**15**	**100.00**

From Table 4.1 shows that there are a total of 15 respondents. Most of them are from Networking Equipment business. Due to low number of samples, it is difficult to say which type of business prefers to use ERP system more than the other. However, from this small set of samples, it can be concluded that any type of businesses can use and benefit from the ERP system.

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Table 4.2 Frequency and percentage of respondents grouped by nationality of the business

Nationality of business	Frequency	Percentage
Thai	5	33.33
American	6	40.00
Italian	1	6.67
Taiwanese	1	6.67
German	1	6.67
Dutch	1	6.67
Total	15	100.00

Based on the result displayed in Table 4.2, the majority of the companies that the respondents work for are Thais and Americans. It can be concluded that ERP systems are widely used regardless of which country the company is from.

Table 4.3 Frequency and percentage of respondents grouped by number of employees

No. of Employees	Frequency	Percentage
1-50	2	13.33
51-200	0	0.00
201-500	3	20.00
501-1000	4	26.67
More than 1000	6	40.00
Total	15	100.00

Table 4.3 shows that most of the respondents are from large companies (more than 200 employees). From this small set of samples, it can be concluded that ERP systems are mostly used by large companies, however, the ERP systems are not bound to just large companies. Small and medium companies can also benefit from the use of the ERP systems.

Table 4.4 Frequency and percentage of respondents grouped by name of ERP
software package

Name of ERP software package	Frequency	Percentage
In-house developed ERP system	3	20.00
SAP Business Suite	3	20.00
Oracle E-Business Suite	5	33.33
Microsoft Dynamic AX	2	13.33
Infor ERP LX (IBM AS/400)	1	6.67
Infor System21 (IBM AS/400)	1	6.67
Total	15	100.00

From Table 4.4 shows that there are various ERP software packages used by
the respondents. From this small set of samples, it is very difficult to distinguish
which ERP software package is the most preferred. What can be concluded from this
small set of samples is that companies do not just purchase a software package
because of the brand of the ERP software package. Other variables must also be
considered (e.g. IT infrastructure).

Table 4.5 Frequency and percentage of respondents grouped by number of years ERP
system was used

No. of Years	Frequency	Percentage
4	2	13.33
5	1	6.67
6	0	0.00
7	1	6.67
8	2	13.33
9	0	0.00
10	4	26.67
15	3	20.00
20	2	13.33
Total	15	100.00

The result in Table 4.5 clearly shows that most ERP systems are used for a
long period of time. Although, versions and updates can change periodically, the base
platform of the ERP system tends to stay for a long period of time.

Table 4.6 Frequency and percentage of respondents grouped by initial planning

Initial planning	Frequency	Percentage
Started with HR module.	1	6.67
Started with Supply chain module.	1	6.67
Started with Finance module.	2	13.33
Started with Ordering module.	1	6.67
To upgrade version of existing ERP system.	3	20.00
To align with parent company.	1	6.67
To unify global system.	1	6.67
Implemented first instance of ERP	1	6.67
Started with a single module (Did not specify which one)	1	6.67
Brought in 3rd party consultant to map out work process.	1	6.67
Unknown / No answer	2	13.33
Total	15	100.00

The result from Table 4.6 shows that upgrading existing ERP system was the number one reason why an ERP implementation project was initiated. Finance module was the first of many modules that companies planned to implement first.

Table 4.7 Frequency and percentage of respondents grouped by expected benefit

Expected benefit	Frequency	Percentage
Business process automation	5	11.90
Process transparency	1	2.38
High quality of data / Accurate data	3	7.14
Improved planning, forecasting, and analysis	5	11.90
Centralized data / One-stop for all data need / Integrated data / Data sharing	4	9.52
Backbone of the business	1	2.38
Standardized business process across business functions	3	7.14
Flexible to customize.	1	2.38
Minimize customization.	1	2.38
Effective workflow / Improved operation speed / Eliminate duplicate work process / Boosting work efficiency	7	16.67

Table 4.7 Frequency and percentage of respondents grouped by expected benefit (Cont.)

Expected benefit	Frequency	Percentage
Cost control / Minimize cost	3	7.14
Support customer requirements, inquiries, or KPI	2	4.76
Improved performance review	1	2.38
Improved business decision making	1	2.38
Improved traceability	1	2.38
Minimize use of paper	1	2.38
Real-time data	1	2.38
Improved product quality	1	2.38
Total	42	100.00

Based on the result displayed in Table 4.7, all companies had realistic expectations. Effective workflow is the number one expectation, followed by business process automation, and improved planning and forecasting. Centralized data is another main expectation.

Table 4.8 Frequency and percentage of respondents grouped by resistance from users

Resistance	Frequency	Percentage
Yes	4	26.67
No	7	46.67
Not stated / Unknown	3	20.00
Not clear answer	1	6.67
Total	15	100.00

Table 4.8 shows that it is surprising that there was not much resistance. The reasons why there were no resistance because it was either ordered by the upper management. Those that had some resistance solved the issue by communication from upper management. Therefore, it is apparent that upper management has a lot of impact on this factor.

Table 4.9 Frequency and percentage of respondents grouped by how users adapted to
the ERP system

Adaptation	Frequency	Percentage
Rely heavily on the ERP system.	5	33.33
Use less spreadsheet	2	13.33
Minor adjustment (Because system was customized to fit work process).	2	13.33
Use and adjust to fit work process.	1	6.67
Users adjusted to how standard ERP system work. (Not relying on customization)	3	20.00
Paper-based forms were adjusted to better match the ERP system for faster data entry.	1	6.67
Not clear answer	1	6.67
Total	15	100.00

The result from Table 4.9 shows that after the ERP was introduced, users adapted their work process to fit the ERP system and relied heavily on the system. Different techniques were used to help ease the users to the ERP system. Some companies preferred to customize the ERP system to fit the users, while the others tried to fit the users to the system. It cannot be determined clearly which technique worked better, since both techniques worked for different environments.

Table 4.10 Frequency and percentage of respondents grouped by the need of
integration of legacy systems

Legacy system	Frequency	Percentage
No integration needed.	3	12.50
No. Most of the legacy system were decommissioned.	1	4.17
Yes. Needed to integrate with global ERP system / Unified ERP system.	2	8.33
Yes. Needed to integrate with systems from customers or partners. / B2B systems.	4	16.67
Yes. Needed to integrate with Mainframe system.	1	4.17
Yes. Needed to integrate with text file system.	1	4.17
Yes. Needed to integrate with Business Intelligent system.	2	8.33
Yes. Needed to integrate with WMS system.	3	12.50

Table 4.10 Frequency and percentage of respondents grouped by the need of
integration of legacy systems (Cont.)

Legacy system	Frequency	Percentage
Yes. Needed to integrate with Scheduling system.	1	4.17
Yes. Needed to integrate with in-house system.	1	4.17
Yes. Needed to integrate with corporate credit card system.	1	4.17
Yes. Needed to integrate with contract system.	1	4.17
Yes. Needed to integrate with systems from acquired companies.	1	4.17
Yes. Needed to integrate with e-Commerce system.	1	4.17
Yes. Needed to integrate with fax-ordering system.	1	4.17
Total	24	100.00

The result from Table 4.10 clearly shows that the ERP system must be adjusted to work with existing systems within the companies. This is very common to most ERP implementations. Most companies have other separated systems that they need to keep running, but they also would like the ERP system to communicate with or gather data from those separated systems for higher work efficiency.

Table 4.11 Frequency and percentage of respondents grouped by whether the ERP
system could be deployed in the cloud or integrated with mobile devices

Cloud-enabled / Integratable with mobile devices	Frequency	Percentage
Yes. Can be deployed in the Cloud in the future.	9	34.62
Yes. Can be integrated with mobile devices in the future.	5	19.23
Yes. Already deployed in the Cloud.	1	3.85
Yes. Already integrated with mobile devices.	6	23.08
No. Cannot be deployed in the Cloud.	2	7.69
No. Cannot be integrated with mobile devices.	2	7.69
Not sure.	1	3.85
Total	26	100.00

Table 4.11 indicates that it is apparent that most ERP systems currently deployed at these companies can be deployed to the cloud. Many of them already integrated their ERP systems with mobile devices. As for the "No" or "Not sure"

answers, their current ERP systems can actually be deployed in the cloud and be integrated with mobile devices. The respondents might not be aware of those features. Most current ERP systems can now be deployed on the cloud. This is the future trend in the ERP software industry as described in Chapter 2 of this research. As for the integration with mobile devices, this trend has been around way before the emergence of the cloud technology. However, the integration was mostly limited to companies with strong financial status. This is due to the high cost of mobile devices and implementation fee during the early stages of the trend. This trend has changed dramatically during the past few years because of the lower cost of mobile devices and ubiquitous acceptance of mobile integration.

Table 4.12 Frequency and percentage of respondents grouped by how the users were initially trained to use the ERP system

Training	Frequency	Percentage
Used training modules / test environment / training sessions provided in-house.	3	21.43
Trained by external ERP consultants.	2	14.29
On-the-job training	2	14.29
Trained supervisors (Key users). Then supervisors (Key users) trained staff.	5	35.71
Read user manuals.	1	7.14
No answer	1	7.14
Total	14	100.00

From the result in Table 4.12 above, many companies chose the technique to train their key users first, then have those key users train other staff. This technique offers a lot of benefits. First, it is more cost-effective to train a group of key users a few times rather than having to hold training sessions multiple times. Second, it allows the key users to build strong relationship with other staff. This is healthy for businesses that stress team-oriented work environment.

Table 4.13 Frequency and percentage of respondents grouped by how companies
provided on-going training

On-going Training	Frequency	Percentage
Experienced users trained other users through on-the-job training.	4	33.33
No structured plan for on-going training.	1	8.33
Yearly training.	1	8.33
Trained through "key user community"	1	8.33
Trained through normal "staff orientation"	1	8.33
Via documentation / Video-training / Virtual Training.	4	33.33
Total	12	100.00

From the result displayed in Table 4.13 above, many companies chose the technique to have experienced users train other staff. Self-training via documentation, video-training, and virtual training were also popular techniques.

Table 4.14 Frequency and percentage of respondents grouped by how companies
provide on-going technical support

Support team	Frequency	Percentage
Used software vendor / Consultant support.	6	37.50
Established dedicated support team in-house (either local or global).	10	62.50
Total	16	100.00

Table 4.14 indicates that companies are using both techniques. Those companies without highly-trained IT or ERP professionals in-house preferred to contract external vendor or consultant to support the system. Those companies that have highly-skilled professionals tend to support in-house, then hire external support when necessary.

Table 4.15 Frequency and percentage of respondents grouped by how much the top management was involved

Executive involvement	Frequency	Percentage
Heavily involved. Served as project manager.	5	33.33
Heavily involved. Served as policy enforcer.	3	20.00
Heavily involved. (No clear role was specified.)	5	33.33
Unknown	2	13.33
Total	15	100.00

Table 4.15 shows that owners and executives were heavily involved with the ERP projects. Since ERP projects typical impact the overall efficiency of the company, owners and executives will likely be involved most of the time.

Table 4.16 Frequency and percentage of respondents grouped by satisfaction of top management

Satisfaction	Frequency	Percentage
Yes. Highly satisfied.	6	40.00
Yes. Satisfied.	6	40.00
No. Did not meet the expected results.	2	13.33
Not sure.	1	6.67
Total	15	100.00

From Table 4.16, apparently, most of the ERP implementations were deemed successful, especially companies with skilled IT professional in-house. The company that was not satisfied with the implementation, might not have a lot of experience in ERP implementation and not enough IT experts in-house. Therefore, it is imperative to have some skilled IT professional in-house to increase the success of ERP implementation.

4.2 Discussion of Findings

After all the data were entered and calculated by the spreadsheet, the results are displayed below. The percentage is calculated by the number of times each factor was mentioned divided by the total number of literature journals or respondents.

Table 4.17 Ranking of top ten success factors determined by the literature journal

Rank	Success Factor	Percentage
1	Top management support and involvement	66.67
2	Business process reengineering / automation	50.00
3	Effective education and training to users	50.00
4	Effective project management	50.00
5	Competent members of ERP team	50.00
6	Have clear desired results and objectives	33.00
7	User involvement	33.00
8	Right ERP vendor and consultant	33.00
9	Change management	33.00
10	Adequate IT infrastructure	33.00

Table 4.18 Ranking of top ten success factors determined by the questionnaire

Rank	Success Factor	Percentage
1	Effective education and training to users	100.00
2	Have clear desired results and objectives	93.33
3	Top management support and involvement	86.67
4	Must be able to integrate with legacy system	73.33
5	Business process reengineering / automation	46.67
6	Planning before implementation	46.67
7	Effective communication	33.33
8	Shared / Centralized / Integrated Data	26.67
9	Data accuracy	26.67
10	Right ERP vendor and consultant	20.00

From the top ten ranking statistics in Table 4.17 and 4.18, only five critical success factors are in common (not in ranking order):

- Top management support and involvement
- Business process reengineering / automation

- Effective education and training to users
- Have clear desired results and objectives
- Right ERP vendor and consultant

These common critical success factors are further discussed in more detail in the next chapter. Based on these common success factors, the independent variables introduced in the Conceptual Framework in Chapter 1 can now be mapped.
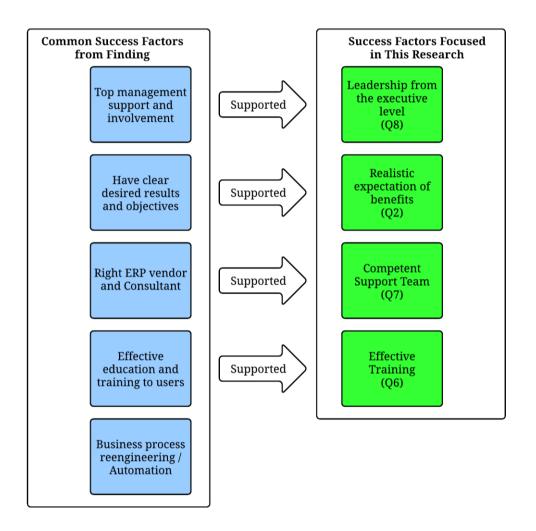

Figure 4.1 Mapping of common success factors from finding to success factors focused in this research.

As a result of the mapping, only four independent variables are supported by the finding of the research. The other four independent variables will be discarded. The research questions can now be reviewed and answered as follows:

Table 4.19 Result of research question testing

Alias	Research Question	Test Result
Q1	The success of an ERP implementation depends on thorough planning before the implementation.	Not enough supporting evidence
Q2	The success of an ERP implementation depends on having realistic expectation of benefits.	Agree
Q3	The success of an ERP implementation depends on having a scalable and integrable software package.	Not enough supporting evidence
Q4	The success of an ERP implementation depends on having adequate IT Infrastructure.	Not enough supporting evidence
Q5	The success of an ERP implementation depends on having the users adapt to the system.	Not enough supporting evidence
Q6	The success of an ERP implementation depends on having effective training.	Agree
Q7	The success of an ERP implementation depends on having competent support team.	Agree
Q8	The success of an ERP implementation depends on the leadership from the executive level.	Agree

Regardless of the size of the company, it is very common that the owners and the executives of the company would want to know if they should invest in a commercial ERP system or develop the ERP system in-house. Would a commercial ERP system be a better investment since it had been tried and tested? Which path would give better overall result? Based on the collected data in this research, it is apparent that the commercial ERP system does not guarantee overall satisfaction. In most cases, the overall satisfaction indicates whether the ERP implementation is a success or a failure. According to the data in Table 4.20, in-house developed systems

were used many years by companies. The satisfactions received were also very good among those companies that developed the ERP system in-house.

Table 4.20 Relationship between types of ERP system, number of years used, and satisfaction received

Respondent	Type of ERP system	No. of Years	Satisfaction
C001	In-house Development	8	Yes. Highly satisfied.
C002	Commercial ERP system	5	No.
C003	In-house Development	10	Yes. Satisfied.
C004	In-house Development	10	Yes. Satisfied.
C005	Commercial ERP system	4	Yes. Satisfied.
C006	Commercial ERP system	8	Yes. Satisfied.
C007	Commercial ERP system	4	Yes. Highly satisfied.
C008	Commercial ERP system	7	Yes. Highly satisfied.
C009	Commercial ERP system	15	No.
C010	Commercial ERP system	10	Yes. Highly satisfied.
C011	Commercial ERP system	15	Not sure.
C012	Commercial ERP system	10	Yes. Satisfied.
C013	Commercial ERP system	20	Yes. Highly satisfied.
C014	Commercial ERP system	15	Yes. Highly satisfied.
C015	Commercial ERP system	20	Yes. Satisfied.

The real benefit of the commercial ERP system is that it comes with standardized system out of the box, thus, there is no need to reinvent the wheel. That saves time, and perhaps, learning curve. However, the commercial ERP system does not guarantee 100% successful implementation out of the box. Other factors during the implementation process may deter the success of the implementation.

CHAPTER 5
SUMMARY, CONCLUSION & RECOMMENDATION

5.1 Summary

ERP implementation was chosen as the topic of the research due to personal curiosity of the researcher who had been involved with ERP systems for many years at work. At the start of the research, a number of critical success and failure factors of ERP implementation were identified by reviewing many academic journals and ERP software vendor information materials (i.e. websites and brochures). The critical factors were grouped and then ranked by the number of mentions in those academic journals and vendor information materials. These critical factors were then used to construct a questionnaire which would be used as a method of data collection. The questionnaire was designed to collect information from pre-implementation to post-implementation. The questionnaire was prepared in two formats: paper-based and online.

The online questionnaire was chosen as the medium for data collection since it was the easiest way to reach the selected group of subjects. Once the data from the respondents was collected, it was dissected, grouped by critical factors, and ranked by the number of mentions. The descriptive statistic derived from the data was created using spreadsheet software. The ranking result from the academic journals and ERP software vendor information materials was then matched with the ranking result from the respondents to justify which critical success factors were in common. Based on the findings from the questionnaire and the ranking results, conclusions and the basic framework could finally be created.

5.2 Limitations of the Research

Because an ERP system contains many important and confidential data of a company, it turned out to be very difficult to get responses for the questionnaire. Although, the survey clearly stated that it was not intended to ask for any confidential data, many companies did not give back any responses. A total of 56 companies (large and small, public and private) were invited to complete the survey, only ten companies (15 respondents) returned responses.

Due to time constraints, face-to-face interviews were removed as the method of data collection. However, this removal did not seem to affect the quality of the data. Responses from the questionnaire proved to be just as good.

5.3 Discussion

Based on the comparison of the rankings conducted in this research, five critical success factors were found to be in common: Top management support and involvement, Business process reengineering / automation, Effective education and training to users, Have clear desired results and objectives, and Right ERP vendor and consultant.

Top management support and involvement

Top management support and involvement is by far the most mentioned critical success factor among literature journals. It is very understandable why this success factor is so critical to the success of the ERP implementation. Because the ERP system involves many functions of the business, top management must play the role of coordinator to have users from different functions work together to create the most optimal ERP system for the company. This finding coincides with the research from Garg and Agarwal. Garg and Agarwal also concluded that top management support is one the top critical success factors. Top management has to be committed to the company and the project team. Top management should be a part of the Steering Committee to make important decisions (Garg & Agarwal, 2014).

The finding from the research conducted by Dezdar also supports that top management support and involvement is critical to the success of the ERP implementation. Dezdar concluded that top management must be involved actively and regard ERP implementation as a top-priority project. Top management has the responsibility to build a competent project team. They should also serve on the steering committee to oversee the implementation and the project team (Dezdar, 2012).

Business process reengineering and automation

According to the research from Garg and Agarwal, business process reengineering and automation is another key success factor. Garg and Agarwal concluded that business process should be reengineered and is necessary for ERP implmentation. They recommended that business should try to adapt to the default ERP system rather than modifying the ERP system to adapt to the business. Doing so would align the business process to the best practices worldwide (Garg & Agarwal, 2014). From the finding of this research, respondents from large companies mentioned that their companies tried to minimize the customization and stick with the standard of the ERP package as much as possible.

Often times, business process reengineering and automation would require some modification to the standard ERP system. Many literature journals recommended that customization should be minimized to have better rate of success in ERP implementation. While it is evident that business process reengineering and automation is a critical success factor, the choice whether to minimize the customization is still in debate. Based on the finding of this research, a number of companies clearly preferred to customize the ERP system extensively. The heavily customized ERP systems produced great results and were used for many years.

One reason why extensive customization of the ERP system is not considered a bad thing to do is mostly because many companies had complex requirements that standard ERP software packages do not support out of the box. Evidence from the research by Katerattnakul, Lee, & Hong supported this notion that small manufacturing companies are often forced by their customers, which are mostly larger companies, to adapt to the way the larger companies operate. The ERP systems of the smaller companies may be incompatible with the requirements of the larger companies. Thus, the managers of the smaller companies must either ask the larger companies to reduce or remove those incompatible requirements. That is not an easy task, however. The alternative is to modify the ERP system of the smaller companies to meet those requirements from the larger companies to overcome those incompatibilities (Katerattanakul, Lee, & Hong, 2014). This is an easier task. This seems to coincide with the data from this research. Two out of three companies that extensively customized their ERP systems are relatively small in terms of size (less

than 500 employees). Therefore, based on the finding of this research, minimization of customization cannot yet be considered a critical success factor.

Effective education and training to users

The research conducted by Dezdar supported that providing effective education and training to users are critical to the success of ERP implementation. Dezdar wrote that ERP training should include all areas of the ERP system. In order to obtain the full advantage of the ERP system, users must learn the functions that are related to their jobs and they must be trained continuously (Dezdar, 2012).

The data collected for this research indicates that all of the sampled companies conducted user training and on-going training. They differ in the method they used to train the users. The majority of the samples preferred to use the technique of training the key users first, then have the key users train the other users. Although, it is the most used method by this group of sample, there is no clear evidence that it is the best approach to train the users. It appears that this approach is used because it is cost-effective. No need to pay outside consultants many times.

Larger companies took a step further. They actually established training area with test environment ready for users to come and train what they need to be trained. Training materials such as video, user manual, and documentation were provided as supplement to the training.

Have clear desired results and objectives

According to the data obtained for this research, all companies from the samples had clear desired results of what the ERP systems should accomplish. The top four results are: effective workflow, business process automation, improved planning and forecasting, and centralized data.

Right ERP vendor and consultant

Having the right ERP vendor and consultant are critical to most ERP implementations, especially for companies that choose to purchase ERP system rather than develop the system themselves. Maditinos, Chatzoudes, and Tsairidis concluded in their research that having ERP consultants to help implement the ERP system may

improve the performance of ERP systems because the consultants have experience and technical expertise. They can effectively transfer and share the ERP system know-how to the users. Users can then use the obtained knowledge to successfully maintain and modify the ERP system themselves (Maditinos, Chatzoudes, & Tsairidis, 2011).

The findings in the research from Dezdar also supported that having the right ERP vendor and consultant is critical. Dezdar explained that ERP implementing companies need comprehensive support because ERP implementation is a complex project. The support should include the following: user training, technical assistance, emergency maintenance, and updates (Dezdar, 2012).

5.4 Conclusion

Among the eight chosen critical success factors (a.k.a. independent variables) that are focused in this research, only four critical success factors had enough evidence to support that they are critical to ERP implementation for manufacturing businesses in Thailand. See Figure 5.1. They are Leadership from the executive level, Realistic expectation of benefits, Effective training, and Competent support team. These critical success factors seem to hold true regardless of areas where the manufacturing businesses are physically located. Literature journals that are referenced by this research conducted their research using samples from areas such as Korea, India, and Europe. The results are similar to the samples conducted in Thailand.

The other four success factors that did not have enough evidence to conclude (i.e. planning before implementation, scalable and integrable software package, IT infrastructure, and user adaptation to the system) are, by no means, not critical. They are legitimate success factors that have supporting evidence by other researches. They should be used as part of the recommendation for ERP implementation.
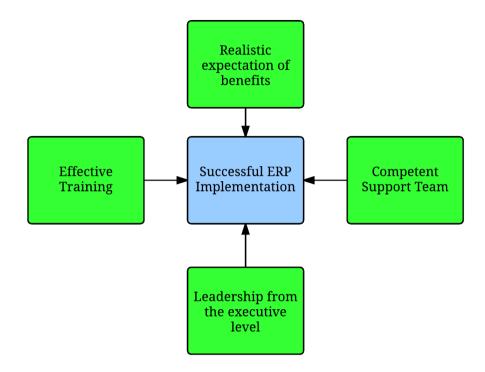
Figure 5.1 Evidence supported critical success factors for ERP Implementation

It can be concluded that to achieve success in ERP implementation, business should focus on the non-technical aspects of an ERP implementation much more than which software package to purchase because those non-technical aspects are often the leading causes of failure in ERP implementation. Emphasis on leadership from the top management must be the top priority. Realistic expectation of results must be established. A support team must be identified early in the implementation process. Once the ERP system is up and running, continues to train and re-train users.

5.5 Final Basic Framework & Recommendation

In Chapter 2, the basic framework for successful ERP implementation was proposed. The basic framework was, however, too broad to be used as a reliable guideline for ERP implementation. In this Chapter, the basic framework can now be modified to include tested results conducted in this research. Remember that this is a basic framework, which means that additional steps can be added to the list depending on the need of each business. However, if only the tasks listed in the framework are performed, those elements of success listed are expected to be achieved. Note that

these elements of success are from the ANP framework for success ERP implementation depicted in Figure 2.4 in Chapter 2.
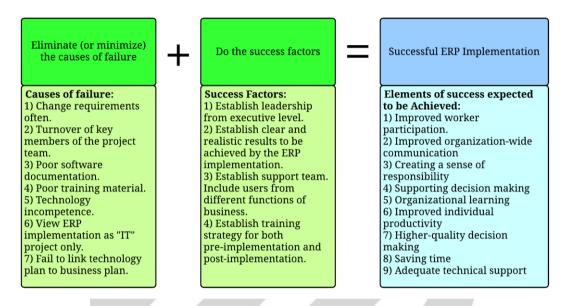

Figure 5.2 Final Basic Framework

To clarify when the guidelines listed in the framework should be applied, the guidelines can be further broken down to the three phases of ERP implementation: Pre-Implementation, In-Process Implementation, and Post-Implementation. However, these guidelines can generally be applied to any phases of the ERP implementation.

Pre-Implementation:

- Management must be actively involved in the planning of the implementation.

- Establish clear and realistic expectations of what the ERP system will provide for the business once the ERP system has gone live.

- Establish the support team and get them involved early in the implementation process. The team may consist of in-house IT professionals, ERP software consultant, and key users from different functions of business. Do not view the ERP implementation as an "IT" project only. This is one of the critical failure factors.

- Provide initial training to the key users. At this stage, the training would be mostly overview of the ERP system. Also, set training plan for post-implementation.

In-Process Implementation

- Avoid changing the requirements. This is one of the critical failure factors. The requirements should be discussed and signed off during the pre-implementation phase. However, if small problems occur, do not overlook them.

- Create good software documentation of the new work process. Poor quality of software document is one of the critical failure factors.

- Gradually train key users once some requirements have been met. This will not overwhelm the users.

Post-Implementation

- Provide on-going training to users for new features and updates to the ERP system.

- Try to retain the key members of the project team. Turnover of key members is one of the critical failure factors.

For manufacturing companies that are planning to implement new ERP systems or improve existing systems, the basic framework described above can be used as a starting point. These guidelines are based on the findings of this research and the critical factors, both success and failure, found in literature journals.

5.6 Further Research

For researchers that are planning to conduct further investigation of critical success factors, having more samples would definitely improve the justification of the critical success factors. Larger samples would help the researcher to see the distinction in the ranking of the critical success factors. More variation in terms of company size from the sample would also be helpful. Unfortunately for this research, only two samples were collected from small and medium-sized businesses. Having more samples from small and medium-sized businesses may improve or lower the ranking of some critical success factors (e.g. IT infrastructure).

Another improvement to future research is to include more inferential statistics to support the test result. In this research, the dependent variable (Successful ERP Implementation) was based on satisfaction received by the samples (e.g. Highly

Satisfied). This research did not use numbers to represent the level of satisfaction received. In future research, this dependent variable can use numbers to represent the level of satisfaction; therefore, it could be tested against other independent variables using the t-test.

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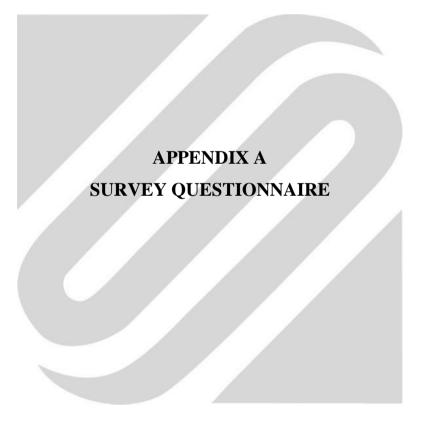
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APPENDIX A
SURVEY QUESTIONNAIRE

ERP Implementation Survey

Thank you very much for taking the time to fill out this survey. This survey is part of a research testing the success of ERP implementation for manufacturing or manufacturing-related businesses. This survey is designed to test different success and failure factors of ERP implementation to determine if your ERP implementation is considered successful.

All information from the survey will be used only for the study and kept completely confidential. The survey does not intend to ask for any confidential data. In any questions, if you feel that your answers will be too confidential to disclose, please skip or write "Confidential".

Sincerely,
Armorntape Sinthorntham
Graduate student
Stamford International University (Bangkok)
eMail: armorntape.s@stamford.edu

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ขอขอบพระคุณท่านผู้ตอบคำถามเป็นอย่างสูงที่ได้สละเวลาในการตอบแบบสอบถามนี้ แบบสอบถามนี้เป็นส่วน หนึ่งของงานวิจัยเพื่อทดสอบความสำเร็จในการใช้งานระบบ ERP สำหรับบริษัทอุตสาหกรรมหรือบริษัทที่ เกี่ยวข้อง แบบสอบถามนี้ถูกออกแบบมาเพื่อทดสอบองค์ประกอบต่างๆในการพัฒนาและการใช้งานระบบ ERP เพื่อนำมาสรุปว่าการใช้งานระบบ ERP ของบริษัทท่านได้รับประโยชน์สูงสุดหรือไม่

ข้อมูลจากแบบสอบถามนี้จะถูกนำไปใช้ประกอบงานวิจัยนี้เท่านั้นและจะถูกเก็บเป็นความลับ แบบสอบถามมิได้ มุ่งหวังที่จะถามคำถามที่เป็นความลับของบริษัทท่าน หากในคำถามใดที่ท่านรู้สึกว่าจะเกี่ยวข้องกับความลับของ บริษัทซึ่งไม่อาจเปิดเผยได้ รบกวนให้ข้ามคำถามไปหรือเขียนว่า "เกี่ยวกับความลับ"

ขอบพระคุณอย่างสูง
อมรเทพ สินธรธรรม
นักศึกษาระดับปริญญาโท
มหาวิทยาลัยนานาชาติแสตมฟอร์ด (กรุงเทพฯ)
อีเมล์: armorntape.s@stamford.edu

General Information | คำถามทั่วไป   (* = required)

1) Name of your company *
   ชื่อบริษัทของท่าน

2) Type of business *
   ประเภทธุรกิจของท่าน

3) Nationality of your company *
   สัญชาติของบริษัทของท่าน

   O Thai   O Other

   _____

4) Number of employees *
   จำนวนพนักงาน

   O 1-50   O 51-200   O 201-500   O 501-1000   O >1000

5) Your name
   ชื่อของท่าน

6) Company title
   ตำแหน่งงานของท่าน

Question regarding ERP system | คำถามเกี่ยวกับระบบ **ERP**

1) What is the name of the ERP system your company is using?
   กรุณาระบุชื่อของระบบ ERP ที่บริษัทของท่านใช้งานอยู่

2) How long has your company been using your current ERP system?
   บริษัทของท่านใช้งานระบบ ERP ที่ใช้อยู่ปัจจุบันมานานเท่าไหร่แล้ว

3) How did your company plan for the ERP implementation?
   บริษัทของท่านได้วางแผนในการใช้ระบบ ERP อย่างไร

4) What were the expectations or benefits your company would gain from the ERP system?
   บริษัทของท่านหวังจะได้ประโยชน์อะไรจากการใช้งานระบบ ERP

5) Were there any resistance from the users before the ERP system was introduced? How did your company resolve the issue?

ก่อนเริ่มใช้ระบบมีผู้ใช้ต่อต้านในการใช้งานระบบ ERP หรือไม่ หากมีบริษัทของท่านจัดการปัญหานี้อย่างไร

6) How have the users adapted to the ERP system?

ผู้ใช้งานระบบ ERP ได้ปรับวิธีการทำงานเพื่อให้เข้ากับระบบ ERP อย่างไรบ้าง

7) Did you have any legacy systems that the ERP system must integrate with? Please explain.

บริษัทของท่านมีระบบสารสนเทศอื่นๆ ที่ระบบ ERP ต้องปรับให้ทำงานร่วมกับระบบดังกล่าวหรือไม่ กรุณาอธิบาย

8) Can your ERP system be deployed in the Cloud or be integrated with mobile devices?

ระบบ ERP ที่ใช้อยู่ปัจจุบันสามารถปรับใช้กับเทคโนโลยีก้อนเมฆ $(Cloud)$ หรืออุปกรณ์เคลื่อนที่ได้หรือไม่

9) How did your company train users when the ERP system was introduced?

บริษัทของท่านทำการอบรมผู้ใช้งานระบบ ERP อย่างไรตอนเริ่มใช้งานระบบ

10) How does your company provide on-going training for the ERP system?

บริษัทของท่านมีการอบรมต่อเนื่องให้กับผู้ใช้งานระบบ ERP อย่างไร

11) How does your company provide on-going technical support or improvement to the ERP system currently?

บริษัทของท่านให้การสนับสนุนทางด้านเทคนิคหรือการปรับปรุงระบบ ERP อย่างไร

12) How much have the owners or the executives of the company been involved in the ERP implementation?

เจ้าของหรือผู้บริหารของบริษัทได้มีส่วนร่วมในการพัฒนาหรือใช้งานระบบ ERP มากน้อยเพียงใด

13) Are the owners or executives satisfied with the results and benefits of the current ERP system? Please explain.

เจ้าของหรือผู้บริหารของบริษัทพึงพอใจกับประโยชน์ที่ได้รับจากระบบ ERP หรือไม่ กรุณาอธิบาย

APPENDIX B
CLASSIFICATION OF BUSINESS SIZE

Classification of Business Size. Based on Thai law issued in year 2000.

Type	No. of Employees (Person)		Total value of Fixed Assets (Million Baht)	
	Small	Medium	Small	Medium
Manufacturers	Less than or equal to 50	51 to 200	Less than or equal to 50	51 to 200
Wholesalers	Less than or equal to 25	26 to 50	Less than or equal to 50	51 to 100
Retailers	Less than or equal to 15	16 to 30	Less than or equal to 30	31 to 60
Services	Less than or equal to 50	51 to 200	Less than or equal to 50	51 to 200

Remarks: In case the number of employees of the business falls in the Small category, but the total value of fixed assets falls in the Medium category, the business is classified as a small business. In case the number of employees of the business falls in the Medium category, but the total value of fixed assets falls in the Small category, the business is classified as a small business.

Source: http://www.rd.go.th/publish/38056.0.html

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