A BALANCED SCORECARD MODEL FOR THE PERFORMANCE MEASUREMENT OF ENTERPRISE RESOURCE PLANNING IMPLEMENTATION

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_____

Prof. Dr. Sencer Ayata

Director

I certify that this thesis satisfies all the requirements as a thesis for the degree of Master of Business Administration.

_____

Prof. Dr. Can Şımga Muğan

Head of Department

This is to certify that we have read this thesis and that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of Master of Business Administration.

_____

Assoc. Prof. Dr. Zeynep Onay

Supervisor

Examining Committee Members

Prof. Dr. Semih Bilgen (METU, EE) _____

Assoc. Prof. Dr. Zeynep Onay (METU, BA) _____

Assoc. Prof. Dr. Nazlı Wasti Pamuksuz (METU, BA) _____

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Name, Last name : Ayşe Gül Arık

Signature :

ABSTRACT

A BALANCED SCORECARD MODEL FOR
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ENTERPRISE RESOURCE PLANNING IMPLEMENTATION

Arık, Ayşe Gül
M.B.A., Department of Business Administration
Supervisor: Assoc. Prof. Dr. Zeynep Onay

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In this study, the applicability of the Balanced Scorecard Framework, developed by Robert S. Kaplan and David P. Norton in 1992 for measuring performance at the organizational level or the business unit level, to performance measurement during the implementation phase of Enterprise Resource Planning (ERP) systems is investigated. A model based on the Balanced Scorecard Framework is presented with sample indicators for each of the four perspectives -Financial Perspective, Customer Perspective, Internal Business Perspective and Innovation and Learning Perspective- proposed in the original framework. The indicators for measuring ERP implementation success are derived from a comprehensive literature survey. Furthermore, a software tool is developed to operationalize the proposed balanced scorecard model. The model and the software tool demonstrate the applicability of the Balanced Scorecard Framework for monitoring and measuring performance during the implementation phase of ERP systems; that is, the relevance of the Balanced Scorecard Framework at the project level.

Keywords: Enterprise Resource Planning, Balanced Scorecard, performance measurement

ÖZ

KURUMSAL KAYNAK PLANLAMA SİSTEMİ YERLEŞTİRME AŞAMASININ PERFORMANS ÖLÇÜMÜNDE KULLANILABİLİR DENGELİ ÖLÇÜM TABLOSU MODELİ

Arık, Ayşe Gül
Yüksek Lisans, İşletme Bölümü
Tez Yöneticisi: Doç. Dr. Zeynep Onay

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Bu çalışmada Robert S. Kaplan ve David P. Norton tarafından 1992 yılında kurumsal seviyede performans ölçümü için geliştirilmiş olan Dengeli Ölçüm Tablosu aracının, Kurumsal Kaynak Planlama (KKP) sistemlerinin yerleştirme aşamasının performans ölçümünde kullanılabilir olup olmadığı incelenmektedir. İncelemenin gereği olarak, Dengeli Ölçüm Tablosu aracında bulunan her perspektife -Finans Perspektifi, Müşteri Perspektifi, İç İşletme Perspektifi ve Yenilik ve Öğrenme Perspektifi- göre performansın değerlendirilmesinde kullanılabilecek örnek ölçüleri kapsayan bir model sunulmaktadır. Bu örnek ölçüler kapsamlı bir literatür araştırmasının sonunda elde edilmiştir. Bu çalışmada, ayrıca, sunulan modeli işler hale getiren bir yazılım uygulaması da geliştirilmektedir. Sunulan model ve geliştirilen yazılım uygulaması, Dengeli Ölçüm Tablosu aracının KKP sistemlerinin yerleştirme aşamasının performans ölçümünde kullanılabilir olduğunu, dolayısıyla proje seviyesinde de anlamlı olduğunu göstermektedir.

Anahtar Kelimeler: Kurumsal Kaynak Planlama, Dengeli Ölçüm Tablosu, performans ölçümü

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INTRODUCTION

1.1. Background

The transition from the industrial age characterized by the industrial revolution to the information age or the *new economy* of today characterized by the digital revolution has significantly altered the competitive landscape and affected the business practices of enterprises.

While the industrial age emphasized low cost production with standard operating principles and standardized products, the information age necessitates infinite differentiation and customization of goods and services in order to gain competitive advantage. In other words, in the information age, mass production and mass consumption practices of the industrial age have been replaced with mass customization. In addition, economies of scale of the industrial age that was already replaced with economies of scope in the post-industrial age left the scene to economies of flexibility and speed dictated by the time based competition in the information age.

Organizational structures have also been affected by the *new economy*. Centralized and strict command and control structures have been altered by decentralized ones emphasizing cross-functional coordination and teamwork. Industrial boundaries have been blurred and alliances and partnerships with customers, suppliers, and even competitors have become a common practice. Internal control of the enterprise of the

industrial age is now superseded by external control of the competitive environment, continuously seeking for new opportunities.

In the industrial age, the enterprises focused on the management of manufacturing, whereas in the information age, they primarily focus on the management of information since they have discovered the importance of using their knowledge-based intangible assets as a source of competitive advantage. The development of information systems has gained acceleration, the inventory management or manufacturing management systems of the industrial age such as Materials Resource Planning have now been replaced with Enterprise Resource Planning systems promising to provide enterprise-wide seamless flow of information.

> *As companies around the world transform themselves for competition that is based on information, their ability to exploit intangible assets has become far more decisive than their ability to invest in and manage physical assets. (Kaplan and Norton, 1996)*

In the industrial age, enterprises used to evaluate their performance by looking primarily at their financial scores. However, they now recognize the fact that good financial performance in the past never guarantees good performance in the future in such a rapidly changing competitive landscape. Therefore, enterprises realize the necessity of using new performance measurement models that not only report past performance, but also include indicators of future performance.

> *Most senior managers will judge the company's performance by financial results as reflected on the profit and loss statement and the balance sheet. Top management in new economy companies will also examine the marketing scorecard to interpret what is happening to market share (not just sales revenue), customer loss rate, customer satisfaction, product quality relative to competitors, and other measures. They recognize that changes in marketing indicators predict changes in financial results. (Kotler, 2003, p 38)*

Since the 1990s, many enterprises have been investing considerably large sums of time, money and expertise in the implementation and operation of Enterprise Resource Planning systems. However, most of the time, the enterprises are incapable

of properly measuring their return on investment in these systems. In order to measure the value that an Enterprise Resource Planning system adds to an organization, first of all, the system should be implemented successfully enough to go live and to be used operationally. Therefore, organizations should measure the performance of the implementation and the operational usage phases of an Enterprise Resource Planning system in order to fully evaluate the value added by the system.

The necessity of having indicators of future performance and using not only financial but also other performance measures to evaluate organizational performance led to the development of several organizational performance measurement models, one of which is the Balanced Scorecard Framework developed by Robert S. Kaplan and David P. Norton in 1992.

Similar concerns about the insufficiency of measuring success based only on financial outcomes and not taking into account other indicators of success for organizational performance measurement also arise for the performance measurement of the implementation and the operational usage phases of an Enterprise Resource Planning system. Taking these concerns as a starting point, this study poses the question: *Can the Balanced Scorecard Framework, originally developed for organizational performance measurement, be used as a guide to measure the performance of the implementation phase of Enterprise Resource Planning systems?*

The performance measurement of the operational usage and maintenance phase of Enterprise Resource Planning systems, on the other hand, is beyond the scope of this study.

1.2. The Research Problem

In this research, a balanced scorecard model to be used in measuring the performance of Enterprise Resource Planning (ERP) implementation is proposed. The basis for

the model is the Balanced Scorecard Framework developed by Robert S. Kaplan and David P. Norton of Harvard Business School in 1992. Kaplan and Norton's original framework was designed for measuring performance at the organizational level or the business unit level. Since then, the framework has been widely accepted for measuring performance at not only the organizational or business unit level, but also the functional level. In 1999, Michael Rosemann and Jens Wiese claimed that the Balanced Scorecard Framework could be used to measure the performance of ERP systems, in the implementation phase or in the operational usage and maintenance phase (Rosemann and Wiese, 1999).

This study also suggests that the Balanced Scorecard Framework is applicable to the performance measurement of the implementation phase of ERP systems. The study supports this thesis by proposing a balanced scorecard model developed following the methodology suggested for the original Balanced Scorecard Framework (Kaplan and Norton, 1996 [2]) and building a software application based on the proposed model.

1.3. Purpose of the Study

The rationale behind the thesis proposed in this research is to meet the following purposes:

- To ensure that the performance of an ERP implementation is fairly evaluated, in terms of not only traditional financial measures, but also a balanced set of measures from other perspectives indicating performance at a point during implementation as well as driving performance in later stages of implementation.

- To provide an easy-to-communicate balanced scorecard model and an easy-to-monitor software application based on that model to be used in measuring the performance of the implementation phase of an ERP system, in terms of the level of achievement of the objectives set forth at the beginning of the implementation.

1.4. The Research Approach

In order to attain the purposes mentioned in the previous section, first a comprehensive literature review was performed. In the literature review, Enterprise Resource Planning systems were investigated in detail from their origins, scope, functionality, and benefits, to the challenges imposed on their implementation. In addition, the Balanced Scorecard Framework was covered from the rationale behind its introduction to its components, construction process, and relationship with vision and strategy. Finally, the inadequacy and inappropriateness of the traditional performance measurement models for meeting the first research purpose was analyzed to point out the need for a strategic approach to measure the performance of ERP implementation. A considerable number of success factors for ERP implementation projects identified by various researchers were also collected in the final stage of the literature review.

Secondly, in order to develop an easy-to-communicate balanced scorecard model for measuring the performance of ERP implementation, a systematic methodology in parallel with the scorecard construction process suggested by Kaplan and Norton (1996 [2]) was followed. For each perspective suggested in the original framework -Financial Perspective, Customer Perspective, Internal Business Perspective, and Innovation and Learning Perspective-, clear and relevant sample objectives were set forth. Next, sample measures to be used in measuring performance according to the level of achievement of each of these objectives were identified. The sample objectives and measures suggested for the balanced scorecard model were deduced from the success factors for ERP implementation collected in the literature review or inferred from the results of relevant surveys conducted by reputable research firms. As a final step, the identified list of sample measures was narrowed down by validating them and eliminating the inappropriate ones. As a result, four tables consisting of sample objectives and relevant sample measures to be used in measuring the performance of ERP implementation from four different perspectives of the balanced scorecard were established.

Finally, an easy-to-monitor software application, "*ERP Implementation Balanced Scorecard"*, was built in order to demonstrate the applicability of the proposed balanced scorecard model in real life, and to provide the flexibility to alter the list of sample objectives and measures identified in this study.

1.5. Organization of the Thesis

In Chapter I, the research problem and the research approach as well as the purpose of the study are clarified.

In Chapter II, a review of the relevant literature about Enterprise Resource Planning systems, the Balanced Scorecard Framework, and the concept of performance measurement in the implementation phase of ERP systems are provided.

In Chapter III, the proposed balanced scorecard model for measuring the performance of ERP implementation is constructed following a systematic process.

In Chapter IV, the software application "*ERP Implementation Balanced Scorecard*", built based on the balanced scorecard model developed in Chapter III, is described by providing technical and content specifications.

In Chapter V, the conclusions drawn from this study are presented as well as recommendations for future research.

CHAPTER II

LITERATURE REVIEW

2.1. Enterprise Resource Planning

2.1.1. Historical Background

The term *Enterprise Resource Planning* was coined by the research firm Gartner Group in the early 1990s in order to differentiate it from its antecedents. Since then, the term *Enterprise Resource Planning* has been used to identify the application software which aim to integrate the core business processes performed in the primary or support functions in the value chain of an enterprise by providing an enterprise-wide seamless flow of information, where *"business processes refer to the unique manner in which work is organized, coordinated and focused to produce a valuable product or service"* (Laudon and Laudon, 2004, p 7). For a typical manufacturing enterprise, the primary functions are Inbound Logistics, Operations, Sales and Marketing, Service and Outbound Logistics, whereas the support functions are Finance and Accounting, Human Resources, Research and Development and Information Technology, as explained in the Value Chain Model developed by Michael E. Porter in 1985.

The origins of ERP systems go back to the 1960s. In those years, customized application software focusing on inventory management were introduced by software vendors and used by manufacturing enterprises. Later, in the 1970s, the focus was

shifted from inventory management to production planning and control. As a result of this shift, *Materials Requirements Planning (MRP)* systems emerged. The main functionality of MRP software was to translate the Bill of Materials for independent demand items (end-items) into time-phased net requirements for the production and procurement of the dependent demand items (subassemblies, components, and raw materials) in a manufacturing enterprise.

MRP software proved to be effective in reducing inventories and lead times; however, it had a major drawback: It took into account only the production time constraints. In an effort to overcome this drawback, *Closed Loop MRP* systems, which took into account not only the production time constraints, but also the production capacity constraints, were introduced. Closed Loop MRP is also known as *Capacity Requirements Planning (CRP).*

In the 1980s, MRP and CRP software evolved into an integrated manufacturing management system, *Manufacturing Resources Planning (MRP II),* with an aim to integrate all resources of a manufacturing enterprise. MRP II also extended MRP and CRP by integrating them with finance.

Later, in the early 1990s, the need to have integrated software systems that enhance the management of all business processes across the enterprise and include the other functions of the enterprise in addition to manufacturing and finance, led to the development of *Enterprise Resource Planning (ERP)* systems.

2.1.2. Scope of ERP Systems

While MRP, CRP, and MRP II mainly focus on the production planning and control functions of a manufacturing enterprise, ERP systems can encompass all functions within an enterprise operating not only in manufacturing, but in any industrial sector. ERP systems are also called *Enterprise Systems*. "*Enterprise systems can coordinate*

activities, decisions and knowledge across many different functions, levels and business units in a firm" (Laudon and Laudon, 2004).

ERP systems do not treat functional transactions as stand-alone activities; instead, they consider those transactions as parts of business processes performed for the continuity of business in an enterprise. Hence, rather than being function oriented, "*Enterprise systems are inherently cross-level, cross-functional and business process oriented"* (Laudon and Laudon, 2004).

In order to give a general idea about the scope of a typical standard ERP system, the functional modules included in *mySAP*, the Web based ERP application software offered by the leading ERP software vendor, *SAP AG*, are provided in Appendix A.

2.1.3. Benefits of ERP Systems

The business process orientation of Enterprise Resource Planning systems is consistent with their primary objective of providing information integration among the core business processes and the main organizational functions of an enterprise.

Information integration refers to the concept of having a shared, comprehensive database which stores transactional data about each enterprise function and allows the other functions to use that data. Information integration offered by Enterprise Resource Planning systems provides various benefits for organizations. The most important of these benefits identified from the relevant literature can be listed as:

- Replacing the non-interconnected legacy systems that complicate the analysis of organizational business processes and performance, which leads to enterprise-wide seamless flow of information and improved managerial decision-making,

- Eliminating redundancies, inconsistencies, and complex links among transactions, which leads to saving time and resources and cutting costs,

- Automating, reengineering, or rationalizing the tasks involved in performing business processes, which also leads to resource saving and cost cutting,

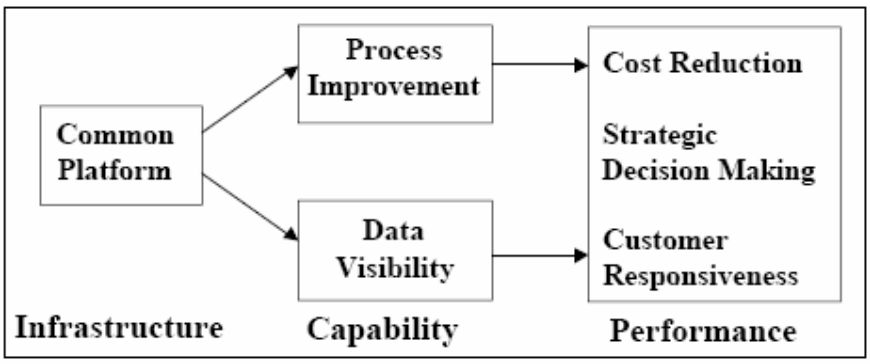
- Providing faster communication of enterprise functions with each other, which leads to increased flexibility and efficiency in resource management and customer service,

- Making the same data about a transaction performed in a function available to all the other functions instantaneously, which leads to more efficient analysis of the business and faster decision-making,

- Integrating financial data (for instance, integrating revenues in the sales function with expenses in the procurement function), which leads to easier and faster preparation of periodic financial reports,

- Standardizing manufacturing processes, which leads to increased throughput and resource saving (improved efficiency),

- Standardizing the definitions and formats of input / output data of transactions and business processes, which leads to elimination of inconsistencies.



Source: Ross, 1999

Figure 2.1. How ERP Enhances Business Value

In summary, as illustrated in Figure 2.1, ERP systems enhance business value by reducing costs, improving managerial decision making and enhancing customer responsiveness (Ross, 1999).

2.1.4. ERP Market Trends since the 1990s

Davenport states that *"the business world's embrace of enterprise systems may in fact be the most important development in the corporate use of information technology in the 1990s"* (Davenport, 1998). This means that, since the early 1990s, the strong demand triggered by the organizations enthusiastically seeking to realize one or more of the enticing benefits of information integration (See Section 2.1.3) has led the ERP market to become one of the most rapidly growing markets. This section summarizes the overall trends and the distribution of market share in the ERP market for the last 15 years, quoted from the research firm *AMR Research.*

2.1.4.1. Overall ERP Market Trends

In the years from 1990 to 1995, ERP systems were mostly implemented by manufacturing enterprises to replace their MRP packages or built-in legacy systems.

> *These older systems generally did an adequate job of material planning and inventory control, many had custom-developed order-processing modules that reflected exactly the way the sales organization did business, and in most instances the implementations were at least moderately successful. If these systems were adequate, then why are billions of dollars being spent each year to replace them? Perhaps the most common answer to this question is "to gain better information access through a single, integrated system". (Bermudez, 1996)*

According to AMR Research, the increased demand of manufacturers for information integration, together with the potential Y2K compliance problems in the legacy systems and increasingly globalized business focus of the enterprises led to the explosion of the ERP market. By the year 1995, the overall ERP market size had

exceeded $4 billion in terms of revenue from software licenses and vendor provided services, and its growth rate for 1996 was estimated to be 30% by AMR Research. In 1996, Jim Shepherd from AMR compared the rapidly growing demand potential of the ERP market to the gold rush and interpreted the expected growth rate of 30% as: *"It appears now that even the notoriously optimistic software vendors were too conservative. This market is booming!"* The extremely high growth rates continued for the next three years and in 1998, the ERP market had reached $16.9 billion in size with a 39% growth from 1997.

However, in the 1999 – 2002 period, the ERP market slowed down to nearly 0% growth rates. AMR Research attributes this slowdown to the following reasons:

- Enterprises shrinked their IT budgets and restricted capital spending severely due to the overall economic crisis.

- In the earlier years, the overall industrial enterprise applications market revenue was mostly generated by application software license sales, and the ERP software had the greatest share. However, starting from 2000, ERP started to lose its share to other emerging software applications such as *Customer Relationship Management (CRM)* and *Supply Chain Management (SCM).*

- The great size and complexity of ERP applications was a strong handicap for the ERP vendors' response to market.

In the year 2003, ERP market started to experience positive growth rates again, but the rates were more modest this time. The market grew by 14% in 2003 and 7% in 2004, and is expected to expand in the upcoming years as vendors promote differentiated services. AMR Research attributes this improvement in the ERP market to:

- Improved economic conditions and the shifts in global currency valuations

- Growth strategy pursued by big vendors by acquiring smaller niche vendors

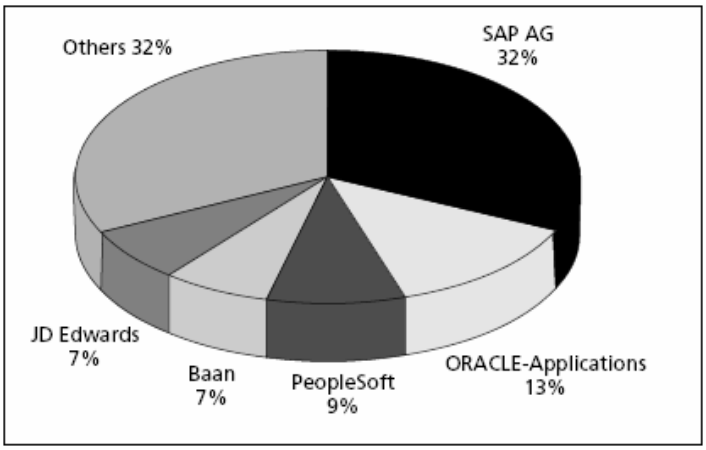
- Increased demand triggered by the previously untapped midsized companies' awareness of the need for having enterprise-wide information systems, which was anticipated by AMR Research in 1997 as:

> *Historically, the enterprise applications market has been supported by Fortune 500 companies with incomes from $250 million to more than $1 billion. Today, these companies represent 65 percent of software revenues. Vendors are gradually realizing, however, that there is a largely untapped market of mid-sized companies with incomes between $50 million and $250 million. This segment currently holds 21 percent market share, but based on the number of companies in this range, there is huge potential for growth. (Bonasera, 1997)*

2.1.4.2. ERP Market Shares

Since the introduction of ERP application software, *SAP AG* has been the dominant market leader. *SAP* (*S*ystems, *A*pplications, and *P*roducts) was founded in 1972 with the vision *"to develop standard application software for real-time business processing",* and since its foundation it has undertaken a pioneer role in the development of the ERP market. ERP market share data illustrated in Figure 2.2 reveals that *SAP* was followed by *Oracle Applications, PeopleSoft, Baan,* and *JD Edwards,* and the top five vendors constituted 68% of the overall ERP market in 1998.

In 2003, *PeopleSoft* acquired one of its closest rivals, *JD Edwards*, and took the second position after *SAP* by the end of 2003. While the top three vendors had a total share of 54% in 1998, their total share increased to 64% in 2003 due to *PeopleSoft*'s growth by acquisition strategy (See Table 2.1). In those years, this strategy had been pursued not only by big vendors like *PeopleSoft*, but also by the smaller vendors. The vendor in the fourth position in 1998, *Baan*, was also acquired by one of its rivals, *SSA Global*, in 2003.



Source: AMR Research Inc., 1998

Figure 2.2. ERP Market Shares, 1998

It can be inferred from the ERP market share data in Table 2.1 that *SAP* had strengthened its position by increasing its market share in the 1998-2004 period and *Oracle* had lost some of its share to *SAP* and smaller vendors. The higher-than-market growth rate of the *Sage Group* should also be attributed to its acquisition strategy like that of *SSA Global*. It can be inferred from *Microsoft*'s entrance into the market as a late follower that the ERP market is still attractive and has growth potential. Table 2.1 also demonstrates that the overall ERP market grew by 14% from $20.7 billion in 2003 to $23.7 billion in 2004.

Table 2.1. ERP Market Shares, 2003 and 2004

2004 Revenue Rank	Company Name	Revenue, 2003 ($M)	Revenue, 2004 ($M)	Revenue Share, 2003	Revenue Share, 2004	Growth Rate, 2003–2004
1	SAP	7994	9372	39%	40%	17%
2	PeopleSoft	2682	2880	13%	12%	7%
3	Oracle	2470	2465	12%	10%	-0%
4	Sage Group	900	1243	4%	5%	38%
5	Microsoft Business Solutions	683	775	3%	3%	14%
6	SSA Global	471	700	2%	3%	49%
Total (including other ERP vendors)		**20711**	**23649**	**100%**	**100%**	**14%**

Source: AMR Research Inc., 2005

Bruce Richardson (2004) from AMR Research states that *"Here's a peek of where ERP is headed: JBOPS are gone, SMOPS are in"*. *JBOPS* is an abbreviation standing for the top five ERP vendors in 1998, *J*D Edwards, *B*aan, *O*racle, *P*eopleSoft and *S*AP, whereas *SMOPS* stands for the top five ERP vendors in 2003, *S*age Group, *M*icrosoft Business Solutions, *O*racle, *P*eopleSoft and *S*AP.

Table 2.2. ERP Market Shares, 2005

2005 Revenue Rank	Vendor	Revenue Share, 2004	Revenue Share, 2005	Growth Rate, 2004–2005
1	SAP	40%	42%	12%
2	Oracle	10%	20%	110%
3	Sage Group	5%	6%	16%
4	Microsoft	3%	4%	15%
5	SSA Global	3%	3%	7%

Source: AMR Research Inc., 2006

In 2005, *Oracle* repositioned itself as the second after *SAP* by acquiring its closest rival, *PeopleSoft*, at the end of 2004 (See Table 2.2). As illustrated in Table 2.2, all the other top vendors preserved their growth rate and market share figures, with the exception of the apparent decline in the growth rates of the *Sage Group* and *SSA Global*, which can be attributed to the decrease in the number or the size of the companies acquired.

2.1.5. Challenges in the Implementation of ERP Systems

The crucial point about ERP systems is that their very appealing benefits cannot be realized unless a great investment in terms of money, time, and expertise is dedicated to all stages of having an ERP system. A research report prepared by the META

Group, covering 63 ERP projects, reveals that "*the average ERP implementation takes 23 months, has a total cost of ownership of $15 million and results in a negative net present value of $1.5 million"* (Meta Group, 1999). Total implementation time and total cost of ownership vary depending on such criteria as the size of the enterprise, the number of ERP modules adapted by the enterprise, the level of expertise of the implementation team, the level of external consultancy received, and the extent of customization. Since an ERP system encompasses all functions of an enterprise, an ERP implementation project is unsurprisingly very big and complex in terms of size, scope, structure, and the level of necessary investment.

In addition, Enterprise Systems *"require not only large technology investments but also fundamental changes in the way the business operates"* (Laudon and Laudon, 2004, p 55). Many enterprises have to rework their business in order to adapt an ERP system successfully.

Some enterprises prefer to change their business processes before building an ERP system, while others prefer to delay the change until the implementation stage. It is an organizational strategy whether to change the business processes before, after or in parallel with the implementation of an ERP system. Nevertheless, the requirement to change the business processes is another crucial point that proves the complexity of implementing ERP systems.

On one hand, ERP implementation efforts, giving enough attention to the business aspect of the issue as well as the technological aspect, lead to spectacular returns satisfying the enterprise that invested large sums of money, time and expertise in the project. On the other hand, usually, the big size and complexity of ERP systems cause pain and disruption during the implementation, and can lead to the ultimate failure of ERP implementation projects.

Furthermore, it is not sufficient that the ERP system is implemented successfully unless the system is flexible enough to adapt to the continuously evolving needs of enterprises that trigger new requirements in today's rapidly changing global market. Also, the issue of resistance to change applies in the context of adapting an ERP

system in an enterprise, which leads to conflict and friction among those who dictate the use of the new system and those who resist changing their way of doing business. These challenges concerning the issue of adapting an ERP system to an enterprise adversely affect the performance of ERP implementation projects and often prevent the enterprise from getting a satisfactory return on investment.

Davenport attributes the failure of ERP implementation projects to two main reasons: *"the technical complexity of solutions that requires a great deal of expertise and the mismatch between technical specifications of the system and the business requirements of the company"* (Davenport, 1998)

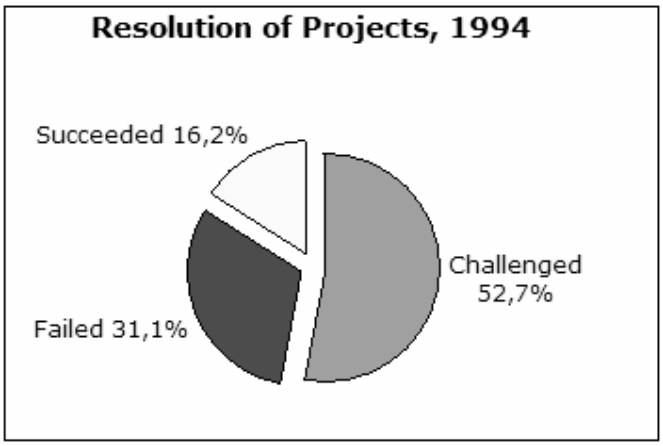
The Chaos Report prepared by The Standish Group International in 1994 identifies the success and failure rates, as well as the reasons for failure of Information Systems (IS) projects. In this report, IS projects are classified as:

- *Succeeded; if the project is completed on-time and on-budget, with all features and functions as initially specified.*

- *Challenged; if the project is completed and operational but over-budget, over the time estimate, and offers fewer features and functions than originally specified.*

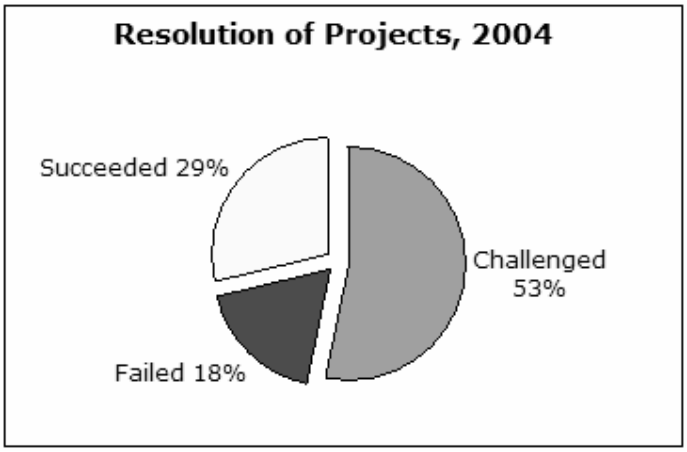
- *Failed or impaired; if the project is canceled at some point during the development cycle.*

The results of the 1994 Chaos Report are illustrated in Figure 2.3 demonstrate that more than half of the IS projects are challenged, and more than a quarter of them failed. Only a small percentage of the projects could be completed on-time, on-budget, and fulfilling the initial expectations. The Standish Group repeated their research about IS project success and failure rates in their 2004 Third Quarter Research Report, and arrived at the results shown in Figure 2.4.



Source: The Chaos Report, 1994, The Standish Group International, Inc.

Figure 2.3. Resolution of IS Projects, 1994



Source: Third Quarter Research Report, 2004, The Standish Group International, Inc.

Figure 2.4. Resolution of IS Projects, 2004

By the end of the third quarter of 2004, the success rate of IS projects almost doubled and correspondingly, the failure rate declined almost by half. The improvement in the success rate is mainly due to increased experience of the enterprises about managing IS projects. Enterprises' experience has been increasing over time by learning from not only the best practices of benchmarked firms, but also from their own wrong practices. Another reason explaining the improvement in the success rate is the increased managerial and technical level of expertise about implementing IS

projects. A final reason can be the increased level of emphasis given to taking not only external guidance about the technical details of the software implemented, but also external consultancy for how to manage the business-related or people-related challenges in the implementation phase. Yet, it is interesting that the percentage of challenged projects in 2004 is almost the same as that observed in 1994.

2.2. The Balanced Scorecard Framework

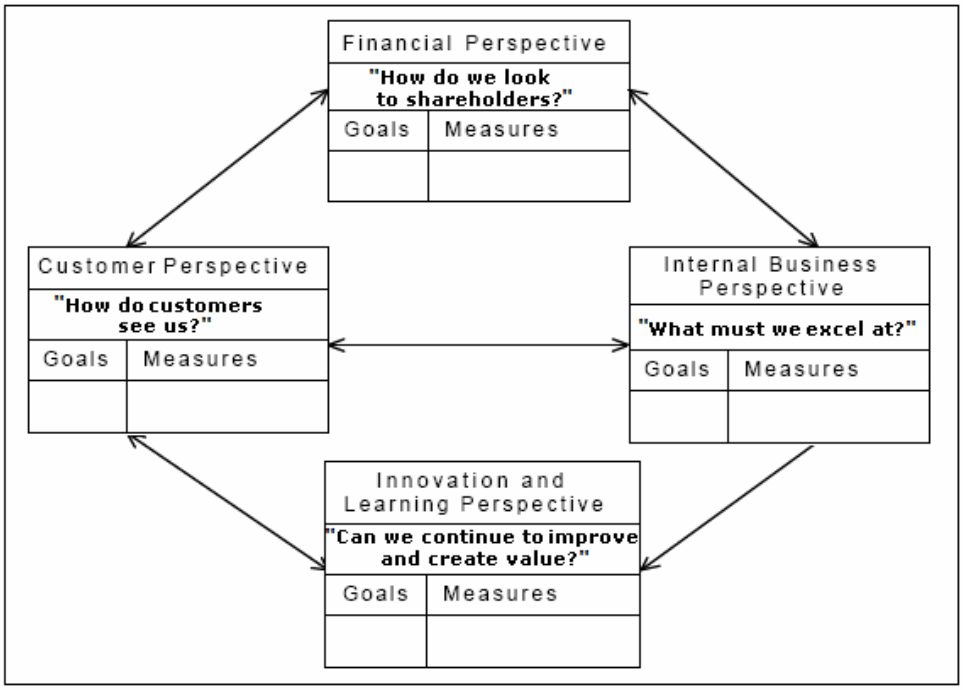
2.2.1. Historical Background

The Balanced Scorecard Framework was introduced by Robert S. Kaplan and David P. Norton in 1992 as an alternative to the then-existing organizational performance measurement models. Kaplan and Norton described those models as outdated, lagging, and misleading, due to two reasons: First, they were mostly based on traditional financial measures, and did not take into account other indicators of organizational performance. Second, they were reporting how well an enterprise did in the past period, but did not include any measures that drive future performance. As a new alternative, the Balanced Scorecard Framework balanced the traditional financial measures with those from additional perspectives. Since its introduction in 1992, the Balanced Scorecard Framework has been widely accepted and used by many enterprises in order to measure and improve organizational performance.

2.2.2. Theoretical Background

In the Balanced Scorecard Framework, organizational performance is measured from four main perspectives (See Figure 2.5). Kaplan and Norton suggest several goals to be set as a target of desired performance for each of these perspectives, and several quantitative measures to be used to evaluate the performance with respect to the level of achievement of each of these goals (See Tables 2.3 to 2.6).

The diagrammatical form represented in Figure 2.5 implies that the Balanced Scorecard allows interconnections and interactions to occur between the four main perspectives. In addition, the list of goals and measures given in Tables 2.3 to 2.6 demonstrate the superiority of the Balanced Scorecard over traditional financial measures in terms of the scope of performance measurement capability.



Source: Kaplan and Norton, 1992

Figure 2.5. The Balanced Scorecard

2.2.2.1. Financial Perspective

At the end of each year, organizations compare their realized financial figures to the ones they estimated at the beginning of that year, and evaluate their financial performance accordingly. This approach is definitely a good indicator of current performance, but does not give any idea about future performance. In the Balanced

Scorecard Framework, traditional financial measures are not totally disregarded, but they are balanced with measures indicating future performance.

Table 2.3. Financial Perspective of the Balanced Scorecard - Goals and Measures

Goal	Measure
Revenue Growth	• Sales and market share • Number of new customers and markets • Number of new strategies
Effective Cost Management	• Revenue per employee • Unit cost reduction
Effective Asset Utilization	• Inventory reduction • Cash-to-cash cycle • Return on capital • Productivity/Efficiency

Source: Kaplan and Norton, 1992

2.2.2.2. Customer Perspective

One of the changes in business practices dictated by the transition from the industrial age to the information age is the shift of enterprises from being production- and product-focused to being customer-focused. This shift has happened as a result of the realization of the increase in the bargaining power of customers due to richness of and ease of access to information. Enterprises have recognized that an unsatisfied customer can easily switch to another supplier that meets the same need with a lower price or a better service. This recognition has led enterprises to set targets like "Customer Satisfaction" and "Customer Retention". In the Balanced Scorecard Framework, the measures used to evaluate current performance with respect to the level of achievement of such targets are also leading indicators of future performance.

Table 2.4. Customer Perspective of the Balanced Scorecard - Goals and Measures

Goal	Measure
Market Share Growth	• % of segment captured
Customer Retention	• Number of defections • Increase in sales to current customers • Frequency of orders, visits or contacts with customers
Customer Acquisition	• Number of new customers • Ratio of sales to inquiries • Average cost to acquire • Average order size
Customer Satisfaction	• Number of complaints • Number of customers that indicate their satisfaction
Customer Profitability	• Total profit per customer • Total cost per customer

Source: Kaplan and Norton, 1992

2.2.2.3. Internal Business Perspective

In order to meet the goals set forth in the Customer Perspective, in other words, in order to ensure that the products or services of the enterprise not only conform to customer requirements and expectations, but also guarantee customer satisfaction and retention; enterprises should continuously improve their internal business processes. This improvement can be in the form of decreasing the number of defects and the processing time by setting a target such as "Efficient Production" or in the form of decreasing the time to market of newly designed products by setting a target such as "Rapid Design". In the Balanced Scorecard Framework, the measures in this perspective are also leading indicators of future performance. This perspective is referred as the *Internal Business Process Perspective* (Kaplan and Norton, 1996 [2]).

Table 2.5. Internal Business Perspective of the Balanced Scorecard – Goals and Measures

Goal	Measure
Identify or "make" the Market	• Profitability by segment • % of revenue from new customers
Rapid Design	• Time to market • Break even time
Efficient Production	• Number of defects • Process time
Efficient Delivery	• % of on time delivery • % defects
After-sales Service	• Average satisfaction rating • Number of reorders • Number of customers who do not reorder

Source: Kaplan and Norton, 1992

2.2.2.4. Innovation and Learning Perspective

In today's rapidly changing business landscape, enterprises cannot catch up with the continuously evolving technological initiatives unless they support continuous learning and improvement and invest considerable amount of resources in new technologies. Therefore, in order to ensure long term growth and improvement, an enterprise should set targets such as "Improved Employee Capabilities", which can be attained by continuous learning and sharing of information among employees. Another target can be "Effective Use of Information Technology".

Table 2.6. Innovation and Learning Perspective of the Balanced Scorecard – Goals and Measures

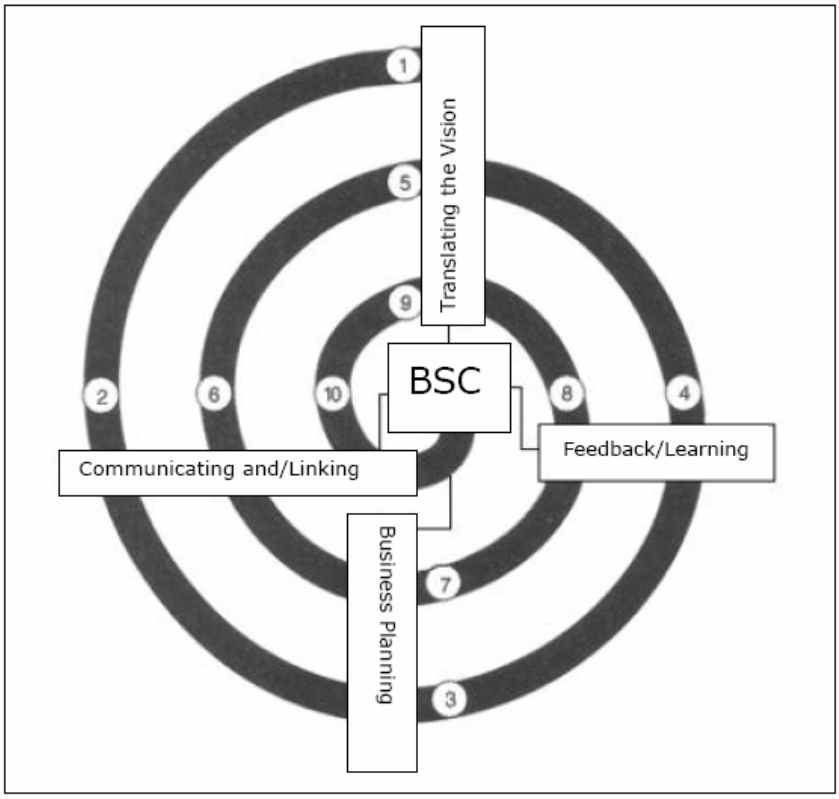
Goal	Measure
Improved Employee Capabilities	• Employee satisfaction • Staff turnover • Productivity • Number of employees qualified for key jobs
Effective Use of Information Technology	• Information coverage ratio • Return on data
High Motivation and Alignment	• Suggestions received • Suggestions implemented • Rewards provided

Source: Kaplan and Norton, 1992

In the Balanced Scorecard Framework, the measures in this perspective are also leading indicators of future performance since an effectively learning enterprise will easily follow the new technologies and be successful in the future. This perspective is referred as the *Learning and Growth Perspective* (Kaplan and Norton, 1996 [2]).

2.2.3. Linking the Balanced Scorecard to Strategy

Early users of the Balanced Scorecard approach experienced some difficulty in aligning their short term goals identified by the scorecard to their visions and long term strategies. Consequently, in order to solve this difficulty, in 1996, Kaplan and Norton broadened their Balanced Scorecard concept by integrating it with the concept of vision and strategy. They suggested following a four-stage iterative process for linking the overall vision of an organization to the business processes performed at the operational level (See Figure 2.6).



Source: Kaplan and Norton, 1996 [1]

Figure 2.6. Constructing the Balanced Scorecard

The iterative stages illustrated in Figure 2.6 can be explained as follows:

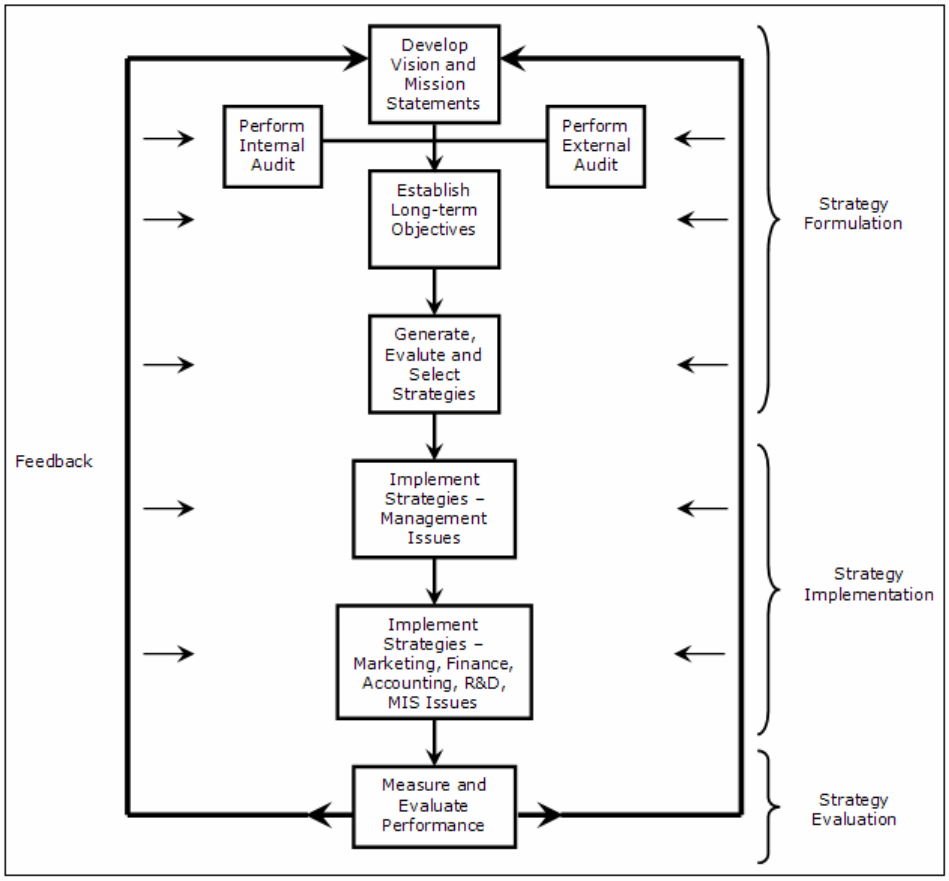
Stage 1: Translating the vision: Ensure that the long term vision of the organization is clearly understood and accepted by everyone in the organization.

Stage 2: Communicating and linking: Link the long term vision to the business unit or department and individual objectives at the business unit level or functional level.

Stage 3: Business planning: Align business intentions with the long term vision; in other words, assign priorities to and allocate resources among business investments according to their level of alignment with the long term strategic goals.

Stage 4: Feedback and learning: Arrange feedback and review sessions to monitor performance in terms of the level of fit between the business results and the business objectives set forth in the previous stage and discuss on how to improve performance.

This iterative process complies with the generally accepted strategic management process, in which organizations go through the stages of strategy formulation, implementation, and evaluation iteratively. These stages are also interconnected with feedback relations (See Figure 2.7).



Source: David, 1988

Figure 2.7. A Comprehensive Strategic Management Model

As Figure 2.7 demonstrates, organizational strategies are formulated in accordance with the long-term objectives based on the organizational vision and mission at the organizational level of strategy. Next, lower level strategies based on the organizational level strategies are formulated. If the organization is divided into Strategic Business Units (SBU), then the business unit level strategies are formulated first, and functional level strategies are formulated for each SBU. Otherwise, the organizational level strategies are adapted into appropriate functional level strategies implemented in the Marketing, Finance, Accounting, Human Resources, Research and Development, or Information Technology (IT) functions of the organization. Implementation refers to all tasks performed in the organizational functions in parallel with the functional level strategies, from accomplishing large projects to the simplest transactional operations at the project level or the operational level.

To sum up, the Balanced Scorecard Framework was designed to be used for evaluating the performance of an organization or a SBU, where success is measured as the level of fit between the organizational vision and mission and the final results of business operations performed with the intent to realize that vision and mission.

2.3. Performance Measurement in the Implementation of Enterprise Resource Planning Systems

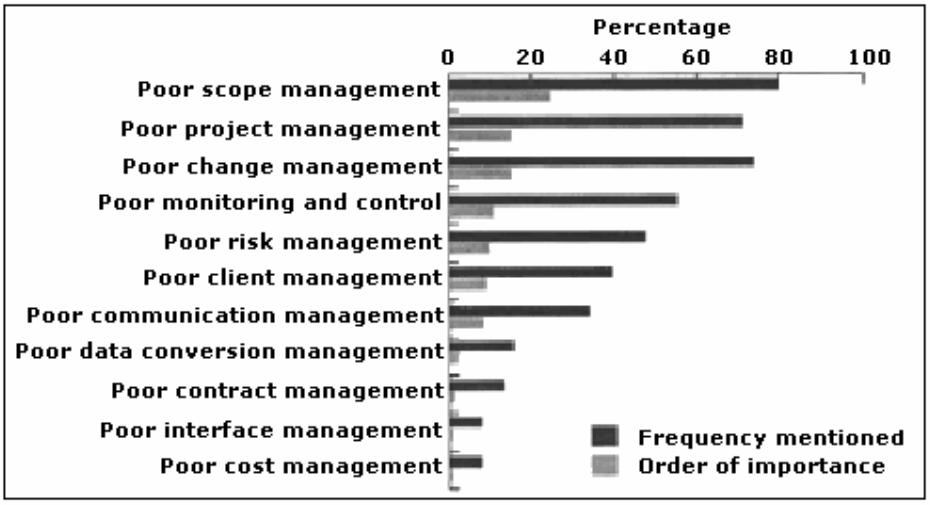
2.3.1. The Importance of Performance Measurement in the Implementation of ERP Systems

Plotkin defines the ultimate measure of success for an ERP implementation as the value that the system adds to the organization (Plotkin, 1999). As mentioned in Section 2.1.3, an Enterprise Resource Planning system adds value to an organization's business by reducing costs, improving managerial decision making and enhancing customer responsiveness (Ross, 1999).

Although the main rationale behind the implementation of ERP systems is to promote business value, most of the time organizations cannot fully realize the value added by an ERP system, either because they cannot complete the implementation phase successfully, or the challenges that emerge during implementation lead to ERP systems having less functionality than the initial expectations.

As mentioned in Section 2.1.5, the research reports prepared by The Standish Group demonstrate that more than half of information systems projects, including ERP, are classified as challenged; in other words, they are completed over time, over budget, and without the initially expected performance and functionality, and about a quarter of those projects are classified as failed.

The British Computer Society conducted a survey over 1027 IT projects, including ERP implementations, in the year 2000. The results of the survey in which project success was defined as "delivering to the sponsor everything specified to the quality agreed on or within the time and costs laid out at the start" revealed that the primary causes of project failure are the deficiencies in scope management, project management, change management, and monitoring and control (See Figure 2.8).



Source: The British Computer Society, 2000

Figure 2.8. Management Activities Contributing to Project Failure

Similar studies about project success and failure rates and reasons demonstrate similar results. In order to pull the rate of challenged or failed projects down to reasonable levels, organizations should monitor the performance in the implementation phase using appropriate methods and take corrective actions when necessary.

2.3.2. Appropriateness of the Balanced Scorecard Framework for Measuring the Performance of ERP Implementation

Taking into account the complexity and size -in terms of the level of investment made in the hardware, software and human resources-, and the level of impact on business value of an ERP system, the project of implementing such a system, in other words *"putting the enterprise into the enterprise system"* (Davenport, 1998) or vice versa, is a risky experience for any enterprise. Therefore, it is crucial to handle such a project successfully, but more important than that is to understand what success is and how it should be evaluated.

Traditionally, business value has been viewed by organizations only in terms of economic value. Therefore, organizational performance has been primarily measured in terms of the success in financial figures. Similarly, the value of information systems has been evaluated with capital budgeting models that view the development of an IS as a capital investment and measure its value by the models like Return on Investment (ROI), Net Present Value (NPV), or Economic Value Added (EVA).

However, these financial performance measurement methods have significant limitations. First of all, they are backward looking in the sense that they display the results of already accomplished tasks and evaluate performance with respect to the level of fit between the estimated and realized cost and time figures. Secondly, they are incapable of quantifying intangible results which are related with the social and organizational dimensions of IS implementations such as the costs from the resistance to change dictated by the new system. The high rate of technological

obsolescence and short life cycles of information systems pose another limitation on the capability of financial models, which are historically concerned with manufacturing investments with long life cycles, to evaluate the performance of IS implementations (Laudon and Laudon, 2004, p. 418).

As mentioned earlier, ERP systems originated from the need to have enterprise-wide information integration in order to survive in the cutthroat competitive landscape of the Information Age in which strategy and vision, not control, have become the focus. Hence, it is evident that the implementation of an ERP system is a strategic investment rather than just a capital investment. Consequently, traditional performance measurement systems are not adequate for evaluating the performance of ERP implementation.

The Longman Pocket English Dictionary defines the verb *"succeed"* as *"to achieve a desired object or end"*. So, success should be evaluated as the level of achievement in a desired object or the level of performance in the accomplishment of a desired object. Consequently, in order to evaluate the success of an ERP implementation project, it is necessary to measure its performance in accomplishing the desired business objectives of that project. This kind of performance measurement can be handled by the top-down approach followed by the Balanced Scorecard Framework for translating the vision and mission into strategies and objectives to be achieved and identifying relevant measures to be used to measure the performance with respect to the level of achievement of these objectives (See Section 2.2).

In addition, the model provided by the Balanced Scorecard Framework which clearly monitors and communicates not only financial, but also a balanced set of measures which not only indicate past performance but also drive future performance can strongly facilitate the already complicated ERP implementations.

Rosemann and Wiese (1999) suggest the application of the Balanced Scorecard Framework for evaluating ERP in either the implementation phase or the operational usage phase. They explain the assumption behind their suggestion as follows:

> *The assumption is that the Balanced Scorecard addresses exactly two main tasks of ERP management. First, the Balanced Scorecard helps to transfer visions into strategies and in the final phase into a running business which conforms to the business objectives. Second, the optimization of the usage of ERP software requires continuous controlling of the system usage. (Rosemann and Wiese, 1999)*

The part of this suggestion related with the operational use of ERP is beyond the scope of this study. For the ERP implementation phase, Rosemann and Wiese suggest to add a fifth perspective to the original Balanced Scorecard, the *Project Perspective***,** to handle the project management tasks such as the identification of the critical path and the definition of milestones. However, these tasks should be considered as the internal processes of an ERP implementation project since the scorecard itself deals with the performance measurement at the project level. Moreover, the scorecard proposed in their study does not present objectives and measures that are specific to the ERP implementation or operation phases.

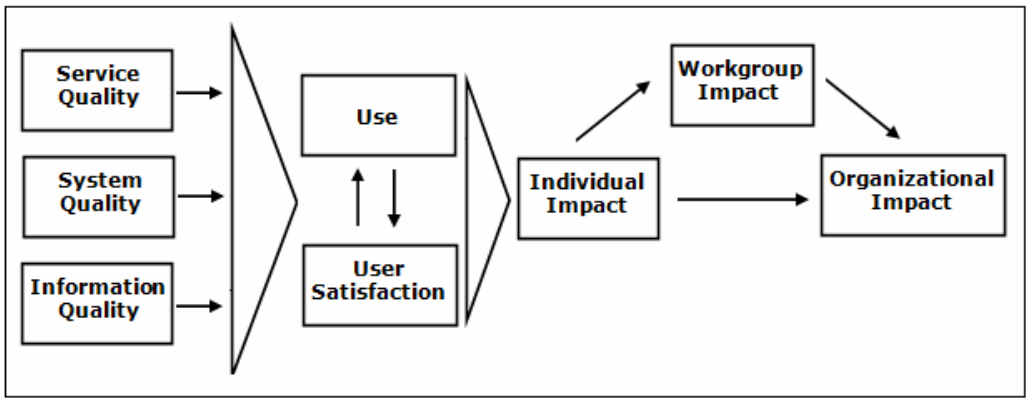
2.3.3. Success Factors for ERP Implementation

The *Project Management Institute* defines *project management* as follows:

> *Application of knowledge, skills, tools, and techniques to project activities in order to meet or exceed stakeholder needs and expectations from a project. Meeting or exceeding stakeholder needs and expectations invariably involves balancing competing demands among:*
> - *Scope, time, cost, and quality,*
> - *Stakeholders with differing needs and expectations,*
> - *Identified requirements (needs) and unidentified requirements (expectations). (Project Management Institute Inc., 1996, p 6)*

In parallel with this definition of project management, Robey, Ross and Boudreau (2000) define ERP implementation success as the satisfaction of the initial project requirements for going live, such as meeting deadlines, staying within budget, and achieving system performance as expected.

To evaluate system performance, the widely accepted *IS Success Model* developed by DeLone and McLean (1992), which measures the performance of information systems according to their level of impact on organizational performance, can be used. The model demonstrates the relationships among the six interdependent dimensions of information systems success, which are *System Quality, Information Quality, Amount of Use, Level of User Satisfaction, Individual Impact,* and *Organizational Impact.* In 1997, Myers, Kappelman and Prybutok offered a comprehensive IS assessment model by adding the *Service Quality* and *Workgroup Impact* variables to DeLone and McLean's *IS Success Model* (See Figure 2.9). In 2003, DeLone and McLean also updated their *IS Success Model* by adding *Service Quality* to the factors that singularly and jointly affect use and user satisfaction, as suggested by Myers, Kappelman and Prybutok (1997).



Source: Myers, Kappelman and Prybutok, 1997

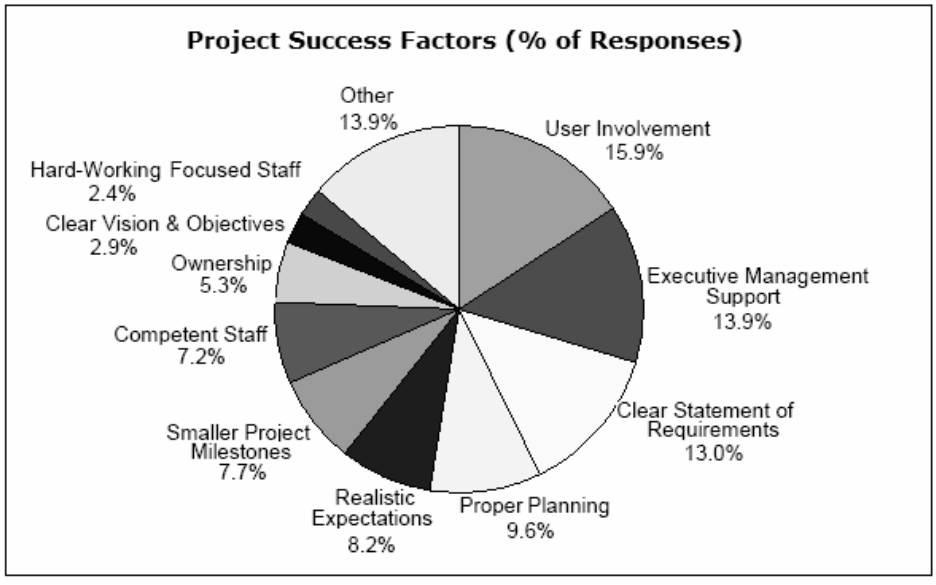
Figure 2.9. A Comprehensive IS Assessment Model

According to the IS assessment model shown in Figure 2.9, the quality of service, system, and information affect use and user satisfaction, which have an either

positive or negative impact on individual, work group, and eventually organizational performance. The variables of IS success identified by DeLone and McLean (1992) and validated by Myers, Kappelman and Prybutok (1997) are highly correlated to each other and they can be used for measuring ERP performance.

To evaluate project performance, on the other hand, it is evident that completing the project on time and within budget is not sufficient to indicate acceptable performance. How well the project management activities are handled from the project team members' and users' point of view should also be monitored. In addition, the capability and flexibility of the project management tasks to continue to succeed in the later phases of the project should also be examined. In determining the performance of the ERP implementation project and the implemented ERP system from the project team members' and users' perspective, the dimensions in the IS assessment model offered by Myers, Kappelman and Prybutok (1997) can be used.

The Chaos Report prepared by The Standish Group in 1994, which was previously mentioned in Section 2.1.5, also identifies the major success factors in IT projects (See Figure 2.10).



Source: The Standish Group Inc., 1994

Figure 2.10. Success Factors in IT Projects, 1994

As shown in Figure 2.10, more than half of the responses from the IT executives surveyed point to user involvement, executive management support, clear statement of requirements, and proper planning as the major success factors in IT projects.

The same report also reveals the factors causing IT projects to be challenged or to fail. Not surprisingly, most of those factors are the opposite of the success factors, such as lack of user involvement, unrealistic expectations and so on (See Tables 2.7 and 2.8). Other factors are concerned with the following risks and deficiencies in the IT projects surveyed or in the information systems implemented in those projects:

- obsolescence of the information systems' technology against new technologies
- incapability of the project team or inflexibility of the information systems in meeting changing requirements and specifications
- technology incompetence of the project team
- technology illiteracy of the users
- disappearance of the need for the information systems under construction

Table 2.7. Factors that Challenge IT Projects

Project Challenged Factors	% of Responses
1. Lack of User Input	12.8%
2. Incomplete Requirements & Specifications	12.3%
3. Changing Requirements & Specifications	11.8%
4. Lack of Executive Support	7.5%
5. Technology Incompetence	7.0%
6. Lack of Resources	6.4%
7. Unrealistic Expectations	5.9%
8. Unclear Objectives	5.3%
9. Unrealistic Time Frames	4.3%
10. New Technology	3.7%
Other	23.0%

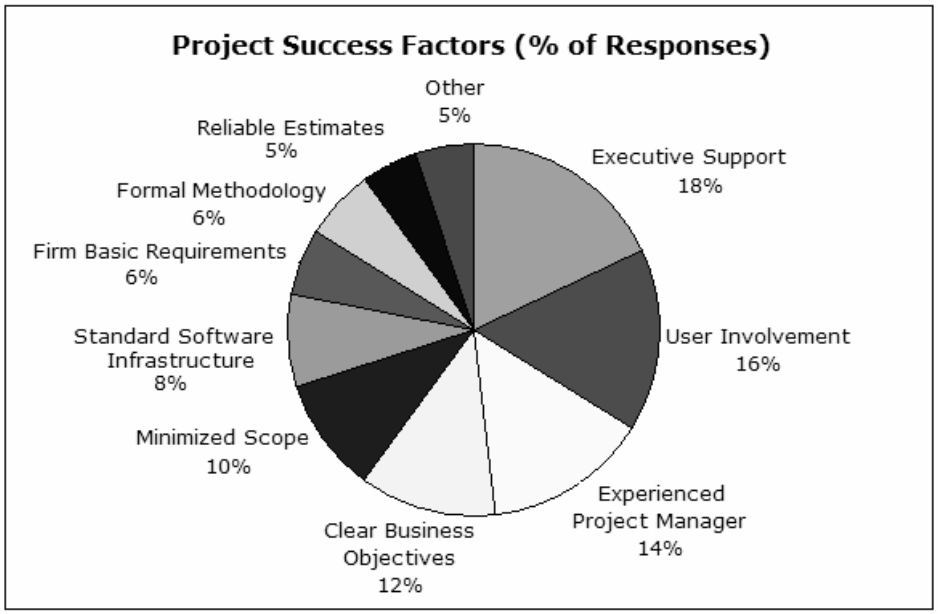
Source: The Standish Group Inc., 1994

Table 2.8. Factors that Demise IT Projects

Project Impaired Factors	% of Responses
1. Incomplete Requirements	13.1%
2. Lack of User Involvement	12.4%
3. Lack of Resources	10.6%
4. Unrealistic Expectations	9.9%
5. Lack of Executive Support	9.3%
6. Changing Requirements & Specifications	8.7%
7. Lack of Planning	8.1%
8. Didn't Need It Any Longer	7.5%
9. Lack of IT Management	6.2%
10. Technology Illiteracy	4.3%
Other	9.9%

Source: The Standish Group Inc., 1994

In 2001, The Standish Group prepared another Chaos Report concerning the success and failure rates of IS projects, which also reveals the major success factors (See Figure 2.11).



Source: The Standish Group Inc., 2001

Figure 2.11. Success Factors in IT Projects, 2000

As Figure 2.11 implies, executive management support replaced user involvement as the number one success factor. In addition, the realization of the high dependency of project success on the level of experience of the project manager led this factor to have the third position. Having a clear vision and clear business objectives was ranked fourth, up from 2.9% in 1994 to 12% in 2000, underlining the strategic importance of IS projects. The 10% share of having a minimized scope among the other success factors stems from the realization of the high level of impact of the project size on the project risk. The success factors of having firm basic requirements and reliable estimates, as well as using a formal methodology identified in 2001 are the prerequisites of proper planning which was another major success factor in 1994.

Many studies in the relevant literature identify success factors for IT projects, including ERP implementations, similar to those identified in the Chaos Reports prepared by the Standish Group in 1994 and 2001. Through an extensive review of the literature, Somers and Nelson (2001) proposed a comprehensive list of critical success factors (CSFs) for system implementation projects. Most of those critical success factors overlap with the ones identified by The Chaos Reports (1994 and 2001). Among the non-overlapping success factors, the ones that are relevant for the implementation phase of ERP systems are listed in Table 2.9.

The critical success factors listed in Table 2.9, along with the success factors illustrated in Figures 2.10 and 2.11, can be used in defining sample objectives and measures for the *Internal Business Perspective* of the balanced scorecard model developed in the next chapter. However, some of the factors cannot be easily quantified, so the performance of the project according to those factors can be assessed by conducting user surveys and translating the results into measurable scales, or making observations on the project team members and users involved in the implementation.

Table 2.9. Critical Success Factors for ERP Implementation Projects

Critical Success Factor
Effective change management Assigning a "*project champion*" Assigning a "*steering committee*"
User training and education Use of external consultants
Careful selection of the appropriate package Partnership among the organization and the ERP vendor Use of vendors' development tools
Interdepartmental communication Interdepartmental cooperation
Effective data analysis and conversion

Beath (1991) suggests appointing an individual who has extensive knowledge of the business processes of the organization as a *"Project Champion"* who will perform transformational leadership and will market the project to the users. The project champion, who will act as a middleman between users and the system throughout the implementation, is also referred as a *"Change Agent"* in some contexts (Laudon and Laudon, 2004, p 429). The availability of a project champion or a change agent can be an enabler for the effective implementation of ERP projects.

Another enhancer of effective change management can be the availability of a *"Steering Committee"* or group of *"super users"* (Sumner, 1999). A steering committee include executives of different organizational functions, project leaders, and end users to ensure appropriate level of user involvement in controlling the decision making processes of the project team (Whitten and Bentley, 1998).

Interdepartmental communication and cooperation can also help to improve the success rate in ERP implementation projects by ensuring an appropriate level of user

involvement. Since ERP systems are cross-functional in nature, ERP implementation efforts necessitate a high level of interdepartmental communication (Slevin and Pinto, 1986) and cooperation (Robinson and Dilts, 1999).

The success factors discussed in this section form the basis for the sample objectives and measures identified for each perspective of the balanced scorecard model for ERP implementation, the development process of which is described in Chapter III.

CHAPTER III

A BALANCED SCORECARD MODEL FOR ERP IMPLEMENTATION

3.1. Methodology

The development of a balanced scorecard for an organization or a business unit is the process of translating the general organizational vision and mission into specific measures indicating success or failure in terms of the level of achievement of the long term objectives and strategies established in line with the vision and mission (See Section 2.2.3). In this study, this process, which takes place at the organizational level or the business unit level, is adapted to the project level in order to develop a balanced scorecard model to be used in measuring the performance of the implementation phase of ERP systems (See Table 3.1).

As shown in Table 3.1, the development of the balanced scorecard for an ERP implementation project necessitates a process of translating the project vision and mission into specific measures indicating success or failure in terms of the level of achievement of the objectives set forth for each perspective of the balanced scorecard in the planning phase of the project.

This study assumes that the project vision is one of the business objectives for having an ERP system in an organization. Project mission is, on the other hand, to complete the implementation phase with acceptable levels of performance measured from each

perspective of the balanced scorecard. Acceptable levels of performance are the acceptable levels of achievement of the objectives set forth for each perspective in the planning phase of the project.

Table 3.1. Adaptation of the Balanced Scorecard Construction Process from Organizational Level to Project Level

Items in the Original Balanced Scorecard Framework (Organizational Level)	Corresponding Items in the Balanced Scorecard Model for ERP Implementation (Project Level)
Organizational Vision	**Project Vision** "To implement an ERP system that will provide an enterprise-wide information integration among the main functions and the core business processes of the organization" (See Section 2.1.3)
Organizational Mission	**Project Mission** "To complete the implemention of the ERP system with acceptable levels of performance measured from each perspective of the balanced scorecard."
Long-term and Short-term Strategies	**Project Plan** • Project schedule prepared according to time estimations • Project budget prepared according to cost estimations • Establishment of the project team
Goals and Measures <u>Financial Perspective</u> How do we look to shareholders? <u>Customer Perspective</u> How do customers see us?	**Goals and Measures** <u>Financial Perspective</u> What are the major cost components in the total cost of implementing the ERP system? <u>Customer Perspective</u> Are the project team members and users involved in the project satisfied with the project?

Table 3.1. (Cont'd) Adaptation of the Balanced Scorecard Construction Process from Organizational Level to Project Level

Items in the Original Balanced Scorecard Framework (Organizational Level)	Corresponding Items in the Balanced Scorecard Model for ERP Implementation (Project Level)
Goals and Measures Internal Business Perspective What must we excel at? Innovation and Learning Perspective Can we continue to improve and create value?	**Goals and Measures** Internal Project Perspective How well are the project management tasks accomplished during implementation? Innovation and Learning Perspective Are the project team and the ERP system implemented capable of adapting to changing requirements?

In order to develop a balanced scorecard model for ERP implementation, the following successive stages are repeated for the Financial Perspective, Customer Perspective, Internal Business Perspective, and Innovation and Learning Perspective in Sections 3.2 to 3.5 respectively:

Stage 1: Defining sample objectives

In this stage, sample objectives which may lead to improved performance in the implementation of ERP systems are suggested for the perspective in concern.

Stage 2: Identifying sample measures for each objective

In this stage, for the perspective in concern, sample measures that can be used for evaluating success with respect to the level of achievement in each objective defined in Stage 1 are suggested. Measures are the key performance indicators (KPIs) that can be used in measuring the performance of ERP implementation according to each objective from each perspective of the balanced scorecard. While suggesting the measures, special attention is paid to being as precise as possible. The suggested list

of measures is refined by eliminating the ones which are not easy quantify and are not controllable by the organization implementing the ERP system.

Some of the measures or the KPIs to be identified in this stage are capable of not only measuring the current progress of the ERP implementation toward the defined objectives, but also driving performance for the later phases of implementation.

Stage 3: Establishing a table of objectives and measures

The sample objectives and measures identified at the end of the previous stages are used for establishing a table for the perspective under consideration.

At the end of the discussion for all perspectives, four tables are obtained, each of which constitutes one of the perspectives of the balanced scorecard model proposed in this study.

3.2. Financial Perspective

Stage 1: Defining sample objectives

An important financial objective for many businesses is maximizing profits, which has two components: maximizing revenues and minimizing costs. For the case of an investment or a project, the primary financial goal is to maximize benefits and minimize costs. If one of the capital budgeting methods mentioned in Section 2.3.2 was used for evaluating the financial performance of an ERP implementation project, that method would view the project as a capital investment to measure its financial success. Costs would be calculated as the cash outflows made for the investment, revenues would be calculated as the cash inflows generated by, for instance, the increased sales due to the increased demand of customers triggered by the improved quality of products enhanced by the implemented ERP system. However, it is

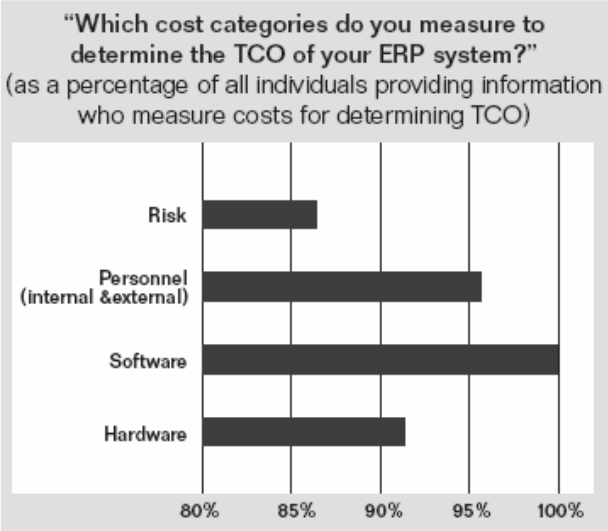
impossible to justify which portion of increased sales is directly due to the ERP system, and which to the other factors. Therefore, the investment made in an ERP implementation project is easily quantifiable as financial costs, whereas the benefits cannot be quantified directly as financial revenues.

As a result, the objective *"Maximize revenues"* is not reasonable for the ERP implementation balanced scorecard. On the other hand, *"Minimize costs"* is a valid objective for enhancing the financial success of ERP implementation.

Stage 2: Identifying sample measures for each objective

All costs incurred in the ERP implementation project constitute the total cost of implementing the ERP system. Hence, the objective to *"Minimize costs"* can be referred as *"Minimize the total cost of implementation"*. In order to satisfy this objective, the total cost of implementation is decomposed into individual cost components to be minimized. The examination of the financial perspective of the ERP implementation balanced scorecard model also starts with the question *"What are the major cost components in the total cost of implementing the ERP system?"* (See Table 3.1)

The survey "Total Cost of Ownership in the ERP Environment" conducted in 2003 by *SAP SI* reveals that of the 30 European companies surveyed from different industries owning an ERP system, 91% measure the costs of hardware, 100% measure the costs of software, whereas 96% measure the internal and external personnel-related costs, including training and consulting, and 87% measure the risk associated with the ERP system in order to determine the total cost of ownership (TCO) (See Figure 3.1).

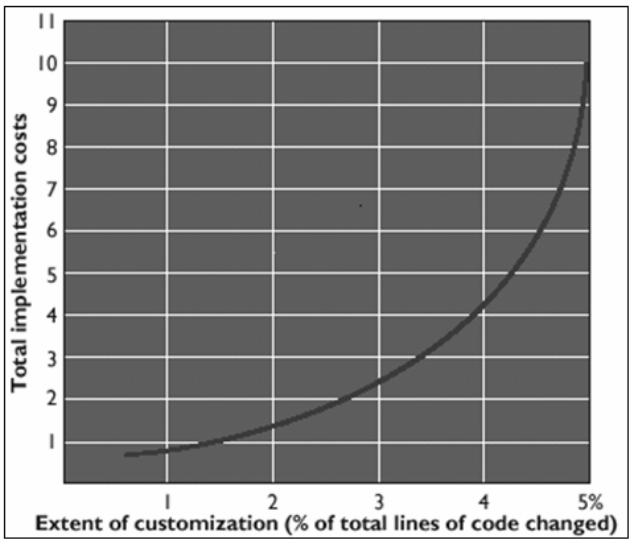


Source: SAP SI, 2003

Figure 3.1. Cost Categories Measured to Determine the TCO of ERP

In fact, in addition to the cost categories shown in Figure 3.1, the TCO should also include the costs related to the maintenance and upgrades in the ERP system during its operation. The cost categories in Figure 3.1 are the major costs that are incurred during the implementation phase, and they are used in determining the total cost of ERP implementation in this study. Hardware costs consist of the investment made in hardware resources, such as purchasing and installing server machines, desktop computers, input-output devices, and establishing the network infrastructure. The software costs mainly include the licenses of the ERP software and the other supporting software purchased. The salaries and overtime payments of the project team members constitute the internal personnel costs and the training and consultancy expenses form the external personnel costs.

Customization costs constitute an additional major cost component to the ones shown in Figure 3.1. Customization refers to the modifications made in the ERP software with the intent to meet an organization's unique requirements that are not satisfied with the standard modules provided by the software. TCO increases exponentially with the increased extent of customization (See Figure 3.2).



Source: Laudon and Laudon, 2004

Figure 3.2. The Effect of Customization Costs on Total Implementation Costs of IS Projects

According to SAP SI (2003), the TCO in ERP implementation projects may also include risk components, such as:

- *The risk that there are not enough bearers of know how available,*
- *The risk of delays and of exceeding the budget, which may, for instance, result from a lack of commitment on the part of the top management,*
- *The risk of not achieving the degree of system use required for economic success fast enough due to underestimated psychological barriers and the resistance of employees.*

An additional risk component may be the risk that the hardware and software technology used in the project will be obsolete sooner than expected.

The performance of ERP implementation from the financial perspective of the balanced scorecard model proposed in this study can be measured by the following sample measures:

- *Hardware cost performance index* → percentage deviation of realized hardware costs from the budgeted hardware costs

- *Software cost performance index* → percentage deviation of realized software costs from the budgeted software costs

- *Internal personnel cost performance index* → percentage deviation of realized salary and overtime payments from the budgeted amount

- *External personnel cost performance index* → percentage deviation of realized training and consultancy expenses from the budgeted amount

- *Extent of customization* → percentage of total lines of code (LOC) modified in the ERP package

Once these sample measures are set as financial targets at the beginning of implementation, the financial performance of the project can be evaluated by computing these indices at a point during implementation. The lower the index values, the better the financial performance of the implementation.

The cost performance indices of hardware, software, and personnel costs and can be calculated by comparing the realized and budgeted values in monetary units, and the extent of customization can be calculated by comparing the modified and the total lines of code, hence they are valid measures for the objective *"Minimize the total cost of implementation"*.

The only measurable risk component from the financial perspective is the risk of delays and of exceeding the budget, which can be measured by continuously monitoring the realized project costs and project duration and comparing them to the estimated project budget and schedule. Other risk components are not valid measures for this perspective since they are not easily quantifiable and controllable, and those

risk components are handled in the discussion of the Internal Business Process Perspective in Section 3.4.

Stage 3: Establishing a table of objectives and measures

Sample objectives and measures that can be used to measure the performance of ERP implementation from the financial perspective of the balanced scorecard are listed in Table 3.2.

Table 3.2. Financial Perspective of the ERP Implementation Balanced Scorecard: Sample Objectives and Measures

What are the major cost components in the TCO of the ERP system?	
Objective	**Measure**
Minimize the Total Cost of Implementation	**. Hardware cost performance index =** (Realized – Estimated) Hardware costs * 100 / Estimated Hardware costs **. Software cost performance index =** (Realized – Estimated) Software costs * 100 / Estimated Software costs Realized software costs = Number of licenses purchased * Unit price per license **. Internal personnel cost performance index =** (Realized – Estimated) Salaries and Overtime * 100 / Estimated Salaries and Overtime Salaries paid = Number of employees in the project team * Project duration (in months) * Salary per employee per month Overtime paid = Total overtime (in hours) * Overtime payment per hour **. External personnel cost performance index =** (Realized – Estimated) Training and Consultancy expenses * 100 / Estimated Training and Consultancy expenses Training expenses = Hours of training received * Training expense per hour Consultancy expenses = Hours of consultancy received * Consultancy expense per hour **. Extent of customization =** LOC modified / Total LOC * 100

3.3. Customer Perspective

This perspective of the balanced scorecard measures the performance of the ERP implementation from the customers' point of view. Therefore, at first, the customers of the ERP implementation should be identified before taking steps to define sample objectives and measures for this perspective. In this context, a clear distinction should be made between the direct and indirect customers of ERP implementation.

The direct customers consist of two groups, one of which includes the project team members who are actively involved in the project and the other includes the employees of the organization who will be the end users of the ERP system after the completion of the implementation. In the implementation phase, some of these end users may also be actively participating in the project for testing or training purposes. The end users who are not involved in the implementation phase are beyond the scope of this study since the proposed scorecard specifically pertains to the implementation phase.

The indirect customers, on the other hand, consist of the customers, suppliers, and the other external stakeholders of the organization, as they are not directly involved in the implementation. Indirect customers are also beyond the scope of this study. This perspective of the balanced scorecard model measures the performance of ERP implementation only from the viewpoints of direct customers.

Stage 1: Defining sample objectives

The customer perspective includes objectives and measures concerning the direct customers of the ERP system, i.e. the project team members and the users participating in the project for training or testing purposes. Therefore, the examination of this perspective starts with the question *"Are the project team members and the users involved in the project satisfied with the project?"* (See Table

3.1) Hidden in this question are two objectives: *"Ensure project team's satisfaction"* and *"Ensure involved users' satisfaction"*.

Kaplan and Norton (1992) state that *"Customers' concerns tend to fall into four categories: time, quality, performance and service, and cost."* Hence, this perspective of the ERP implementation balanced scorecard includes sample measures that can measure project team and user satisfaction in terms of time, quality, performance and service dimensions. Cost is beyond the scope of this perspective, and is included in the Financial Perspective in Section 3.2.

The satisfaction of the project team with the project can be examined in two dimensions. The first one is related with their perception of the success of the project management activities. The second one is related to the satisfaction of the project team with the ERP system they are trying to adapt to the organization throughout the implementation phase.

The satisfaction of the users who are actively participating in the project for training or testing purposes can also be examined in two dimensions, one of which is related with the users' satisfaction with the ERP system, and the other is related with their perception of the level of impact the ERP system will make on their performance. The project team members' and the involved users' satisfaction with the ERP system can be examined together.

Stage 2: Identifying sample measures for each objective

The project team members' perception of the success of the project management activities can improve with their level of involvement in the management of the project. An appropriate amount of involvement will enhance the project team's understanding of the project vision and mission and how their individual efforts contribute to the project in order to achieve the vision and mission. Therefore, the level of involvement of the project team members in the project management

activities can be used as a measure for the first objective of this perspective. It can be calculated as:

Level of involvement → percentage number of meetings attended in the total number of meetings about project management tasks (average for project team members)

Involved users' perception of the level of impact the ERP system will make on their performance can improve by conducting training sessions about the system and ensuring that the users have an acceptable level of participation in those sessions, which can be a measure for the second objective of this perspective. An increased level of user training also enhances the users' confidence with the system, which leads to improved user satisfaction. It can be calculated as:

Level of participation in user training sessions → percentage number of training sessions attended in the total number of training sessions (average for users)

In order to identify sample measures for the project team members' and involved users' satisfaction with the ERP system, the *IS Success Model* developed by DeLone and McLean (1992 and 2003) and the *IS Assessment Model* offered by Myers, Kappelman and Prybutok (1997) can be used (See Section 2.3.3). According to this model, the users' satisfaction with and usage of information systems is a function of *service quality*, *system quality,* and *information quality*.

Service quality can be measured by conducting surveys among the project team and users about the effectiveness of consultancy sessions provided by the ERP vendor or another consultancy firm and translating the survey results into quantifiable scales. Any deficiencies pointed out in survey results can be communicated to the ERP vendor or consultancy firm to ensure corrective actions. Therefore, service quality can be to some extent quantifiable and controllable.

The quality of other services concerning the maintenance of a hardware resource -if provided by the vendor- or solving a problem about software can be assessed by the following measures:

- *Average Service Response Time* → average time elapsed between the request for a support from the vendor and the response of the vendor to that request (hours)

- *Service Response Performance Index* → percentage deviation of the average realized service response time from the service response time promised by the vendor in the contract (The lower, the better.)

- *Service Reliability (Parasuraman, Zeithaml and Berry, 1985)* → percentage of service performed right at the first time (no need for requesting additional service for the same problem) in the total number of service requests

- *Competence and courtesy of the personnel providing service (Parasuraman, Zeithaml and Berry, 1985)* → cannot be controlled by the organization, hence this is not a valid measure

An ERP system is a standard software package which is not built in-house but purchased from one of the ERP vendors. Therefore, the system quality of the standardized modules cannot be controlled by the organization. On the other hand, system quality can be measured and controlled for the customized modules of the ERP package by the following measures suggested by DeLone and McLean (2003):

- *System Reliability* → percentage of proper system responses right the first time in the total number of system responses

- *System Response Time* → average time elapsed between a user request and the system's response to that request

- *Ease of Use* → improves with the increased number of user friendliness characteristics in the user interfaces of the system. The number of such characteristics such as the navigation aids, shortcuts, warning messages before critical actions can be easily calculated for each user interface screen. However, the absolute numbers of those features cannot give an idea about the quality of the user interface. Ease of use can be assessed by conducting user surveys and interpreting the results.

- *Usefulness* → is also hard to quantify and can be assessed by conducting user surveys and interpreting the results.

- *Flexibility* → is the extent to which the system can adapt to changes in user requirements and improves with the increased modularity of the system. Modularity can be improved by techniques like using object oriented programming languages for the customizations made in the standard ERP package. However, it is not easy to quantify and not a valid measure for the conceptual balanced scorecard.

- *Accessibility* → percentage number of unsuccessful attempts to access the system in the total number of attempts

In addition to these measures, system quality can also be measured by:

- *System security* → average number of breakdowns in the system (per week / month)

- *Documentation quality* → average number of software specification documents or user manuals prepared per module

Information quality can be measured in terms of the accuracy, timeliness, reliability, currency, and completeness of the information provided by the ERP system (Huff

and Munro, 1985). Timeliness and reliability of information can be quantified by using similar parameters as the ones used for quantifying the system response time and system reliability. However, the other measures are subject to differentiation according to the context the information is used. Therefore, they cannot be used as valid measures for this perspective of the ERP implementation balanced scorecard. Information quality is critical for effective data conversion, which is discussed in the Internal Business Perspective in Section 3.4.

Stage 3: Establishing a table of objectives and measures

Sample objectives and measures that can be used to measure the performance of ERP implementation from the project team members' and users' perspective of the balanced scorecard are listed in Table 3.3.

Table 3.3. Customer Perspective of the ERP Implementation Balanced Scorecard: Objectives and Measures

Are the project team members and the users involved in the project satisfied with the project?	
Objective	**Measure**
Ensure project team's satisfaction	**Level of involvement =** number of meetings attended * 100 / total number of relevant meetings (average for project team members)
Ensure involved users' satisfaction	**Level of participation in training sessions =** number of training sessions attended * 100 / total number of training sessions (average for end users)

Table 3.3. (Cont'd) Customer Perspective of the ERP Implementation Balanced Scorecard: Objectives and Measures

Objective	Measure
Ensure project team's and involved users' satisfaction	Service Quality: **. Average Service Response Time =** average time elapsed between the request for support from the vendor and the response of the vendor to that request (hours) **. Service Response Performance Index =** (average realized service response time - service response time promised) * 100 / service response time promised **. Service Reliability =** number of service performed right the first time * 100 / total number of service requests System Quality: **. System Reliability =** proper system responses right at the first time * 100 / total number of system responses **. System Response Time =** average time elapsed between a user request and the system's response to that request **. System security =** average number of breakdowns in the system **Documentation =** average number of software specification documents / user manuals prepared per module

3.4. Internal Business Perspective

This perspective of the balanced scorecard monitors the success of the internal processes, decisions and actions (Kaplan and Norton, 1992) occurring throughout the implementation of the ERP system. In other words, the objectives and measures in this perspective are concerned with the project management practices that lead to a successful ERP implementation project.

The examination of this perspective starts with the question: *"How well are the project management tasks accomplished during implementation?"* (See Table 3.1) In order to answer this question, sample quantifiable and controllable objectives and measures for monitoring the progress of project management tasks are deduced from the project success factors revealed by The Chaos Reports (1994 and 2001) illustrated in Figures 2.10 and 2.11, and the critical success factors for ERP implementation illustrated in Table 2.9.

Stage 1: Defining sample objectives

As implied in Figures 2.10 and 2.11, one of the objectives for this perspective can be *"Ensure appropriate level of user involvement"*. Users should be encouraged to participate in the project to communicate their needs and expectations from the ERP system to be implemented. An appropriate level of user involvement in the analysis and design phases may lead to a *clear statement of requirements*, which is another success factor for IT projects. It is important not to delay the clarification of user expectations to the later phases in order to do as little rework as possible.

In addition, users tend to have more *realistic expectations* if they have a chance to recognize some of the technical limitations of the project, which is also another success factor for IT projects. Furthermore, users tend to have less resistance to the new system if they feel confident with it, which can be achieved by an appropriate level of involvement in the project.

As mentioned before, a more than necessary amount of user involvement may be a burden for the project in terms of increased customization costs, increased implementation time, and reduced benefits from vendor software maintenance and updates (Janson and Subramanian, 1996). Therefore, it is important to determine the most appropriate level of user involvement and try to maintain it throughout the implementation. An appropriate level of user involvement can be ensured by

assigning a *Steering Committee* and encouraging interdepartmental communication and cooperation (See Section 2.3.3).

Another objective can be *"Ensure appropriate level of executive management support"*. If the executive managers believe in and support the project, then the project team will take their job more seriously and the users will accept the new system more easily, which means that all parties take on ownership of the project. Without top management support, such large and complex projects like ERP implementation may not survive.

At the beginning of an ERP implementation project, a sufficient amount of time should be spent in the planning phase to establish the project plan, which includes the estimated project budget and schedule, as well as the organization of the project team. Estimated costs in the project budget are used as criteria against which the realized costs in the project are compared in order to monitor the financial progress of the project, as described in Section 3.2. Similarly, the project schedule, which summarizes which task will be accomplished when, by whom, serves as a guide to see the overall progress of the project. Therefore, in order to have a fair evaluation of the project progress in the later phases, as well as to establish clear vision and goals, it is necessary to plan properly in the beginning, which can be another objective for this perspective. Formal project planning tools such as Program Evaluation and Management Technique (PERT), Critical Path Method (CPM), and Gantt Charts are widely used in projects to facilitate planning.

The *technical competence* of the project team is another success factor for IT projects. The project team members should have the necessary technical skills to be able to implement the ERP modules with the expected functionality in acceptable time limits. Perhaps the most important of all is the project leader's technical and administrative competence to manage the technical complexity of the implementation as well as the administrative issues such as staying within the budget and in parallel with the schedule, coordinating tasks and ensuring harmony among

project team members and so on. *"Ensure acceptable level of technical competence of the project team*" can then be defined as another objective.

In addition to the technical competence of the project team, *technological literacy* of the users involved in the project is also important for the success of the implementation. Therefore, *"Ensure acceptable level of technological literacy of involved users*" can also be used as a valid objective for this perspective.

Another success factor for ERP implementation projects is the use of external consultants (Piturro, 1999). External consultants can facilitate the project by transferring their knowledge about best practices in ERP package implementation as well as change management to the organization lacking experience in ERP. User training provided by external consultants can also strongly enhance the project team members' and involved users' level of expertise and confidence with the ERP system, provided that the knowledge of the external consultants is transferred to the project team members and involved users effectively (Davenport, 1998). However, high levels of dependency on external consultancy may result in a loss of control and authority on the project, and increase costs. Therefore, it is important to determine the most appropriate level of external consultancy. Therefore, "*Get appropriate level of external consultancy"* and *"Get appropriate level of user training"* can also be used as objectives for this perspective.

Janson and Subramanian (1996) propose that the level of fit between the organization's needs and expectations from the ERP system and the functionality of the ERP package purchased, as well as the relationship of the organization with the ERP vendor, is critical to ensure successful implementation. Hence, two other objectives can be *"Ensure high level of fit between the ERP package and the expected functionality from it"* and *"Establish strong partnership with the ERP vendor".*

Effective management of data is another critical factor for the success of ERP implementation projects (Kapp, 1998), and a final sample objective for this

perspective can be *"Effective Data Analysis and Conversion"*. Data in the legacy systems should be collected carefully and converted into the appropriate format accepted by the new ERP system, which is a very complicated issue.

Stage 2: Identifying sample measures for each objective

Sample measures for the objective *"Ensure appropriate level of user involvement"* can be:

- *Level of user involvement* → percentage of number of relevant meetings attended in the total number of relevant meetings (average for involved users)

Sample measures for the objective *"Ensure appropriate level of executive management support"* can be:

- *Level of executive management involvement* → percentage of number of relevant meetings attended in total number of relevant meetings (average for executives)

- *Incentive supporting behavior* → percentage weight of effort put in the project in the determination of by project team members' incentives, and percentage weight of cooperation in the project in the determination users' incentives

- *Funds allocating behavior* → average time elapsed between the request for fund and the release of fund

Sample measures for the objective *"Plan properly"* can be:

- *Cost estimation accuracy index* → percentage deviation of realized costs from the costs estimated in the project plan (per cost item)

- *Time estimation accuracy index* → percentage deviation of realized duration from the duration estimated in the project plan (per project milestone)

- *Usage of formal planning tools* → such as Program Evaluation and Management Technique (PERT), Critical Path Method (CPM), and Gantt Charts

Sample measures for the objective *"Ensure acceptable level of technical competence of the project team"* can be:

- *Level of expertise* → percentage number of employees with B.S. or M.S. degrees in IT-related areas and percentage number of employees possessing industry specific expertise certificates (in the total number of project team members)

IT-related expertise certificates are provided by leading IT companies and have a high level of industry-wide acceptance in recruitments. In order to give a general idea, Table 3.4 lists the certificate programs provided by Microsoft, each of which has a comprehensive curriculum completed in six to twelve months.

Table 3.4. Expertise Certificates Provided by Microsoft

Microsoft Certified IT Professional (MCITP)
Microsoft Certified Professional Developer (MCPD)
Microsoft Certified Technology Specialist (MCTS)
Microsoft Certified Desktop Technician (MCDST)
Microsoft Certified Systems Administrator (MCSA)
Microsoft Certified Systems Engineer (MCSE)
Microsoft Certified Database Administrator (MCDBA)
Microsoft Certified Applications Developer (MCAD)
Microsoft Certified Solution Developer (MCSD)
Microsoft Certified Trainer (MCT)
Microsoft Certified Learning Consultant (MCLC)
Microsoft Office Specialist (MOS)

Source: www.microsoft.com

- *Level of experience* → average number of years working in IT-related jobs and average number of years working in ERP projects (for the project team)

Sample measures for the objective *"Ensure acceptable level of technological literacy of involved users"* can be:

- *Level of technological literacy* → average number of years working with computers and percentage number of involved users with basic, intermediate or advanced level of computer skills in the total number of involved users

Sample measures for the objective *"Get appropriate level of external consultancy"* can be:

- *Level of external consultancy* → number of external consultants hired and number of hours of consultancy service taken

- *Effectiveness of external consultancy* → perceived effectiveness of the external consultants in transferring their knowledge to the project team members and involved users. This measure can be deduced by translating the results of questionnaires conducted among project team members and involved users into measurable scales.

Sample measures for the objective *"Get appropriate level of user training"* can be:

- *Level of user training* → number of training hours per project team member and per involved user and number of total training hours

- *Effectiveness of user training* → perceived effectiveness of the training sessions in terms of the quality of documentation and competence of trainers and perceived adequacy of the number of training hours. This measure can also be

deduced by translating the results of the questionnaires conducted among project team members and involved users into measurable scales.

- *Project team success rate* → average success rate of project team members in the examinations held after training sessions

- *Involved user success rate* → average success rate of involved users in the examinations held after training sessions

Sample measures for the objective *"Ensure high level of fit between the ERP package and the expected functionality from it"* can be:

- *Expectation coverage ratio* → percentage number of user needs covered by the ERP modules in the total number of user needs specified at the beginning

- *Extent of customization* → percentage of total lines of code (LOC) modified in the ERP package (See the discussion of the Financial Perspective in Section 3.2).

Sample measures for the objective *"Establish strong partnership with the ERP vendor"* can be:

- *Service response rate* → average time elapsed between the request for a support from the vendor and the response of the vendor to that request

- number of complaints from the project team or results of user surveys about the quality of documentation, training and consultancy services provided by the vendor. User survey results can be translated into measurable scales.

- quality of the additional tools provided by the ERP vendor

Additional tools provided by the ERP vendor can be software development platforms, training or testing material and tools, hardware resources, and so on. The criteria for acceptable levels of quality of these tools can be stipulated by the organization in the initial contracts. Since the quality of such tools is static and does not deviate during implementation, this is not a valid measure for the ERP implementation balanced scorecard.

Sample measures for the objective *"Effective Data Analysis and Conversion"* can be:

- *Data loss rate* → percentage of data lost during conversion from legacy systems to the ERP system (due to incompatibilities) in all data converted

- *Redundancy elimination rate* → percentage amount of data redundancies eliminated during conversion from legacy systems to the ERP system in all data redundancies

Stage 3: Establishing a table of objectives and measures

Sample objectives and measures that can be used to measure the performance of ERP implementation from the internal business perspective of the balanced scorecard are listed in Table 3.5.

Table 3.5. Internal Business Perspective of the ERP Implementation Balanced Scorecard: Objectives and Measures

How well are the project management tasks accomplished during implementation?	
Objective	**Measure**
Ensure appropriate level of user involvement	**Level of user involvement =** number of relevant meetings attended * 100 / total number of relevant meetings (per user representing a department)

Table 3.5. (Cont'd) Internal Business Perspective of the ERP Implementation Balanced Scorecard: Objectives and Measures

Objective	Measure
Plan Properly	**. Cost estimation accuracy index =** (Realized - Estimated) cost * 100 / Estimated cost (per cost item) **. Time estimation accuracy index =** (Realized - Estimated) duration * 100 / Estimated duration (per project milestone) . Usage of formal planning tools
Ensure appropriate level of executive management support	**. Level of executive management involvement =** number of relevant meetings attended * 100 / total number of relevant meetings (per executive) **Incentive supporting behavior:** . percentage weight of effort put in the project in the determination of by project team members' incentives . percentage weight of cooperation in the project in the determination of users' incentives **. Funds allocating behavior =** average time elapsed between the request for funds and the release of funds
Ensure acceptable level of technical competence of the project team	**Level of experience:** . average number of years working in IT related jobs (for the project team) . average number of years working in ERP projects (for the project team) **Level of expertise:** . number of project team members with B.S. or M.S. degrees in IT related areas * 100 / total number of employees in the project team . number of project team members possessing IT expertise certificates * 100 / total number of employees in the project team
Get appropriate level of external consultancy	**Level of external consultancy:** . number of external consultants hired . number of hours of consultancy service taken

Table 3.5. (Cont'd) Internal Business Perspective of the ERP Implementation Balanced Scorecard: Objectives and Measures

Objective	Measure
Ensure acceptable level of technological literacy of involved users	**Level of technological literacy:** . average number of years working with computers (for involved users) . number of involved users with basic computer skills * 100 / total number of users . number of involved users with intermediate computer skills * 100 / total number of users . number of involved users with advanced computer skills * 100 / total number of users
Get appropriate level of user training	**Level of user training:** . number of number of training hours (per project team member and per involved user) . number of total training hours **. Project team success rate =** average success rate of project team members in the examinations held after training sessions **. Involved user success rate =** average success rate of involved users in the examinations held after training sessions
Ensure high level of fit between the ERP package and the expected functionality from it	**. Expectation coverage ratio =** number of user needs covered by the ERP modules * 100 / total number of user needs specified at the beginning **. Extent of customization =** LOC modified * 100 / Total LOC
Establish strong partnership with the ERP vendor	**. Service response rate =** average time elapsed between the request for a support from the vendor and the response of the vendor to that request . number of complaints about the quality of documentation, training and consultancy services provided by the vendor (from the project team members or involved users)

Table 3.5. (Cont'd) Internal Business Perspective of the ERP Implementation Balanced Scorecard: Objectives and Measures

Objective	Measure
Effective Data Analysis and Conversion	**. Data loss rate =** amount of data lost during conversion from legacy systems to the ERP system * 100 / all data converted **. Redundancy elimination rate =** amount of data redundancies eliminated during conversion from legacy systems to the ERP system * 100 / all data redundancies

3.5. Innovation and Learning Perspective

Sample objectives and measures proposed for the previous three perspectives are concerned with monitoring the success of an ERP implementation project by comparing the realized values of those measures at a time with the target values set forth at the beginning of the project. This perspective, on the other hand, deals with the improvement potential of the project in the later phases.

In order to emphasize the role of this perspective in the evaluation of organizational success, Kaplan and Norton (1992) state that *"a company's ability to innovate, improve and learn ties directly to the company's value"*. This statement can be adapted to a project by paraphrasing it as *"the ability of the project team to innovate, improve and learn directly enhances the success of the project."*

In this perspective, learning refers to the capability of the project team to adapt to unforeseen and chaotic events that may occur during the project (De Meyer, Loch and Pich, 2002). Such events may occur due to changing business or technological requirements triggered by either organizational or environmental forces. In an ERP implementation project, the improvement capacity of the ERP system implemented is also taken into account and the examination of this perspective starts with the

question *"Are the project team and the ERP system implemented capable of adapting to changing requirements?"* (See Table 3.1)

The innovation and learning perspective from the users' point of view has already been covered in the discussion of the Customer Perspective and Internal Business Perspective in Sections 3.3 and 3.4 respectively.

Stage 1: Defining sample objectives

The capability of the project team to adapt to changing business or technical requirements is a consequence of the project team members' technical competence, as well as their ambition and motivation for the project. Therefore, two sample objectives for this perspective can be *"Ensure high level of technical competence of the project team"* and *"Ensure high level of ambition and motivation of the project team"*.

The flexibility of the project team members in terms of substituting each other when necessary can also improve the project team's capability to adapt to changing business or technical requirements. Therefore, *"Ensure high level of flexibility of the project team"* can be another objective for this perspective.

The more experienced in the project the project team members, the more likely that they can predict chaotic events in earlier phases of the project and take corrective actions or apply contingency plans. Hence, the objective *"Ensure high level of accumulated experience in the project"* can also be valid for this perspective.

In addition to the technical competence of human resources of the project, the technological adequacy of the hardware resources is also a success factor for this perspective. As implied before, one of the risks in ERP implementation projects is the technological obsolescence of the hardware resources used due to rapid changes

in technology (See Section 2.3.3). Hence, another objective for this perspective can be *"Ensure technological adequacy of hardware"*.

Flexibility of the ERP system in terms of the ease of integrating new modules to the system in order to meet changing business requirements that emerge during the implementation phase is another success factor for this perspective. Therefore, a final objective for this perspective can be *"Ensure high level of flexibility of the ERP System"*. As mentioned in the discussion of the Customer Perspective in Section 3.3, the flexibility of the standardized modules of an ERP package is not controllable by the organization. However, the organization can measure and control the time and effort required for implementing the new modules. Therefore, this objective should be corrected as *"Ensure high level of flexibility in manipulating the ERP system"*.

Stage 2: Identifying sample measures for each objective

Sample measures for the objective *"Ensure high level of technical competence of the project team"* can be the *level of experience* and the *level of expertise* of project team members, as well as the *level and effectiveness of consultancy and training* provided to them, which are discussed in the examination of the Internal Business Perspective in Section 3.4.

The level of ambition and motivation of the project team members can be assessed by applying one of the motivation theories in the organization, such as the *Motivator-Hygiene Factors Theory* developed by Frederick Herzberg in 1966. Those levels can be increased by tying some of the incentives to them. Therefore, sample measures for the objective *"Ensure high level of ambition and motivation of the project team"* can be:

- *Motivation incentive weight* → percentage weight of ambition and motivation in the determination of incentives of the project team members

Sample measures for the objective *"Ensure high level of flexibility of the project team"* can be:

- *Substitution flexibility index* → percentage number of project team members possessing skills in more than one expertise area in the total number of project team members

Sample measures for the objective *"Ensure high level of accumulated experience in the project"* can be:

- *Level of accumulated experience in the project* → average amount of time worked for the project (for project team)

- *Project team turnover rate* → percentage number of project team members leaving the project versus the total number of project team members

The higher the project team turnover rate, the lower the accumulated level of experience in the project, which adversely affects the learning of project team to cope with the chaotic events during the implementation. In order to reduce the turnover rate, the organization should look for ways to improve the satisfaction of the project team members with the project.

Sample measures for the objective *"Ensure technological adequacy of hardware"* can be:

- *Hardware resource breakdown rate* → average number of breakdowns per hardware resource (per week, per month, etc.)

- *Hardware resource productivity* → percentage amount of time working properly in the total working hours (per resource)

- *Hardware upgrade period* → average number of months between successive upgrades (per resource)

Sample measures for the objective *"Ensure high level of flexibility in manipulating the ERP system"* can be:

- *Module implementation effort* → average time needed for implementing a new module and average number of employees needed for implementing a new module

- *Extent of modification* → percentage LOC modified in the existing code (to integrate the new module) in the total LOC

Stage 3: Establishing a table of objectives and measures

Sample objectives and measures that can be used to measure the performance of ERP implementation from the innovation and learning perspective of the balanced scorecard are listed in Table 3.6.

Table 3.6. Innovation and Learning Perspective of the ERP Implementation Balanced Scorecard: Objectives and Measures

Are the project team and the ERP system implemented capable of adapting to changing requirements?	
Objective	**Measure**
Ensure high level of courage and motivation of the project team	**. Motivation incentive weight =** percentage weight of courage and motivation in the determination of incentives of project team members
Ensure high level of flexibility of the project team	**. Substitution flexibility index =** number of project team members possessing skills in more than one expertise areas * 100 / total number of project team members

Table 3.6. (Cont'd) Innovation and Learning Perspective of the ERP Implementation Balanced Scorecard: Objectives and Measures

Objective	Measure
Ensure high level of accumulated experience in the project	**. Level of acc. experience in the project =** average amount of time worked for the project (for project team) **. Project team turnover rate** = number project team members leaving the project * 100 / total number of project team members
Ensure technological adequacy of hardware	**. Hardware resource breakdown rate =** average number of breakdowns per hardware resource (per week, per month etc.) **. Hardware resource productivity =** amount of time working properly * 100 / total working hours (per resource) **. Hardware upgrade period =** average number of months between successive upgrades (per resource)
Ensure high level of flexibility in manipulating the ERP system	**Module implementation effort:** . average time needed for implementing a new module . average number of employees needed for implementing a new module **. Extent of modification =** LOC modified in the existing code (to integrate the new module) * 100 / total LOC

CHAPTER IV

THE SOFTWARE APPLICATION
"ERP IMPLEMENTATION BALANCED SCORECARD"

4.1. Introduction

In Chapter 3, sample objectives and measures for monitoring the success of an ERP implementation project are identified and a table visualizing the relationships among those sample objectives and measures is established for each perspective of the balanced scorecard model presented in this study. This balanced scorecard model may serve as a guideline to evaluate the success of ERP implementation projects.

In order to demonstrate the applicability of, in other words, in order to operationalize the proposed scorecard model, a small scale software application, *"ERP Implementation Balanced Scorecard"* has been developed. The technical and content specifications of this software application are described in this chapter.

4.2. Technical Specifications

"ERP Implementation Balanced Scorecard" is a web based software application, that is, it has a web site as its user interface and users can access the application through this web site provided that they are connected to the Internet and are authorized for access. The web based nature of the application serves the following advantages for organizations:

- Once the application is loaded on a server machine in the organization's local area network, it can be accessed by all authorized users who are connected to that network. There is no need to install the application on each computer in the network, which significantly reduces the setup time and effort not only for the first installation of the application, but also for the future installations necessitated due to updates in the software.

- Since the application is installed only on a server, it is easier to maintain its security by system administrators who continuously monitor the security threats against servers than to do so for many applications installed on many client computers.

- The application can be easily integrated with other systems in the organization, by adding a hypertext link to the existing systems that will point to the starting page of the web site of the application.

- The application is easy to understand and easy to use by end users, most of whom are already familiar with browsing web sites on the Internet.

The operating system, the software development environment and the database server platforms used while developing the *"ERP Implementation Balanced Scorecard"* are described below:

- Operating System:
  Microsoft Windows XP Professional

This operating system serves as an infrastructure for the software development environment and the database server used for building the software application. In addition, the web service *"Internet Information Services (IIS)"* provided by the operating system serves as a publishing mechanism for the *"ERP Implementation Balanced Scorecard"*, i.e. IIS publishes the application on the Internet.

- Software Development Environment:
  Microsoft Visual Studio .NET 2003 Enterprise Developer

Visual Studio .NET is a rapid application development environment used for implementing software applications easily. It includes an interactive, user friendly interface as well as a comprehensive set of documentation, which lead to increased quality of and decreased time spent for coding.

Visual Studio .NET allows programmers to code using one of the programming languages supported by the Microsoft .NET Framework. Among those languages, C Sharp (C#) was used for coding the *"ERP Implementation Balanced Scorecard"*. C# is an object oriented programming language used conveniently for implementing web based software applications.

- Database Server:
  Microsoft SQL Server 8.0

SQL Server is a Relational Database Management System (RDBMS) which allows software applications to store their data and to make manipulations on that data. Through several connection interfaces, a software application can reach a database in SQL Server and insert, update, or delete data stored in that database provided that the application has the necessary access rights on that data.

4.3. Content Specifications

4.3.1. Database Related Specifications

For the software application *"ERP Implementation Balanced Scorecard"*, a local database "`erp_bsc_db`" was established on SQL Server, and several database tables were created in that database. Figure 4.1 illustrates the major database tables -

PERSPECTIVES, OBJECTIVES, MEASURES, USER_AUTHENTICATION and NEW_ID- used in the application, along with the relationships among them.

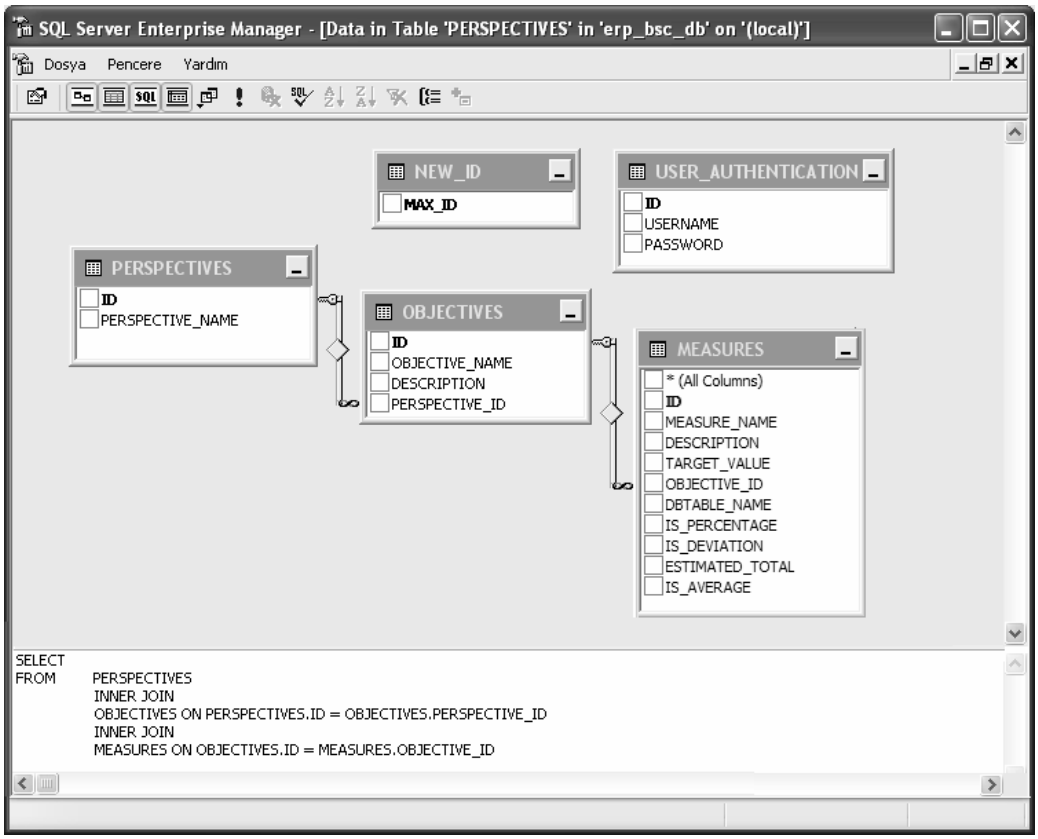


Figure 4.1. Major Database Tables in *"ERP Implementation Balanced Scorecard"*

"PERSPECTIVES" is the database table that stores the names of the four perspectives of the balanced scorecard, as shown in Figure 4.2.

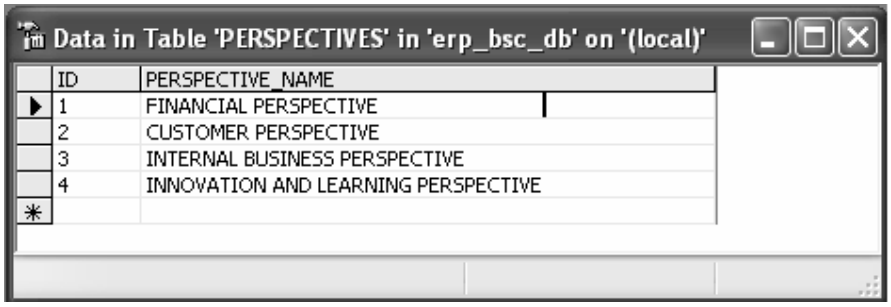
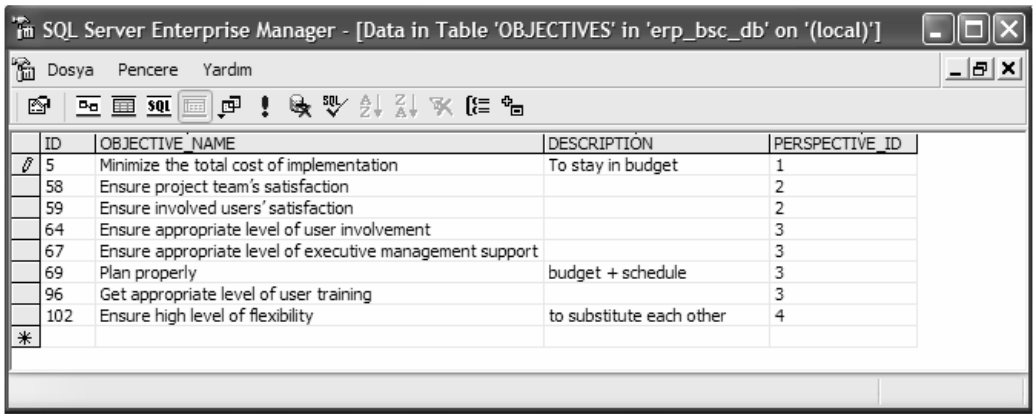


Figure 4.2. Data in "PERSPECTIVES" Table

"OBJECTIVES" is the database table that stores the names and descriptions of the objectives suggested for each perspective of the balanced scorecard. New objectives defined by users via the interface of the software are inserted into this table. Through the interface, users can also modify or delete an existing objective in this table. Sample data in this table is shown in Figure 4.3.



ID	OBJECTIVE_NAME	DESCRIPTION	PERSPECTIVE_ID
5	Minimize the total cost of implementation	To stay in budget	1
58	Ensure project team's satisfaction		2
59	Ensure involved users' satisfaction		2
64	Ensure appropriate level of user involvement		3
67	Ensure appropriate level of executive management support		3
69	Plan properly	budget + schedule	3
96	Get appropriate level of user training		3
102	Ensure high level of flexibility	to substitute each other	4

Figure 4.3. Sample Data in "OBJECTIVES" Table

As shown in Figures 4.1 and 4.3, OBJECTIVES is related with PERSPECTIVES through the unique identifier of PERSPECTIVES, hence every objective in this table knows to which perspective it belongs. For instance, the first objective record in Figure 4.3 is a sample objective for the Financial Perspective of the ERP implementation balanced scorecard, whereas the last one is a sample objective for the Innovation and Learning Perspective.

"MEASURES" is the database table that stores the names, descriptions, and target values for the measures identified for each perspective. In addition, this table stores data indicating whether the measure is an average, a percentage, a deviation, or a combination of those and the estimated total value of the measure which is needed in the calculation of the average, percentage, or deviation.

New measures defined by users from the interface of the software application are inserted into this table. Through the interface, users can also modify or delete an existing measure in this table. Sample data in this table are shown in Figure 4.4.

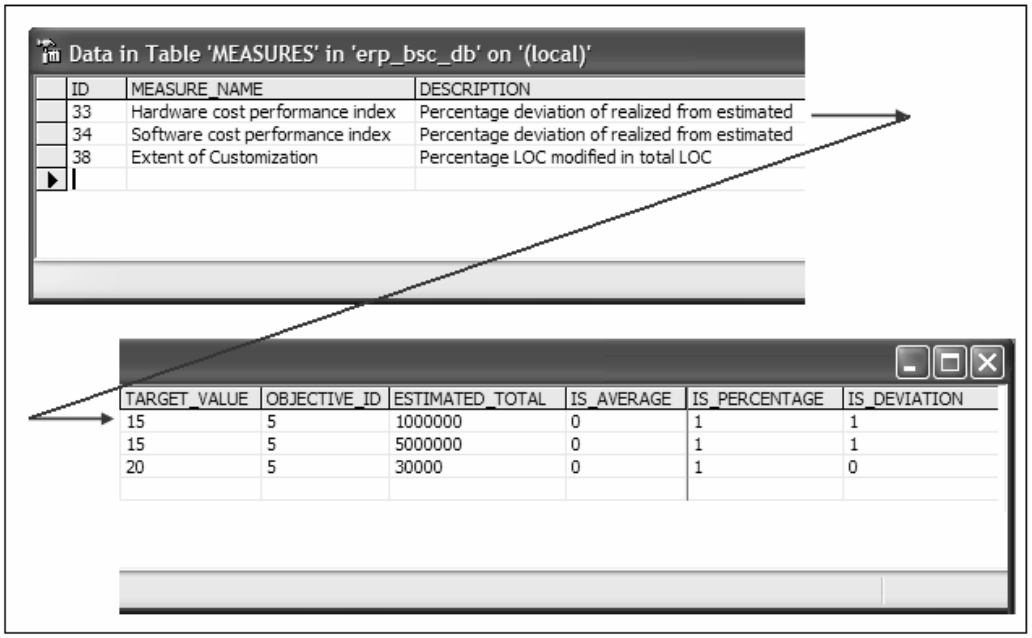


Figure 4.4. Sample Data in "MEASURES" Table

As shown in Figures 4.1 and 4.4, MEASURES is related with OBJECTIVES through the unique identifier of OBJECTIVES, hence every measure in this table knows to which objective it belongs. It can be inferred from Figures 4.3 and 4.4 that all measures seen in Figure 4.4 are sample measures for the first objective seen in Figure 4.3, because their OBJECTIVE_ID values are the same as the ID of *"Minimize the total cost of implementation"*.

Figure 4.4 also implies that the first two financial measures, *Hardware cost performance index* and *Software cost performance index*, are percentage deviations, whereas the other financial measure, *Extent of customization*, is just a percentage. The TARGET_VALUE column of this database table stores the desired target values of measures set forth by the organization at the beginning of the ERP implementation project. For instance, the data in the TARGET_VALUE column for *Extent of*

customization is 20. This means that, throughout the project, the organization wishes to limit the customized lines of code to 20 percent of the total lines of code in the ERP package. The data value of the ESTIMATED_TOTAL column for this measure implies that the total lines of code in the ERP system implemented are estimated to be 30000 at the beginning of the project. ESTIMATED_TOTAL is used for computing the realized value of measures and evaluating whether the project has the desired performance with respect the level of match with the TARGET_VALUE.

"NEW_ID" is the database table that holds the maximum unique identifier number in the database. Whenever a new record is inserted in the database, this number is incremented by one and the new number is assigned to that record as its unique identifier.

"USER_AUTHENTICATION" is the database table that stores the user names and passwords of users who are authenticated to login to and use the software application. It is an organizational level decision to determine the users who will be authorized to use the application and who will not. In the future, user names and passwords of new users can be inserted into this table by the system administrator.

4.3.2. User Interface Specifications

As mentioned earlier, the *"ERP Implementation Balanced Scorecard"* is a web based software application and its user interface is in the form of an interactive web site. Interactivity of the web site stems from the capability of users to enter data into and get data from the application.

Users can access the application from the same computer that the application is loaded by typing the following URL address on the address bar of the web browser:

```
http://localhost/erp_bsc/erp_bsc_start.aspx
```

The term "localhost" is used when the same computer serves both as a server and a client for accessing a web application. If a user desires to access the application from another computer connected to the computer on which the application is loaded via a local area network or the Internet, then the IP address or name of the computer on which the application is loaded should be typed instead of "localhost" in the address bar of the web browser:

```
http://<IP or name of the computer>/erp_bsc/erp_bsc_start.aspx
```

The web browser perceives this URL address as an http request from the user and responds to that request by displaying the main page of the application, which is shown in Figure 4.5.

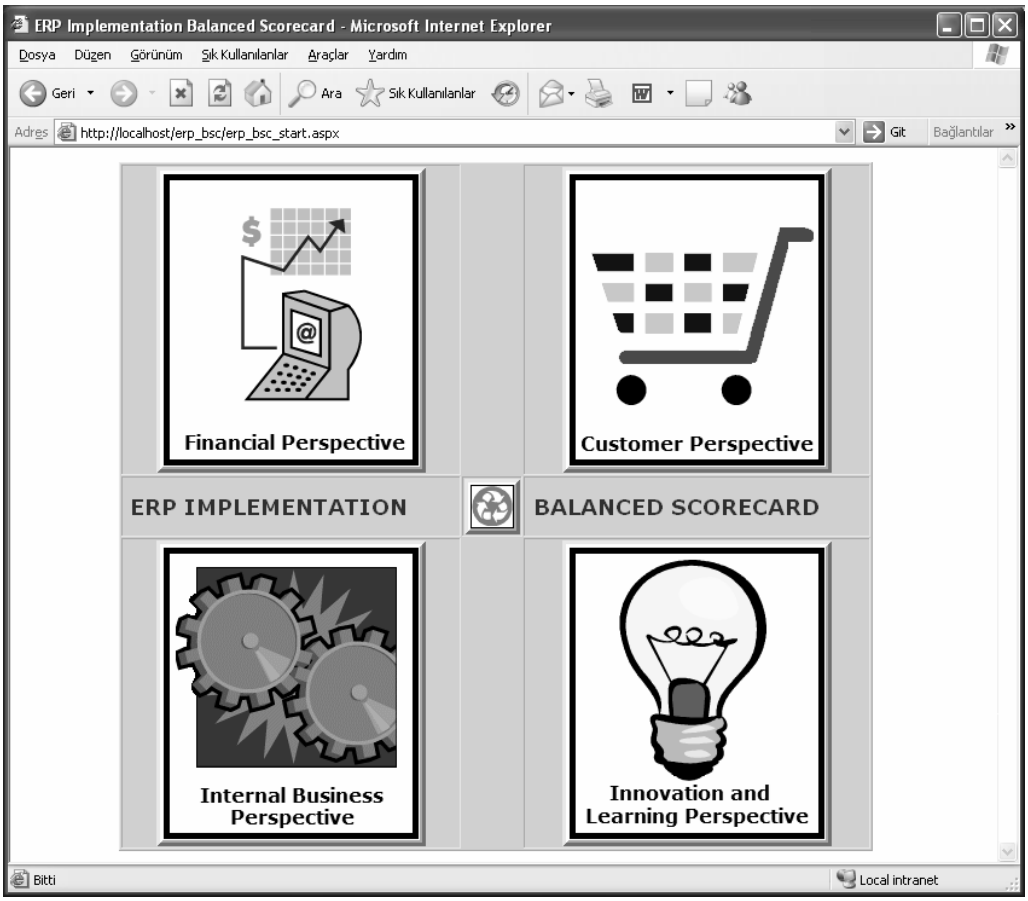


Figure 4.5. ***"ERP Implementation Balanced Scorecard"*** **- Main Page**

There are four images on this main page, each of which corresponds to a perspective of the balanced scorecard. These images were selected from the Clipart Gallery of Microsoft Office and adapted to this application by adding the names of the perspectives on them. The application allows users to switch to the web page devoted to a perspective of the balanced scorecard by clicking on the image corresponding to that perspective.

A user should be authorized to access the application in order to view the web pages of the perspectives. The software application *"ERP Implementation Balanced Scorecard"* grants perspective-based access rights for the users. Therefore, if any one of the images is clicked, an interface for user login appears on the screen, and the user attempting to see the web page of the perspective in concern is asked for a username and password, in order to understand whether that user is allowed to enter or not (See Figure 4.6). Access controlling is important since the interface allows for the insertion, modification and deletion of objectives and measures for each perspective.

Figure 4.6. *"ERP Implementation Balanced Scorecard"* - Login Page

If the user is not allowed to view the web page of the desired perspective, the message shown in Figure 4.7 appears on the screen.

Figure 4.7. *"ERP Implementation Balanced Scorecard"* - Authorization Failure Page

On the other hand, if the user has the necessary rights for accessing the requested perspective, then the web page devoted to that perspective is opened, through which users can define new objectives or measures for the financial perspective, as well as view, modify, or delete existing objectives or measures.

The following procedure illustrates the functionalities of the *"ERP Implementation Balanced Scorecard"* software from the Financial Perspective. The steps and operational logic are the same for the other perspectives -Customer Perspective, Internal Business Perspective, and Innovation and Learning Perspective-. The web page of the Financial Perspective of the balanced scorecard is shown in Figure 4.8.

The table titled "`Financial Objectives`" positioned on top of the page lists the objectives for the financial perspective. On the right of this table, a group of buttons with the names "`Add`", "`Modify`" and "`Delete`" appear.

The "`Add`" button allows a user to define a new objective for the financial perspective. When this button is clicked on, several components on the web page are displayed to allow the user to enter the data of the new objective into the system (See Figure 4.9).

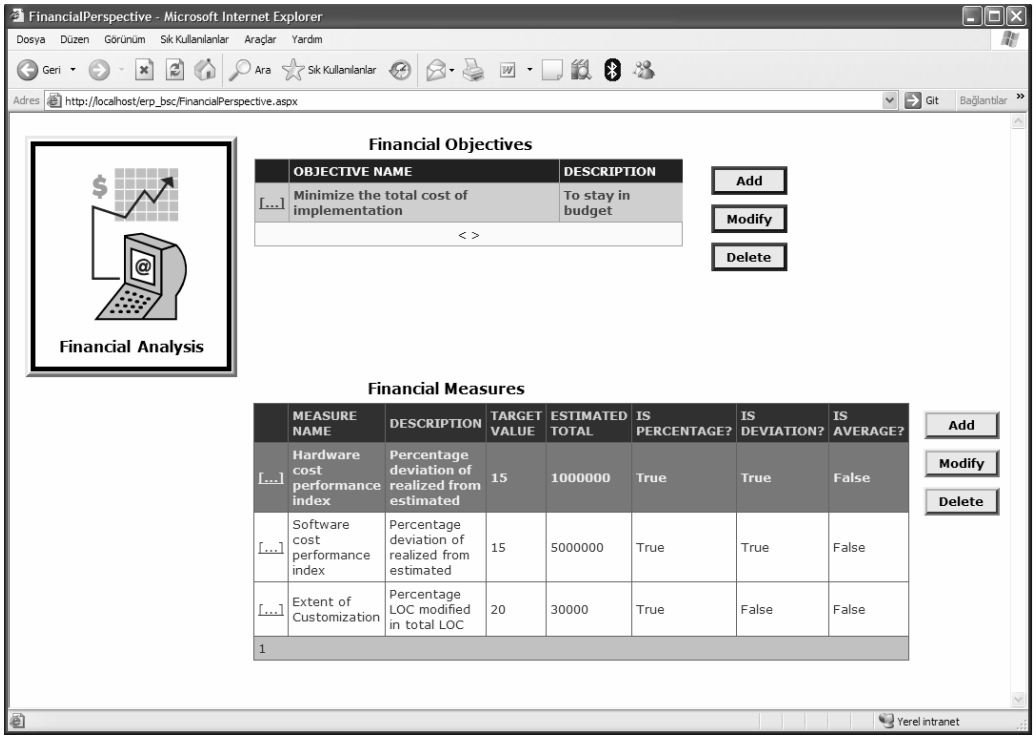


Figure 4.8. ***"ERP Implementation Balanced Scorecard"*** **- Financial Perspective**

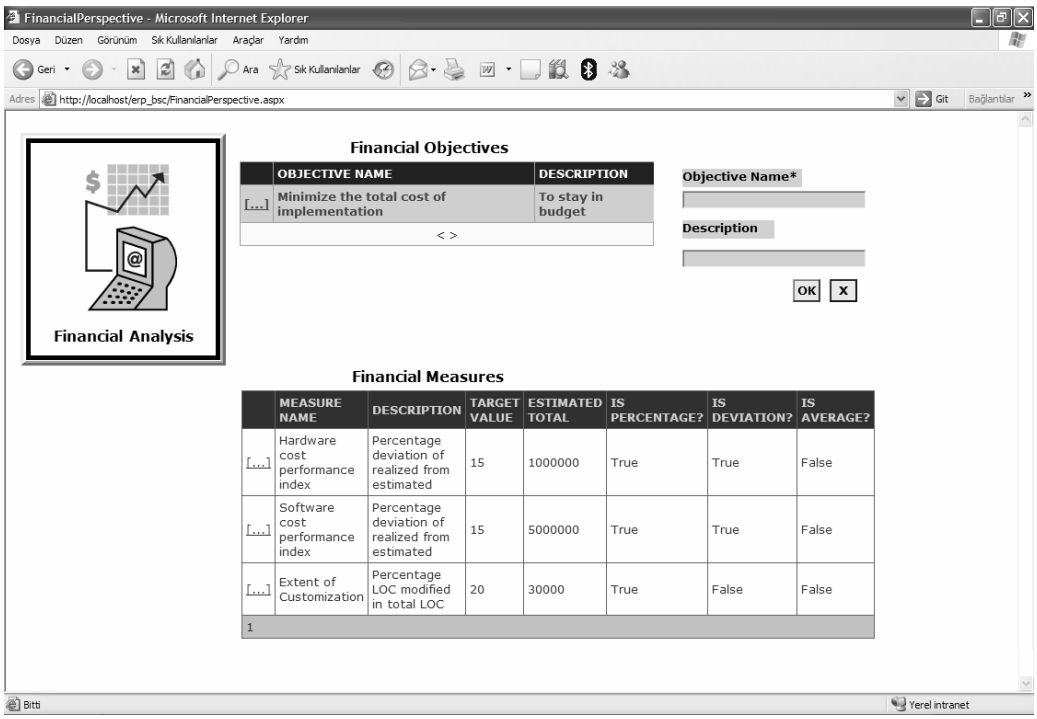


Figure 4.9. ***"ERP Implementation Balanced Scorecard"*** **- Add Objective**

The user enters the name and description of the new objective via the interface and for the newly defined objective, a new data record is inserted to the database table "OBJECTIVES" with the objective name and description provided by the user (See Section 4.3.1).

The "Modify" button allows a user to modify an existing objective. This button becomes visible only if one of the objectives in the table is selected, otherwise it is invisible. When this button is clicked, several components on the web page are displayed to allow the user to modify the data of the selected objective in the system (See Figure 4.10).

The user modifies the name and / or the description of the selected objective via the interface and the data record corresponding to the modified objective is updated in the database table "OBJECTIVES" (See Section 4.3.1).

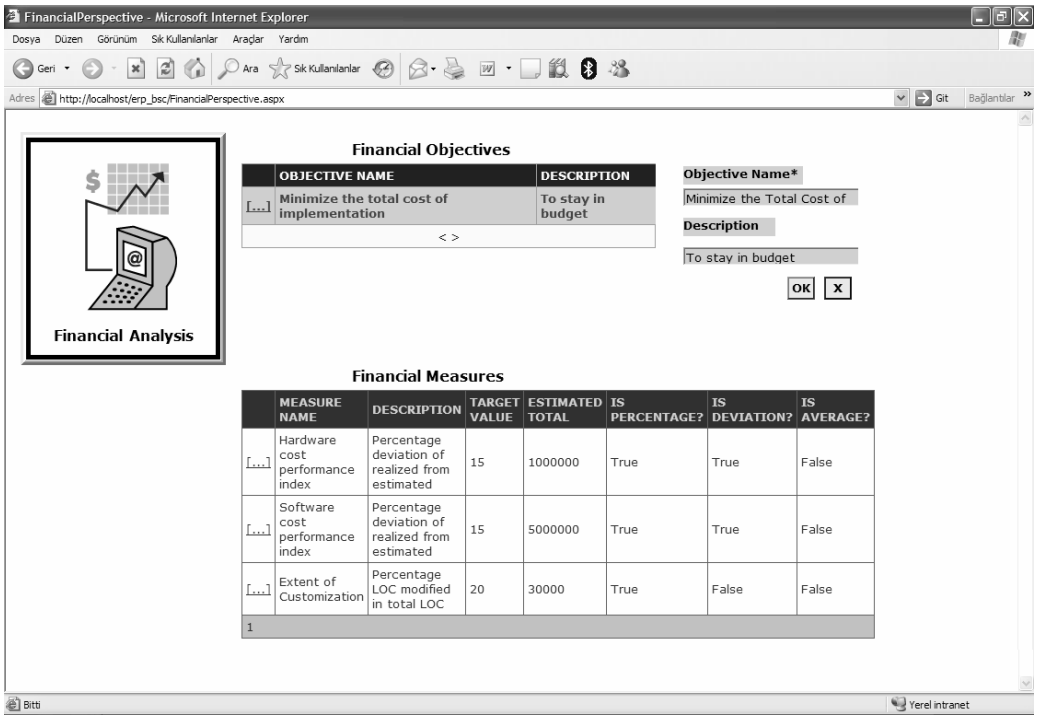


Figure 4.10. ***"ERP Implementation Balanced Scorecard"*** **- Modify Objective**

The "Delete" button allows a user to delete an existing objective. Similar to the "Modify" button, this button also becomes visible only if one of the objectives in the table is selected, otherwise it is invisible. The data record corresponding to the objective deleted by the user is removed from the database table "OBJECTIVES" (See Section 4.3.1).

After the "Add", "Modify", or "Delete" operations, the table titled "Financial Objectives" is automatically refreshed to display the added or modified objective and not to display the deleted objective. There is no need to reload the page.

The table titled "Financial Measures" positioned below the "Financial Objectives" table is loaded dynamically to list the measures of the selected financial objective in the "Financial Objectives" table. Otherwise, it is invisible. To the right of this table, a group of buttons with the names "Add", "Modify" and "Delete" appear.

The "Add" button allows a user to define a new measure for the selected financial objective. When this button is clicked, several components on the web page are displayed to allow the user to enter the data of the new measure into the system (See Figure 4.11).

The user enters the name, description, target value, estimated total value and the data on whether the new measure is an average, a percentage, or a deviation. For the newly defined measure, a new data record is inserted to the database table "MEASURES" with the measure name, description, target value, estimated total value and measurement unit provided by the user (See Section 4.3.1).

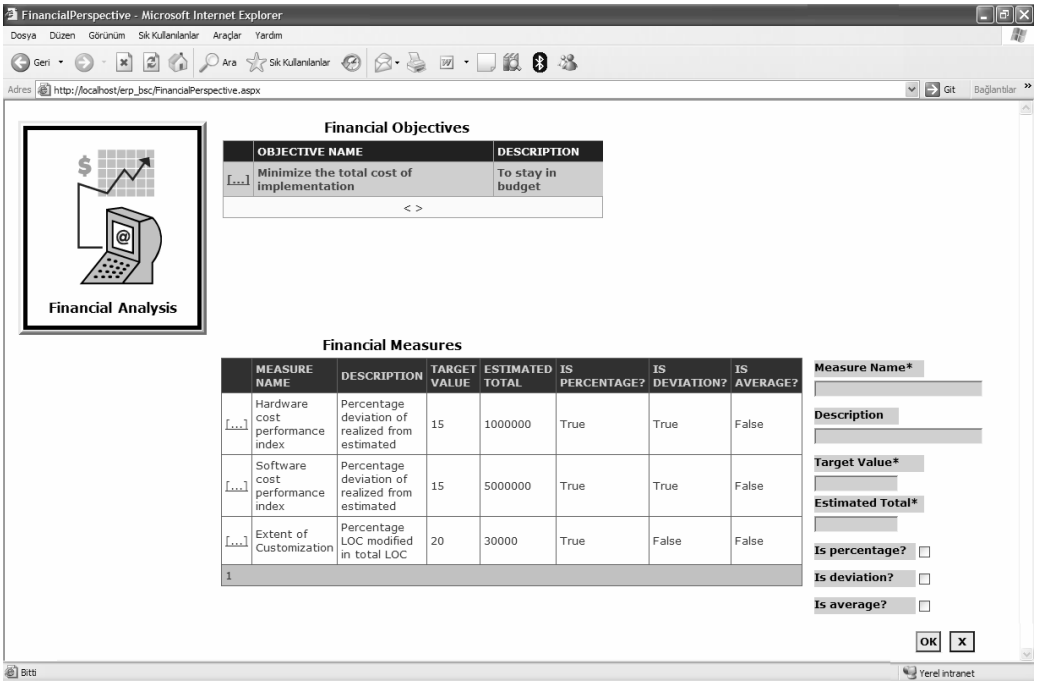


Figure 4.11. *"ERP Implementation Balanced Scorecard"* - Add Measure

The "Modify" button allows a user to modify an existing measure. This button becomes visible only if one of the measures in the table is selected, otherwise it is invisible. When this button is clicked on, several components on the web page are displayed to allow the user to modify the data of the selected measure in the system. The user modifies the desired fields of the selected measure via the interface and the data record corresponding to the modified measure is updated in the database table "MEASURES" (See Section 4.3.1).

The "Delete" button allows a user to delete an existing measure. Similar to the "Modify" button, this button also becomes visible only if one of the measures in the table is selected, otherwise it is invisible. The data record corresponding to the measure deleted by the user is removed from the database table "MEASURES" (See Section 4.3.1).

After the "Add", "Modify", or "Delete" operations, the table titled "Financial Measures" is automatically refreshed to display updated objective. There is no need to reload the page.

In order to evaluate the performance of the ERP implementation project from the financial perspective, users click on the image with the name "Financial Analysis". When this image is clicked, the user is directed to the web page which displays the analysis results for the performance of the ERP implementation project from the financial perspective.

The web page of the Financial Analysis of the balanced scorecard is shown in Figure 4.12. This page displays the financial status of the project in terms of the level of achievement of each financial objective. The levels of achievement are shown in terms of the measures.

As seen in Figure 4.12, the *Hardware cost performance index* is -100% at the beginning of the project, when no hardware expenses are made. When new hardware resources are purchased, the expenses can be entered into the system by clicking on the "Add" button. When this button is clicked on, several components on the web page are displayed to allow the user to enter the data of the new hardware expense into the system (See Figure 4.13). These components and the table titled "Hardware cost performance index" listing the hardware expenses were created for demonstrating the operation of the performance analysis function of the software. In real life, *"ERP Implementation Balanced Scorecard"* should be integrated with the information systems in an organization in such a way that a hardware expense made during the ERP implementation entered into an existing IS will be an input to the application automatically. The same explanation holds true for every measure.

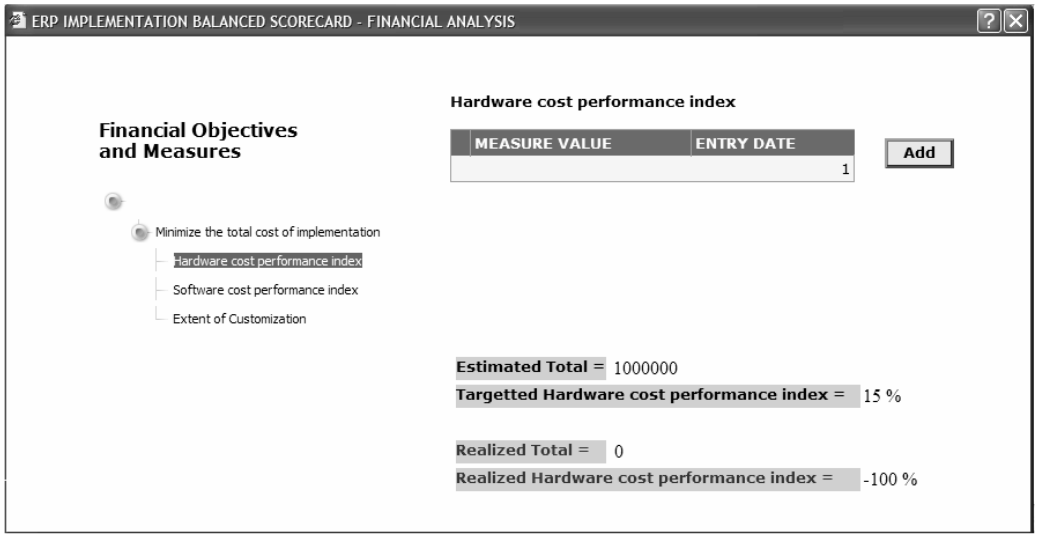


Figure 4.12. ***"ERP Implementation Balanced Scorecard"*** **- Financial Analysis - 1**

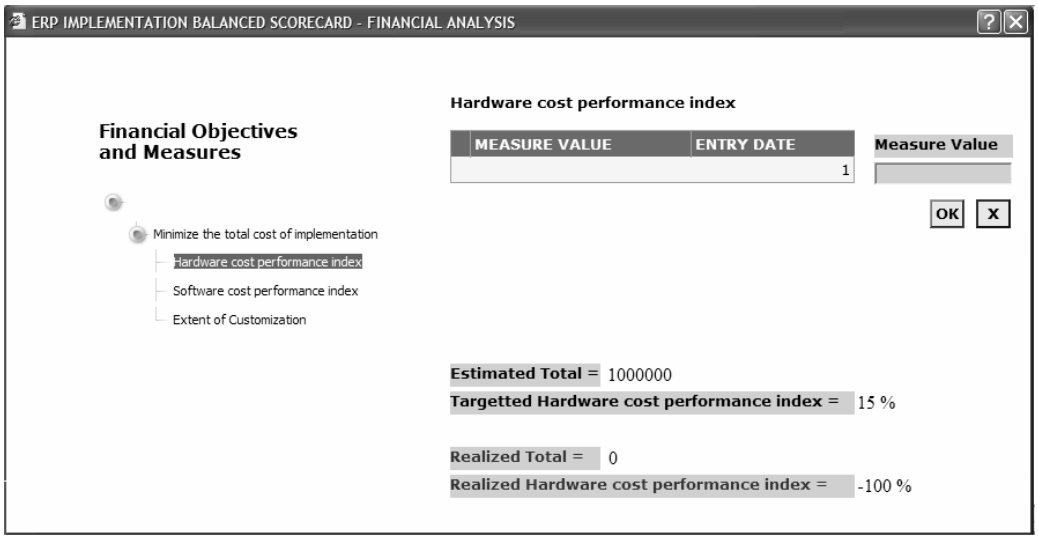


Figure 4.13. ***"ERP Implementation Balanced Scorecard"*** **- Financial Analysis - 2**

After the insertion of the new hardware expense, the *Hardware cost performance index* is updated automatically (See Figure 4.14). As seen in Figure 4.14, when a new hardware resource is purchased, the *Hardware cost performance index* becomes nearer to the target value set forth for that measure, 15%. The important thing is to

maintain the hardware expenses at such a level that the realized *Hardware cost performance index* is in close proximity to the desired one.

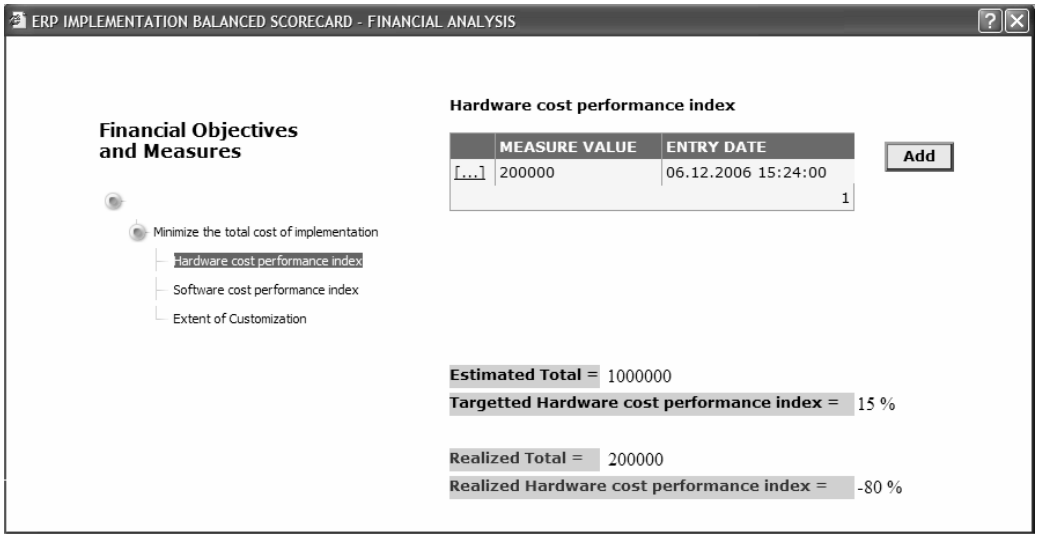


Figure 4.14. ***"ERP Implementation Balanced Scorecard"*** **- Financial Analysis - 3**

The analysis described above can be performed for each measure suggested for each objective in the ERP implementation balanced scorecard. The application also allows an organization to conduct an overall performance analysis of the ERP implementation by clicking on the little image positioned at the center of the images corresponding to the four perspectives in the main page of the application shown in Figure 4.5. When a user clicks on this image and logs in to the application, a web page showing all objectives and measures defined for the four perspectives of the ERP implementation balanced scorecard appears (See Figure 4.15).

The software application allows the users to analyze the performance of the ERP implementation project at any point during implementation and take corrective actions when needed. As a result, the analysis provided by the software application for every single measure of the ERP implementation balanced scorecard strongly facilitates the monitoring and control of performance of an ERP implementation project and indicates the corrective actions required for the future.

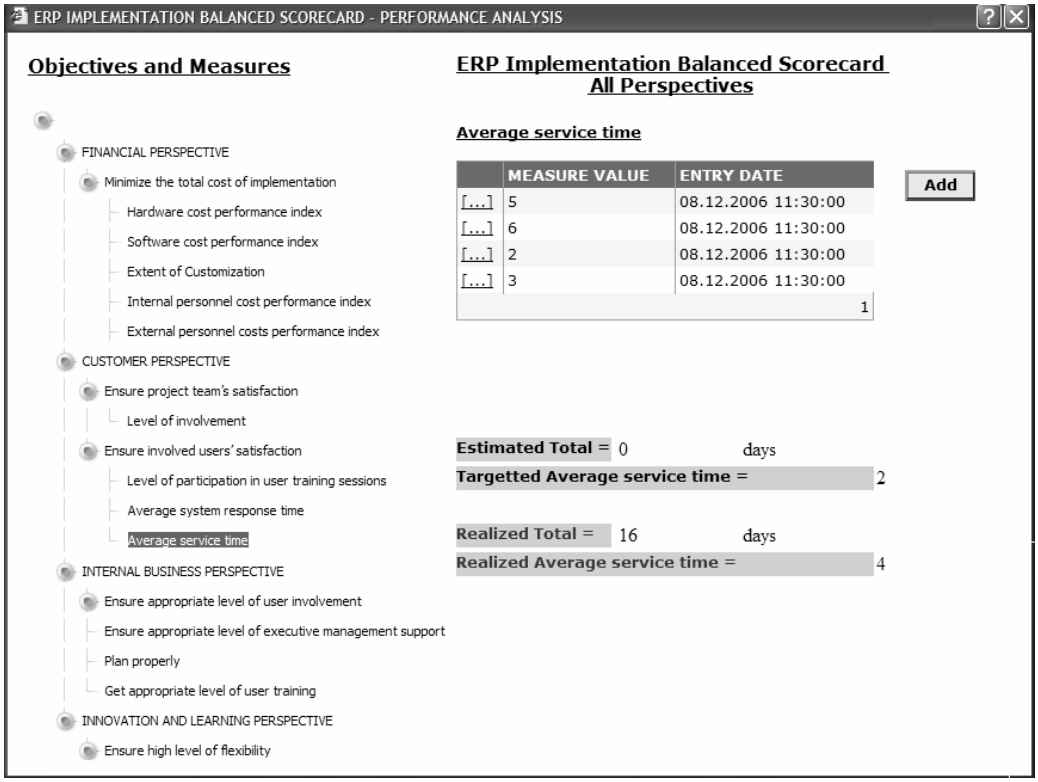


Figure 4.15. ***"ERP Implementation Balanced Scorecard"*** **- All Perspectives**

The user interfaces for Customer Perspective, Internal Business Perspective, and Innovation and Learning Perspective are shown in Appendix B.

CHAPTER V

CONCLUSION

5.1. Discussion

The research problem addressed in this study stems from the observation that although organizations make a considerable amount of investment in the implementation of Enterprise Resource Planning systems, most of the time they cannot realize the benefits of those systems due to implementation challenges or even failures. Various comprehensive surveys concerning the success and failure rates of information systems projects, including ERP, demonstrate this fact.

This study suggests a performance measurement model developed based on the assumption that in order to improve the performance of ERP implementations, organizations should set clear, measurable objectives at the beginning of the implementation phase and continuously monitor the progress of implementation with respect to the level of achievement of those objectives.

The performance measurement model proposed in this study originates from the widely accepted organizational performance measurement system, the Balanced Scorecard Framework. The model demonstrates the applicability of the Balanced Scorecard Framework for measuring the performance of ERP implementation projects. In order to demonstrate this applicability, the items in the Balanced Scorecard Framework, which was originally designed to measure organizational or business unit performance, have been translated to the project level.

To construct the proposed balanced scorecard model, sample objectives and measures are identified for each of the four perspectives -Financial Perspective, Customer Perspective, Internal Business Perspective and Innovation and Learning Perspective- of the framework. The sample measures and objectives are deduced from the relevant literature concerning the factors that enhance or challenge IS projects, including ERP.

The balanced scorecard model brings together the separate views concerning the performance of ERP implementation in a compact summary, which ensures that the ERP implementation is evaluated fairly in terms of a balanced set of performance indicators. The model can be used as a guide to monitor the progress of ERP implementations in terms of the level of achievement of the objectives set by the organization at the beginning of the implementation phase. By providing the capability to monitor the progress of the ERP implementation, the model allows the organization to take corrective actions and improve performance in the later phases of the implementation.

The model is scalable to any number of objectives and measures that can be identified for different organizations and industries. This scalability provides a strong flexibility for the model and enhances its scope of applicability.

The balanced scorecard model developed for measuring the performance of ERP implementation is supported by building a small scale web based software application, *"ERP Implementation Balanced Scorecard"*. This software application provides an interface for defining or modifying objectives and measures for each perspective of the balanced scorecard. In addition, it allows the user to monitor the performance of ERP implementation by comparing the target values set forth for each measure at the beginning of implementation with the realized values at any point during implementation.

The software *"ERP Implementation Balanced Scorecard"* offers the flexibility to alter the set of sample objectives and measures identified in this study by providing

the capability to add, modify or delete objectives and measures easily via the user interface. In other words, organizations are not constrained to use the objectives and measures suggested in this study; instead, they are allowed to manipulate them according to their priorities for tracking ERP implementation performance for each perspective. This is a considerable advantage since there is no universally accepted set of objectives and measures.

Another advantage offered by the *"ERP Implementation Balanced Scorecard"* software is the control on user access to critical data. The software does not allow users to enter the system unless they have predefined access rights to do so. This access controlling mechanism allows organizations to minimize potential data corruption or loss and prevent data manipulation by unauthorized parties.

The web based nature of the *"ERP Implementation Balanced Scorecard"* enhances its understandability and usability by users, most of whom are already familiar with browsing web sites on the Internet. In addition, the capability of the software to automatically refresh its interface after all user transactions is another enabler of user friendliness. Finally, the application can be accessed remotely by the users at anytime from anywhere via the Internet.

5.2. Recommendations for Future Research

As previously mentioned, the balanced scorecard model proposed in this study consists of sample measures deduced from relevant literature. These objectives and measures can considerably vary among organizations and industries. This study does not impose any constraint on the set of objectives and measures for measuring the performance of ERP implementation using the balanced scorecard. The set of objectives and measures can be expanded and even tailored to specific cases. The validity and applicability of the objectives and measures can also be tested through case studies.

The proposed balanced scorecard model can be improved by identifying the cause and effect relationships among the measures, as suggested by Kaplan and Norton (1996 [2]), which will promote the understanding of how the measures are interrelated to each other and whether a potential improvement or deterioration in one of the measures can affect others positively or negatively.

The applicability of the Balanced Scorecard Framework for measuring the performance in the operational usage phase of ERP systems can also be investigated by following a similar methodology offered in this study.

In addition, the applicability of the proposed model for measuring the performance in the implementation phase of information systems other than Enterprise Resource Planning systems can be examined. Most of the sample objectives and measures suggested in this study are valid for not only ERP systems, but also other IS, including Supply Chain Management systems, Customer Relationship Management systems and so on.

5.3. Further Enhancements to the Software Application

The software application "*ERP Implementation Balanced Scorecard"* can be subject to further improvement. The performance analysis functionality offered by the software can be enhanced by adding graphical components to the interface. Such graphical components as bar charts, alerts or signals, pointer needles indicating the performance levels can strongly increase the users' awareness of the progress of the ERP implementation.

The operation and performance of the software application could be validated and tested in a real life situation, by integrating it with existing systems in an organization.

The user access controlling mechanism can also be enhanced by adding a mechanism to track users' transactions in the system. This mechanism can help organizations identify who is accountable for an improper manipulation on the objectives or measures. Another enhancement for the access control can be fine tuning the mechanism to create objective based or measure based rather than perspective based access rights, which will tighten the control on user access.

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APPENDIX A

Major functional modules of *mySAP*, the Web based ERP application software offered by *SAP AG*, are *Financials, Operations, Human Capital Management,* and *Corporate Services,* sub modules of which are illustrated in Tables A.1 to A.4.

Table A.1. Sub modules of *mySAP Financials*

Sub module	Provided Functionality
Financial Accounting	• Consolidations • General-ledger management • Accounts receivable and payable • Fixed-asset, Bank, Cash journal accounting • Inventory, Tax, Accrual accounting • Financial closing and reporting • Parallel valuation
Management Accounting	• Profit center, Profitability accounting • Cost center and internal order accounting • Project, Product cost accounting • Investment management • Revenue and cost planning • Transfer pricing
Corporate Governance	• Management of internal controls • Management of the audit information system • Support of whistle blower complaints • Management of capital and risk • Support of general-ledger tasks, fast-close initiatives and compliance • Improvement of corporate governance
Financial Supply Chain Management (FSCM)	• Electronic invoicing and payments • Dispute, Collections, Credit management • Cash and liquidity management • Treasury and risk management • Bank relationship management • Contract accounting

Source: www.sap.com

Table A.2. Sub modules of *mySAP Operations*

Sub module	Provided Functionality
Procurement and Logistics Execution	• Procurement • Supplier collaboration • Inventory and warehouse management • Inbound and outbound logistics • Transportation management
Product Development and Manufacturing	• Production planning • Manufacturing execution • Product development • Life-cycle data management
Sales and Service	• Sales order management • Aftermarket sales and service • Professional-service delivery • Incentive and commission management

Source: www.sap.com

Table A.3. Sub modules of *mySAP Human Capital Management*

Sub module	Provided Functionality
Talent Management	• Recruitment • Career management • Succession management • Enterprise learning management • Employee performance management • Compensation management
Workforce Process Management	• Employee administration • Organizational management • Global employee management • Benefits management • Time and attendance • Payroll and legal reporting • HCM processes and forms
Workforce Deployment	• Project resource planning • Resource and program management • Call center staffing • Retail scheduling

Source: www.sap.com

Table A.4. Sub modules of *mySAP Corporate Services*

Sub module	Provided Functionality
Enterprise Asset Management	• Reduce operating costs • Minimize equipment downtime • Deploy strategic assets • Increase support for facts-based decision making • Improve environmental, safety and regulatory compliance
Project and Portfolio Management	• Strategic portfolio management • Project planning • Resource and time management • Project execution • Project accounting
Environment, Health and Safety	• Identify and minimize employee health risks • Support preventive health care • Ensure product safety • Hazardous substance management • Track dangerous goods • Manage waste disposal
Quality Management	• Audit management • Quality engineering • Quality assurance and control • Continuous improvement • Project accounting
Global Trade Services	• Ensure full regulatory compliance • Expedite customs clearance • Automate customs warehousing procedures • Accelerate and optimize product classification • Mitigate the financial risk of global transactions • Take full advantage of international trade agreements
Real Estate Management	• Acquisition or disposal of real estate • Real estate portfolio management • Property and technical management • Management accounting and reporting
Travel Management	• Web application for travelers, travel arrangers, and managers • Power-user graphical interface for expense administrators • Reporting dashboard for travel managers • Policy configurator for system managers

Source: www.sap.com

APPENDIX B

The user interfaces of the Customer Perspective are shown in Figures B.1 and B.2.

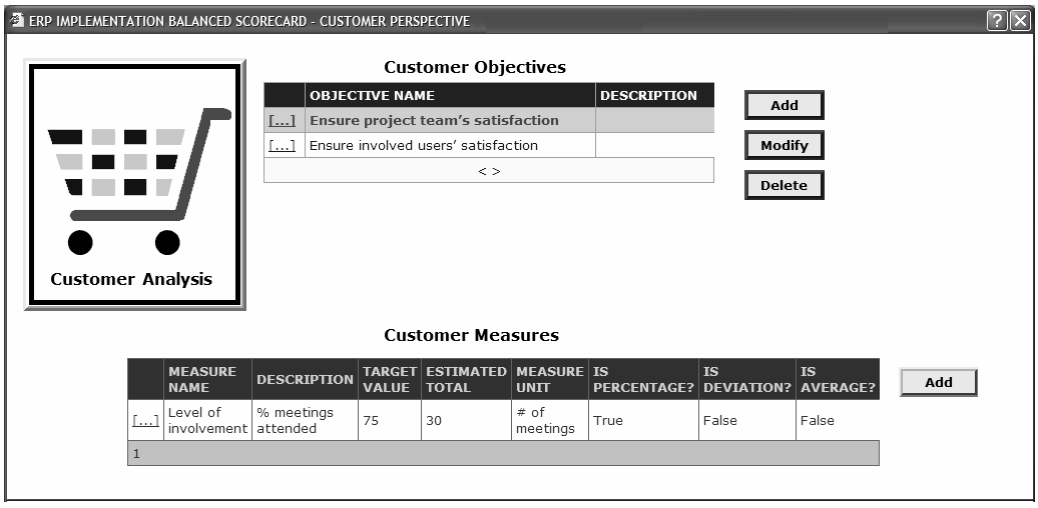

Figure B.1. ***"ERP Implementation Balanced Scorecard"*** **- Customer Perspective**

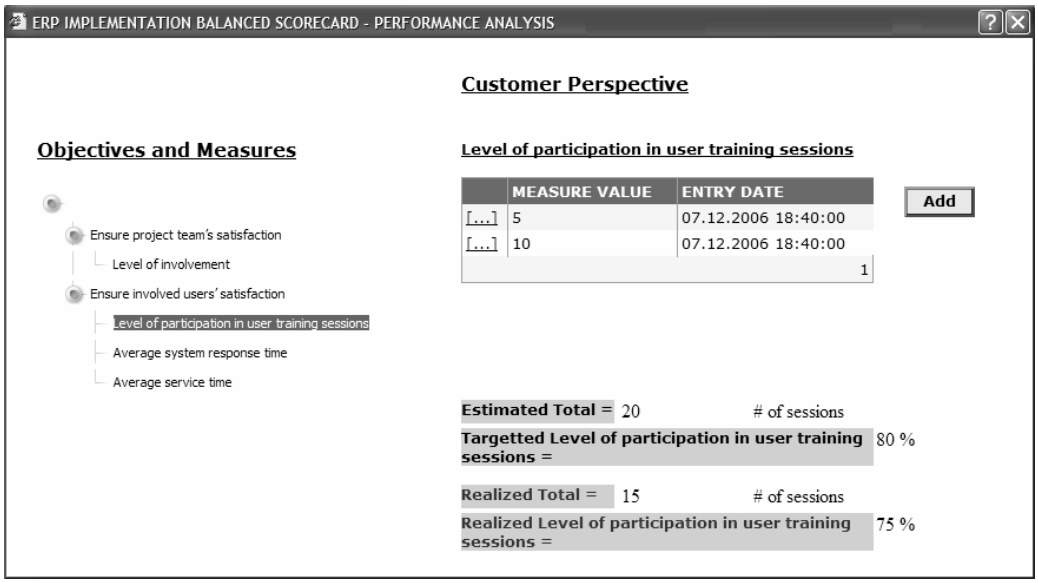

Figure B.2. ***"ERP Implementation Balanced Scorecard"*** **- Customer Analysis**

The user interfaces of the Internal Business Perspective are shown in Figures B.3 and B.4.

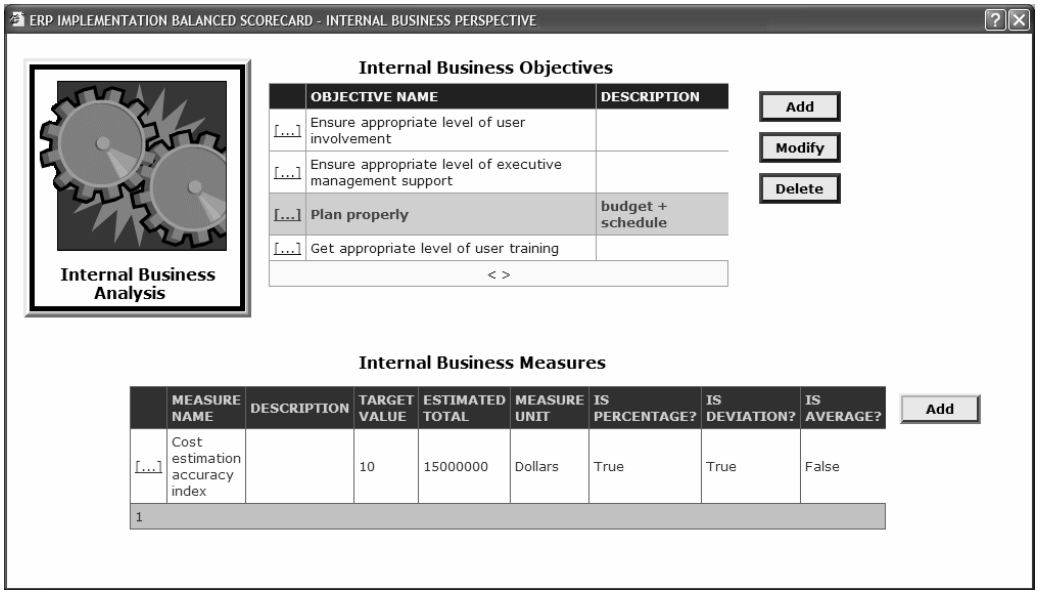

Figure B.3. ***"ERP Implementation Balanced Scorecard"*** **– Internal Business Perspective**

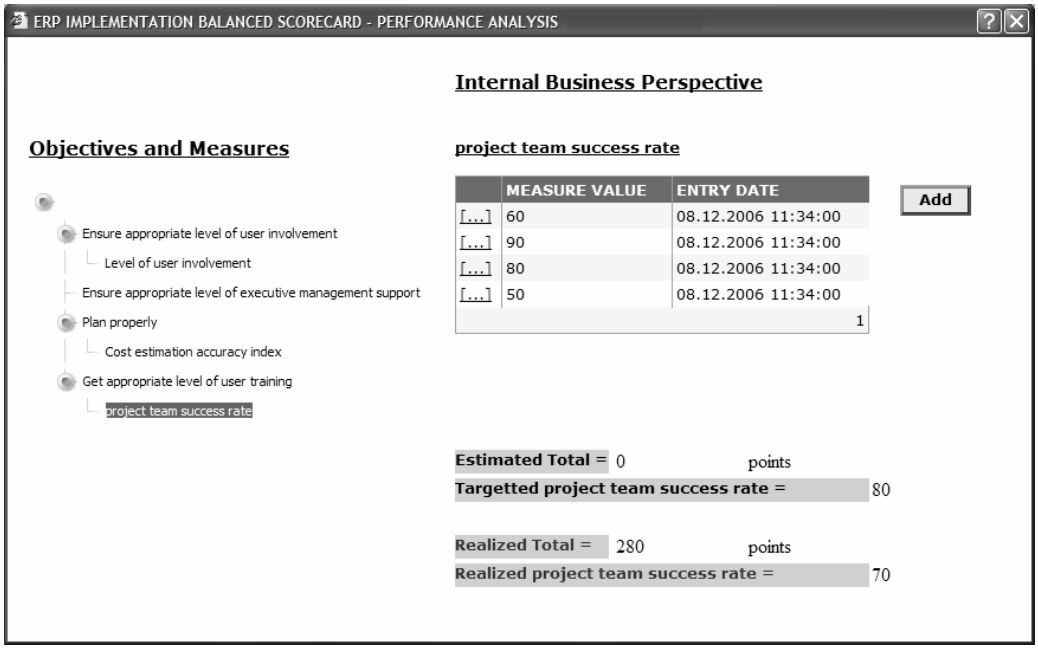

Figure B.4. ***"ERP Implementation Balanced Scorecard"*** **– Internal Business Analysis**

The user interfaces of the Internal Business Perspective are shown in Figures B.5 and B.6.

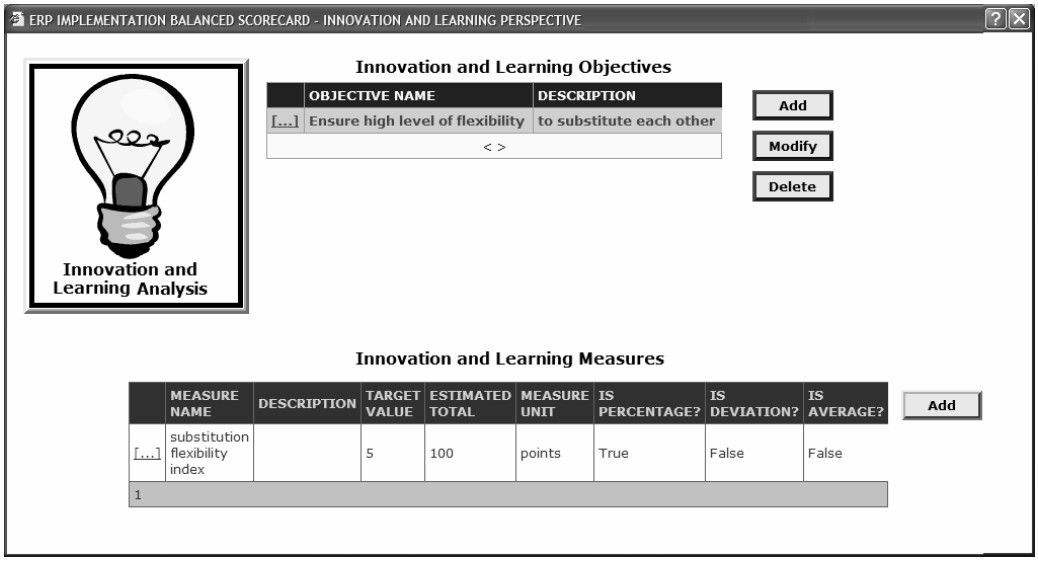

Figure B.5. ***"ERP Implementation Balanced Scorecard"*** **– Innovation and Learning Perspective**

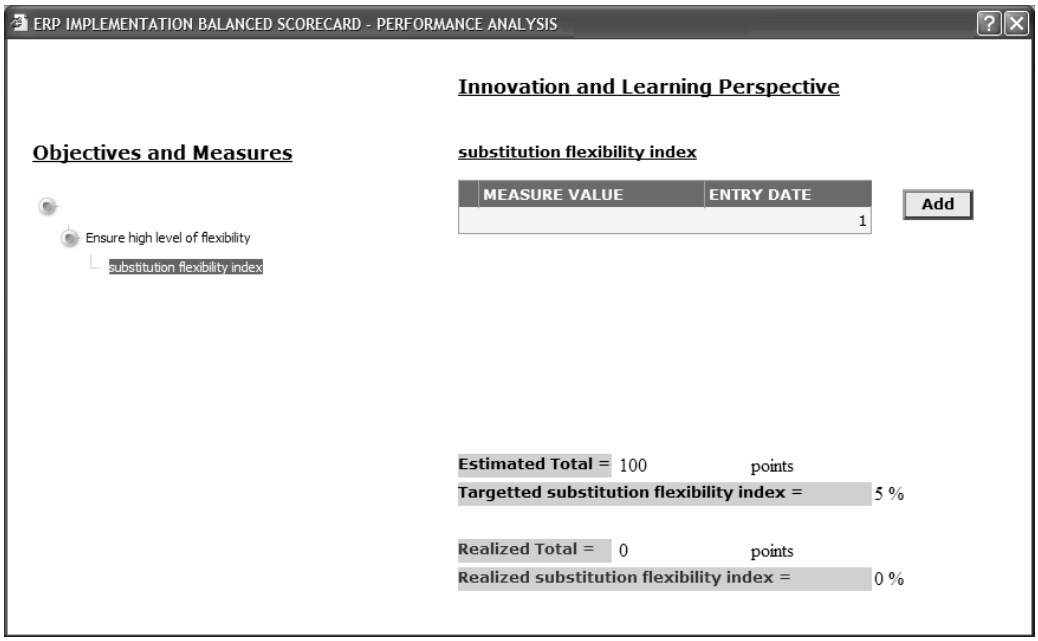

Figure B.6. ***"ERP Implementation Balanced Scorecard"*** **– Innovation and Learning Analysis**

APPENDIX C

An executable copy of the software application *"ERP Implementation Balanced Scorecard"*, together with the execution instructions, exists in the compact disk placed in the envelope attached inside the back cover of the thesis bound.