IMPLEMENTATION OF ENTERPRISE INFORMATION SYSTEMS: A COMPARATIVE STUDY OF ENTERPISE APPLICATION INTEGRATION (EAI) VS ENTERPRISE RESOURCE PLANNING (ERP)

by

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ABSTRACT

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This dissertation is a two part study which examines and compares two of the most common Enterprise Integration technologies: Enterprise Resource Planning (ERP) and Enterprise Application Integration (EAI). The first part examines the perceptions of individuals toward each of the technologies.

The second part of the study compares and contrasts the two Enterprise Integration technologies with respect to the factors leading to success (or failure). The model determines three levels of factors and is derived from the two-factor motivational studies of Herzberg and Maslow's Hierarch of Needs. In addition, it attempts to discover

which groups of factors may be more important for explaining the variance in implementation success, leading to a more theoretically compelling model than previously available. Finally, there is a re-examination of the factor groups to determine if different factor groups are more or less important for implementation success of each of the two integration technologies.

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CHAPTER 1

INTRODUCTION

1.1 Background

The last half-century has shown us some phenomenal growth in the Information Technology arena. From the introduction of the first all-electronic computer (ENIAC) in 1947 and the first personal computer (Simon) in 1949, computers have progressed to ever-increasing speeds, memory and storage capacity, and processing power. We have seen Super Computers and Mini-Super Computers, Sun and UNIX workstations and servers, Apple and IBM (and others) personal computers, and laptop computers. The applications available to run on these computers have proliferated nearly as fast as the computers. We have spreadsheets, databases, word-processors, and many specialized applications for finance, sales, customer service, human resources, etc.

At first, many of these systems were dedicated to specific tasks, such as accounting and finance or human resource management. Because of this dedication, many organizations found themselves acquiring a variety of computer systems and applications to handle their many different functional areas, leading to a mix-mash of computer technologies. As the power and capacity of computers increased, the need for separate application specific systems was reduced. A single system could now handle multiple applications at the same time, reducing or eliminating the need for multiple

systems. However, organizations found than many of their systems were incompatible with each other and would not seamlessly interact. Rather than replace systems, organizations continued to operate with their existing hardware and applications, leading to obsolete systems, redundancy of hardware and data, inconsistencies of data from one system to another, etc., leading to islands of automation

In an attempt to alleviate some of the problems many organizations turned to networks. At first, networks were simply central mainframes connected to remote, dumb terminals. As technology advance, however, networks moved toward the client/server architectures which had servers which provided applications and databases, but instead of dumb terminals, the clients were full computers. In some cases, clients also functioned as servers. While this aided in linking systems together, allowed multiple applications to be executed from a single server, and allowed many users to access the same application in a client/server environment, many systems simply would not interact with each other. In addition, while networks aided somewhat, they also acerbated the problems of incompatibilities with many different approaches to networking such as, Novell, Cisco, MicroSoft, etc.

As it became increasingly important (for a variety of reasons) for organizations to consolidate their applications, hardware, data, etc., the concept of Enterprise Integration (EI) arose. EI has progressed through a variety of generations including Materials Requirements Planning (MRP), Enterprise Resource Planning (ERP), Business Process Re-engineering (BPR), and Enterprise Application Integration (EAI). BPR and ERP have seen much interest from researchers through the last few decades, and are very

closely related. EAI on the other hand is fairly new and has just recently become a topic for research, although earlier versions such as middleware and Federations of Systems have been around for about as long as ERP. ERP and EAI are quite different in their implementations, but have the same basic goal of integrating the Information Systems across the entire enterprise. These similarities as differences will be addressed later in this paper (Chapter 3).

There have been many articles dealing with ERP and BPR, with a majority focusing on success or failure of ERP/BPR implementations as will be discussed later. Even with all these articles about success/failure and the factors leading to success or failure, however, many implementations continue to fail. This raises questions about why so many implementations fail with all the research. Perhaps it is because we, as researchers, have failed to investigate the underlying theories surrounding implementation success and failure.

This study is an attempt to introduce some theoretical perspectives into the Enterprise Integration stream of research. It re-examines the success and failure factors from a perspective of needs. The model is derived from Maslow's Hierarchy of Needs (Maslow, 1943, 1954) as related to an organization and influenced by the two-factor perspective pioneered by Herzberg (Herzberg, 1965, 1974, 2003). Success (and failure) factors are grouped into either hygienic factors which must be present, but are not sufficient for success and motivational factors which are more helpful to success, but will not work without the foundation of hygienic factors. In addition, the attitudes and

perceptions of Information Systems professionals are evaluated to better understand Enterprise Integration decisions.

There are two major portions of this study. The first is driven by the need to understand individual perceptions and perspectives on Enterprise Integration technology choices. The primary research question for the first portion of the thesis is:

> "What shapes an individual's perceptions of Enterprise Integration technologies, specifically Enterprise Resource Planning and Enterprise Application Integration?"

The answer to this question will be answered through the use of an electronic survey (e-survey) targeting Information Technology individuals. The model for the first portion is detailed in Chapter 2. Understanding individuals' perceptions is an important part of explaining why some technologies are more widely accepted than others, but is only one of several potential factors in the successful implementation of an Enterprise Integration system. This brings us to the second major portion of the study, which examines the success factors associated with Enterprise Integration implementations.

Many studies have provided us with a plethora of factors and factor groupings. This second major portion of this study is an attempt to introduce some theoretical perspectives into the Enterprise Integration stream of research and to simplify the model to highlight the criticality or necessity of the major factors and factor groups associated with Enterprise Integration success. It addresses questions associated with success factors and implementation success, as well as differences in level of impact of the factors on implementation success. A final question deals with the differences between

the implementation needs of the two Enterprise Integration technologies. The three primary research questions for the second half of this study are:

1. "What factors are significant for implementation success?"
2. "Are any factor groups more important or significant than others for implementation success?"
3. "Are the associations of the factor groups different for each of the different Enterprise Integration technologies?"

The model for part two is derived from Maslow's Hierarchy of Needs (Maslow, 1943, 1954) as related to an organization and influenced by the two-factor perspective pioneered by Herzberg (Herzberg, 1965, 1974, 2003). Success (and failure) factors are grouped into either hygienic factors which must be present, but are not sufficient for success, and motivational factors which are helpful, but not necessarily required. Chapter 3 contains the details of the model and the e-survey used to capture the data for the second portion of this study. The target audience for this e-survey is the same group of Information Technology individuals previously mentioned.

1.2 History of Enterprise Integration

The need for enterprises to integrate their Information Systems is derived from the proliferation of Information Technology throughout the second half of the twentieth century. The phenomenal growth and diversification of Information Systems has made it easy for organizations to have separate systems for each different application.

There are four major functional areas where Information Technology has had an impact on organizational operations. These four areas are: Marketing and Sales,

Production and Materials Management, Accounting and Finance, and Human Resources (Brady et al, 2001). The functional areas are not independent, but often share critical data and processes. Historically, however, these areas have been treated as separate entities with little or no interaction between them (Brady et al, 2001). This narrow view of operations has created many problems for organizations. Some of the biggest problems involve the way Information Technology has been procured and managed.

There are many systems and applications available for each functional area. As organizations focused attention on each area, they often selected proprietary systems and software to handle the operations. In many cases, several different systems and applications were utilized, each performing only a single set of functions. The result was that organizations found themselves with many different systems performing many different functions and, usually, not able to share information between them. This meant that data might have to be entered in several places, increasing the risk of error or inconsistencies. In addition, maintaining this variety of systems and software required personnel trained in each of the systems. Providing the needed personnel required either adding new Information Technology workers or training current ones on each new technology.

1.2.1 Materials Requirements Planning

One area of operations in which organizations have found integration to be vitally important is that of the supply chain operations or materials planning. Having an integrated system throughout the supply chain is critical for successful operations. For instance you need to be able to use the number of orders to determine the number of

products needed which then determines the number of parts needed. The warehouse needs to be checked to see if there are sufficient parts or finished products to fill the order. New parts need to be ordered when warehouse supplies get low. Conversely, you need to know how many finished products can be produced so the sales department can know when to promise goods to the customers.

The need to integrate all the functions of inventory management became increasingly important to organizations. Inventory costs, lost sales, and other factors drove the development of ways to increase the efficiency of the Materials Management processes. One of the most logical steps was to automate the management process and to integrate all the functions into a single, cohesive process. Since these functions were currently being handled by a variety of different systems, some means for communicating between the various functions became critical. Electronic Data Interchange (EDI) allowed some computers to share information, but not all systems were able to utilize EDI. In addition, modifying the existing systems to allow them to use EDI required major changes to both applications and hardware. These changes were disruptive to operations, required highly skilled workers, and were often cost prohibitive.

As an alternative, new systems and applications were developed to replace the old ones. These new Information Systems, referred to as Materials Requirements Planning (MRP), encompassed the entire process of Materials Management (Chiplunkar, Chattopadhyay, & Deshmukh, 2001; Schaaf, 1999; Vandaele & De Boeck, 2003). In order to handle the entire set of operations associated with Materials Management, an MRP system not only integrated systems and processes in the Production and Materials

Management functional area, but also crossed functional boundaries to incorporate aspects of other functional areas. To understand this need to cross the functional boundaries, we need to examine the entire set of business processes associated with Materials Management. A business process is a series of steps necessary to complete a task. For example, a customer wants to order a product. The customer places an order. The order then goes through accounting to record the funds transfer. Once the funds are verified, the order goes to manufacturing. If the product is available, it can be packaged and shipped. If the product is not available, it must either be produced or procured. If production is required, then the parts must be allocated. If parts are not available, they need to be procured or manufactured, repeating parts of the process. In addition, manufacturing and personnel must be scheduled to produce the product. To order parts or products, procurement and accounting need to be involved. Once all the parts are ordered and the manufacturing is scheduled, packaging and delivery must be considered. Finally, the customer can be given an expected date of delivery. As this example shows, the ordering and manufacturing process crosses all functional areas of the organization. Information Systems which cross multiple functional boundaries are often referred to as Enterprise Systems. Because they cross several functional boundaries, these MRP systems were some of the earliest versions of an Enterprise System.

Technological advances aided in the capability and spread of MRP systems. Computer systems got faster and more powerful, while at the same time they got smaller and less expensive. More powerful computers meant that multiple applications could be performed by a single computer which came to be known as a server. The server could

then allow other computers, called clients, to access the applications and data on the server. The development and spread of local intranets and client/server architectures aided this effort tremendously. Intranets provided the backbone for server-to-server communications as well as between servers and clients. Development of relational databases also aided in the centralization of data for an organization. Centralization of data into a single database led to the concept of normalization. Under normalization, each fact or piece of data is stored in a single location, reducing the need for duplication of data. Elimination of duplicate data reduces data anomalies and inconsistencies, and ensures that everyone is using the same set of data. The centralized database is one of the critical underpinnings of MRP and, eventually to other Enterprise systems such as Enterprise Resource Planning (ERP).

1.2.2 Enterprise Resource Planning

The wide-spread use of the MRP systems led organizations to evaluate other business processes. Continued improvements in computer capacity and speed allowed the MRP system to be expanded to include other processes within various functional areas, even though these new processes may have had nothing to do with materials management. These additional applications or modules could be designed to take advantage of the existing servers and centralized database. The resulting system was coined "MRP-II" (Altomonte, Mooney, & Sheldon, 1999; Schaaf, 1999). MRP-II is actually a misnomer, however, since the additional modules really have nothing to do with MRP. MRP-II should still be considered one of the first Enterprise Systems.

The first ERP system was developed by two German engineers who founded SAP in the early 1970s (Edmondson, 1994; Okrent & Vokurka, 2004). SAP has become the world's largest inter-enterprise software company and the world's third-largest independent software provider overall (www.sap.com). Since the foundation of SAP and the introduction of ERP, growth of ERP systems has been dramatic with many vendors offering ERP systems. Some of the major ERP vendors include: SAP, Oracle, and PeopleSoft.

ERP systems have been defined in many ways (see Table 1.1). In fact, there are probably as many definitions as there are articles and books about ERP. For the purposes of this study, ERP is an enterprise-wide combination of business management practice and technology, where Information Technology integrates and automates many of the business practices associated with the core business processes, operations, or production aspects of a company to achieve specific business objectives. It is a centralized system with a central database and application server, which all functional areas share. An implementation usually encompasses an entire replacement of the existing system(s) with the new ERP system. Even though there are many parameters to allow for some customization, and ERP system is still a rigid system which requires organizations to conform their business practices to fit the ERP system.

Table 1.1: ERP Definitions

Definition	Source
Sets of business applications that allow for an organization-wide management of operations.	(Al-Mashari, Al-Mudimigh, & Zairi, 2003)
A software infrastructure embedded with "best practices," respectively best ways to do business based on common business practices or academic theory.	(Bernroider & Koch, 2001)
A company-wide Information System that tightly integrates all aspects of a business. It promises one database, one application, and a unified interface across the entire enterprise.	(Bingi, Sharma, & Godla, 1999)
Highly integrated enterprise-wide Information Systems (software packages) that automate core corporate activities (business processes) such as finance, human resources, manufacturing, and supply and distribution.	(Holland & Light, 1999)
A packaged business software system that enables a company to manage the efficient and effective use of resources by providing a total, integrated solution for the organization's information-processing needs.	(Nah, Lau, & Kuang, 2001)
Software packages that integrate information across the entire organization. This integration removes inconsistencies and enables the organization to attain consolidated reports.	(Shakir, 2000)
A combination of business management practice and technology, where Information Technology integrates and automates many of the business practices associated with the core business processes, operations, or production aspects of a company to achieve specific business objectives.	www.sap.com

ERP systems are usually highly complex, expensive, and difficult to implement. Besides the traditional MRP functionality, ERP systems include applications for many other functional areas such as Customer Relationship Management (Gefen & Ridings, 2002; Kim, 2004; Lewis, 2001), Sales and Marketing processes (Gardiner, Hannam, & LaTour, 2002; Hsu & Chen, 2004; Muscatello, Small, & Chen, 2003), Human Resources (Francalanci, 2001; Markus, Tanis, & van Fenema, 2000; Willis, Willis-Brown, & McMillan, 2001), Accounting and Finance (Caglio, 2003; Gornas, 2004), Supply Chain Management (Akkermans, Bogerd, Yücesan, & van Wassenhove, 2003; Al-Mashari & Zairi, 2000; Nah, 2004), and Operational and Logistical Management (Al-Mashari et al.,

2000; Schonsleben, 2000). Many ERP vendors are offering some or all of these functions as options (of modules) within their offering. Organizations can usually pick and choose between modules, implementing only those which are applicable to their situation.

Since implementing an ERP requires the replacement of existing systems with the new system, there are many challenges for organizations. Users must learn to use the new system and may harbor bitterness about having to change. Organizations may have to restructure how they operate in order to fit into the rigid requirements of the ERP system. Business may be disrupted during the restructure or during the cutover from the old system to the new. All data migrating from the various legacy systems must be examined and normalized to reduce the possibility of data corruption or inconsistency.

Many ERP implementations fail for a variety of reasons, leading to a popular stream of academic research to attempt to explain why implementations fail and what needs to be done to prevent or reduce future failures. There are many research articles discussing the success and failure factors associated with ERP implementations (Barker & Frolick, 2003; Ho & Lin, 2004; Huang, Chang, Li, & Lin, 2004). We also have several case studies (Gibson, Holland, & Light, 1999; Mandal & Gunasekaran, 2003; Wiers, 2002) and best practices studies (Frantz, Southerland, & Johnson, 2002; Kumar, Maheshwari, & Kumar, 2002; Mabert, Soni, & Venkataramanan, 2000) which give us additional insight into how to proceed with an implementation to improve chances of success. Even with all the research about ERP system success and failure, there is still a high percentage of failure in ERP implementations (Kim, 2004; Sarkis & Sundarraj,

2003). This indicates that more research is needed to discover why ERP implementations continue to fail.

It is important to understand the consequences of an ERP failure. There are several well-known cases of ERP implementation failures which can be used to demonstrate the implications of ERP failure. Fox Meyer is an excellent example. In addition to the cost of the new system, problems encountered during the ERP implementation cost Fox Meyer $34 million to cover uncollectible costs related to shipping and inventory problems, eventually leading to the company filing for bankruptcy. Another example is Hershey Corp. who lost 35% in stock price and lost a bundle in sales (Melymuka, 2004) resulting in a 19% loss in profit, and that's after spending $112 million to set up ERP and supply chain applications (Songini, 2000).

The risks involved in an ERP implementation are quite large, but the benefits continue to entice organizations to migrate to an ERP system. Take Hershey Corp. for instance. After spending $112 million and an initial profit loss of 19%, they struggled through the implementation and now have a successful system which aided in a recent revenue increase of more than 12%, a $100 million increase (Songini, 2000). In addition, they have also started to realize benefits associated with the simplicity of upgrading an ERP system (Weiss & Songini, 2002). Once the system is installed, upgrades can be very easy with very little impact, as long as the initial configuration did not require changes to the core code of the ERP system. These benefits, along with the disadvantages should be examined closely before any decision is made about making the plunge into an ERP

implementation. Some of the benefits and disadvantages of ERP are listed in Table 1.2 and Table 1.3, respectively.

Table 1.2: Benefits of ERP

Benefit	Source
Accurate, Trouble-free DataBases	Lee, Siau, Hong (2003), Fowler & Gilfillan (2003)
Better Product Quality	Lea, Gupta, Yu (2005)
Centralized Data Repository	Lee, Siau, Hong (2003), Davenport (1998), Fowler & Gilfillan (2003)
Cost Containment	Lee, Siau, Hong (2003)
Cost Reduction	Lee, Siau, Hong (2003), Lea, Gupta, Yu (2005)
Faster Customer Responsiveness	Lea, Gupta, Yu (2005), Fowler & Gilfillan (2003)
Fewer Personnel	Lea, Gupta, Yu (2005)
Higher Productivity	Lea, Gupta, Yu (2005), Davenport (1998), Fowler & Gilfillan (2003)
Improved order management	Lea, Gupta, Yu (2005)
Increase Agility/Flexibility	Lee, Siau, Hong (2003), Davenport (1998)
Lower inventory	Lea, Gupta, Yu (2005)
Minimize Data Complexity/ Redundancy	Lee, Siau, Hong (2003), Davenport (1998), Fowler & Gilfillan (2003)
On-time delivery	Lea, Gupta, Yu (2005)
Reduce Cycle Times	Lee, Siau, Hong (2003), Davenport (1998), Fowler & Gilfillan (2003)
Standardize Business Processes	Lee, Siau, Hong (2003), Davenport (1998), Fowler & Gilfillan (2003)
Streamline Data Transfer	Lee, Siau, Hong (2003), Davenport (1998)
Defragment Business Processes	Davenport (1998), Fowler & Gilfillan (2003)
Higher Efficiencies	Davenport (1998)
Lose Competitive Advantage through standardization	Davenport (1998)
Streamline Management structure (flatter/ more flex)	Davenport (1998)
Centralized control	Davenport (1998)
Inject Discipline into Organization	Davenport (1998)
Consistency of Operations	Fowler & Gilfillan (2003)
Faster Updates (SW Revisions)	Fowler & Gilfillan (2003)
Easier Backups	Fowler & Gilfillan (2003)
Facilitates Benchmarking	Fowler & Gilfillan (2003)
Faster System Response Time	Fowler & Gilfillan (2003)

Table 1.3: Disadvantages of ERP

Disadvantage	Source
Adequacy of new business process designs	Lea, Gupta, Yu (2005)
Centralized Structure	Davenport (1998)
Compatibility of data architectures	Lea, Gupta, Yu (2005), Davenport (1998)
(Legacy vs. New ERP system)	
Complexity of ERP	Lea, Gupta, Yu (2005), Davenport (1998)
High Implementation Costs	Lee, Siau, Hong (2003), Davenport (1998)
Difficulty in Customizing	Davenport (1998)
Does not allow for non-standard processes	Davenport (1998)
Employee Resistance to Change	Lea, Gupta, Yu (2005)
Requires High Level of Expertise	Davenport (1998), Sheu, Yen, & Krumweide (2003), Fowler & Gilfillan (2003)
High Risk	Lea, Gupta, Yu (2005), Davenport (1998)
Inadequate Training	Lea, Gupta, Yu (2005)
Matching ERP w/ Business Needs	Davenport (1998)
Org Structure Changes	Lea, Gupta, Yu (2005), Davenport (1998)
Scope of Project	Davenport (1998)
Strategic View of Technology Adoption	Lea, Gupta, Yu (2005)
Technology readiness of org	Lea, Gupta, Yu (2005)
Time Consuming	Lee, Siau, Hong (2003), Sheu, Yen, & Krumweide (2003)
Underestimated Implementation Cost	Lea, Gupta, Yu (2005)
Underestimated Implementation Time	Lea, Gupta, Yu (2005)
Unwillingness to adopt new business processes	Lea, Gupta, Yu (2005)
Initial Performance Dip	Fowler & Gilfillan (2003)
Going Live not End of Story	Fowler & Gilfillan (2003)
Ongoing/Maintenance Costs	Fowler & Gilfillan (2003)
Cultural Changes	Fowler & Gilfillan (2003)
Inflexibility of System	Fowler & Gilfillan (2003)
Supplier Lock-In	Fowler & Gilfillan (2003)
BPR incompatible with new system	Fowler & Gilfillan (2003)

1.2.3 Business Process Reengineering

As the popularity of ERP increased, it became more and more apparent that businesses re-evaluate their processes to achieve more efficient and effective operations. While ERP systems typically offer a variety of processes to choose from, they are still very rigid and actually force organizations to realign their business processes to fit into the particular business processes supported by that ERP architecture. Technological

advances, such as corporate intranets, shared databases, faster computers, etc. greatly aided in the ability of organizations to reengineer their processes. The basic concept was for organizations to examine their business processes to determine where problems might be with the process. Once a process was detailed and the problems defined, the process could be redesigned, or reengineered, to help alleviate the problems. This reengineering effort gave us the concept of Business Process Reengineering (BPR).

BPR is a management approach that examines aspects of a business and its interactions, and attempts to improve the efficiency and performance of the underlying processes through deliberate and fundamental change in business processes (Grover, Jeong, Kettinger, & Teng, 1995). BPR attempted to help organizations to understand what they were doing right and what was being done wrong. It also gave them insight into which processes might benefit from an integration system such as MRP.

BPR projects were often long and costly (Davenport, 1998; Teng, Jeong, & Grover, 1998). Solutions, such as Information Systems, might require time, effort, and expense to develop. Failure was common (Grover et al., 1995; Ip & Chen, 2004). Since the functional areas from one company to another are basically the same, systems developers created standard solutions. These solutions had some success, but still had many problems. What works for one organization might not work for another. Many organizations used the standard solutions or "best practices" to "fix" their own processes by simply copying what their competitors were doing (Davenport, 1998). In many cases, these copycat organizations did not perform BPR to determine if they needed to apply the

solution. It is also important to note that what might be a best practice for one organization or industry might not be a best practice for another.

Not all BPR projects were failures. From the successes, researchers have tried to capture the best practices of a BPR project and determine factors which led to success. The failures were also examined to aid in finding factors which might lead to failures (Grover et al., 1995; Teng, Grover, & Fiedler, 1994).

1.2.4 Enterprise Application Integration

One of the most often cited practices to improve the odds of success of ERP is to implement in small steps, either a module at a time, a business unit at a time, or some other manageable procedure. ERP implementers have begun following this method with some success, but a new approach is emerging which embraces this process inherently. Enterprise Application Integration (EAI) is an alternative to ERP and allows integration to proceed as quickly or as slowly as desired.

As with BPR and ERP, EAI has been defined in many different ways (see Table 1.4). EAI is a set of processes, software and hardware tools, methodologies and technologies, which, when implemented together, have the aim of consolidating, connecting and organizing all a business's computer applications, data and business processes (both legacy and new) into a seamlessly interfaced framework of system components to allow real-time exchange, management and easy reformulation of all of a company's mission critical information and knowledge. EAI is more of a de-centralized approach with a centralized controller which allows communications and sharing of information between systems. An implementation (unlike for ERP) usually encompasses

a system at a time and does not replace the system, but integrates it into the EAI architecture. EAI goes by many other names such as Application Services, Federation of Systems, Middleware, etc. Some of the most popular vendors are MicroSoft with its Web Services Architecture, Vitria Technology, Tibco Software, and webMethods. A specific vendor technology, however, is not required. MicroSoft and Sun, for instance, provide frameworks (.Net and Java Enterprise Edition, respectively) which make EAI possible through tools such as XML and SOAP.

Table 1.4: EAI Definitions

Definition	Source
A framework by which an organization centralizes and optimizes application integration, usually through some form of push technology that is event-driven.	(Imhoff, 2005)
A set of tools utilizing a message broker to transfer data between applications. A set of tools which allow users to define business processes and make data integration subject to rules that govern those processes.	(McNurlin & Ralph H. Sprague, 2002)
A solution to the complex technical challenge of creating a number of interfaces between disparate applications to implement collaborative sharing of information.	(Shields, 2001)
Connecting internal enterprise applications such as financial, ERP, CRM, and manufacturing systems with each other and with transactional e-business systems.	(Watt, 2002)
The unrestricted sharing of data and business processes throughout the networked applications or data sources in an organization.	http://www.webopedia.com

The concept of EAI has been around for several years in various incarnations. It has only been during the last few years, however, that it has become more popular, mostly due to the release of MicroSoft's Web Services and the .Net architectures. The basic concept of EAI is to continue to use existing systems, but to tie them together with a coordination system. The coordinating system allows communications with and between the various systems which have been integrated with it. The system is very flexible and allows an organization to integrate as quickly or slowly as desired. Since

there are no major hardware or software changes, implementation is fairly simple and straightforward.

In contrast to ERP systems, the impact of EAI on the organization is more manageable. Operations are transparent to users as they continue to use the existing systems. No additional training is required. Organizational processes do not necessarily have to be modified to conform to some "perfect" form. There is little disruption to operations since existing systems continue to operate. Costs and implementation times are reported as being much lower for EAI than ERP implementations.

There are downsides, however. Some systems are very difficult to integrate with the coordinating system. Extensive code modifications may be required to build the interface to these systems. Highly skilled programmers are needed to perform the interfacing. The organization will have to continue providing support for multiple platforms and applications, also requiring highly skilled Information Systems personnel. Again, the advantages and disadvantages of EAI should be weighed before an integration decision is made.

CHAPTER 2

LITERATURE REVIEW

2.1 Enterprise Resource Planning

Enterprise Systems and the Integration of Information Systems across the enterprise has been a popular area of research for several years. There are thousands of articles addressing the issues related to Enterprise Integration. In just the area of Enterprise Resource Planning (ERP), there have been several hundred publications since the early 1980's. Figure 2.1 shows the publication trend for ERP articles, indicating a few articles starting in the 1980's through about 1987, with a marked increase in the late 1990's. Publications spiked during Y2K, and have dramatically increased since, to more than 450 in 2004 and 2005 (each). While the number of articles for 2006 appears to be a decline, it must be understood that this review was performed in mid 2006 and there are already nearly 200 publications available, so it can be expected that this number will also increase to more than 400. There are many other Enterprise Integration technologies besides ERP, so this example is only the tip of the iceberg.

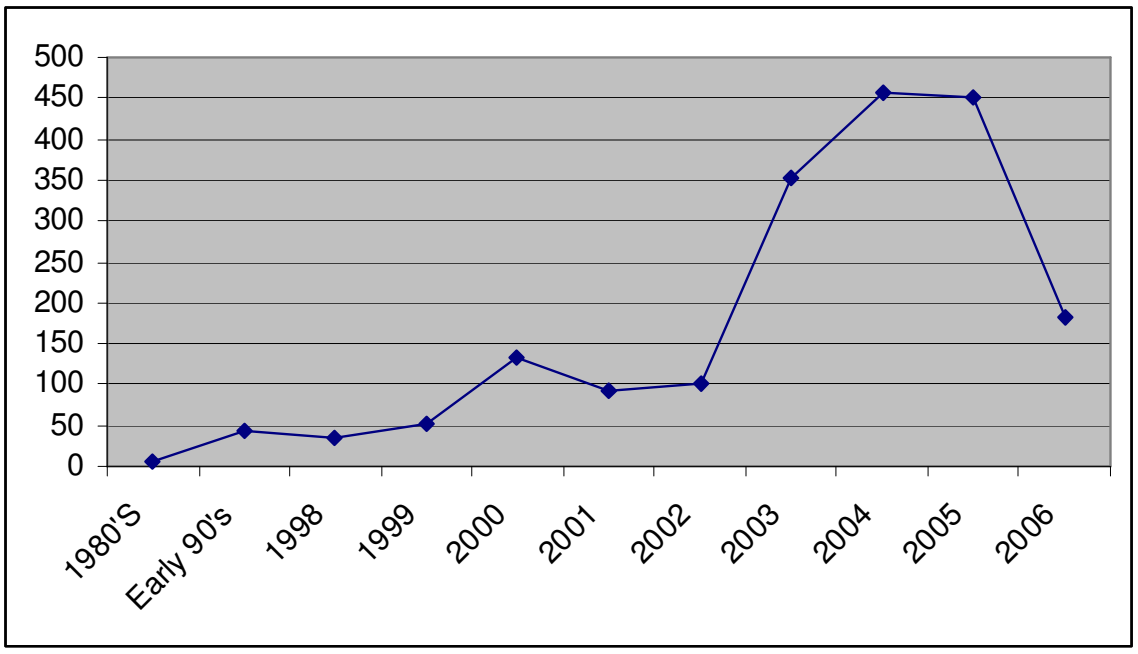


Figure 2.1: Trend in ERP publications

The continued publication of articles dealing with Enterprise Integration suggests that this is still an area of great interest to both researchers and practitioners. This is not surprising considering the large numbers of organizations which are turning to Enterprise Integration as a solution for their problems (Sarkis et al., 2003).

2.1.1 Overview of ERP Publications

The earliest articles about ERP systems were in the early 1980's, which is to be expected considering the first ERP system (SAP) was not developed until the 1970's (Edmondson, 1994) and it took some time before the real impact of this type of system became widespread. Many of these early articles, however still had a focus on Materials Requirements Planning (MRP) rather than specifically on ERP (Brucker, Flowers, & Peck, 1992; Bruggeman & van Dierdonck, 1985; Domnick, 1991; Kneppelt, 1981).

In the mid 1990's the topic of Business Process Reengineering (BPR) began to emerge (Canton, 1994; Cullinane, 1994; De Bruyn & Gelders, 1997; Maull & Weaver, 1995). BPR was closely tied to ERP and many studies indicate that you cannot have one without the other (Grover et al., 1995; Guimaraes & Yoon, 1997; Sheridan, 1994; Teng et al., 1994).

Even though many of these early articles discussed the concept of ERP, a concentration on ERP systems did not occur until the late 1990's (Bowen, 1998; Corcoran, 1998; Upton & McAfee, 1997). This increase in interest was possibly in response to all the concerns about issues surrounding the year 2000 (Y2K) (Cole, 1999; Dugan, 1999); however, many of the articles were still simply mentioning companies which were implementing (or not implementing) ERP systems (Avital & Vandenbosch, 2000; Hirt & Swanson, 1999; Hughes, 1999; Zerega, 1998).

It was also during the late 1990's when we began to see articles discussing the challenges involved in implementing an ERP system (Glover, Prawitt, & Romney, 1999; McAlary, 1999), as well as the large numbers of implementation failures (Kettinger & Teng, 1998; Narasimhan & Jayaram, 1998). Following closely on the challenges and failures were studies aimed at discovering the antecedents of ERP success (Bingi et al., 1999; Holland et al., 1999). Frameworks and models also began to appear (Boudreau & Robey, 1999; Brown & Vessey, 1999; Kettinger et al., 1998).

Since the turn of the century, interest in ERP has gained in momentum. Even with all the studies which have been done, a large number of Enterprise Integration projects fail (Barker et al., 2003; Holland & Skarke, 2001; Umble & Umble, 2002). The

failure rate has been significant with reports indicating that anywhere from 66% (Sarkis et al., 2003) to 90% (Kim, 2004) of these project fail.

The large number of failures has encouraged researchers to try to answer the question of why these projects fail. Many studies have attempted to detail the success factors or antecedents for success of Enterprise System implementations (Al-Mashari et al., 2003; Dowlatshahi, 2005; Guimaraes, 1997; Guimaraes et al., 1997; Hong & Kim, 2002; Loh & Koh, 2004b). Enterprise Systems can be very complex (Francalanci, 2001; Ko, Kirsch, & King, 2005; Scheer & Habermann, 2000), resulting in many factors which could have an impact on the successfulness of a project. Taxonomies and typologies have attempted to classify these factors (Al-Mashari et al., 2003; Soh, Kien Sia, Fong Boh, & Tang, 2003; Somers & Nelson, 2004; Themistocleous & Irani, 2000). Frameworks (Ash & Burn, 2003; Childe, Maull, & Bennett, 1994) and models (Al-Mashari, 2003; Dong, 2000; Shanks, 2000; Teltumbde, 2000) have also been developed to aid in understanding the phenomena associated with Enterprise Integration.

2.1.2 Categories of ERP Studies

Many of the ERP articles reviewed during the course of this study mention ERP only in passing, such as ERP being an Information System being used (Fan, Stallaert, & Whinston, 2000). Others are announcements which either discuss an organization's implementation of ERP (Avital et al., 2000; Bhattacherjee, 2000; Hirt et al., 1999), or improvements made by ERP vendors (Bacheldor, 2003; Bartholomew, 2004; Bradley, 2006; Saran & Thomas, 2004; Songini, 2004). These articles, while showing the growing popularity of ERP systems, do not really add much value to academic research. There

are many other studies, however, which are useful to academicians. The following sections briefly discuss several of the major categories of ERP research.

2.1.2.1 ERP Case Studies

Case studies are one of the most popular categories of ERP studies. There have been over 100 articles involving case studies in ERP. The earliest case study was performed in 1992, and really focuses on an MRP system, but discusses ERP as well (Brucker et al., 1992). It was not until the late 1990s, however, that ERP case studies began to proliferate. One popular topic for case study research is that of ERP success (McGinnis, Pumphrey, Trimmer, & Wiggins, 2004; Motwani, Mirchandani, Madan, & Gunasekaran, 2002; Scheer et al., 2000) or failure (Barker et al., 2003; Narasimhan et al., 1998; Rantala & Hilmola, 2005).

Case studies have focused on a variety of organizations and industries, such as Chemical and Petroleum (Badell, Romero, Huertas, & Puigjaner, 2004; Chen, Chiniwar, Lin, & Chen, 2006), banks (Cooper, Watson, Wixom, & Goodhue, 2000; Lam, 2005a) and other finance (Luo & Strong, 2004; Mandal, 2001; Shtub, 2001), and manufacturing (Narasimhan et al., 1998; Rantala et al., 2005; Tatsiopoulos, Panayiotou, Kirytopoulos, & Tsitsiggos, 2003). Some of the major companies represented by case studies include CISCO (Austin, Nolan, & Cotteleer, 1999), Dow Chemical (Chen et al., 2006), and Dow Corning (McNurlin et al., 2002; Ross, 1999).

In addition to the variety of industries represented by case studies, we have also seen a focus on several different type of applications presented by ERP systems, such as Data Warehousing (Chen et al., 2006; Cooper et al., 2000), Materials Requirements

Planning (Brucker et al., 1992; Koh & Saad, 2006), Customer Relationship Management (Chen et al., 2006; Holiday, 2003; Lam, 2005a), and Finance (Luo et al., 2004; Mandal, 2001; Shtub, 2001).

2.1.2.2 Success Factors, Antecedents, Frameworks, and Models

In addition to case studies, the search for Critical Success Factors (CSFs) or Antecedents for success has driven a lot of ERP research. This literature review turned up nearly forty studies attempting to identify the CSFs or Antecedents for ERP success (Al-Mashari et al., 2003; Guimaraes et al., 1997; Ho et al., 2004; Holland et al., 1999; Loh & Koh, 2004a).

These antecedents and CSFs, along with the case studies, have led to the development of several categorization schemes (Al-Mashari et al., 2003; Parr & Shanks, 2000b; See Pui Ng, Gable, & Chan, 2002; Somers et al., 2004; Themistocleous et al., 2000) and frameworks (Brown et al., 1999; Luo et al., 2004; Shtub, 2001; Teltumbde, 2000). Nearly 100 articles discussing taxonomies and frameworks were located throughout the development of this dissertation.

In addition to the taxonomies and frameworks, many models have been developed. These models and discussions of them encompass perhaps the largest group of studies, approaching 200 at the time of this writing. These models cover areas such as CSFs (Holland et al., 1999; Somers & Nelson, 2001), extensions of other models to include ERP (Amoako-Gyampah & Salam, 2004), ERP project issues (Parr & Shanks, 2000a; Shanks, 2000), Top Management Issues (Dong, 2001), Change Management (Al-Mashari, 2003; Nah et al., 2001), and many others.

Current models, frameworks, taxonomies, etc. are quite complex with many categories, factors, and antecedents. A practitioner attempting to utilize one of these models is faced with a huge number of activities which must be done correctly for their project to succeed. If he tries to do all of them, he might not be able to do all of them well, resulting in a mediocre performance on most of them. If he chooses some to do well, then others suffer from lack of attention. The result is that there is much confusion among practitioners who try to sort through the many articles, models, frameworks, factors, antecedents, etc. associated with Enterprise Integration to try to find a solution to their Enterprise System problems. Making the right decisions about which factors to concentrate more on becomes a hit and miss proposition, resulting in the large number of failures previously mentioned. The goal of this study is to provide a better model for Enterprise Integration Implementation which will help the practitioner make informed decisions about where to focus efforts to control projects, leading to an increase in potential for success.

2.2 Enterprise Application Integration

Examining literature relating to Enterprise Application Integration (EAI) proves to somewhat more difficult than for ERP. One of the reasons for the difficulty is the variety of names and terms used to refer to EAI, including: middleware, federation of systems (FOS), systems of systems (SOS), web services, and service oriented architecture (SOA). Some of these terms, such as web services, do not necessarily refer to application integration, making searches even more difficult and time-consuming.

2.2.1 Overview of EAI Publications

The earliest articles located which discuss EAI do not really focus on a specific application, but they do discuss Enterprise Integration and the need for it (Benjamin & Morton, 1988; Fornalczyk, 1980; Sundaram & Thangamuthu, 1986). In the 1990s, the terms Federation of Systems (FOS) or Systems of Systems (SOS) began to appear (Owens, 1995; Sage & Cuppan, 2001). Since the end of the 1990s and early 2000s, EAI was referred to as middleware (Caseau, 2005; Kara, 1999; Nof, 2003).

In the early 2000s, MicroSoft presented an EAI application called "Web Services", which has become a popular new way of referring to EAI (Knorr, 2003; Kreger, 2003; Lim & Wen, 2003). The growth of Web Services has led to the advent of the Service-Oriented Architecture (SOA), which many IT professionals consider to be the new EAI (Ferguson, 2005; Garritano, 2005; Gutteridge, 2005; Lager, 2005).

2.2.2 Categories of EAI Publications

As with the ERP publications, there are several different directions for EAI studies. Many of the articles are discussions of what EAI or, in many cases, SOA is (Crowley, 1998; Gulledge, 2006; Lager, 2005; Taft, 2004). Other articles discuss features and enhancements of EAI applications or why organizations should select EAI applications (Baker, 2005; Bradbury, 2004; Imhoff, 2005; McKean, 2005). There are many other articles which have discussed EAI in its different incarnations, but only a few are of interest to the academic world.

Unlike for ERP, the number of EAI case studies is really quite limited. In fact, there were really only fourteen located during the research for this study (Fricko, 2006;

Geerts & White, 2004; Sutherland & Heuvel, 2002). There have also been very few (the author located six) articles investigating factors for success and failure for EAI (Fraser, 2006; Karpinski, 1999; Lam, 2005b; Plain, 2003; Shin & Leem, 2002; White, 2006). One might infer from this that the field has not yet been tapped for academic research. Of course it could also be that studies simply have not yet been completed for publication.

The number of frameworks developed for EAI is somewhat better, with nearly fifty EAI articles discussing frameworks. Several of these focus on an Enterprise Architecture Framework rather than specifically for EAI (Hite, 2004; Morganwalp & Sage, 2003). Others are specifically for EAI (Busschbach, Pieterse, & Zwegers, 2004; Currie, 2003; Giachetti, 2004). Model development articles are also well represented with well over seventy (Bernus, 2003; Smart, Maull, & Childe, 1999; Tao, Hong, & Sun, 2004).

CHAPTER 3

MODEL DEVELOPMENT

3.1 Individual Perspective

With all the research previously performed on Enterprise Integration, there is little or no literature on the perceptions of technology individuals toward the various Enterprise Integration technologies. This is surprising since personal opinions weigh heavily in making decisions of any kind and Enterprise Integration decisions are no different. In addition, sometimes what a person would like to do is not always what his organization does, especially when the decision is technical in nature and the decision maker is a general manager. There are several studies on end-user perceptions (Amoako-Gyampah, 2004; Nah, Tan, & Teh, 2004). However, that is not the direction of this study.

In the case of an organization making an Enterprise Integration decision, technical people such as the Chief Information Officer (CIO) should be involved in determining the needs of the organization. When the CIO is involved in this type of decision, he can voice his opinions as well as his recommendations about which technology to adopt. His opinions may be respected and followed. In other instances, however, the CIO's recommendations may not follow industry trends and may be ignored and a decision made simply because the organization is doing "what everyone else is doing". Following

the crowd is common and institutional theory, particularly mimetic isomorphism, provides some understanding into this phenomenon (DiMaggio & Powell, 1983; Gates, 1997; Hambrick, Finkeistein, Cho, & Jackson, 2005). Sometimes an organization may not have a choice, but is mandated (possibly by the government) to adopt a particular technology. This is another type of isomorphism (coercive) that is represented by institutional theory.

Whether information technology personnel are involved in the decision making process or not, the organization's Enterprise Implementation choice may or may not match the individual's. It is important to understand the individual's perspectives and opinions because it is the individual of a group of individuals who will be involved in implementing the technology chosen. If the choice matches that of the individual, he may be more enthusiastic about the project and do a better job than if the choice does not match, especially if the choice has a high level of risk and potential to damage the organization. Information systems success literature provides us with some verification of this phenomenon. Measures such as perceived usefulness, expectation of benefits, intention to use, user satisfaction, etc. have proven to be important to the success of information systems (DeLone & McLean, 2003; Seddon, 1997).

One of the objectives of this thesis is to understand individual perspectives about Enterprise Integration technologies and to compare individual choice to organization choice. In addition, the impact of the individual perspective on the success of Enterprise Integration implementation will be examined.

There are two major types of Enterprise Integration which will be included in this thesis – Enterprise Resource Planning (ERP) and Enterprise Application Integration (EAI). ERP is an enterprise-wide combination of business management practice and technology, where Information Technology integrates and automates many of the business practices associated with the core business processes, operations, or production aspects of a company to achieve specific business objectives. It is a centralized system with a central database and application server, which all functional areas share (Caglio, 2003; Gupta, 2000; Harris, 1999; Ribbers & Schoo, 2002). An implementation usually encompasses an entire replacement of the existing transaction processing or core system(s) with the new ERP system. This could possibly be compared to the performance of a heart-lung transplant, with the same criticalness for the organization as is experienced by the individual – a successful operation could mean new or extended life for the patient or organization, while a failure normally means death (Scott & Vessey, 2002). It is also a rigid system which requires organizations to conform their business practices to fit the processes supported by the ERP system.

EAI is similar to ERP, but has some critical differences. EAI is a set of processes, software and hardware tools, methodologies and technologies, which, when implemented together, have the aim of consolidating, connecting and organizing all a business's computer applications, data and business processes (both legacy and new) into a seamlessly interfaced framework of system components to allow real-time exchange, management and easy reformulation of all of a company's mission critical information and knowledge. EAI is more of a de-centralized approach with a centralized controller

allowing and enabling communications and sharing of information between systems. An EAI implementation (unlike for ERP) usually encompasses a system at a time and does not replace the system, but integrates the existing system(s) into the EAI architecture (Anderson et al., 2005; Lee, Siau, & Hong, 2003; Tao et al., 2004).

The basic goals of ERP and EAI are quite similar in that they strive for operational improvement. This is achieved by both through recognizing gains in productivity, product quality, efficiency, and customer satisfaction. It is also reached through reductions in cycle-time, inventory, and cost (Davenport, 1998; Fowler & Gilfillan, 2003; Lea, Gupta, & Yu, 2005; Lee et al., 2003).

Likewise, ERP and EAI share many of the same challenges. When integrating systems to share a central database, the data from all the different systems must be standardized and any discrepancies repaired. This can be a very difficult proposition in either EAI or ERP. Project management challenges are basically the same for both – managing resources, time, people, etc.

The differences in ERP and EAI, however, are striking. One huge difference is that ERP represents a total replacement of a system or set of systems, requiring the user to learn an entirely new way of performing his job. EAI, on the other hand, does not replace any systems. Instead, it connects or interfaces existing systems with a controlling system (often referred to as middleware since it functions in the middle of the interconnected systems), resulting in an integration of multiple systems with little impact to the users (i.e. they don't have to learn a new system). The trade-off here, though, is that the technical skills required for ERP are much less than that for EAI. ERP requires

the IT personnel to know only the ERP system, and customization of ERP is kept to a bare minimum if performed at all. ERP systems do typically provide a selection or menu of various business processes which allow some customization, but still only as dictated by the ERP system. Interestingly, this customization is usually performed by functional employees who have been trained by the vendor rather than IT personnel. Conversely, EAI requires the IT personnel to be familiar with all systems being integrated as well as the interface technology. It also requires a significant amount of customization to incorporate the various interfaces for the integrated systems. Since ERP represents a replacement of several different systems with a new one, it can be much more costly than EAI which only adds a system for coordinating the others.

A second major difference is that ERP is very rigid. Since customization is kept to a minimum, business processes are forced to conform to the processes supported by the ERP system. Although ERP systems do let the organization select from a menu of processes, EAI is much more flexible and more customizable to the specific business processes of each organization. Again, this requires the IT personnel to have in-depth knowledge and training on how to customize the EAI system to meet the needs of their organization. Another way of describing this difference is that, for ERP, you program the organization and its processes to fit the ERP system, but for EAI, you program the system to fit the organization.

Another important difference lies in the way the technologies are implemented. ERP implementations have historically followed the "big-bang" approach of doing everything all at once (Duplaga & Astani, 2003; Hirt et al., 1999). Studies have shown

that the big-bang approach is quite risky and likely to fail and that one of the safest ways to implement ERP is to do a phased approach and only implement one module or business unit at a time (Davenport, 1998; Scott et al., 2002). Only recently have ERP vendors attempted to follow a more step-by-step approach to implementation. EAI implementations, on the other hand, are inherently step-by-step, allowing implementation of only one system at a time.

When considering the advantages and disadvantages of ERP and EAI it can be seen that there are trade-offs between each of the technologies. Each has positive aspects and negative aspects. In forming a preference for one or the other, an individual needs to have some knowledge about each one. A person who has had experience working with either technology will have that experience to draw upon when forming an opinion. Those without experience must rely on word-of-mouth or publications about ERP and EAI in order to make an opinion judgment.

Table 3.1: A Comparison of ERP to EAI

ERP	EAI
Replacement of entire system(s)	Continued use of existing system(s)
High impact on users	Low impact on users
High cost	Low (relative to ERP) cost
Low levels of customization required	High levels of customization required
Low level of technical skill required	High levels of technical skill required
Program organization's processes to new system	Program new system to organization's processes
Long time frame for implementation	Shorter time frame for implementation
High risk	Low risk
High level of commitment (difficult to go to a different system)	Low level of commitment (easy to go to a different system)
Decreased organizational agility	Increased organizational agility
Centralized architecture	Distributed architecture
High resistance	Low resistance

3.2 Individual Model

The goal of this part of the thesis is to determine individual preference for EAI and ERP. Opinions about EAI and ERP are not mutually exclusive. An individual can have high opinions about one, both, or neither. Our dependent variable for this part of the thesis, therefore, examines the perception the individual has about the each of the technologies separately, and measures the likelihood of the individual selecting EAI and/or ERP (or neither).

Because of their high cost, long implementations, big-bang approach (historically) to implementation, and high failure rates, ERP systems can represent a significant risk to organizations. Most ERP vendors realize that the big-bang approach does present some significant risks, however, and no longer advocate the all-at-once approach. In fact, SAP recommends a phased approach. This does not reduce the significant commitment involved in an entire forklift system replacement. The total replacement of systems by a new system still represents an all or nothing project. If the new system does not work properly, then the old system (or another new one) must be reactivated, which could impose significant risks. Also, because of the high cost and commitment, once an ERP system is selected an organization is usually stuck with it whether they like it or not. EAI systems, however, are much less risky. If the new system doesn't work properly, the old system is usually still in place and nothing is lost besides the relatively small (compared to ERP) cost of the middleware. Since ERP systems are considered very risky (especially when compared to EAI), more risk averse organizations may choose EAI over ERP. Examining an individual's preference for either ERP or EAI, therefore, should contain an

evaluation of his risk-taking propensity. The individual's risk-taking propensity (RTP) therefore, becomes an independent variable.

In addition to measuring an individual's risk-taking propensity, people are motivated in many different ways and have widely different personalities. There are many measures of personality, but the one we are interested in for this study is the concept of a career anchor. A career anchor is defined as "the one thing a person would not give up if forced to make a choice," (Schein, 1990). Knowing a person's career anchor can give some insight into what motivates him in his decisions. Each of the career anchors will act as a moderating variable, affecting the relationships between Risk-taking Propensity and the preferences for ERP and EAI.

Schein described eight different career anchors (Schein, 1990). When applying the career anchor concept to making Enterprise Integration decisions, however, we really only need to look at two. The Technical/Functional (TF) Competence anchor describes people who have a strong talent and high motivation for a particular kind of work, and strive to be the experts in their field. Knowledge in other areas is weaker and if placed in a different area, a TF would not be as happy and would work to get back into their area of competence and comfort. A strong TF personality would likely be very familiar with the different technologies in their field, including Enterprise Integration. Therefore, it would be expected that the TF would have stronger opinions one way or the other about each of the technologies, providing a more clear-cut and defined position on ERP or EAI preference.

The second anchor to be considered for this study is the General Managerial (GM) Competence. The GM anchor describes people who are essentially the opposite of the TF. Instead of developing an expertise in a single area, they view that goal as being an undesirable trap. Instead, they desire knowledge in several functional areas, allowing them to be able to make decisions across an entire organization rather than only a single functional are. Since they are not as knowledgeable about technology as the TF, and must consider many different aspects of the organization, a GM's preference for ERP or EAI would be more clouded and less-well defined.

Experience with either (or both) of the Enterprise Integration technologies (ERP and EAI) will have some impact on this choice with bad experiences resulting in lower potentials for selection and good experiences having higher potentials for selection. It is expected to act as a moderating variable, which will have a strong impact on the relationship between RTP and the preference of the individual for the Enterprise Integration technology. A high level of experience will equate to a good experience and low levels of experience will equate to a bad experience. Experience will be split into two variables, one for Experience with ERP (E-ERP) and one for Experience with EAI (E-EAI).

Based on these variables and relationships, we can design our model as depicted in Figure 3.1.

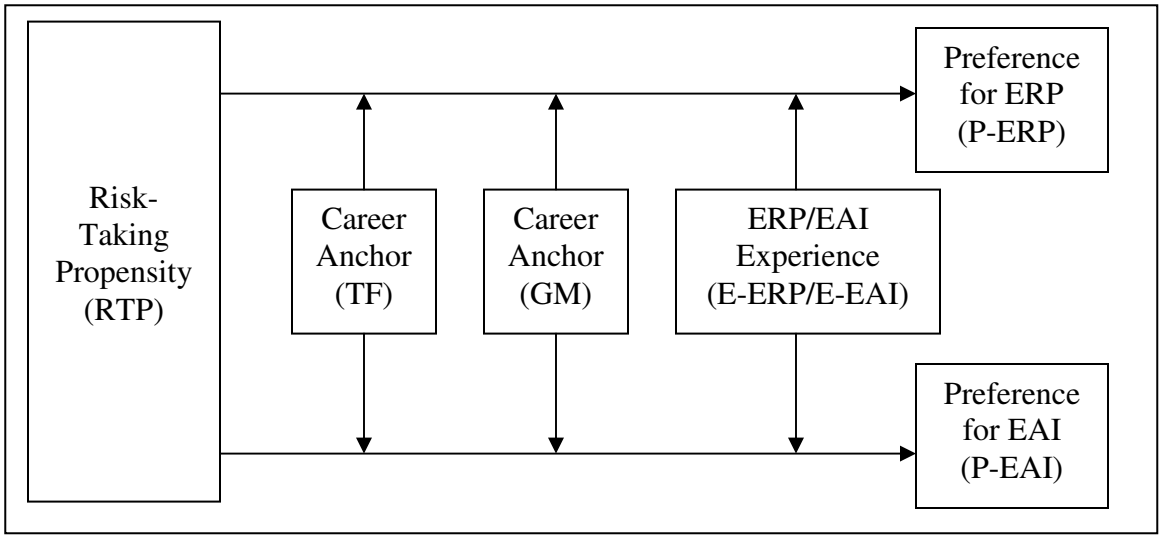


Figure 3.1: Individual Selection Model

ERP is viewed as being very risky with high costs and high failure rate. EAI is viewed as being less risky with lower costs. It is expected that people with low risk-taking propensities would be less likely to choose ERP, and more likely to choose EAI, but only because that is the only other option. High risk-taking propensity should lead to a higher level of ERP selection than for low risk-taking propensities. However, high risk-taking propensity is not expected to reduce the likelihood of selecting EAI. From this we get the following hypotheses:

Hypothesis 1: Risk-Taking Propensity (RTP) is positively related to Preference for ERP (P-ERP)

Hypothesis 2: RTP is negatively related to Preference for EAI (P-EAI)

Measuring risk-taking propensity can be a challenge. Several studies provide insight into risk-taking propensity (Kamalanabhan & Sunder, 1999; Stewart Jr. & Roth, 2001; Stoddard & Fern, 1999; Williams, 1965). For this study, several previously used measurements were examined and adapted to the particulars of evaluating risk in

Enterprise Integration perceptions (Brendle, 2001; Kogan & Wallach, 1964; MacCrimmon & Wehrung, 1990). Table 3.2 details the statements which were used to measure risk-taking propensity.

Table 3.2: Risk Propensity Measures

When I want something, I'll sometimes go out on a limb to get it.
If the possible reward was very high, I would not hesitate putting my money into a new business that could fail.
Taking risks does not bother me if the gains involved are high.
I would enjoy the challenge of a project that could mean either a promotion or a loss of a job.
I rarely, if ever, take risks when there is another, safer alternative.
I try to avoid situations that have uncertain outcomes.
I would participate only in business undertakings that are relatively certain.
I would probably not take the chance of borrowing money for a business deal even if it might be profitable.

As described previously, the career anchor is expected to make the choice either more or less clear-cut depending on which career anchor the individual falls under, making it a moderating variable. The hypotheses related to the career anchors are:

Hypothesis 3a: Technical/Functional career anchor (TF) will positively moderate the strength of the relationship between RTP and P-ERP

Hypothesis 3b: TF will positively moderate the strength of the relationship between RTP and P-EAI

Hypothesis 4a: General Manager career anchor (GM) will negatively moderate the strength of the relationship between RTP and P-ERP

Hypothesis 4b: General Manager career anchor (GM) will negatively moderate the strength of the relationship between RTP and P-EAI

Table 3.3 shows the survey questions used to determine TF and Table 3.4 shows the survey questions used to determine GM. These questions were drawn directly from Schein's Career Anchors (Schein, 1990).

Table 3.3: Technical/Functional Competence Questions

I dream of being so good at what I do that my expert advice will be sought continually.
I will feel successful in my career only if I can develop my technical or functional skills to a very high level of competence.
Becoming a senior functional manager in my area of expertise is more attractive to me than becoming a general manager.
I would rather leave my organization than accept a rotational assignment that would take me out of my area of expertise.
I am most fulfilled in my work when I have been able to use my special skills and talents.

Table 3.4: General Manager Competence Questions

I am most fulfilled in my work when I have been able to integrate and manage the efforts of others.
I dream of being in charge of a complex organization and making decisions that affect many people.
I will feel successful in my career only if I become a general manager in some organization.
Becoming a general manager is more attractive to me than becoming a senior functional manager in my current area of expertise.
I would rather leave my organization than accept a job that would take me away from the general managerial track.

Finally, experience has the potential to be a major motivator for preference for either EAI or ERP. A positive experience should increase the preference, while a negative experience should reduce the preference. Thus, the following hypotheses describe the expected impact of experience of preference based on good and bad experiences:

Hypothesis 5a: Experience with ERP (E-ERP) will positively moderate the relationship between RTP and P-ERP

Hypothesis 5b: Experience with EAI (E-EAI) will positively moderate the relationship between RTP and P-EAI

Table 3.5: Summary of Hypotheses for Individual Perception Model

H_1: RTP is positively related to P-ERP
H_2: RTP is negatively related to P-EAI
H_{3a}: TF will positively moderate the strength of the relationship between RTP and P-ERP
H_{3b}: TF will positively moderate the strength of the relationship between RTP and P-EAI
H_{4a}: GM will negatively moderate the strength of the relationship between RTP and P-ERP
H_{4b}: GM will negatively moderate the strength of the relationship between RTP and P-EAI
H_{5a}: E-ERP will positively moderate the relationship between RTP and P-ERP
H_{5b}: E-EAI will positively moderate the relationship between RTP and P-EAI

3.3 Implementation Model

In addition to examining individual perceptions about Enterprise Integration, this study attempts to provide a more theoretically compelling perspective on the successful implementation of an Enterprise Integration system. The many factors and antecedents investigated by prior research suggest that most, if not all, of them are somewhat related to success or failure of an Enterprise Integration project. However, there are some factors which are more important for success than others (Grover et al., 1995; Teng et al., 1998). In fact, some factors are absolutely necessary for success. Telecomm infrastructure, for example, is necessary for success since the enterprise network is the backbone for communications between the various IT used in implementing an Enterprise System or integrating systems across the enterprise (Bensaou, 1997). These necessary factors are

not, however, sufficient by themselves for implementation success. Other factors must be included to increase the potential for success.

The division between necessary, but not sufficient, factors and factors which facilitate success, but will not lead to success without the foundation of the necessary factors, follows the concepts laid out by Herzberg in his series of articles on motivating employees (Herzberg, 1965, 1979, 2003). Necessary factors are classified as hygienic and must be present, while the other factors are classified as motivators which do not have to be present, but are certainly helpful in dealing with the problems at hand. Some factors are difficult to classify as they can be justified in either category.

In addition to the division of factors into hygienic and motivational categories, other works have categorized factors according to various levels of need. One important categorization is Maslow's Hierarchy of Needs (Maslow, 1943, 1954). The hierarchy is a pyramid with varying levels indicative of levels of need. The bottom, foundational level contains need directly associated with survival, such as food and water. Basic survival depends on this foundational layer and without the layer, the organism will die. The second layer builds on the first and deals with security and safety issues such as protection from the elements or from predators. Again this layer is very important because exposure to elements and dangers from predators account for a high mortality among organisms. The third layer represents the need for procreation to perpetuate the species. At this point, the organism has reached adulthood and is now ready to raise a family and repeat the process. The final two layers deal with higher levels of thinking and socialization which are specific to humans.

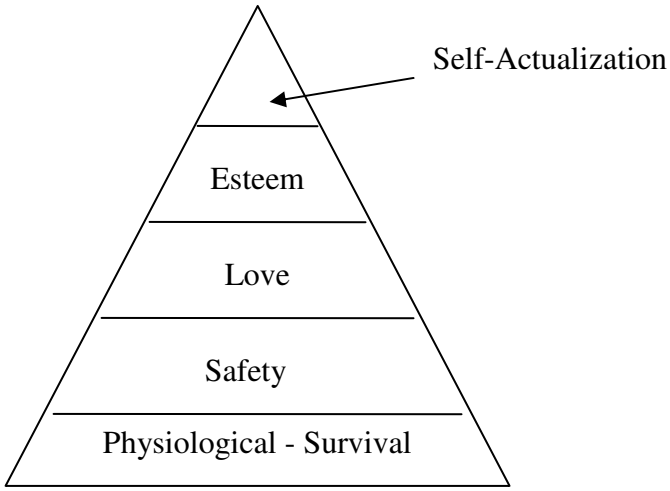


Figure 3.2: Maslow's Hierarchy of Needs (Maslow, 1943)

Maslow's hierarchy is important to study because organizations exhibit many of the same needs and wants as organisms and can be modeled in similar fashion. Taking this further, a project can also be modeled in a similar fashion. This study combines the ideas of Herzberg's 2-factor approach of hygienic and motivational factors with Maslow's Hierarchy of Needs. The result is a pyramid structure with the foundation being those items which are critical to the success of the project. The upper layers build on each other and fill the varying needs of the project to survive and attain success.

Dividing Enterprise Integration implementation success factors between the hygienic and motivating categories requires a close look at prior studies which have already done some classification. Grover et al's study, which provides a fairly comprehensive list of factors, is an excellent place to start (Grover et al., 1995). While this study examines the problems associated with Business Process Reengineering (BPR) rather than Enterprise Integration, it is still a valuable contribution since BPR has been shown to be very closely related to ERP (Ip et al., 2004; Ng, Ip, & Lee, 1999; Schrnederjans & Kim, 2003). Grover has classified sixty-four potential problems into

nine categories. This study begins with a basis on Grover's research, but adds factors as necessary from other studies (Anderson et al., 2005; Wixom & Watson, 2001) and also reclassifies some factors into other categories which are then further classified into either hygienic or motivational categories.

During their analysis of the categories of implementation problems, Grover et al. discovered that there were several categories which demonstrated a high level of severity but low levels of correlation. This indicates that the problems are difficult to manage, but that managing them well does not necessarily lead to success. The conclusion was that successful handling of all these categories of problems is necessary to the survival and success of the project, but is not sufficient for success. Five of the categories described by Grover at al. fit this level of need. They are Technology, Technological Competence, Strategic Planning, Time Frame, and Management Support. Because these categories are classified as necessary, but not sufficient, they are hygienic factors and become the foundation to the success of the project. We call the foundational layer factors enablers since they are required to enable the project to progress, but in and of themselves do not add to the potential for success. Instead, they must be effectively utilized to increase the probability of success.

A second need grouping suggested by Grover et al. is that of problems which are highly correlated with success, but do not appear to cause much difficulty during the project. These problem categories are Human Resource, Process Delineation, Project Management, and Tactical planning. As these problems are highly correlated to success, but are somewhat easy to manage, they become our first layer of motivational factors,

called facilitators factors. These must be performed to some degree of effectiveness to facilitate any level of success (Teng, Slinkman, & Nerur, 2005).

The second layer of motivational factors includes those problem areas which are both highly correlated with success of the project and difficult to manage. This category of factors is key in achieving the highest levels of success. Without this layer, a project will, at best, only achieve some levels of efficiency, but probably not effectiveness. Effective implementation of this highest level of motivators will potentially increase the level of implementation success significantly. Therefore, we call this highest level of motivators the actualizing factors. There is only one category suggested by Grover et al. fitting this classification, and that is Change Management. Utilizing these three levels of hygienic and motivational categories, a hierarchical model of project needs can be developed. Figure 3.3 depicts the proposed model. The following sections provide a description of how various factors were categorized into the hierarchy of hygienic and motivational categories.

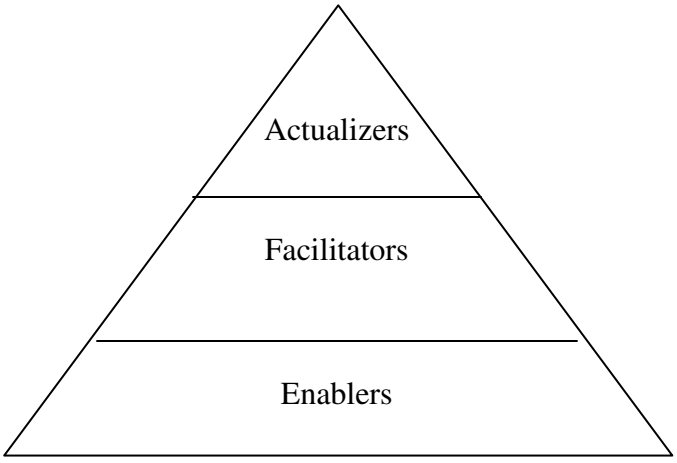


Figure 3.3: Generalized 3-Factor Model of Implementation Success

3.1.1 Enterprise Integration Success

Measuring success of information systems has been a popular topic among researchers and there have been many ways to measure success. Two of the most popular models are the DeLone & McLean (D&M) model (DeLone & McLean, 1992; DeLone et al., 2003), and Seddon's respecification of the D&M model (Seddon, 1997). These models target information systems in general and provide us with a good starting point for measuring success for Enterprise Integration since the integration involves one or more information systems. Aspects such as quality (Fowler et al., 2003; Lea et al., 2005; Lee, 2000) and performance improvements or benefits (Davenport, 1998; Sheu, Yen, & Krumwiede, 2003) are among the most often cited benefits of Enterprise Integration. Table 3-6 lists some of the Success Measures identified in prior research.

Table 3.6: Enterprise Integration Success Measures

Product quality improvement	(Fowler et al., 2003; Lee et al., 2003)
Cost reduction	(Lea et al., 2005; Lee et al., 2003)
Productivity gains	(Davenport, 1998; Fowler et al., 2003; Lea et al., 2005)
Lower inventory	(Lea et al., 2005)
Increase in on-time delivery	(Lea et al., 2005)
Increased customer satisfaction	(Fowler et al., 2003; Lea et al., 2005)
Reduced cycle times	(Davenport, 1998; Fowler et al., 2003; Lee et al., 2003)
Data accuracy	(Fowler et al., 2003; Lee et al., 2003)
Reduction in redundant data	(Davenport, 1998; Fowler et al., 2003; Lee et al., 2003)
Standardized business processes	(Davenport, 1998; Fowler et al., 2003; Lee et al., 2003)
Defragment and streamline business processes - Higher efficiencies	(Davenport, 1998; Fowler et al., 2003)

Data consolidation, accuracy, and timeliness are some of the information quality benefits desired with Enterprise Integration. Product quality, reduced cycle times, on-time delivery, higher efficiencies and productivity, cost reduction, and higher customer satisfaction are all important operational benefits. Defragmenting and standardizing business processes are also desired outcomes of Enterprise Integration (Davenport, 1998; Fowler et al., 2003; Lea et al., 2005; Lee et al., 2003). A close examination of all these goals, as well as discussions with a group of experts in the field (see Chapter 4 for details) yielded a set of success questions based on the basic goals of the new system. These questions are detailed in Table 3.7.

Table 3.7: Basic Goals of Enterprise Integration Systems Implementations

The new system has achieved all the goals set for it
The new system has helped increase market share for the organization
The new system has helped achieve higher sales for the organization
The new system has helped reduce costs
The new system has helped reduce cycle time of operations
The new system has improved sharing of information across the enterprise
The new system has reduced the need to enter the same information multiple times
The new system is flexible and adaptable to new requirements
The new system improved cross-functional business processing
The information provided by the new system is customizable to individual requirements
The information provided by the new system is secure

The goals detailed in Table 3.7 focus on the general performance of the new system being implemented. However, since an implementation of a new system usually implies that an old system has been replaced or enhanced, there are many additional measures which focus on the differences or improvements provided by the new system

over the old system. Again, the D&M (DeLone et al., 1992, 2003) and Seddon Models (Seddon, 1997) have been widely accepted and were relied upon heavily to determine measures which appropriately examine the aspects of information quality and usefulness, but with an examination of the improvements of these factors provided by the new system over the existing one. This leads to an additional set of questions relating the new system to the old as defined by Table 3.8. The focus for success, therefore will be on the combination of the basic goals with the operational improvement benefits achieved by the new system over the old, giving us a dependent variable of Enterprise Integration Success (EIS), as well as the quality, reliability, and usefulness of the information provided by the new system.

Table 3.8: Operational Improvements of New System over the Old System

The information provided by the new system is more complete than the previous system
The information provided by the new system is clearer and more easily understood than the previous system
The information provided by the new system is more relevant and usable than the previous system
The information provided by the new system is more timely and up-to-date than the previous system
The new system is more reliable than the previous system
The new system is available a larger percentage of time (less down-time) than the previous system
Response time of the new system is noticeably shorter than that of the previous system
The information provided by the new system is more accurate that that of the previous system
The new system has more functionality/features than the previous system

3.1.2 Enabling Factors

Once we have determined the measures for measuring the dependent variable of System Implementation Success, we must define the independent variables. As previously described, there are three levels of factors, resulting in three levels of independent variables. The first level of factors contains the Enabling (hygienic) factors, which are necessary for success, but are not in and of themselves, sufficient. It is expected that there will not be a high association between these factors and success, but that they still must be present for success. These factors are foundational in that they provide the basis for all other factors involved. They must be present before adding any other factors into the planning and implementation processes.

There are several categories which should be considered enabling factors. Research has shown that for Enterprise Integration projects to succeed, an organization's infrastructure (telecomm, database, and application) must be sufficient to support the new technology (Anderson et al., 2005; Cooper et al., 2000; Grover et al., 1995; Grover, Teng, & Fiedler, 1998; Scott et al., 2002; Wixom et al., 2001). The infrastructures are classified as part of a project's technology factors (see Table 3.9).

It is necessary for the systems to be able to communicate and share information with each other. In many cases (especially for EAI implementations) electronic links, also referred to as interfaces, are required to allow communications between systems (Chung et al., 2003; Wixom et al., 2001).

Table 3.9: Technology Factors

Limited flexibility of Information Technology infrastructure links and connections for the purpose of implementing the new system	(Anderson et al., 2005; Chung, Rainer, & Lewis, 2003; Grover et al., 1995; Scott et al., 2002)
Insufficient database infrastructure for the needs of the new system	(Anderson et al., 2005; Grover et al., 1995; Scott et al., 2002)
Insufficient bandwidth for access to text, voice, and graphical data for the needs of the new system	(Grover et al., 1995; Scott et al., 2002; Wixom et al., 2001)
Difficulty in adding, modifying, or removing hardware from existing Information Technology infrastructure for the purpose of implementing the new system	(Wixom et al., 2001)
Limited number of electronic links and connections in the Information Technology infrastructure for the purpose of implementing the new system	(Chung et al., 2003; Wixom et al., 2001)
Insufficient electronic links for the needs of the new system	(Chung et al., 2003; Wixom et al., 2001)

Interestingly, while information technology is important, it will not improve the effectiveness of a project without being properly utilized (Applegate, Bensaou, Earl, Garvin, & Gogan, 1999; Bensaou, 1997; Davenport, 1998). It may, however, provide additional coordination and cooperation capabilities as well as providing the enabling infrastructure for the Enterprise Integration system (Gurbaxani & Whang, 1991; Malone, Yates, & Benjamin, 1987; Porter & Millar, 1985). As an enabler, Technology should provide additional explanatory power to the model, but only if the other two layers of the model are firmly in place. The hypothesis related to technology is as follows:

Hypothesis 6a: Quality of Technology (T) infrastructure will have a positive association with Implementation Success.

A second category of enabling factors deals with the technical competence of IS personnel to utilize the technology and implement the new Enterprise Integration system. Table 3.10 lists the problems associated with technical competence (Chung et al., 2003; Lai & Mahapatra, 2004). Without the training or experience to deal with the technology being implemented, a project will probably flounder around until it is over budget and extremely late. In some cases, project team members may not even understand what the technology is or is supposed to do. There must also be an understanding of the existing information technology (IT) across the organization. Without a clear understanding of the IT the project team will be hard pressed to provide a successful solution.

Table 3.10: Technological Competence Factors

Lack of experience in technology utilized in implementation of new system	(Anderson et al., 2005; Grover et al., 1995; Scott et al., 2002)
Insufficient understanding of IT personnel about existing data, applications, & other IT across organization	(Grover et al., 1995)
Lack of knowledge about new technology among IT personnel	(Grover et al., 1995; Lai et al., 2004; Scott et al., 2002)
Inability of IT personnel to develop appropriate technical solutions to business problems	(Chung et al., 2003)
IT personnel skilled in only a limited number of technologies and tools	(Chung et al., 2003; Lai et al., 2004)
Inability of IT personnel to work well with other functional areas	(Chung et al., 2003)

Technological Competence (TC) becomes our second independent variable. Like Technology (T), TC is presented as a set of problems, so after reversing the scale, high scores are actually good. Also like Technology, TC only adds additional explanatory power given that the facilitating and actualizing factors have been considered, leading us the hypothesis:

Hypothesis 6b: Technological Competence (TC) will have a positive association with Implementation Success

The final set of enabling factors deal with the ability of the Information Technology personnel to understand and apply the concepts associated with the day-to-day business activities of the rest of the organization (Bassellier & Benbasat, 2004). In other words, the business competence of the IT personnel. Since IT personnel are the ones who evaluate computing and application needs and also develop and implement solutions to those needs, it is critical for them to have an understanding of the operational aspects of the organization (Enns, 2005; Greenstein & McKee, 2004). Teo and King identified a relationship between business planning and information systems planning as being key to the successfulness of the system (Teo & King, 1997). The set of factors (Table 3.11) used to measure Business Competence comes directly from the study of Bassellier and Benbasat (Bassellier et al., 2004). The hypothesis based on Business Competence follows that of the other enabling factors:

Hypothesis 6c: Degree of Business Competence of Information Technology personnel (BC) will have a positive association with Implementation Success

Table 3.11: Business Competence Factors

Lack of experience in technology utilized in implementation of new system	(Anderson et al., 2005; Grover et al., 1995; Scott et al., 2002)
Insufficient understanding of IT personnel about existing data, applications, & other IT across org.	(Grover et al., 1995)
Lack of knowledge about new technology among IT personnel	(Grover et al., 1995; Lai et al., 2004; Scott et al., 2002)
Inability of IT personnel to develop appropriate technical solutions to business problems	(Chung et al., 2003)
IT personnel skilled in only a limited number of technologies and tools	(Chung et al., 2003; Lai et al., 2004)
Inability of IT personnel to work well with other functional areas	(Chung et al., 2003)

3.1.3 Facilitating Factors

Many of the factors do not fall into the hygienic categories as being necessary and must be classified in the various motivational categories. This is not to say that these factors are any less important, because they are still highly associated with the success of the Enterprise Integration implementation. In fact, it is likely that the relationship between these motivational factors and Implementation Success will be greater than that between the enabling factors and Implementation Success. Therefore, they become independent variables in our model.

There are two levels of motivating factors illustrated in the model (Figure 3.3), Facilitating and Actualizing. Facilitating factors are directly associated with the likelihood of success, and are important to achieve any level of success at all. However, without the foundational layer (enablers), the facilitators are ineffective. In addition, without the higher level motivators (actualizers), any successes will likely be efficiency improvements only and not effectiveness, leading to what the Standish Group refer to as "Challenged Systems" (Standish Group International, 2003). These systems are considered successes, but only barely.

To achieve higher levels of effectiveness as well as efficiency, the actualizing factors at the top of the model must be included. The inclusion of the actualizing factors can provide increased levels of success, given that the facilitating factors have already been considered. Without the facilitating factors, actualizers will not provide any benefit. However, assuming that the facilitating factors have been effectively addressed, the actualizers should enable the highest levels of success. All factors for all motivating

variables are presented as problems, but the scores will be reversed before analysis, with a high score indicating the lack of a problem (good).

The split between actualizing and facilitating factors may seem somewhat ambiguous at first glace. However, there is a distinct split between the two. Actualizing factors deal with the upper level management of the project and managing changes involved with the project. The facilitating factors, on the other hand, are more closely related to the planning, management, and implementation of the project itself. These three groups of factors build on the foundation of the enabling factors and provide a necessary basis for the actualizing factors.

The first set of facilitating factors deals with the project definition and scope. The scope details the processes, applications, and systems which are to be included in the integration project. Normally, one might expect project scope to be included in project planning. However, a project team is often handed a set of requirements and told to make it happen. For this reason, scope has been defined on its own. It is important that the scope be defined accurately and completely so that problems such as scope creep can be avoided as much as possible. The scope is highly critical to the success of a project. The Standish Group published the Chaos Report which indicated that the larger a project is, the less likely it is to succeed. Once it reaches a certain size (more than $10 Million), there is a zero percent success rate (Standish Group International, 2003).

Controlling project scope is very important. Without a well defined scope and procedures for controlling scope changes, projects can become excessively large and unwieldy. A term referred to as “scope creep” is used to describe the gradual addition of

project requirements (Merideth & Samuel J. Mantel, 2003). If not carefully managed, the amount of change to the project can be significant, leading to many issues during project implementation (Davenport, 1998). The project needs to be sized appropriately for the time and resources allocated to the project and, conversely, appropriate resources and time need to be allocated to the project. Again, as an enabling factor, the relationship between Project Scope and Implementation Success is as an additional explanation.

Hypothesis 7a: Project Scope (PS) optimality will have a positive association with Implementation Success

Table 3.12 outlines the factors associated with project scope and some of the studies which identified the potential problem.

Table 3.12: Project Scope Factors

The scope of the project is difficult to manage	(Grover et al., 1995; Wixom et al., 2001)
The scope of the project is never agreed upon	(Grover et al., 1995; Scott et al., 2002)
The scope of the project is not clearly defined	(Grover et al., 1995; Scott et al., 2002)
The scope of the project is too large	(Grover et al., 1995; Standish Group International, 2003; Wixom et al., 2001)

The second independent facilitating variable is Project Planning which overlaps somewhat with the project scope and definition, but generally takes up where definition leaves off. In this category, we include the outlining of the goals for the project and the plans for meeting those goals (Pinto & Prescott, 1990). It is important for the goals of the project to match the goals of the organization or there will be a lot of confusion and conflict during the project. These goals must be clearly defined so everyone knows

where the project is going. Also, the goals must meet the requirements or the project is a waste of time and resources.

Plans must be put in place to cover a variety of issues. The basic plan for meeting the goals set out is critical. It must cover all aspects of the project and include milestones to detail where the project should be throughout the implementation period. The budget must be defined according to the needs of the project and based on the project plan. Again, milestones should be used to determine the budget throughout the project. Financial justification or return on investment should be fully detailed to show benefits of system integration. Knowing whether the project is on-budget is important throughout the implementation. Finally, plans must be put in place for contingencies. There are any number of areas where a project could go wrong, and planning for the most likely issues will help the project progress smoothly even when problems do occur.

Being a facilitating factor, project planning is expected to have a high positive association with the success of the implementation, whether for an ERP, an EAI, or some other Enterprise Integration project.

Hypothesis 7b: Project Planning (PP) will have a positive association with implementation success

Measuring project planning effectiveness is difficult as it encompasses many different aspects of a project. Table 3.13 lists some of the various project planning problems encountered through a variety of research studies. These problems relate directly to questions on the survey used for to gather data for this study.

Table 3.13: Project Planning Factors

The planned goals of the system do not meet requirements	(Pinto et al., 1990; Scott et al., 2002)
Misalignment of project goals with general organization goals in planning for the project	(Grover et al., 1995; Pinto et al., 1990)
The planned goals of the system do not meet requirements	(Grover et al., 1995; Pinto et al., 1990)
Lack of detailed budget planning for the project	(Anderson et al., 2005; Grover et al., 1995)
Lack of detailed plan for completion of the project	(Grover et al., 1995; Pinto et al., 1990)
Lack of contingency planning for the project	(Pinto et al., 1990)
Lack of adequate milestone planning for the project	(Pinto et al., 1990)
IT personnel are unable to adequately define project requirements	(Lai et al., 2004)

The final facilitating category is project management, where the effectiveness of the project team is considered. This area is not unique to Information Systems and the information is common to any type of project (Merideth et al., 2003). The project leader must gain control of the efforts and closely manage resources allocated to the project (Jiang, Klein, & Chen, 2001). Performance measures should be assessed throughout the project for feedback on the project's progression, including a post implementation evaluation. In addition, analyzing existing processes, applications, and systems or extensive package customization can lead to problems with the project.

Issues with the team members are also included in this category. Problems with communications between team members and with other organizational members leads are considered here as well as how well the team works together. In addition, the inclusion of users in the implementation can make a difference in project performance. Jobs should be clearly defined for all team members so there is no ambiguity in job

expectations. Conflicts might arise between team and functional responsibilities, so cross-functional cooperation is important.

Table 3.14: Project Management Factors

Inability to measure progress of project implementation	(Anderson et al., 2005; Grover et al., 1995; Jiang et al., 2001)
Lack of communication between project manager and team members	(Grover et al., 1995; Jiang et al., 2001; Wixom et al., 2001)
Lack of cooperation between IT personnel and other project team members	(Jiang et al., 2001; Wixom et al., 2001)
Project manager exercised inadequate leadership	(Jiang et al., 2001)
Inability of project manager to motivate the team members	(Jiang et al., 2001)
Failure to inform management and users about the progress of the project	(Grover et al., 1995; Jiang et al., 2001; Lai et al., 2004)
Inappropriate selection of personnel for project team	(Grover et al., 1995; Jiang et al., 2001)

Since it is also a facilitating factor, project management exhibits the same characteristics as project planning, and is expected to have a high positive association with the success of the implementation, whether for an ERP, an EAI, or some other Enterprise Integration project. Again, this association assumes that all other factors remain constant, giving us the following hypothesis:

Hypothesis 7c: Project Management (PM) will have a positive association with implementation success

3.1.4 Actualizing Factors

Change Management stands alone among the motivational factors, and is an actualizing factor placed in the highest segment of our hierarchy. It is here where we must first recognize the need for change management, then anticipate and plan for resistance to change both from individual and organizational perspectives. Consideration

of existing organizational structure, politics, and culture are addressed as well as potential changes required for these areas. Also needed are programs and systems to cultivate the new values represented by the changes. In addition, change managers or agents need to have the skills required to adequately affect the changes.

Throughout the development of the model, Human Resources issues continually tend to show up as a part of Change Management, both from expert evaluations and prior studies(Grover et al., 1995). Human Resources, therefore, is included in the Change Management section. Analysis will be run to confirm this decision or to determine a different alignment for Human Resources. This factor is associated with preparing people for the new technology and values associated with it. Changes to human resources policies may also need to be made, leading to a need to communicate reasons for the change, appropriate compensation and incentives to encourage acceptance of the changes, training for personnel affected by project, and time to develop the new skills required. The factors associated with Human Resources are included with the Change Management factors in Table 3.15.

Actualizing factors depend on the successful application of the variables in the two lower levels of the model, especially the Facilitators layer. Without fully utilizing the foundational and middle layers, actualizing variables will have little impact. However, actualizing factors can have a dramatic effect on the successfulness of implementation, significantly increasing the potential for success, yielding the following hypothesis:

Hypothesis 8a: Quality of Change Management (CM) will have a positive association with Implementation Success

Table 3.15: Change Management Factors

Failure to anticipate and plan for the organizational resistance to change	(Grover et al., 1995)
Failure to consider the changes to people's jobs and authority	(Grover et al., 1995)
Failure to consider existing organizational culture in managing change	(Anderson et al., 2005; Grover et al., 1995; Scott et al., 2002)
Failure to communicate reasons for change to organization members	(Anderson et al., 2005; Grover et al., 1995; Scott et al., 2002)
Lack of project participants who are experienced in managing change	(Grover et al., 1995; Scott et al., 2002)
Lack of organization arrangements for transitioning to the new system	(Grover et al., 1995)
Failure to anticipate impact of the changes caused by the new system	(Grover et al., 1995)
The change process was hampered due to lack of user participation	(Grover et al., 1995; Lai et al., 2004)
The project requires too many radical changes in the organization	(Grover et al., 1995)
Lack of appropriate incentives for employees to accept the new system	(Grover et al., 1995)
Inadequate training for employees affected by the new system	(Grover et al., 1995)
Insufficient time to develop new employee skills required by the new system	(Grover et al., 1995)
Lack of participation from the human resources function in the development of the new system	(Grover et al., 1995; Scott et al., 2002)

The final independent variable included in the model is Management Support. Management support has been repeatedly cited as being very important for project success (Davenport, 1998; Merideth et al., 2003) and it is no surprise it appears as an actualizer. Management support is required throughout all level of an organization. Without management support at any level, it is unlikely that a project will proceed effectively (Davenport, 1998; Fui-Hoon Nah, Zuckweiler, & Lee-Shang Lau, 2003). In addition, management needs to be knowledgeable about the technology being

implemented so they can understand why some parts of the project have to be done a certain way. The goals of top management need to be fully understood so the project team knows what is expected of the resulting system. Finally, having a strong project champion can help push a project through even when there is a lot of resistance (Davenport, 1998; Parr et al., 2000a). The hypothesis related to Management Support is additive and is listed as follows:

Hypothesis 8b: Management Support (MS) will have a positive association with Implementation Success

Table 3.16: Management Support Factors

Lack of senior management leadership for project	(Grover et al., 1995)
Lack of top management support for project	(Anderson et al., 2005; Grover et al., 1995; Scott et al., 2002; Wixom et al., 2001)
Line managers in the organization unreceptive to innovation	(Anderson et al., 2005; Grover et al., 1995)
Top management's insufficient understanding about Enterprise Integration	(Grover et al., 1995)
Managers' failure to support the new values and beliefs	(Grover et al., 1995; Scott et al., 2002)
Insufficient understanding about the integration goals of top management	(Grover et al., 1995)
Lack of project champion	(Grover et al., 1995; Scott et al., 2002; Wixom et al., 2001)

Based on the model and factors as just described, the pyramidal model can be re-represented as indicated in Figure 3.4, with the hypotheses summarized in Table 3.17. Note that while we have strived to follow categorizations suggested by prior works, some factors may need to be moved to different categories, added, or removed.

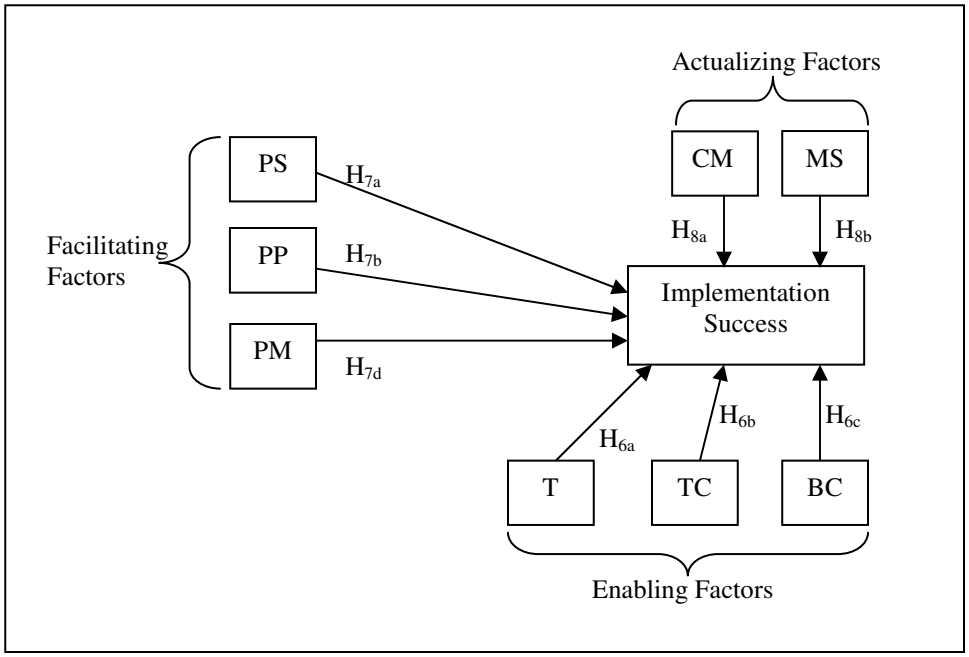


Figure 3.4: Enterprise Integration Implementation Success

Table 3.17: Summary of Hypotheses for Implementation Success

Enabling Factors
H_{6a}: Quality of T will have a positive association with Implementation Success
H_{6b}: TC will have a positive association with Implementation Success
H_{6c}: Degree of BC will have a positive association with Implementation Success
Facilitating Factors
H_{7a}: PS optimality will have a positive association with Implementation Success
H_{7b}: PP will have a positive association with Implementation Success
H_{7c}: PM will have a positive association with Implementation Success
Actualizing Factors
H_{8a}: Quality of CM will have a positive association with implementation success
H_{8b}: MS will have a positive association with Implementation Success

3.1.5 Factor Group Effects

In addition to the individual correlations of each of the factors, the relative influence of each category of factors on Implementation Success is important. Understanding which group of factors explains the most amount of variance, will aid the

researcher and practitioner alike in determining where best to focus efforts for the most effective implementation. Since the actualizing factor, by definition, helps the project to achieve the highest levels of success, it would be expected to have the highest level of association with Implementation Success. Conversely, the enabling factors really only allow for the possibility of success, but don't have a high association with success, putting it as the bottom with the lowest association with Implementation Success. The following hypotheses will be examined to determine the comparative contribution of each factor group with implementation success:

Hypothesis 9a: Actualizing Factors will explain a larger percentage of the variance in Implementation Success than Facilitating Factors

Hypothesis 9b: Facilitating Factors will explain a larger percentage of the variance in Implementation Success than Enabling Factors

Finally, since one of the main objectives of this study is a comparison of the two Enterprise Integration technologies (ERP vs. EAI), a closer look at the difference, with respect to the factors, between the two technologies is necessary. As mentioned previously, EAI requires a higher-level of technological competence than ERP. This would indicate that the enabling factors should also have higher associations with EAI Implementation Success than for ERP Implementation Success. ERP, on the other hand, requires much more change as far as users are concerned than EAI. Since change is the primary focus of the actualizing factors, one might expect there to be a higher association between the actualizing factors and ERP Implementation Success than between the actualizing factors and EAI Implementation Success. Hypotheses 10 and 11 state the

assumptions which need to be tested to examine the differences between the success factors and ERP or EAI Implementation Success.

Hypothesis 10: Enabling Factors will have a higher level of association with Implementation Success for EAI than for ERP

Hypothesis 11: Actualizing Factors will have a higher level of association with Implementation Success for ERP than for EAI

Table 3.18: Summary of Hypotheses for Factor Group Analysis

H_{9a}: Actualizing Factors will explain a larger percentage of the variance in Implementation Success than Facilitating Factors
H_{9b}: Facilitating Factors will explain a larger percentage of the variance in Implementation Success than Enabling Factors
H_{10}: Enabling Factors will have a higher level of association with Implementation Success for EAI than for ERP
H_{11}: Actualizing Factors will have a higher level of association with Implementation Success for ERP than for EAI

CHAPTER 4

METHODOLOGY

4.1 Methodology Selection

There are a variety of methodologies available to researchers. In fact, McGrath (McGrath, 1981) classified research into eight primary types of research methodologies with three areas of maximum concern or focus. Obviously, not all of these methods are appropriate for every study, so the researcher must select the ones which are most appropriate. Many studies utilize only one methodology due to lack of time, funds, or other resources. The use of multiple methodologies to study the same phenomenon, often referred to as triangulation, provides multiple perspectives, and can often result in more useful and applicable studies (Mangan, Lalwani, & Gardner, 2004; Modell, 2005; Perlesz & Lindsay, 2003).

The scope of this project covers actual deployment of Enterprise Integration Systems, eliminating the experimental and simulation methodologies. Of the remaining methods, case (or field) studies and surveys are the most commonly used. Again, the scope of this study is quite large and targets a wide variety of implementations, making a case study somewhat impractical. However, extensive reviews of previous case studies were included in the model development procedure, adding some depth to the process (Akkermans & van Helden, 2002; Barker et al., 2003; Gibson et al., 1999; Lee & Lee,

2000; Sarker & Lee, 2003; Wiers, 2002). After reviewing the various methodologies, it was decided to use a survey approach.

4.2 Survey Methodology

4.2.1 Survey Development

Development of a survey can be a lengthy and challenging process. Finding and determining the measures to use often leads to a large number of variables. There is also much room for ambiguity and confusion between questions and factor groups. This study is no different.

As mentioned in the previous chapters, much research into previous studies was performed to compile a list of measures for determining the various variables of the model. In some cases, these lists became quite large and many measures had to be combined or eliminated. To aid in developing the most practical survey, previously developed and validated scales were closely examined and utilized whenever applicable. The use of previously validated scales reduces duplication of effort and increases the validity and reliability of a survey.

4.2.1.1 Career Anchors

The model is divided into two major portions. The first examines the perspectives of Information Technology (IT) professionals and targets two basic aspects of the IT professional's personal preferences. The first set of measures is aimed at determining what drives an individual's career choices and directions, often referred to as a career anchor based on Schein's work (Schein, 1990). Schein defined several different

categories of career anchors, however, only two are immediately useful for this study. The first career anchor pertinent to this study is the Technical/Functional Competence, which refers to people who are more interested in specializing in a specific technical or functional area. The other career anchor is the General Managerial Competence, which refers to people who are more interested in generalizing across all areas of business rather than specializing in a single functional or technical area. The scales for the career anchors were taken directly from the questionnaires used by Schein, and are listed in Tables 4-1 and 4-2.

Table 4.1: Functional/Technical Competence Questions

I dream of being so good at what I do that my expert advice will be sought continually.
I will feel successful in my career only if I can develop my technical or functional skills to a very high level of competence.
Becoming a senior functional manager in my area of expertise is more attractive to me than becoming a general manager.
I would rather leave my organization than accept a rotational assignment that would take me out of my area of expertise.
I am most fulfilled in my work when I have been able to use my special skills and talents.

Table 4.2: General Manager Competence Questions

I am most fulfilled in my work when I have been able to integrate and manage the efforts of others.
I dream of being in charge of a complex organization and making decisions that affect many people.
I will feel successful in my career only if I become a general manager in some organization.
Becoming a general manager is more attractive to me than becoming a senior functional manager in my current area of expertise.
I would rather leave my organization than accept a job that would take me away from the general managerial track.

4.2.1.2 Risk-Taking Propensity

The second aspect of the IT professional's personality included in this study targets risk-taking propensity. There are numerous studies on risk-propensity with many different scales (Brendle, 2001; Kogan et al., 1964; MacCrimmon, Wehrung, & Stanbury, 1986). Most of these, however do not deal with Information Technology, but are aimed at other topics such as stocks, sex, etc. However, there were several general questions which dealt with issues pertaining to business undertakings which are also applicable to the implementation of Information Technology. The final set of constructs dealing with risk propensity is detailed in Table 4.3.

Table 4.3: Risk-Taking Propensity Questions

When I want something, I'll sometimes go out on a limb to get it.
If the possible reward was very high, I would not hesitate putting my money into a new business that could fail.
Taking risks does not bother me if the gains involved are high.
I would enjoy the challenge of a project that could mean either a promotion or a loss of a job.
I rarely, if ever, take risks when there is another, safer alternative.
I try to avoid situations that have uncertain outcomes.
I would participate only in business undertakings that are relatively certain.
I would probably not take the chance of borrowing money for a business deal even if it might be profitable.

4.2.1.3 Systems Implementation Success

The dependent variable for the second portion of the model is Enterprise Integration Success. Utilizing previously designed and tested constructs for this variable proved somewhat challenging since there are many studies dealing with Information Systems (IS) Success (DeLone et al., 2003; Larsen, 2003; Seddon, 1997; Shin, 2003) and Implementation Success (Amoako-Gyampah et al., 2004; Grover et al., 1995;

Kraemmerand, MÃ¸ller, & Boer, 2003; Lai et al., 2004). However, there are few which really deal with both (Wixom et al., 2001), and none which examine Enterprise Integration Success.

Since an Enterprise Integration System (EIS) is in essence an Information System, the IS success studies still have some value, but not enough to qualify the differences and challenges presented by the EIS implementation. To better understand the full impact of EIS Implementation Success, additional constructs are required. These additional constructs were drawn from studies examining the implementation of other Enterprise Systems, such as a data warehouse (Wixom et al., 2001). The resulting set of constructs used to measure EIS Implementation Success is listed in Table 4.4.

Several recent studies have probed the issues dealing with Technology in an Enterprise System implementation (Grover et al., 1995; Lai et al., 2004; Wixom et al., 2001). Rather than creating a new set of measures, this study draws on these existing studies for previously qualified questions to build the measures used in the Technology Factor (Table 4.5). Note that these measures and all the remaining Success Factor measures are phrased as problems and reverse-coded.

Table 4.4: System Success Questions

The new system has achieved all the goals set for it
The new system has helped increase market share for the organization
The new system has helped achieve higher sales for the organization
The new system has helped reduce costs
The new system has helped reduce cycle time of operations
The new system has improved sharing of information across the enterprise
The new system has reduced the need to enter the same information multiple times
The new system is flexible and adaptable to new requirements
The new system improved cross-functional business processing
The information provided by the new system is customizable to individual requirements
The information provided by the new system is secure
The information provided by the new system is more complete than the previous system
The information provided by the new system is clearer and more easily understood than the previous system
The information provided by the new system is more relevant and usable than the previous system
The information provided by the new system is more timely and up-to-date than the previous system
The new system is more reliable than the previous system
The new system is available a larger percentage of time (less down-time) than the previous system
Response time of the new system is noticeably shorter than that of the previous system
The information provided by the new system is more accurate that that of the previous system
The new system has more functionality/features than the previous system

Table 4.5: Quality of Technology Factor Questions

Limited flexibility of Information Technology infrastructure links and connections for the purpose of implementing the new system
Difficulty in adding, modifying, or removing hardware from existing Information Technology infrastructure for the purpose of implementing the new system
Limited number of electronic links and connections in the Information Technology infrastructure for the purpose of implementing the new system
Insufficient bandwidth for access to text, voice, and graphical data for the needs of the new system
Insufficient database infrastructure for the needs of the new system
Insufficient electronic links for the needs of the new system

4.2.1.5 Technological Competence

Technological Competence, the second of the Enabling Factors, examines the issues surrounding the experience and skills of the Information Technology (IT) professionals involved with the Enterprise Integration Implementation. The measures target the knowledge of existing and new technology as well as the ability to apply that knowledge in developing technical solutions to the business problems. Also examined is the ability of IT personnel to work with other functional areas. As with Quality of Technology, and the remainder of the Success Factors, this study draws on previously developed measures (Chung, Byrd, Lewis, & Ford, 2005; Grover et al., 1995; Lai et al., 2004), with the final set of reverse-coded issues listed in Table 4.6.

Table 4.6: Technological Competence Factor Questions

Lack of knowledge about new technology among IT personnel
Inability of IT personnel to develop appropriate technical solutions to business problems
IT personnel skilled in only a limited number of technologies and tools
Insufficient understanding of IT personnel about existing data, applications, & other IT across organization
Lack of experience in technology utilized in implementation of new system
Inability of IT personnel to work well with other functional areas

4.2.1.5 Business Competence

Recently, the impact of Business Competence of IT personnel, or the ability of IT personnel to relate to and understand non-technical business practices, has become an issue of concern to researchers (Bassellier et al., 2004; Enns, 2005; Grenier, 2006; Teo et al., 1997). The concept is that if IT professionals do not understand the business processes, they will be unable to effectively develop technical solutions. It is included here, therefore, as our third Enabling Factor. The questions used in this study are drawn

from the work of Bassellier and Benbasat (Bassellier et al., 2004) and are listed in Table 4.7.

Table 4.7: Business Competence of IT Professionals Factor Questions

Inability of IT personnel to stay informed about business developments not directly related to IT
Lack of participation of IT personnel in activities not directly related to IT
Lack of concern of IT personnel about overall business performance of organization
Lack of experience of IT personnel at recognizing potential ways to exploit new business opportunities
Lack of experience of IT personnel in analyzing business problems in order to identify IT-based solutions
Inexperience of IT personnel at evaluating the organizational impacts of IT solutions
Lack of knowledge of IT personnel about the alignment between business goals and IT project goals in the organization as a whole

4.2.1.6 Project Scope

The optimality of Project Scope is the first of our three Facilitating Factors. It deals with the appropriateness and clarity of the Project Scope. It examines the boundary definitions of the project as well as the size and manageability of the scope. Defining and managing the scope of a project has proven to be critical in the success of a project as defined by the Chaos Report (Standish Group International, 2003). The measures for Project Scope are derived from the Chaos Report, as well as several other studies (Grover et al., 1995; Lai et al., 2004; Pinto et al., 1990), and are detailed in Table 4.8.

Table 4.8: Project Scope Optimality Factor Questions

The scope of the project is difficult to manage
The scope of the project is never agreed upon
The scope of the project is not clearly defined
The scope of the project is too large

4.2.1.7 Project Planning

The second Facilitating Factor, Project Planning, examines the problems associated with determining an enterprise integration project's requirements planning for its execution prior to the start of the project. It looks at defining a project's requirements and goals as well as the alignment of those goals with the organizational goals and the appropriateness of the goals to meeting the actual needs of the organization. It is also concerned with detailed budget and contingency planning in addition to a detailed implementation plan. The measures used (Table 4.9) were derived from scales and factors used by Pinto and Prescott (Pinto et al., 1990) and Grover, Teng, et al. (Grover et al., 1995).

Table 4.9: Project Planning Factor Questions

Misalignment of project goals with general organization goals in planning for the project
Lack of detailed plan for completion of the project
Lack of contingency planning for the project
Lack of detailed budget planning for the project
Goals of the project were not clearly defined
The planned goals of the system do not meet requirements
Lack of adequate milestone planning for the project
IT personnel are unable to adequately define project requirements

4.2.1.8 Project Management

After completing project scope and planning, a project must be managed well, leading to the last of the Facilitating Factors – Project Management. Project Management is concerned with the problems associated with the actual process of executing and implementing an enterprise integration project. Many studies have shown the importance of Project Management to implementation success and have provided many factors for

measuring the effectiveness of the Project Manager (Grover et al., 1995; Jiang et al., 2001; Pinto et al., 1990). The factors used in this study are drawn from these previously defined and validated measures. The issues involved examine the ability of the Project Manager to effectively motivate and lead the team as well as his/her ability to communicate with the team, management, and users.

Table 4.10: Effectiveness of Project Management Factor Questions

Inability to measure progress of project implementation
Project manager exercised inadequate leadership
Inability of project manager to motivate the team members
Lack of communication between project manager and team members
Failure to inform management and users about the progress of the project
Lack of cooperation between IT personnel and other project team members
Inappropriate selection of personnel for project team

4.2.1.9 Management Support

Management must support a project with resources and authority as well as providing a vision and sponsorship. Management Support, therefore, is the first of our two Actualizing Factors. As with the Enabling and Facilitating Factors, the measures used for Management Support have been drawn from previously developed scales and factors (Lai et al., 2004; Pinto et al., 1990).

Table 4.11: Management Support Factor Questions

Top management unwilling to commit resources required for the project
Lack of top management participation during the project
Lack of management support during crises
Insufficient authority granted to project team by top management
Lack of top management leadership during project
Failure to find an effective sponsor or champion for the project

4.2.1.10 Change Management

The final factor examined by this study focuses on managing the changes brought by the new system. Change must be managed at many different levels from the entire organization down to each individual. Cultural as well as structural changes may need to be made to the organization as a whole.

Perhaps the biggest problems, however, deal with people's resistance to change. The reasons for the changes must be communicated to the individuals. Training for the new system needs to be adequately provided, as well as incentives to personnel to embrace the changes. In addition, human resources policies may need to be adjusted to incorporate the changes brought on by the new system.

Change and the Management of Change appear to be among the most critical factors when dealing with project success, and there have been many studies investigating Change Management (Al-Mashari, 2003; Fuchs, 2004; Stapleton & Rezak, 2004). The measures used for this study (Table 4.12) were derived from scales and factors previously developed (Lai et al., 2004; Pinto et al., 1990).

Table 4.12: Change Management Factor Questions

Failure to anticipate and plan for the organizational resistance to change
Failure to communicate reasons for change to organization members
Lack of organization arrangements for transitioning to the new system
Lack of project participants who are experienced in managing change
Failure to anticipate impact of the changes caused by the new system
Failure to consider existing organizational culture in managing change
Failure to consider the changes to people's jobs and authority
The change process was hampered due to lack of user participation
The project requires too many radical changes in the organization
Inadequate training for employees affected by the new system
Insufficient time to develop new employee skills required by the new system
Lack of appropriate incentives for employees to accept the new system
Lack of participation from the human resources function in the development of the new system

4.2.2 Survey Refinement

After initial construct development was complete, the survey went through intense scrutiny to insure it was appropriate and valid for the purposes of the study. Refinement of the survey encompassed several steps, each building on and enhancing the previous stages.

4.2.2.1 Construct Validation

The factors associated with each variable construct were drawn from various studies and merged into a new model based on previous findings, as well as experiences of the researchers and other experts in the field.

To reduce ambiguity and confusion, each question was closely examined by a group of experienced IT professionals comprised of Faculty and Graduate Students at the University of Texas at Arlington, as well as selected IT professionals outside of the university. The outside professionals were selected through close ties to the university.

This group of experts evaluated each question to ensure the questions were clear and concise. In addition, each expert classified the factors into one or more of the variable constructs utilizing a Q-Sort Methodology (McKeown & Thomas, 1988; Stephenson, 1953).

The Q-Sort was performed by providing each expert with the entire set of questions in random order. The experts were then requested to categorize each question into one of the factor groups defined by the study. Each question was to be classified into only one category, but if more than one category might be appropriate, classification into a second category was allowed.

Once the Q-Sort was completed by all the experts, the results were closely examined. Due to the close relationship of several of the factor groups, there was some cross-categorization, but most questions were consistently placed in the same category. The results closely followed the initial coding by the researchers, with only a few differences. Those questions which showed high levels of cross-categorization were scrutinized to determine if modifications were necessary to remove ambiguity. A few questions were too ambiguous and were removed from the study. Others were split into two questions to better fit the targeted factor groups. The final set of constructs had less than 25% cross-categorizations.

4.2.2.2 E-Survey

When all the constructs were finalized, the survey instrument could be designed. Since the target group of respondents was Information Technology Professionals, it was assumed that they would be somewhat Internet savvy. Therefore, to reduce time-frame

and costs of the survey, it was decided to use an electronic survey (e-survey). E-surveys have been in use for several years and people are becoming more comfortable with the idea of completing such surveys. The survey was secured through the use of Secure Socket Layer (SSL) encryption to protect the identity of the respondents. It was also thought that an e-survey would be easier and quicker to complete, increasing the willingness of respondents to complete the survey.

4.2.2.3 Survey Validation

The e-survey was developed based on the results of the Q-Sort and presented to another group of IT professionals. Again, this group consisted of Faculty and Students of the University of Texas at Arlington and selected other IT professionals with close ties to the university. Each expert in this group completed the survey with the researcher present. As they progressed through the survey, the experts were encouraged to comment on the layout and other features of the survey. This allowed the researcher to gain further insight into the effectiveness of the survey. Based on the results of this survey evaluation, questions were again modified, added, or removed. In addition, the survey was rearranged to be more appealing to the respondents. The procedure for each expert took between 20 and 30 minutes, even with the commentary between the expert and researcher. Most of the experts stated that they felt this was not an unreasonable amount of time for a survey, even though the number of questions was quite large.

4.2.2.4 Pilot Test

Based on comments and suggestions from the panel of experts, the survey was again modified slightly, primarily by adding options to existing questions and rearranging the presentation of the questionnaire. The survey was then presented to a group of students taking an on-line class at the University of Texas at Arlington. These students were undergraduates taking an introduction to Information Systems class and represented the portion of the population with little or no experience. The students were offered bonus points toward their class grade as an incentive to participate. Of the 200 students in the class, 110 completed the survey for a response rate of 55%.

4.2.3 Survey Implementation

4.2.3.1 Initial Survey Distribution

This target population of this study is all Information Technology (IT) professionals with at least one year of experience in IT. To sample this large population, several sources were discussed. The membership of the Association of Information Technology Professionals (AITP) was selected since it represents an excellent cross-section of the population with experience levels ranging from entry level to decades of experience. In addition, the list includes professionals who have never been involved in an Enterprise Integration project as well as those who have been involved in many. This is important for being able to differentiate the perspectives of those who have been involved (possibly with a bias toward or against various technologies) with those who have never been involved (hopefully with no bias toward or against various

technologies). This is important for being able to differentiate the perspectives of those who have been involved (possibly with a bias toward or against various technologies) with those who have never been involved (hopefully with no bias toward or against various technologies).

Besides having a membership which matches the target population for the study, the AITP has been very supportive of education. Unfortunately, the national AITP must approve all surveys sent to its membership and, due to the time-frame of this study, the researchers could not wait for this approval. The local AITP region (Region III), however, was very supportive and offered to distribute the survey invitation to the regional membership.

Once the target sample was selected, an e-mail invitation to participate in the survey was developed and sent to the Region III representative. The invitation discussed the partnership between AITP and the University of Texas at Arlington (UTA) as well as the basic premises of the study and the Uniform Resource Locator (URL) or location of the study. The invitation presented an opportunity to the respondents to share their experience and knowledge to aid the entire IT community. It also encouraged participation by providing the opportunity for the respondent to realize an increase in his/her personal performance potential. The participants were told that their experience was valued and that their participation would not only insure the success of the project, but that the results of the project would also be made available to them, increasing their value as IT professionals. Finally, the invitation was endorsed by the AITP leadership.

The participation invitation was sent to a bulk e-mail list by the AITP representative. The e-mail list was not made available to the researchers in any way. Nor did the researchers have any control over how or when the survey was distributed. The survey was sent to approximately 500 e-mail addresses of which about 100 were returned as invalid, leaving only 400 potential respondents. From this group of respondents, 14 began the survey, and only 9 completed it, for a response rate of 2%. To try to increase the number of responses, a request was sent to the AITP representative to resend the invitation. Unfortunately, the invitation was never resent.

4.2.3.2 Second Survey Distribution

When the researchers began experiencing the problems with getting national AITP approval, alternative sources for respondents were discussed. It was decided that the Business Integration Journal (BIJ), an on-line journal aimed at Enterprise Integration, would be an excellent source of respondents. The readership represented IT professionals with varied experience in integration. Even before the survey was distributed to the AITP, Region III members, a line of communication was opened between the researchers and the editors and publishers of the BIJ. A partnership was developed with the BIJ and they agreed to send the survey invitation to 5,000 readers.

The survey invitation was distributed in a similar manner to that of the AITP invitation. The BIJ representatives had full control of who to send the invitation to and when, and the researchers never saw the list of e-mails. Unfortunately, the response rate was even worse from the BIJ. From the 5,000 professionals who received 40 began the survey and 25 completed it for only a .5% response rate. Again, a follow-up invitation

was requested, but never sent. With the time constraints of the study, it was decided to use the responses received for the current study and try to re-group on the survey at a later date.

CHAPTER 5

DATA ANALYSIS

5.1 Overview of Respondents

Before we analyze the data, we need to examine the demographics of the respondents. This is important for aiding in understanding the responses received and for explaining some of the phenomenon observed.

5.1.1 Individual Demographics

It is important for the data to represent a cross-section of the population being studied. The target population for this study was Information Technology (IT) Professionals with at least one year of experience. We would expect, therefore, to see respondents ranging in age from around twenty to over sixty. We would also expect to see experience in IT ranging from one year to more than twenty years. From Table 5.1, we can see that we have a good cross section of ages between thirty and sixty. Surprisingly, there were no respondents younger than thirty years old. This could be due to the sources used to target the respondents. Many professionals may wait a few years to join professional organizations such as the Association for IT Professionals (AITP) or to subscribe to journals such as the Business Integration Journal (BIJ). The low number of responses in the over sixty category is not really very surprising as that is when many people begin to retire. One respondent declined to answer the age question.

Table 5.1: Respondent Ages

Age Range	Number	Percentage of Total
30-39	9	26%
40-49	15	44%
50-59	6	18%
Over 60	3	9%
No Response	1	3%
Total	34	100%

In addition to age, the number of years experience is also important, since we were looking for IT professionals with more than one year of experience in IT. With the age ranges indicating the respondents to all be older than thirty years old, it might be expected that the years of experience would also lean toward the more experienced IT professionals. This is not necessarily true, however, as many people change careers and may not have entered the IT arena until after thirty. Table 5.2 mirrors what was expected with about thirty percent of the respondents having less than fifteen years of experience, while two thirds of the respondents had over fifteen years of experience in IT. One respondent indicated less than one year of experience.

Table 5.2: Respondent Experience

Years of IT Experience	Number	Percentage of Total
Less than 1	1	3%
1 to 3	0	0%
3 to 5	3	9%
5 to 8	2	6%
8 to 10	3	9%
10 to 15	3	9%
15 to 20	11	32%
More than 20	11	32%
Total	34	100%

Many of the questions asked on the survey require experience with the technologies, and the higher the level of experience, the better the responses received. Twenty-eight of the thirty-four respondents (80%) indicated more than eight years of experience. This indicates a high level of experience among the respondents, giving us an excellent set of answers, which should add additional value to the study.

The educational level of the respondents also covered a wide range from only some college to doctorate degrees with the majority (59%) having Bachelor's degrees (Table 5.3). As with experience, the more educated the respondents are, the more familiar they are with the available technologies. With 85% of the respondents having a bachelor's degree or higher, we have an excellent sample.

Table 5.3: Education Level of Respondents

Education	Number	Percentage of Total
Some College	2	6%
Associate's	3	9%
Bachelor's	20	59%
Master's	8	24%
Doctorate	1	3%
Total	34	100%

The final set of individual demographic information of importance is the level of involvement of the respondent to the project. Table5.4 shows that the respondents ranged from Programmers to Top Management with the majority serving as Project Managers or Functional Area Experts. It is to be hoped that these respondents will have the best knowledge of the projects and will honestly report on those projects.

Table 5.4: Level of Involvement

Level of Involvement	Number	Percentage of Total
Project Manager	11	32%
Functional Area Manager	4	12%
Functional Area Expert	10	29%
Programmer/Developer	5	15%
Middle Management	3	9%
Top/Exec Management	1	3%
Total	34	100%

5.1.2 Organizational Demographics

In addition to knowing about the individuals and their demographics, it is also very important to gain an understanding about the organizations represented by the responses. The first area of interest is the industries represented. Our respondents indicated the primary business activities as listed in Table 5.5, but the largest numbers were from Manufacturing (32%) and Education (21%). This wide range of industries represented is important for ensuring a good cross-section of enterprises performing integrations.

Table 5.5: Industry Representation

Industry	Count	Percentage of Total
Biotech/Biomed/ Pharmaceuticals	1	3%
Education	7	21%
Energy	1	3%
Financial/Banking	2	6%
Food and Beverage	1	3%
Government	1	3%
Healthcare	1	3%
Insurance	1	3%
Manufacturing	11	32%
Military	2	6%
Petroleum	1	3%
Retailing/Wholesaling	2	6%
Telephony/ Telecommunications	2	6%
Utilities	1	3%
Total	34	100%

5.2 Data Preparation

5.2.1 Data Scrubbing

The first step in analyzing the data received was to scrub the data to make sure it was as "clean" as possible. Each response was examined for ambiguities or obvious errors such as text in numeric fields or numbers in character fields. Unfortunately, only 55 respondents completed the first page and only 34 finished the last page, leaving us with a very small sample size. Of the 34 "complete" responses, there were several which had some missing values, but which could still be used in the sections of analysis where the responses had all the required data. In addition, some of the 21 "incomplete"

responses contained sufficient data to be included in a very few portions of the analysis, specifically the portion which compares experience with likeliness to use.

Due to the limited number of responses received, this data analysis will only be used to present a preliminary set of results. After much discussion with other researchers and experts, it was discovered that surveys implemented during the summer do not usually perform well. One of the reasons is that Summer is a popular time to take vacation, so potential respondents are not available, and when they are available, they are more concerned with "catching-up" with work rather than taking time to respond to surveys. Another possible reason for the lack of responses with this particular survey (especially when combined with the previous reason) is that people are becoming inundated with e-mail requests for participation in surveys and are not willing to continue to participate in such surveys. Future plans are to re-implement the survey at a later date, hopefully with better results.

5.2.2 Data Consolidation

The data was collected and stored in several different files, one for each major portion of the survey. The first file contained the data from the first page which was very short and took very little time to complete. This page collected information about the participant's experience with ERP and EAI as well as their perceptions/opinions about the technologies. The second file contained the responses for the ERP section of the survey, while the third was the EAI data. Demographic information was collected toward the end of the survey and was stored in the fourth file. The final file contained only e-mail addresses and was not linked to the other files in any way. This fifth file will only

be used to send results to those who requested them or to determine the winners of the iPod Shuffle promotion.

To complete the consolidation, the first four files from each of the two sources were imported into SAS data files. Outer joins were used to combine the data into two new databases – one for each source, then an append was used to combine those two databases into a single consolidated database. A copy of the database was then created to work from, keeping all the original files as backups in case anything happened to the data or the system.

5.2.3 Variable Creation

The final step in preparing the data for analysis was to create variables to represent factors or other groups of variables which were not directly measured or collected during the course of the survey. These created variables represented the averages of each of the variables included in each of our eight factors for the implementation model, as well as averages of the career anchors and risk propensity constructs of the individual perceptions model. An additional variable was created to average the data associated with the dependent variable construct of System Implementation Success.

5.3 Data Validation

5.3.1 Construct Validity (Factor Analysis)

To ensure the construct validity of our model, a factor analysis was performed for the set of variables represented by each independent variable construct in the individual

and implementation models. The preliminary data was evaluated using a varimax rotation, with all variables positively loading on their respective factor constructs. There were no negative loadings on any of the constructs. A second factor analysis was performed on the entire set of measures, again with no negative loadings.

The measures associated with the dependent variable construct of Systems Implementation Success were also analyzed using the varimax rotation factor analysis. As with the other constructs, all measures positively loaded into the construct.

5.3.2 Reliability (Chronbach's Alpha)

Ensuring the construct validity is only one step in making sure the data is measuring what it is supposed to measure. Face validity, which measures whether the questions and groups of questions make sense and are appropriate, was evaluated during the survey development using the Q-Sort as described in Chapter 4. In addition to the validities, reliability and consistency of the constructs is also important. A correlation procedure was implemented on each of the constructs with extremely promising results for such a small number of responses. All of the constructs were above the minimum suggested value of 0.70, and most were above 0.9 (Table 5.6). This high Chronbach's Alpha indicates the constructs used for this study are highly reliable and consistent. It is interesting to note that while both the Change Management and Human Resources are both above 0.90 (0.93 and 0.94, rasp.), the construct combining the two (CMH) was even higher at 0.95, again indicating that our decision to combine them may have been correct. More study is required to fully appreciate these constructs.

Table 5.6: Chronbach's Alphas

Variable/Construct	Chronbach's Alpha
System Success (SS)	0.951937
Change Management (CM)	0.929489
Human Resources (HR)	0.942965
Combined CM/HR (CMH)	0.948977
Management Support (MS)	0.952582
Project Scope (PS)	0.928545
Project Planning (PP)	0.928688
Project Management (PM)	0.882131
Business Competence (BC)	0.919284
Technology (T)	0.909152
Technological Competence (TC)	0.909152
Technical/Functional Career Anchor (TF)	0.721562
General Manager Career Anchor (GM)	0.922433
Risk Propensity (RTP)	0.799077

5.3.3 Construct Correlation Coefficients

The constructs for each of the two models were examined for correlations between the variables. Table 5.7 is the correlation matrix for the Individual Model. The correlation matrix gives us a quick overview of the relationships between the various variables in the Individual Model.

Table 5.7: Individual Model Correlation Coefficients

	RTP	TF	GM	E_ERP	E_EAI	P_ERP	P_EAI
RTP	1						
TF	0.16813 0.3924	1					
GM	0.5653 0.0011**	-0.05531 0.7798	1				
E_ERP	0.29247 0.1983	0.32311 0.1772	-0.12681 0.5839	1			
E_EAI	0.00569 0.9794	-0.15302 0.5078	-0.43993 0.0357*	0.46729 0.0185*	1		
P_ERP	0.67717 0.0004***	-0.00531 0.9818	0.30805 0.1527	0.47733 0.0158*	0.08475 0.6743	1	
P_EAI	-0.21884 0.3158	0.01333 0.9543	-0.19943 0.3616	0.14496 0.4893	0.56381 0.0022**	0.02716 0.893	1

* Significant a p < .05 ** Significant a p < .01 *** Significant a p < .001

The correlation coefficient matrix for the Implementation Success Model is detailed in Table 5.8. There are many significant correlations between the Independent Variables (IVs). Unfortunately, this correlation is undesirable as it indicates some potential for multi-collinearity among the variables, which could affect the performance of the model. The correlations between the IVs and the Dependent Variable, however, are much more appealing. All the correlations are negative, indicating a direct relationship between the severity of a problem area and the success of the implementation.

Table 5.8: Implementation Success Model Correlation Coefficients

	SS	T	TC	BC	PS	PP	PM	CM	MS
SS	1								
T	-0.38557	1							
	0.0354*								
TC	-0.28003	0.65511	1						
	0.1206	<.0001***							
BC	-0.2651	0.5245	0.63058	1					
	0.1425	0.0025**	0.0001***						
PS	-0.46105	0.46537	0.29093	0.42957	1				
	0.0069**	0.0083**	0.1005	0.0126*					
PP	-0.36067	0.60602	0.5343	0.67607	0.69131	1			
	0.0426*	0.0004***	0.0016**	<.0001***	<.0001***				
PM	-0.26273	0.44185	0.49396	0.64148	0.43774	0.73506	1		
	0.1533	0.0164**	0.0047**	0.0001***	0.0122**	<.0001***			
CM	-0.31662	0.62072	0.47585	0.48654	0.65792	0.75098	0.6333	1	
	0.0827*	0.0003***	0.0059**	0.0055**	<.0001***	<.0001***	0.0002***		
MS	-0.10267	0.5949	0.63362	0.55683	0.29961	0.57299	0.64814	0.71415	1
	0.576	0.0004***	<.0001***	0.0009***	0.0903	0.0006***	<.0001***	<.0001***	

* Significant a p < .05 ** Significant a p < .01 *** Significant a p < .001

5.4 Model Evaluation

5.4.1 Individual Preference Model

In Chapter 3, we developed an Individual Preference Model (Figure 5.1) and Hypotheses (Table 5.9) to help us better understand why some IT professionals would favor one Enterprise Integration technology over the other. In this section we examine the hypotheses presented in the Individual Preference Model using the preliminary data gathered.

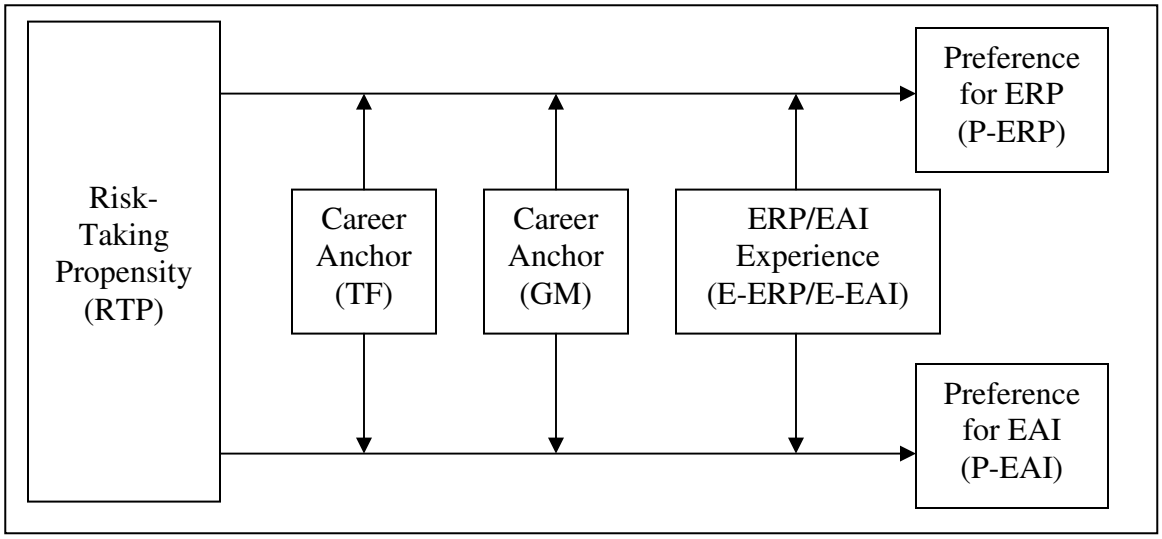


Figure 5.1: Individual Preference Model

Table 5.9: Summary of Hypotheses for Individual Perception Model

H_1: RTP is positively related to P-ERP
H_2: RTP is negatively related to P-EAI
H_{3a}: TF will positively moderate the strength of the relationship between RTP and P-ERP
H_{3b}: TF will positively moderate the strength of the relationship between RTP and P-EAI
H_{4a}: GM will negatively moderate the strength of the relationship between RTP and P-ERP
H_{4b}: GM will negatively moderate the strength of the relationship between RTP and P-EAI
H_{5a}: E-ERP will positively moderate the relationship between RTP and P-ERP
H_{5b}: E-EAI will positively moderate the relationship between RTP and P-EAI

5.3.1.1 Risk Taking Propensity (RTP)

The model indicates that RTP is the primary independent variable, which is modified by a pair of career anchors and experience working with ERP and/or EAI. The first two hypotheses propose that RTP is positively related to a preference for ERP, but negatively related to EAI. A regression analysis was performed using only the independent RTP variable and the dependent variables of Preference for ERP (P-ERP) and Preference for EAI (P-EAI). Even with the low number of responses, we find a

significant positive relationship between RTP and P-ERP, suggesting H_1 may be correct. They are inconclusive for H_2, however, showing the expected negative relationship, but with very low F- and p-values (Table 5.10). There are several possible reasons for H_2 being inconclusive. The first was initially discussed during model development in Chapter 3; professionals with lower risk-taking propensities would be more likely to select EAI over ERP, but that high risk-taking propensities do not impact the selection of EAI over ERP. Another possible reason for inconclusive results is the low response to the survey.

Table 5.10: Individual Model Direct Relationships

Relationship	Coefficient	F-Value	R-Square	p-value
RTP vs. P-ERP	1.12424	17.79	0.4586	0.0002
RTP vs. P-EAI	-0.36663	1.06	0.0479	0.1579
TF vs. P-ERP	-0.01083	0	0	0.4909
TF vs. P-EAI	0.02844	0	0.0002	0.4772
GM vs. P-ERP	0.36323	2.2	0.0949	0.0764
GM vs. P-EAI	-0.2373	0.87	0.0398	0.1808

5.4.1.2 Career Anchors

As proposed by Hypotheses $H_{3a\ \&\ b}$ and $H_{4a\ \&\ b}$, a person's career or business goals (career anchors) are expected to have a moderating effect on the relationship between RTP and Preferences for ERP and EAI (Table 5.9). The moderating effect is expected to be positive for the Technical/Functional (TF) career anchor ($H_{3a\ \&}$ $H_{3b)}$, but negative for the General Manager (GM) career anchor (H_{4a} & $H_{4b)}$.

Before we can examine a moderating relationship, however, we need to confirm that there is little or no direct relationship between the career anchors and the independent

variable of Risk-Taking Propensity (RTP). Simple regression analyses were performed on each of the career anchors with RTP, with the results indicating there is not a significant relationship between TF and RTP (Table 5.11). GM, however, does appear to have a significant relationship ($p < 0.001$) with RTP, which prevents us from further evaluating the moderation effect of GM.

Table 5.11: Test for Direct Relationships Between Career Anchors and RTP

Relationship	Coefficient	F-Value	R-Square	p-value
TF vs RTP	0.16514	0.76	0.0283	0.3924
GM vs RTP	0.37124	13.15	0.3196	0.0011

Next we need to determine if there is a moderating effect and the strength of that effect, if any. To test this, we combined RTP with TF and ran regressions on this combination with each of the two preference variables. The results are listed in Table 5.12. The first row indicates the simple regression equation without the interaction effect between RTP and TF, while the second includes the interaction effect. For a variable to be a moderator, a significant interaction term is needed. The results indicate that without the interaction term, there is still a significant relationship between RTP and P-ERP (H_{3a} and H_{4a}), but still none between RTP and P-EAI (H_{3b} and H_{4b}).

Table 5.12: Moderating effects of Career Anchors on RTP vs. Preference

Regression Equation Includes:		vs. P-ERP				vs. P-EAI			
		Coefficient	F-Value	R-Square	p-value	Coefficient	F-Value	R-Square	p-value
TF and RTP	RTP	1.0635	7.13	0.4419	0.0007***	-0.47295	0.78	0.08	0.1137
	TF	-0.15468			0.3367	0.09241	0.78	0.08	0.4255
TF, RTP, and Interaction	RTP	1.34075	4.5	0.4427	0.4536	4.64105	2.97	.3436	0.0318*
	TF	0.05435			0.9684	3.94807			0.0198*
	RTP*TF	-0.07078			0.8741	-1.30558			0.0182*
		*** Significant at p < .001				* Significant at p < .05			

Once we add the interaction term, however, we see a completely opposite result. The relationship between RTP and P-ERP becomes insignificant while the relationship between RTP and P-EAI becomes significant. We also see that the interaction term between RTP and TF is not significant for the relationship with P-ERP, but it is significant for the relationship with P-EAI. This indicates that TF does not act as a moderator for the RTP/P-ERP relationship, but does for the RTP/P-EAI relationship.

A closer look at the moderated results shows a lower coefficient and R^2 for the RTP/P-ERP relationship when moderated by TF than when not moderated. This is the opposite of what was expected through H_{3a}, but is really meaningless since TF does not appear to be a moderator for this relationship. We do find significant results for H_{4a}, with the coefficient and R^2 higher for the RTP/P-EAI relationship when moderated by TF rather than lower. From this analysis, we find support for H_{3b}, but no support for H_{3a}, H_{4a}, and H_{4b}.

5.4.1.3 Experience

A final major influence in influencing an IT Professional's preference for ERP or EAI is prior experience with one or the other or both. Like the career anchors, experience was expected to be a moderating variable, influencing the strength (and direction) of the relationship between RTP and preference. As indicated by the values in Table 5.13 there do not appear to be direct relationships between experience with either ERP (E-ERP) or EAI (E-EAI) and RTP, allowing us to continue investigating the moderation effects of experience.

Table 5.13: Experience vs. RTP

Relationship	Coefficient	F-Value	R-Square	p-value
E-ERP vs RTP	0.41996	1.78	0.0855	0.1983
E-EAI vs RTP	0.01037	0.00	0.0000	0.9794

To test the hypotheses associated with E-ERP and E-EAI, regression analyses were run combining Experience with RTP to determine if there are any moderating effects on RTP by either E-ERP or E-EAI. Table 5.14 shows the results of the regression analyses both with and without the required interaction effect variable. H_{5a} proposed that the relationships between RTP and P-ERP would be positively moderated by the presence of E-ERP. We can see in Table 5.14, however, that without the interaction effect between RTP and E-ERP, the coefficient drops slightly, indicating a negative moderation rather than positive. Once we add the interaction term, however, we see the coefficient gets much larger, but changes sign, while the R^2 also gets quite a bit larger. We do find the interaction term to be significant, indicating the moderation assumption is correct. In addition, while RTP and E-ERP are not significant at $p < .05$, they are quite close and, with more observations, could become significant, showing some support for the model. Since the strength of the coefficient is much larger with the moderation variable, we still find partial support for H_{5a} which suggests there is a positive moderation effect. The change in sign indicates that the moderation may actually have an inverse effect and more study is needed. There do not appear to be any significant relationships between E-ERP and P-EAI, which supports the decision not to include a hypothesis based on this relationship.

Table 5.14: Moderating Effect of Experience on RTP vs. Preference

Regression Equation Includes:		vs. P-ERP				vs. P-EAI			
		Coefficient	F-Value	R-Square	p-value	Coefficient	F-Value	R-Square	p-value
E-ERP and RTP	RTP	1.00062	9.59	0..5159	0.0013**	-0.53255	1.08	0.107	0.09115
	E-ERP	0.30208			0.07395	0.232			0.1985
E-ERP, RTP, and Interaction	RTP	-2.94805	9.98	0.6379	0.0954	2.12812	1.11	0.1641	0.4064
	E-ERP	-1.81209			0.0604	1.65656			0.2362
	RTP* E-ERP	0.83541			0.0285*	-0.56291			0.2965
E-EAI and RTP	RTP	1.12402	8.49	0.4459	0.0003***	-0.37183	5.26	0.3449	0.11715
	E-EAI	0.02149			0.4437	0.50116			0.00345**
E-EAI, RTP, and Interaction	RTP	-0.88494	12.37	0.6613	0.1804	-1.46130	4.28	0.4033	0.1027
	E-EAI	-1.52795			0.0046**	-0.33911			0.6009
	RTP* E-EAI	0.54289			0.0032**	0.29441			0.1886

*** Significant at p < .001 ** Significant at p < .01 * Significant at p < .05

H_{5b} proposed a positive moderation effect of E-EAI on the relationship between RTP and P-EAI. With no interaction term, the results show a very slight positive influence on the coefficient, and the R^2 is much larger with the moderation than without, indicating a greater level of explanation. Adding the moderation term of RTP*E-EAI, we see an additional increase in the strength of the coefficient and R^2, however, none of the terms appear to be significant, resulting in only partial support for H_{5b}. Again, these results are only preliminary and somewhat ambiguous with some being as expected while others are not.

5.4.2 Enterprise Integration Implementation Success Model

The second part of this project was aimed at investigating the reasons and factors leading to Enterprise Integration success or failure. The model and hypotheses developed in Chapter 3 to study this phenomenon are shown in Figure 5.2 and Table 5.15.

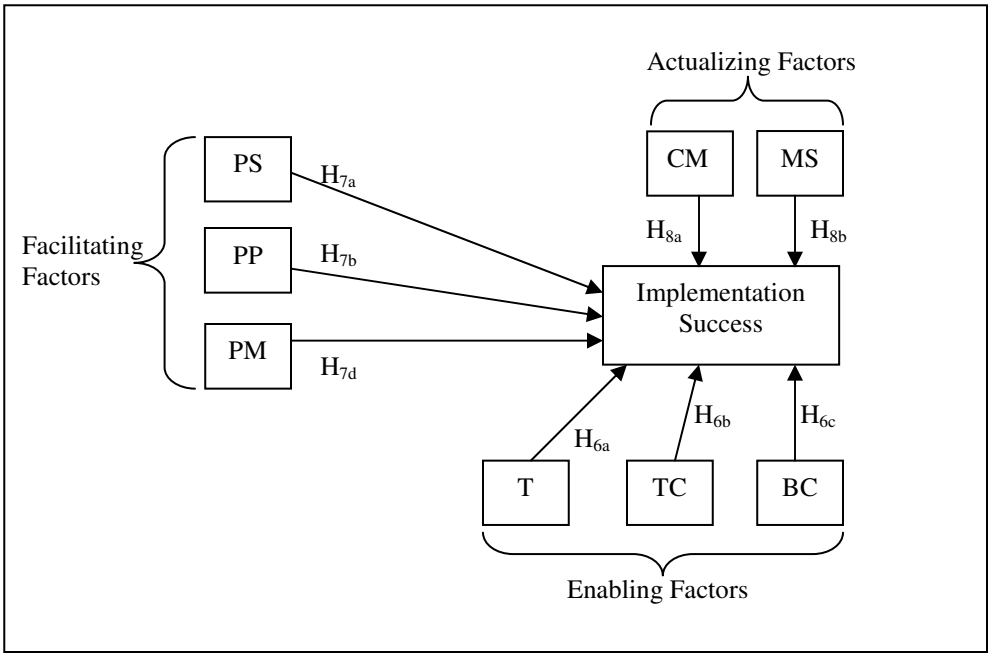


Figure 5.2: Enterprise Integration Implementation Success

Table 5.15: Summary of Hypotheses for Implementation Success

Enabling Factors
H_{6a}: Quality of T will have a positive association with Implementation Success
H_{6b}: TC will have a positive association with Implementation Success
H_{6c}: Degree of BC will have a positive association with Implementation Success
Facilitating Factors
H_{7a}: PS optimality will have a positive association with Implementation Success
H_{7b}: PP will have a positive association with Implementation Success
H_{7c}: PM will have a positive association with Implementation Success
Actualizing Factors
H_{8a}: Quality of CM will have a positive association with implementation success
H_{8b}: MS will have a positive association with Implementation Success

5.4.2.1 Analysis of Enabling Factors

The Three-Factor Theory of Information Systems Implementation (Teng et al., 2005) discussed in Chapter 3 indicates three different categories or levels of factors

influencing IS implementation success. These three factors build on one another beginning with the bottom layer or Enabling Factors.

The hypotheses (H_{6a} – H_{6c}) for this study propose that each of the three Enabling Factors will simply have a positive association with Implementation Success. Regression analyses were performed on each of the three factors (T, TC, and BC) separately, with the results shown in Table 5.16. We can see from the statistics that, when treated separately, all three factors are negatively correlated with Implementation Success. Since the factors are reverse coded on the survey, this actually makes the association positive as expected. Only the factor associated with Technology (T) has a significance level better than $p < .05$, but the other two also have fairly low p-values. Perhaps with more data we would find more significance in these factors, as well.

Table 5.16: Regression Statistics for Enabling Factors

Factor		Coefficient	F-Value	R-Square	p-value
T		-0.3961	4.89	0.1487	0.0177
TC		-0.36663	1.06	0.0479	0.1579
BC		-0.25804	2.27	0.0703	0.07125
All Three Combined	T	-0.26716	1.36	0.1407	0.1381
	TC	-0.15879			0.28675
	BC	0.00643			0.489
Only T and BC	T	-0.34673	2.49	0.1556	0.05485
	BC	-0.09461			0.32035

Since each level of factors builds on the others, we want to combine the effects of the three Enabling Factors. Unfortunately, we can see from Table 5.9 that when we combine these factors, the results are less significant and less important than when treating them separately. In fact, we can see that the coefficient associated with Business

Competence (BC) actually changes signs. This may indicate some co-linearity between the factors, which requires a closer look. However, with the limited number of observations available at this time, a more detailed examination is not feasible.

The survey targeted IT Professionals who may have been somewhat reluctant to indicate poor Technological Competence (TC), which may have resulted in some bias on TC. Removing TC from the regression equation, however, only slightly improves the R^2 while actually reducing the significance of the factors. Therefore, we will retain all three factors as Enablers for the remainder of the study.

5.4.2.2 Analysis of Facilitating Factors

As with the Enabling Factors, the basic hypotheses (H_{7a} – H_{7c}) are that the Facilitating Factors will have a positive association with Implementation Success. Regression analyses were performed on each Facilitating Factor separately and all three combined, with the results indicated in Table 5.17. Our results are somewhat better than those for the Enabling Factors, with two of the factors having significance of better than $p < .05$, with the third being very close. With more observations, we might see some improvement in significance. All three also have negative coefficients which, when reversed, indicate a positive association as expected. Our combined results are somewhat worse, with lower coefficients, less significance, and a directional change on the Project Management (PM) factor.

Table 5.17: Regression Statistics for Facilitating Factors

Factor		Coefficient	F-Value	R-Square	p-value
PS		-0.32853	8.37	0.2126	0.00345
PP		-0.34378	4.49	0.1301	0.0213
PM		-0.32028	2.15	0.069	0.07665
All Three Combined	PS	-0.2804	3.69	0.2909	0.0451
	PP	-0.26114			0.1745
	PM	0.20333			0.25015

5.4.2.3 Analysis of Actualizing Factors

The final category to analyze is the Actualizing Factors. These hypotheses (H_{8a} – H_{8b}), like the two previous categories, are only looking for a positive association. Again, regression analyses were performed on the two factors separately as well as combined. The results (Table 5.18) show that we have our positive association (negative coefficients) for both Change Management (CM) and Management Support (MS), but only CM is significant at $p < .05$.

Table 5.18: Regression Statistics for Actualizing Factors

Factor		Coefficient	F-Value	R-Square	p-value
CM		-0.28589	3.23	0.1002	0.04135
MS		-0.08489	0.032	0.0105	0.288
Both	CM	-0.49827	2.76	0.1647	0.0132
	MS	0.28646			0.0764

When we combine the two Actualizing Factors, we get some rather interesting results. CM gains strength and significance, and the combined model explains more variance (R^2) than when the factors are separate. MS changes direction and gains some

significance, but is still not better than the $p < .05$. It appears that MS may actually have some moderating effect rather than, or in addition to, a direct effect. More observations and additional study is needed to better understand the phenomenon.

A final set of tests were performed on the Actualizing Factors. Since we have questioned whether HR should be combined with CM, regression was evaluated with HR as a separate entity from CM. The separate analyses give us similar results to the combined CM and HR, with the separated coefficients still negative (positive association) and significant at $p < .05$ (Table 5.19). The combined model with MS added, however, appears to be worse than the previous analysis. The results are inconclusive for separating HR, so we will continue to use the combined CM-HR factor.

Table 5.19: Regression Statistics for Actualizing Factors with Separate HR

Factor		Coefficient	F-Value	R-Square	p-value
CM (no HR)		-0.24613	2.4	0.074	0.066
HR		-0.23027	3.18	0.0957	0.04245
MS		-0.08489	0.032	0.0105	0.288
Combined Model	CM	-0.39206	1.79	0.1658	0.0925
	HR	-0.11745			0.27995
	MS	0.29184			0.07835

5.4.2.4 Analysis of Factor Group Effects

A final set of hypotheses addresses a comparison of the explanatory capabilities of the different factor groups as well as differences in association of the groups to the two Enterprise Integration technologies (ERP and EAI). These hypotheses are listed in Table 5.20.

Table 5.20: Summary of Hypotheses for Factor Group Analysis

H_{9a}: Actualizing Factors will explain a larger percentage of the variance in Implementation Success than Facilitating Factors
H_{9b}: Facilitating Factors will explain a larger percentage of the variance in Implementation Success than Enabling Factors
H_{10}: Enabling Factors will have a higher level of association with Implementation Success for EAI than for ERP
H_{11}: Actualizing Factors will have a higher level of association with Implementation Success for ERP than for EAI

To fully examine the explanatory power of each of the three factor groups, more data is required, and additional tests need to be run. However, we can gain some preliminary insight by examining the R^2 for each factor group. From Table 5.21, we can see that the Facilitating Factors have a higher R^2 than the Enablers as proposed by H_{9a}. The data does not support H_{9b}, however, since the Actualizers have a smaller R^2 than the Facilitators. The R^2 for the Actualizing Factors is larger than that for the Enabling Factors, but that was understood from the wording of the hypotheses.

Table 5.21: Explanatory Capability of Factor Groups

Factor Group	F-Value	R-Square
Enablers	1.36	0.1407
Facilitators	3.69	0.2909
Actualizers	2.76	0.1647

The Hotelling's t test can be used to compare two non-independent correlation coefficients based on three variables (Rosenthal & Rosnow, 1991). The first two variables (referred to as X and Y) are predictor variables with the third (Z) being the outcome, or dependent, variable. Since we are examining Implementation Success, our dependent variable is Systems Success (SS). To utilize the t- test equation, the three correlations between X, Y, and Z (referred to in the formula as r_{xy}, r_{xz} and r_{yz}) are

required. For H_{9a}, are comparing the Facilitators to the Actualizers, giving us the correlation table as depicted in Table 5.22. Since we are examining the magnitude of the correlations, we will use the absolute values of the coefficients.

Table 5.22: Correlation Matrix Comparing Facilitators with Actualizers

	Facilitators (X)	Actualizers (Y)	SS (Z)
Facilitators (X)	1		
Actualizers (Y)	0.72209 <.0001	1	
SS (Z)	-0.48748 0.0054	-0.18172 0.3279	1

Following the hypothesis that Actualizers (Y) explain more than Facilitators (X), we get the formula 5.1 for the Hotelling's t test. There are thirty usable observations for this test, which will be used for N. The resulting t_H is -1.964 which is the opposite of what was expected from the hypothesis. In fact, this t_H indicates that there is a 97% confidence that Facilitators actually explain more than the Actualizers, resulting in a lack of support for H_{9a}.

$$t_H = (r_{yz} - r_{xz})\sqrt{\frac{(N-3)(1+r_{xy})}{2(1-r_{xy}^2 - r_{xz}^2 - r_{yz}^2 + 2r_{xy}r_{xz}r_{yz})}} \qquad (5.1)$$

Testing H_{9b} that Facilitators explain more than Enablers uses the same formula (5.1). The correlation matrix is indicated in Table 5.23. Again, there are thirty usable observations. Using the correlations, we get a t_H of 1.505, which gives us a 94% confidence that Facilitators do indeed explain more than Enablers, supporting H_{9b}.

Table 5.23: Correlation Matrix Comparing Enablers with Facilitators

	Enablers (X)	Facilitators (Y)	SS (Z)
Enablers (X)	1		
Facilitators (Y)	0.56509 0.005	1	
SS (Z)	-0.19724 0.367	-0.48748 0.0054	1

To examine Hypotheses 10 and 11, we have to separate the results for each of the Enterprise Integration technologies. Since we are examining the Enabling and Actualizing Factors, we included the Facilitating Factors to see if there was anything interesting. Splitting the preliminary data between the two technologies leaves us with only a few observations for each technology. Because of this, the results may not appear to be significant. In fact, only PS, CM, and MS on the ERP-Success portion are significant at better than $p < .05$ (Table 5.24). Much more data is required to begin to properly analyze the data. Examining just the R^2, we find that all of the factor groups have a higher R^2 for EAI-Success than for ERP-Success. H_{10} appears to have some validity since the Enabling factors have a .5679 R^2 for the EAI-Success, while the ERP-Success only has an R^2 of .0881. H_{11}, however, is not supported by this data, since the R^2 for ERP-Success is very low at .197, while the R^2 for EAI-Success is much higher at .4638.

Table 5.24: Analysis of Factor Groups

Factor		Coefficient	vs. ERP-Success F-Value	R-Square	p-value	Coefficient	vs. EAI-Success F-Value	R-Square	p-value
Enabling Factors	T	-0.24908	0.48	0.0881	0.2093	-0.03345	2.63	0.5679	0.4805
	TC	-0.14784			0.33005	-0.02593			0.4899
	BC	0.18728			0.27005	-0.63607			0.1302
Facilitating Factors	PS	-0.35971	2.67	0.3483	0.04915	-0.34498	1.9	0.4156	0.2186
	PP	-0.34478			0.17215	-0.28754			0.27555
	PM	0.31729			0.22765	-0.00154			0.4989
Actualizing Factors	CM	-0.59999	2.12	0.197	0.0368	-0.35734	3.46	0.4638	0.1672
	MS	0.43899			0.0395	-0.32098			0.21635

5.5 Summary of Analysis

In summary, we have seen that our results are very preliminary due to the limited number of responses available. We do see some support for our model and hypotheses, however. Our constructs appear to be valid with all variables positively loading in their respective factors, and all the factors have Chronbach's Alphas at better than .72. The regression analyses gave mixed results, but we do support, at least partially, a majority of the hypotheses.

Table 5.25 shows a summary of the hypotheses and whether they were supported (Y), not supported (N), or partially supported (P). A hypothesis is considered supported if the direction and strength of the association is correct and that the significance level is at least $p < .05$. A partially supported hypothesis has the correct direction and strength of association, but is not significant at $p < .05$ or better. A hypothesis is not supported if the direction is other than hypothesized.

Table 5.25: Hypotheses Support

Hypothesis	Supported?
H_1: RTP is positively related to P-ERP	Y
H_2: RTP is negatively related to P-EAI	P
H_{3a}: TF will positively moderate the strength of the relationship between RTP and P-ERP	N
H_{3b}: TF will positively moderate the strength of the relationship between RTP and P-EAI	Y
H_{4a}: GM will negatively moderate the strength of the relationship between RTP and P-ERP	N
H_{4b}: GM will negatively moderate the strength of the relationship between RTP and P-EAI	N
H_{5a}: E-ERP will positively moderate the relationship between RTP and P-ERP	P
H_{5b}: E-EAI will positively moderate the relationship between RTP and P-EAI	P
H_{6a}: Quality of T will have a positive association with Implementation Success	Y
H_{6b}: TC will have a positive association with Implementation Success	P
H_{6c}: Degree of BC will have a positive association with Implementation Success	P
H_{7a}: PS optimality will have a positive association with Implementation Success	Y
H_{7b}: PP will have a positive association with Implementation Success	Y
H_{7c}: PM will have a positive association with Implementation Success	P
H_{8a}: Quality of CM will have a positive association with implementation success	Y
H_{8b}: MS will have a positive association with Implementation Success	P
H_{9a}: Actualizing Factors will explain a larger percentage of the variance in Implementation Success than Facilitating Factors	N
H_{9b}: Facilitating Factors will explain a larger percentage of the variance in Implementation Success than Enabling Factors	Y
H_{10}: Enabling Factors will have a higher level of association with Implementation Success for EAI than for ERP	Y
H_{11}: Actualizing Factors will have a higher level of association with Implementation Success for ERP than for EAI	N
Note: Y=Supported N=Not Supported P=Partially Supported	

CHAPTER 6

SUMMARY AND CONCLUSIONS

6.1 Summary

We have seen that there are many studies focusing on both Enterprise Resource Planning (ERP) and Enterprise Application Integration (EAI), as well as other technologies for integrating Enterprise Systems. Several frameworks and models have been used to examine the phenomenon surrounding ERP and EAI and the implementation of these systems. There have been few articles to compare and contrast Enterprise Integration technologies and none which attempt to model both simultaneously. This study has attempted to provide that joint study, resulting in a model which examines both ERP and EAI implementations.

People's attitudes, perceptions, and preferences have also been a major focus of research, playing a major part in such models as the Technology Acceptance Model (Davis, 1989; Davis, Bagozzi, & Warshaw, 1989) and the DeLone and McLeon Model of Information Systems Success (DeLone et al., 1992, 2003). Again, there have been no studies dealing with preferences for Enterprise Integration technologies until now. The first part of this study was designed to show what drives an individual to prefer one Enterprise Integration technology over another.

There were three primary goals of the second part of this study. The first goal was to identify the factors which are significant for success. Many previous studies were examined and a model was developed based on those factors which appeared to be most instrumental in the successful implementation of Enterprise Integration projects. This tied directly into the second goal which was to determine if any of the factor groups were more important or significant than the others. The final goal examined the different technologies to discover if any of the factors associations were different between the two Enterprise Integration technologies.

6.2 Implications

There are several implications to both researchers and practitioners suggested by this study.

6.2.1 Researchers

This model uses a new approach for Information Technology (IT) research models. That approach uses a hierarchy of needs to classify various factors into categories according to the criticality of those factors to success. This model can be modified and applied to many other applications, potentially simplifying IT models, especially those dealing with success.

A second implication to researchers is a verification of the factor groupings suggested by Grover et al (Grover et al., 1995). The Grover study has had a tremendous impact on IT research in recent years and verification of the study will enhance its importance.

6.2.2 Practitioners

There are many models and frameworks in Enterprise Integration literature, but they are all complex with many factors and antecedents, making it difficult for practitioners to follow the models to success. Therefore, many projects still fail, even with all the research available. The model presented here will provide a more straightforward model for implementation success. It will clearly explain the differentiated impact of the various implementation success factors, and provide useful and practical guidelines for improving the potential for implementation success.

A second implication to practitioners is a better understanding of the difference between the approaches used for ERP and EAI. Through this study, we should be able to show that the different factors will have different levels of importance (association) on success for the different technologies.

A third implication is gaining an understanding of the importance of an individual's preference toward each of the technologies. Organizations have often ignored the recommendations of their IS professionals and made decisions based on what the rest of the industry is doing. Many times this results in disaster. It is hoped that bringing IS professionals' preferences for EAI and ERP to light will encourage organizations to put more faith and trust in their IS professionals' opinions.

6.2 Limitations

While the data obtained and analyzed during the course of this study indicated some support for the model and hypotheses, the lack of substantial numbers of respondents greatly hampers the effectiveness of this study. A larger sample is necessary

to effectively analyze the data through analyses methods such as Partial Least Squares or Structural Equation Modeling. Therefore, these results can only be treated as preliminary and more research should be performed. The low response rate may be attributed to the survey being administered during the summer when many people are on vacation. With it being an e-survey, it is also possible that people are getting tired of responding to survey requests obtained through e-mail invitations.

As with any survey research, there are problems associated with self-reporting biases. In this study, Information Technology (IT) Professionals were targeted. Some of the questions asked about the effectiveness of the IT participation in the project and some respondents may have been unwilling to indicate poor performance, resulting in a potential for inflated (or deflated) responses. Non-response bias is also a concern, but was not possible due to the way the survey was implemented. The survey was an e-survey with an invitation sent to an unknown set of e-mail addresses, making it impossible to follow-up with any of the non-respondents.

6.3 Future Research

Potential for follow-up research to this dissertation is practically limitless. There are several different analysis methods which could actually be utilized to examine the effectiveness of the implementation success model, such as Structured Equation Modeling (SEM) and Classification and Regression Tree (CART) analysis, each potentially generating a methodology journal publication in at least high-quality IS journals. In addition, a comparison of analysis techniques could lead to another publication.

The generalized implementation success model will lead to a whole stream of research which applies the model to other applications, especially success models. For instance, there are many success factors for Information Systems success (DeLone et al., 1992; Larsen, 2003; Seddon, 1997). Another example is the set of factors relating to data warehouse success (Shin, 2003; Wixom et al., 2001). The factors associated with success in each of these examples could be remapped to fit our generalized implementation success model, each resulting in high-level IS journal publications such as JMIS or MISQ.

As discussed during the literature review (Chapter 2), the number of articles concerning EAI is somewhat limited from a research perspective. Opportunities for case studies abound and should be investigated, as should the discovery and classification of factors and antecedents for EAI implementation success.

6.4 Conclusion

In conclusion, this study, while still preliminary, has the potential to have a powerful impact on future research about Enterprise Integration Systems. Even with only a few responses, many of the hypotheses were at least partially supported, and once the survey is re-implemented in a few months, the model can be re-evaluated with (hopefully) even better results and support.

Perhaps the most important finding in this study is the impact of project size (scope) on the success of the implementation. Project Scope was significantly ($p < .005$) correlated with Implementation Success, and also had an R^2 indicating that more than twenty percent of variance was explained by Project Scope alone. This is significant in

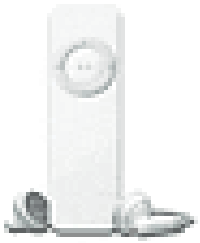
that there is little or no academic research which focuses on the importance of Project Scope on Implementation Success. It should not be surprising, however, since the Chaos Report (Standish Group International, 2003), indicates that the larger the scope of the project, the higher the rate of failure. Academicians should see this as being an area for future focus.

Throughout this study, a focus on change became more and more obvious. With the importance placed on Change Management from prior studies, a closer examination is warranted. Interestingly, many of the critical factors for success are actually related to change or the quantity of change required to complete the project. Project Scope, which defines the size and boundaries of the project, is really all about change (i.e. the number of modules or systems to install and the budget of the project). Project Management, which deals with the team selection for the project as well as managing the project, is also all about change (i.e. the amount of project to manage, the size of the team, etc.) Technological factors deal with the changes required to allow the Enterprise Integration System to function (i.e. infrastructure modifications). Several of the other factors can also add to the amount of change required for a system to be implemented.

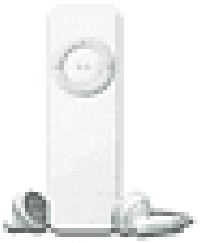
All of these factors being related to change will have a profound effect on how researchers view Systems Implementation projects in the future. The primary thing to remember is: "It's all about change!"

APPENDIX A

SURVEY INSTRUMENT



business integration JOURNAL



The University of Texas ARLINGTON

A Survey of

Enterprise Systems Implementation

Thank you for participating in this survey. Your knowledge and opinions are highly valued.

To be entered in the drawing for one of the five **iPod Shuffles**, you must complete the entire survey by June 25.

All responses will be kept completely confidential and all questions are optional. Responses will be saved in a manner where there will be no way to link responses to specific individuals. Please be patient and answer all questions presented to you.

Click the button below to begin.

Begin Survey

Enterprise Resource Planning (ERP) is an enterprise-wide combination of business management practice and technology, where Information Technology integrates and automates many of the core business processes with templates based on best practices. It is a centralized system with a central database and application server, which all functional areas share. An implementation usually encompasses an entire replacement of the existing system(s) with the new ERP system. Typically, the organization has to conform their business practices to fit the ERP system. Major ERP vendors include: SAP and Oracle (PeopleSoft).

Please rate your level of knowledge and familiarity of ERP?

Very Low Medium Very High

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Based on what you know about ERP, how likely would you be (given a choice) to use ERP in a future Enterprise Integration project?

Would never use it ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 Would use it every time

Have you ever been involved in an ERP implementation? ☐ Yes ☐ No

---

Enterprise application integration (EAI) is a set of processes, software and hardware tools, methodologies and technologies, which, when implemented together, have the aim of consolidating, connecting and organizing all a business's computer applications, data and business processes (both legacy and new) into a seamlessly interfaced framework of system components to allow real-time exchange, management and easy reformulation of all of a company's mission critical information and knowledge.

EAI is more of a de-centralized approach with a centralized controller which allows communications and sharing of information between systems. An implementation (unlike for ERP) usually encompasses a system at a time and does not replace the system, but integrates it into the EAI architecture. EAI goes by many other names such as Application Services, Federation of Systems, Middleware, etc. Some of the most popular vendors are MicroSoft with its Web Services Architecture, Vitria Technology, Tibco Software, and webMethods.

Please rate your level of knowledge and familiarity of EAI?

Very Low Medium Very High

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Based on what you know about EAI, how likely would you be (given a choice) to use EAI in a future Enterprise Application Integration project?

Would never use it ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 Would use it every time

Have you ever been involved in an EAI implementation? ☐ Yes ☐ No

Next Page

You indicated that you have worked on an ERP project in the past. Please answer the following questions concerning ERP projects you have been involved with.

How many ERP projects have you been involved with during your professional career?

How many of these projects would you consider to be unsuccessful?

Considering the most recent ERP project (Project "P") you were involved with (not necessarily with your current employer):

What year did implementation of Project "P" begin?

How many months did it take to complete?

What was the approximate budget of the project? $

What was your level of involvement in the project?

Was there one individual who enthusiastically championed the ERP project?

Yes No

What is this person's title?

Was there an official sponsor who formally announced and kicked off the project?

Yes No

What is this person's title?

Please indicate which business processes were included (check all that apply)?

Customer Relationship Management	Supply Chain Management	Accounting and Finance
Sales Management	Purchasing Quality Management	General Ledger
Order Management	Routing Management	Accounts Receivable
Sales Planning	Shipping	Accounts Payable
Pricing	Vendor Evaluation	Asset Accounting
Marketing	Logistics Management	Cash Management
Materials Requirements Planning	Operations Management	Cash Forecasting
Materials Management	Project Management	Cost-Center Accounting
Production Planning	Production Quality	Profit-Center

	Management	Accounting
☐ Inventory Management	☐ Human Resources	☐ Product-Cost Accounting
☐ Plant Maintenance	☐ Employee Time Accounting	☐ Period-Related Costing
☐ Executive Information System	☐ Payroll Planning	☐ Financial Consolidation
☐ Decision Support System	☐ Travel Expenses	☐ Profitability Analysis

Other? (Please List)

How would you describe the methodology used to implement Project "P"?

☐ An "all-at-once" approach ☐ A phased, "piece-at-a-time" approach

Is Project "P" the first attempt at ERP in the organization? ☐ Yes ☐ No

If yes, you may skip the remaining questions on this page.

Initial ERP implementation attempts sometimes fail.

When was ERP first adopted in Project "P"s organization?

Was the first ERP implementation attempt successful? ☐ Yes ☐ No

How many ERP implementation attempts were unsuccessful prior to Project "P"?

Among these, how many encompass the same business processes as Project "P"?

How many ERP implementation attempts were successful prior to Project "P"?

Next Page

There are many expected benefits of Enterprise Integration. Considering the same ERP Project "P", please indicate the extent of your agreement to each of the following statements using the following scale:
1=Strongly Disagree; 2=Somewhat Disagree; 3=No Opinion;
4=Somewhat Agree; 5=Strongly Agree

System Goal	1	2	3	4	5
The new system has achieved all the goals set for it	☐	☐	☐	☐	☐
The new system has helped increase market share for the organization	☐	☐	☐	☐	☐
The new system has helped achieve higher sales for the organization	☐	☐	☐	☐	☐
The new system has helped reduce costs	☐	☐	☐	☐	☐
The new system has helped reduce cycle time of operations	☐	☐	☐	☐	☐
The new system has improved sharing of information across the enterprise	☐	☐	☐	☐	☐
The new system has reduced the need to enter the same information multiple times	☐	☐	☐	☐	☐
The new system is flexible and adaptable to new requirements	☐	☐	☐	☐	☐
The new system improved cross-functional business processing	☐	☐	☐	☐	☐
The information provided by the new system is customizable to individual requirements	☐	☐	☐	☐	☐
The information provided by the new system is secure	☐	☐	☐	☐	☐
The information provided by the new system is more complete than the previous system	☐	☐	☐	☐	☐
The information provided by the new system is clearer and more easily understood than the previous system	☐	☐	☐	☐	☐
The information provided by the new system is more relevant and usable than the previous system	☐	☐	☐	☐	☐
The information provided by the new system is more timely and up-to-date than the previous system	☐	☐	☐	☐	☐
The new system is more reliable than the previous system	☐	☐	☐	☐	☐

The new system is available a larger percentage of time (less down-time) than the previous system	☐	☐	☐	☐	☐
Response time of the new system is noticeably shorter than that of the previous system	☐	☐	☐	☐	☐
The information provided by the new system is more accurate that that of the previous system	☐	☐	☐	☐	☐
The new system has more functionality/features than the previous system	☐	☐	☐	☐	☐

Over all, would you rate this project as:

Unsuccessful ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 Successful

Please answer the following questions about the organization where Project "P" was implemented. NOTE: Consider the organization to be the largest business unit (unit, branch, division, company, conglomerate, etc.) serviced by the Information Technology unit responsible for the ERP implementation.

What is the primary business activity of the organization:

If "Other", please specify:

Location of organization's headquarters: City State -- Country

Number of locations in the organization:

Number of employees in the organization:

What is the organization's annual gross revenue: $

Next Page

The following factors have the potential to inhibit the success of an Implementation project. Considering the same ERP Project "P", please rate each factor according to the extent that factor was a problem during this project.

1=Not a problem; 2=A Minor Problem; 3=A Significant Problem;
4=A Major Problem; 5=An Extreme Problem

Potential problem:	1	2	3	4	5
Failure to anticipate and plan for the organizational resistance to change	☐	☐	☐	☐	☐
Failure to communicate reasons for change to organization members	☐	☐	☐	☐	☐
Lack of organization arrangements for transitioning to the new system	☐	☐	☐	☐	☐
Lack of project participants who are experienced in managing change	☐	☐	☐	☐	☐
Failure to anticipate impact of the changes caused by the new system	☐	☐	☐	☐	☐
Failure to consider existing organizational culture in managing change	☐	☐	☐	☐	☐
Failure to consider the changes to people's jobs and authority	☐	☐	☐	☐	☐
The change process was hampered due to lack of user participation	☐	☐	☐	☐	☐
The project requires too many radical changes in the organization	☐	☐	☐	☐	☐
Potential problem: **1=Not a Problem; 5=An Extreme Problem**	1	2	3	4	5
Inadequate training for employees affected by the new system	☐	☐	☐	☐	☐
Insufficient time to develop new employee skills required by the new system	☐	☐	☐	☐	☐
Lack of appropriate incentives for employees to accept the new system	☐	☐	☐	☐	☐
Lack of participation from the human resources function in the development of the new system	☐	☐	☐	☐	☐
Top management unwilling to commit resources required for the project	☐	☐	☐	☐	☐

Lack of top management participation during the project	☐	☐	☐	☐	☐
Lack of management support during crises	☐	☐	☐	☐	☐
Insufficient authority granted to project team by top management	☐	☐	☐	☐	☐
Lack of top management leadership during project	☐	☐	☐	☐	☐
Failure to find an effective sponsor or champion for the project	☐	☐	☐	☐	☐
Potential problem: 1=Not a Problem; 5=An Extreme Problem	1	2	3	4	5
The scope of the project is difficult to manage	☐	☐	☐	☐	☐
The scope of the project is never agreed upon	☐	☐	☐	☐	☐
The scope of the project is not clearly defined	☐	☐	☐	☐	☐
The scope of the project is too large	☐	☐	☐	☐	☐
Misalignment of project goals with general organization goals in planning for the project	☐	☐	☐	☐	☐
Lack of detailed plan for completion of the project	☐	☐	☐	☐	☐
Lack of contingency planning for the project	☐	☐	☐	☐	☐
Lack of detailed budget planning for the project	☐	☐	☐	☐	☐
Goals of the project were not clearly defined	☐	☐	☐	☐	☐
The planned goals of the system do not meet requirements	☐	☐	☐	☐	☐
Lack of adequate milestone planning for the project	☐	☐	☐	☐	☐
IT personnel are unable to adequately define project requirements	☐	☐	☐	☐	☐
Potential problem: 1=Not a Problem; 5=An Extreme Problem	1	2	3	4	5
Inability to measure progress of project implementation	☐	☐	☐	☐	☐
Project manager exercised inadequate leadership	☐	☐	☐	☐	☐
Inability of project manager to motivate the team members	☐	☐	☐	☐	☐
Lack of communication between project manager and team members	☐	☐	☐	☐	☐
Failure to inform management and users about the progress	☐	☐	☐	☐	☐

of the project					
Lack of cooperation between IT personnel and other project team members	☐	☐	☐	☐	☐
Inappropriate selection of personnel for project team	☐	☐	☐	☐	☐
Inability of IT personnel to stay informed about business developments not directly related to IT	☐	☐	☐	☐	☐
Lack of participation of IT personnel in activities not directly related to IT	☐	☐	☐	☐	☐
Lack of concern of IT personnel about overall business performance of organization	☐	☐	☐	☐	☐
Potential problem: 1=Not a Problem; 5=An Extreme Problem	1	2	3	4	5
Lack of experience of IT personnel at recognizing potential ways to exploit new business opportunities	☐	☐	☐	☐	☐
Lack of experience of IT personnel in analyzing business problems in order to identify IT-based solutions	☐	☐	☐	☐	☐
Inexperience of IT personnel at evaluating the organizational impacts of IT solutions	☐	☐	☐	☐	☐
Lack of knowledge of IT personnel about the alignment between business goals and IT project goals in the organization as a whole	☐	☐	☐	☐	☐
Limited flexibility of Information Technology infrastructure links and connections for the purpose of implementing the new system	☐	☐	☐	☐	☐
Difficulty in adding, modifying, or removing hardware from existing Information Technology infrastructure for the purpose of implementing the new system	☐	☐	☐	☐	☐
Limited number of electronic links and connections in the Information Technology infrastructure for the purpose of implementing the new system	☐	☐	☐	☐	☐
Potential problem: 1=Not a Problem; 5=An Extreme Problem	1	2	3	4	5
Insufficient bandwidth for access to text, voice, and graphical data for the needs of the new system	☐	☐	☐	☐	☐
Insufficient database infrastructure for the needs of the new system	☐	☐	☐	☐	☐
Insufficient electronic links for the needs of the new system	☐	☐	☐	☐	☐

Lack of knowledge about new technology among IT personnel	☐	☐	☐	☐	☐
Inability of IT personnel to develop appropriate technical solutions to business problems	☐	☐	☐	☐	☐
IT personnel skilled in only a limited number of technologies and tools	☐	☐	☐	☐	☐
Insufficient understanding of IT personnel about existing data, applications, & other IT across organization	☐	☐	☐	☐	☐
Lack of experience in technology utilized in implementation of new system	☐	☐	☐	☐	☐
Inability of IT personnel to work well with other functional areas	☐	☐	☐	☐	☐

Next Page

You indicated that you have worked on an EAI project in the past. Please answer the following questions concerning EAI projects you have been involved with.

How many EAI projects have you been involved with during your professional career?

How many of these projects would you consider to be unsuccessful?

Considering the most recent EAI project (Project "I") you were involved with (not necessarily with your current employer):

What year did implementation of Project "I" begin?

How many months did it take to complete?

What was the approximate budget of the project? $

What was your level of involvement in the project?

Was there one individual who enthusiastically championed the EAI project?

Yes No

What is this person's title?

Was there an official sponsor who formally announced and kicked off the project?

Yes No

What is this person's title?

Please indicate which functional area systems were included (check all that apply)?

Customer Relationship Management	Supply Chain Management	Accounting and Finance
Sales Management	Purchasing Quality Management	General Ledger
Order Management	Routing Management	Accounts Receivable
Sales Planning	Shipping	Accounts Payable
Pricing	Vendor Evaluation	Asset Accounting
Marketing	Logistics Management	Cash Management
Materials Requirements Planning	Operations Management	Cash Forecasting
Materials Management	Project Management	Cost-Center Accounting

☐ Production Planning	☐ Production Quality Management	☐ Profit-Center Accounting
☐ Inventory Management	☐ Human Resources	☐ Product-Cost Accounting
☐ Plant Maintenance	☐ Employee Time Accounting	☐ Period-Related Costing
☐ Executive Information System	☐ Payroll Planning	☐ Financial Consolidation
☐ Decision Support System	☐ Travel Expenses	☐ Profitability Analysis

Other? (Please List)

How would you describe the methodology used to implement Project "I"?

☐ An "all-at-once" approach ☐ A phased, "piece-at-a-time" approach

Is Project "I" the first attempt at EAI in the organization? ☐ Yes ☐ No

If yes, you may skip the remaining questions on this page.

Initial EAI implementation attempts sometimes fail.

When was EAI first adopted in Project "I"s organization?

Was the first EAI implementation attempt successful? ☐ Yes ☐ No

How many EAI implementation attempts were unsuccessful prior to Project "I"?

Among these, how many encompass the same business processes as Project "I"?

How many EAI implementation attempts were successful prior to Project "I"?

Next Page

There are many expected benefits of Enterprise Integration. Considering the same EAI Project "I", please indicate the extent of your agreement to each of the following statements using the following scale:
1=Strongly Disagree; 2=Somewhat Disagree; 3=No Opinion;
4=Somewhat Agree; 5=Strongly Agree

System Goal	1	2	3	4	5
The new system has achieved all the goals set for it	☐	☐	☐	☐	☐
The new system has helped increase market share for the organization	☐	☐	☐	☐	☐
The new system has helped achieve higher sales for the organization	☐	☐	☐	☐	☐
The new system has helped reduce costs	☐	☐	☐	☐	☐
The new system has helped reduce cycle time of operations	☐	☐	☐	☐	☐
The new system has improved sharing of information across the enterprise	☐	☐	☐	☐	☐
The new system has reduced the need to enter the same information multiple times	☐	☐	☐	☐	☐
The new system is flexible and adaptable to new requirements	☐	☐	☐	☐	☐
The new system improved cross-functional business processing	☐	☐	☐	☐	☐
The information provided by the new system is customizable to individual requirements	☐	☐	☐	☐	☐
The information provided by the new system is secure	☐	☐	☐	☐	☐
The information provided by the new system is more complete than the previous system	☐	☐	☐	☐	☐
The information provided by the new system is clearer and more easily understood than the previous system	☐	☐	☐	☐	☐
The information provided by the new system is more relevant and usable than the previous system	☐	☐	☐	☐	☐
The information provided by the new system is more timely and up-to-date than the previous system	☐	☐	☐	☐	☐
The new system is more reliable than the previous system	☐	☐	☐	☐	☐
The new system is available a larger percentage of time (less down-time) than the previous system	☐	☐	☐	☐	☐

Response time of the new system is noticeably shorter than that of the previous system	☐	☐	☐	☐	☐
The information provided by the new system is more accurate that that of the previous system	☐	☐	☐	☐	☐
The new system has more functionality/features than the previous system	☐	☐	☐	☐	☐

Over all, would you rate this project as:

Unsuccessful ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 Successful

Please answer the following questions about the organization where Project "I" was implemented. NOTE: Consider the organization to be the largest business unit (unit, branch, division, company, conglomerate, etc.) serviced by the Information Technology unit responsible for the EAI implementation.

What is the primary business activity of the organization:

If "Other", please specify:

Location of organization's headquarters: City State -- Country

Number of locations in the organization:

Number of employees in the organization:

What is the organization's annual gross revenue: $

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The following factors have the potential to inhibit the success of an Implementation project. Considering the same EAI Project "I", please rate each factor according to the extent that factor was a problem during this project.

1=Not a problem; 2=A Minor Problem; 3=A Significant Problem;
4=A Major Problem; 5=An Extreme Problem

Potential problem:	1	2	3	4	5
Failure to anticipate and plan for the organizational resistance to change	☐	☐	☐	☐	☐
Failure to communicate reasons for change to organization members	☐	☐	☐	☐	☐
Lack of organization arrangements for transitioning to the new system	☐	☐	☐	☐	☐
Lack of project participants who are experienced in managing change	☐	☐	☐	☐	☐
Failure to anticipate impact of the changes caused by the new system	☐	☐	☐	☐	☐
Failure to consider existing organizational culture in managing change	☐	☐	☐	☐	☐
Failure to consider the changes to people's jobs and authority	☐	☐	☐	☐	☐
The change process was hampered due to lack of user participation	☐	☐	☐	☐	☐
The project requires too many radical changes in the organization	☐	☐	☐	☐	☐
Potential problem: **1=Not a Problem; 5=An Extreme Problem**	1	2	3	4	5
Inadequate training for employees affected by the new system	☐	☐	☐	☐	☐
Insufficient time to develop new employee skills required by the new system	☐	☐	☐	☐	☐
Lack of appropriate incentives for employees to accept the new system	☐	☐	☐	☐	☐
Lack of participation from the human resources function in the development of the new system	☐	☐	☐	☐	☐
Top management unwilling to commit resources required for the project	☐	☐	☐	☐	☐
Lack of top management participation during the project	☐	☐	☐	☐	☐

Lack of management support during crises	☐	☐	☐	☐	☐
Insufficient authority granted to project team by top management	☐	☐	☐	☐	☐
Lack of top management leadership during project	☐	☐	☐	☐	☐
Failure to find an effective sponsor or champion for the project	☐	☐	☐	☐	☐
The scope of the project is difficult to manage	☐	☐	☐	☐	☐
Potential problem: 1=Not a Problem; 5=An Extreme Problem	1	2	3	4	5
The scope of the project is never agreed upon	☐	☐	☐	☐	☐
The scope of the project is not clearly defined	☐	☐	☐	☐	☐
The scope of the project is too large	☐	☐	☐	☐	☐
Misalignment of project goals with general organization goals in planning for the project	☐	☐	☐	☐	☐
Lack of detailed plan for completion of the project	☐	☐	☐	☐	☐
Lack of contingency planning for the project	☐	☐	☐	☐	☐
Lack of detailed budget planning for the project	☐	☐	☐	☐	☐
Goals of the project were not clearly defined	☐	☐	☐	☐	☐
The planned goals of the system do not meet requirements	☐	☐	☐	☐	☐
Lack of adequate milestone planning for the project	☐	☐	☐	☐	☐
IT personnel are unable to adequately define project requirements	☐	☐	☐	☐	☐
Inability to measure progress of project implementation	☐	☐	☐	☐	☐
Project manager exercised inadequate leadership	☐	☐	☐	☐	☐
Inability of project manager to motivate the team members	☐	☐	☐	☐	☐
Potential problem: 1=Not a Problem; 5=An Extreme Problem	1	2	3	4	5
Lack of communication between project manager and team members	☐	☐	☐	☐	☐
Failure to inform management and users about the progress of the project	☐	☐	☐	☐	☐

Lack of cooperation between IT personnel and other project team members	☐	☐	☐	☐	☐
Inappropriate selection of personnel for project team	☐	☐	☐	☐	☐
Inability of IT personnel to stay informed about business developments not directly related to IT	☐	☐	☐	☐	☐
Lack of participation of IT personnel in activities not directly related to IT	☐	☐	☐	☐	☐
Lack of concern of IT personnel about overall business performance of organization	☐	☐	☐	☐	☐
Lack of experience of IT personnel at recognizing potential ways to exploit new business opportunities	☐	☐	☐	☐	☐
Lack of experience of IT personnel in analyzing business problems in order to identify IT-based solutions	☐	☐	☐	☐	☐
Potential problem: 1=Not a Problem; 5=An Extreme Problem	1	2	3	4	5
Inexperience of IT personnel at evaluating the organizational impacts of IT solutions	☐	☐	☐	☐	☐
Lack of knowledge of IT personnel about the alignment between business goals and IT project goals in the organization as a whole	☐	☐	☐	☐	☐
Limited flexibility of Information Technology infrastructure links and connections for the purpose of implementing the new system	☐	☐	☐	☐	☐
Difficulty in adding, modifying, or removing hardware from existing Information Technology infrastructure for the purpose of implementing the new system	☐	☐	☐	☐	☐
Limited number of electronic links and connections in the Information Technology infrastructure for the purpose of implementing the new system	☐	☐	☐	☐	☐
Insufficient bandwidth for access to text, voice, and graphical data for the needs of the new system	☐	☐	☐	☐	☐
Insufficient database infrastructure for the needs of the new system	☐	☐	☐	☐	☐
Insufficient electronic links for the needs of the new system	☐	☐	☐	☐	☐
Lack of knowledge about new technology among IT personnel	☐	☐	☐	☐	☐
Inability of IT personnel to develop appropriate technical	☐	☐	☐	☐	☐

solutions to business problems					
IT personnel skilled in only a limited number of technologies and tools	☐	☐	☐	☐	☐
Insufficient understanding of IT personnel about existing data, applications, & other IT across organization	☐	☐	☐	☐	☐
Lack of experience in technology utilized in implementation of new system	☐	☐	☐	☐	☐
Inability of IT personnel to work well with other functional areas	☐	☐	☐	☐	☐

Demographic Information

Sex: ☐ Male ☐ Female

Age:

Highest level of education:

Number of years working in Information Technology:

Number of years working with current employer:

Please rate the following statements according to how true each item is for you. Use the following scale:
1=Never True for Me
2=Occasionally True for Me
3=True About 50% of the Time for Me
4=Often True for Me
5=Always True for Me

Statement:	1	2	3	4	5
I dream of being so good at what I do that my expert advice will be sought continually.	☐	☐	☐	☐	☐
I am most fulfilled in my work when I have been able to integrate and manage the efforts of others.	☐	☐	☐	☐	☐
I will feel successful in my career only if I can develop my technical or functional skills to a very high level of competence.	☐	☐	☐	☐	☐
I dream of being in charge of a complex organization and making decisions that affect many people.	☐	☐	☐	☐	☐
Becoming a senior functional manager in my area of expertise is more attractive to me than becoming a general manager.	☐	☐	☐	☐	☐
I will feel successful in my career only if I become a general manager in some organization.	☐	☐	☐	☐	☐
I would rather leave my organization than accept a rotational assignment that would take me out of my area of expertise.	☐	☐	☐	☐	☐

Becoming a general manager is more attractive to me than becoming a senior functional manager in my current area of expertise.	☐	☐	☐	☐	☐
I am most fulfilled in my work when I have been able to use my special skills and talents.	☐	☐	☐	☐	☐
I would rather leave my organization than accept a job that would take me away from the general managerial track.	☐	☐	☐	☐	☐
When I want something, I'll sometimes go out on a limb to get it.	☐	☐	☐	☐	☐
If the possible reward was very high, I would not hesitate putting my money into a new business that could fail.	☐	☐	☐	☐	☐
Taking risks does not bother me if the gains involved are high.	☐	☐	☐	☐	☐
I would enjoy the challenge of a project that could mean either a promotion or a loss of a job.	☐	☐	☐	☐	☐
I rarely, if ever, take risks when there is another, safer alternative.	☐	☐	☐	☐	☐
I try to avoid situations that have uncertain outcomes.	☐	☐	☐	☐	☐
I would participate only in business undertakings that are relatively certain.	☐	☐	☐	☐	☐
I would probably not take the chance of borrowing money for a business deal even if it might be profitable.	☐	☐	☐	☐	☐

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Please rate the following statements according to how true each item is for you. Use the following scale:
1=Never True for Me
2=Occasionally True for Me
3=True About 50% of the Time for Me
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5=Always True for Me

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I am most fulfilled in my work when I have been able to integrate and manage the efforts of others.	☐	☐	☐	☐	☐
I will feel successful in my career only if I can develop my technical or functional skills to a very high level of competence.	☐	☐	☐	☐	☐
I dream of being in charge of a complex organization and making decisions that affect many people.	☐	☐	☐	☐	☐
Becoming a senior functional manager in my area of expertise is more attractive to me than becoming a general manager.	☐	☐	☐	☐	☐
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I would rather leave my organization than accept a rotational assignment that would take me out of my area of expertise.	☐	☐	☐	☐	☐
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I would enjoy the challenge of a project that could mean either a promotion or a loss of a job.	☐	☐	☐	☐	☐
I rarely, if ever, take risks when there is another, safer alternative.	☐	☐	☐	☐	☐
I try to avoid situations that have uncertain outcomes.	☐	☐	☐	☐	☐
I would participate only in business undertakings that are relatively certain.	☐	☐	☐	☐	☐
I would probably not take the chance of borrowing money for a business deal even if it might be profitable.	☐	☐	☐	☐	☐

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Thank you for taking the time to respond to this survey.

To be entered in the drawing for the iPod Shuffles, please enter your e-mail address below. This e-mail address will be kept confidential and will only be used to contact the winners of the iPod Shuffle Drawing. It will in no way be linked to your survey responses.

Done

APPENDIX B

INVITATION TO PARTICIPATE IN SURVEY

Dear Business Integration Journal Subscriber:

Business Integration Journal is pleased to partner with the University of Texas at Arlington on a research project investigating how we can be more successful in implementing Enterprise Systems Applications, such as Enterprise Resource Planning (ERP) and Enterprise Application Integration (EAI). As a seasoned systems professional, you have experienced how a system can succeed or fail for reasons that are not purely technological. In this project, we need your valuable input in completing a research questionnaire. Respondents who complete the survey will be entered into a drawing to win one of five iPod Shuffles. If you are not permitted to win such gratuities, a donation on your behalf for an equal value will be made to The American Red Cross.

This survey is gathering information concerning your attitudes toward ERP and EAI, your assessments of change management, product management, and other organizational factors that are critical to enterprise systems. Your input is important to us even if you have never been involved in an enterprise system project. The study findings will be published in Business Integration Journal, and should have practical application to your future projects.

The survey will take about 20 minutes to complete. The responses will be strictly confidential and will in no way be linked to any individual respondent. If you are willing to participate, please click this link to begin the survey:
http://www2.uta.edu/infosys/survey/rb/BIJ/

Thank you for sharing your time and expertise!

Best Regards,

Bob Thomas
Publisher
Business Integration Journal (www.bijonline.com)

James T. C. Teng, Ph.D.
West Distinguished Professor
University of Texas at Arlington
http://www2.uta.edu/infosys/teng.html

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Randy also has a Master of Arts in Computer Resources and Information Management, from Webster University, and a Bachelor of Science in Electrical Engineering from the University of Arkansas. In addition, he has earned a professional certification as a Microsoft Certified Systems Engineer. Randy hopes to combine his "real-world" experience with his academics to become a significantly contributing researcher to the Information Systems Body of Knowledge.