ASSESSING REAL ESTATE PROJECT SUCCESS USING THE ANALYTIC NETWORK PROCESS

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ABSTRACT

ASSESSING REAL ESTATE PROJECT SUCCESS USING THE ANALYTIC NETWORK PROCESS

There are various indicators to measure the success of real estate projects. Despite the number of studies focusing on construction project success, there has not yet been a consensus on how to assess the success of real estate projects. Within this study, criteria associated with the real estate project success are identified based on an extensive literature survey and these criteria are classified adopting the Balanced Scorecard (BSC) framework. Then, an analytic network process (ANP) model is developed to examine the links between the attributes of success and compute the importance weights of these variables on the real estate project success. Findings of this study suggest the importance of the attractiveness of project location, level of contribution to business value, and accuracy of cost estimation for successful real estate development. The applicability of the proposed model is tested on ten projects and the results are found to be satisfactory. Real estate companies may benefit from the findings of the proposed model to assess their projects and take necessary actions to have successful projects.

ÖZET

ANALİTİK AĞ SÜRECİ KULLANARAK GAYRİMENKUL PROJELERİNİN BAŞARISININ DEĞERLENDİRİLMESİ

Gayrimenkul projelerinin başarılarının ölçülmesi adına çeşitli göstergeler vardır. İnşaat projelerine odaklı birçok çalışma olmasına rağmen, gayrimenkul projelerinin başarısının nasıl değerlendirileceği üzerine henüz bir fikir birliğine varılamamıştır. Bu çalışmayla birlikte, gayrimenkul projelerinin başarısı ile ilişkilendirilen kriterler kapsamlı bir literatür taraması sonucu belirlenmiş ve bu kriterler Balanced Scorecard (kurum karnesi) çerçevesinde sınıflandırılmıştır. Daha sonra, başarıyı belirleyen faktörlerin aralarındaki bağlantıyı incelemek adına analitik ağ süreci (ANP) modeli geliştirilmiş ve bu faktörlerin gayrimenkul projeleri başarısı üzerindeki önem ağırlıkları hesap edilmiştir. Bu çalışmanın sonuçları, proje lokasyonunun çekiciliğinin, projenin şirket değerine katkısının ve maliyet tahmini doğruluğunun gayrimenkul projeleri başarısı üzerindeki önemlerini ortaya koymuştur. Sunulan model on gayrimenkul projesi üzerinde test edilmiş ve sonuçlar modelin uygulanabilirliğini göstermiştir. Gayrimenkul şirketleri, projelerinin değerlendirilmesi konusunda, sunulan modelin sonuçlarından yararlanabilir ve başarılı projelere imza atmak için gerekli önlemleri alabilir.

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LIST OF ACRONYMS / ABBREVIATIONS

AHP	Analytical Hierarchy Process
ANP	Analytical Network Process
BSC	Balanced Scorecard
CPM	Critical Path Method
DEA	Data Envelopment Analysis
EFQM	European Foundation for Quality Management Excellence Model
FAHP	Fuzzy Analytic Hierarchy Process
KPI	Key Performance Indicators
MAUT	Multi-Attribute Utility Theory
PSC	Project Scorecard
QFD	Quality Function Deployment

1. INTRODUCTION

Introduction chapter of the thesis includes research background, research problem, purpoe of the study, research approach and organzation of the thesis.

1.1. Background of the Research

Success is an award that every company in every industry wants to achieve. A high number of papers have been written about project success. Despite widely discussed, there has not yet been a consensus about the exact definition of project success.

There are many aspects of project success. As Jing-min *et al*. (2010) state, measurement of the project should consider short run, intermediate, and long run. The meaning of value is often extended over long time periods. Project success could be defined as project value realized. And project value could be measured by different stakeholder value during project life-cycle.

Projects in the thesis are real estate projects that are resources allocated for development, acquisition of long-term tangible property and for acquisition of intangible assets in order to receive profit or social result. Traditionally, project success has been measured based on main project objectives including scope, time, cost, and quality. And many researchers agree that project success has more broad sense than project management success and product success. It is declaimed that the days when we could define success in terms of cost, schedule and technical objectives are gone. People should address a much wider range of needs, concerns and issues which are presented to us by a diverse mix of project stakeholders. In some cases, the projects might be over budget and schedule, however they might bring customers value in the long run.

There should be sets of indicators for project success evaluation. This necessity has led to the development of several organizational performance measurement models, one of which is the BSC Framework developed by Robert S. Kaplan and David P. Norton in 1992. The BSC has been extensively used to measure corporate success in different

sectors. In order to adopt the BSC methodology for real estate project success measurement, the framework should be converted into a project scorecard. Such a model has not been proposed in the literature.

1.2. The Research Problem

This thesis focuses on the success of real estate projects and the factors contributing to the success of such projects in the Turkish construction market. Thereby, it aims at providing some recommendations to increase effectiveness of decision making in real estate development.

It is reasonable to assume that assessing real estate project performance will be complex and involve multiple distinct yet interrelated constructs that cover different dimensions and perspectives of the problem. A real estate project has its own features and this thesis helps fill the knowledge gap in the studies of success criteria of real estate projects with an extensive literature review.

There is a big gap about a model that evaluates success of real estate development projects. Some studies that are used to evaluate project success are available but they only list elements contributing to success and they do not have any quantitative results about the importance levels of those elements. BSC is also used in studies about measurement of success of real estate projects, but those studies only comment on what to do in order to have a successful project based on their own success definitions. However, they lack a mathematical model. As a result, it is hard to find real estate scorecards that include factors that could be used to measure the success of projects with their importance weights based on comprehensive frameworks.

In this research, a project scorecard based on BSC concept is proposed to measure the performance of real estate development projects. Kaplan and Norton’s original framework was designed for measuring performance at the organizational level or the business unit level. The framework has also been widely accepted for measuring performance at the functional level.

1.3. Purpose of the Study

The main objective of this study is to construct a model based on the analytic network process (ANP) and BSC for evaluating project success in the real estate development industry.

The BSC concept is applied to define the hierarchy with four major perspectives (i.e. financial, customer, value adding, and operational), and success indicators are selected for each perspective.

This research aims at meeting the following objectives:

- to ensure that the research will help with filling the gap in literature about project success for real estate developers,
- to determine interrelations among investigated factors,
- to provide a project scorecard for real estate projects,
- to calculate the importance weights of scorecard parameters and,
- to test the validity of the findings with various completed real estate projects based on the experiences of experts in this field.

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, BSC concept is explored. As a theoretical model, it can contribute to the evaluation and determination of project performance. BSC creates a framework for strategic performance management transforming mission and strategies of the firms or projects into understandable performance measurements and provide a wider point of view about the performance of the company or the project to the top management (Kaplan and Norton, 1996). It presents an approach to measuring success of projects from four perspectives: financial, customer, learning and growth, and internal. The BSC model was selected because of its seminal nature and applicability in aiding performance evaluation.

The first step in the model construction was to identify the critical success factors contributing to real estate project success. After determining the success factors, these were grouped under four categories based on a modified version of BSC. Then, the interrelations between these factors are specified and an ANP model is constructed accordingly. The ANP model comprises a network of parameters that influence the real estate project success and interdependencies among them. A questionnaire is designed and the four perspectives of the BSC and the selected performance indicators are included. The questionnaire is distributed to senior managers from the real estate development industry, Data is collected for pairwise comparison of these factors. The ANP model is then used to compute the improtance weights of each factor on success.

Verification and applicability of the proposed model will be performed on data from ten real projects and findings derived from the analysis will be discussed. Diverse experiences of large group of experts are used to improve the accuracy of the model. Although the findings of the analysis are limited to the experiences of the professionals from the real estate development industry, companies may benefit from the findings of the model to assess their current situations and take necessary action to have successful results with their projects.

1.5. Organization of the Thesis

This section summarizes the content of the thesis.

In Chapter 2, a review of the related literature about performance measurement, the BSC concept that is utilised for the research, and its applications are provided.

Chapter 3 includes the factors governing the success of projects in the real estate development industry. These factors will be listed based on a broad literature review, as the fundamental target of this thesis. .

Chapter 4 comprises the ANP model that is used to calculate the importance weights of project success factors. In addition, applications of analytic hierarchy process (AHP), ANP, and integrated practices with BSC are given in this chapter. Research

methodology is explained in detail including the proposed model, steps of ANP, findings and testing procedures.

The conclusions based on research findings and recommendations for future work are presented in Chapter 5.

2. MEASUREMENT OF PROJECT SUCCESS

As stated by Love and Holt (2000) one can not manage what can not be measured. The complex global business environment and increasing business competitiveness have highlighted the importance of performance measurement. The performance measurement methods have been widely adopted in many industries and they have received more and more attention.

The construction industry has long been criticized for its underperformance. Many researchers place strong emphasis on the importance of adopting the performance measurement methods to improve the current sate of the construction industry. According to a critical review of performance measurement in construction, the relevant papers published in this field have greatly increased in recent years. This increase has attributed to the rapid development of application of performance measurement methods in other sectors; the increasing complexity of construction projects; and the development of both management and technology in construction. Accordingly, performance measurement in construction has gained more and more attention (Yang *et al*., 2010).

Performance measurement is a continuous dialogue to better understand what to measure in order to assess critical service delivery issues. It is an everyday part of today's business landscape. Top organizations are doing more than just measuring performance; they deploy sophisticated analytics as a strategic resource and a winning advantage (Jordan *et al*., 2009).

Good performance measurement systems create a direct line of sight between corporate real estate goals and stakeholder interests founded on open, strategic dialogue and commitment to consistent process governance (Jordan *et al*., 2009).

Based on a comprehensive literature review on performance measurement, this part presents a critical review of the development of performance measurement, with a special focus on the construction and real estate sector. The strengths and weaknesses of various measurement frameworks and techniques are investigated in this chapter.

Yang *et al*. (2010) stated that performance measurement studies in construction can be divided into three levels: project level at which it was first conducted, organizational, and stakeholder levels. In addition, the major frameworks of performance measurement in construction were found to be: European Foundation for Quality Management excellence model (EFQM), BSC model, and key performance indicators (KPI) model.

However, there are some unique studies about performance measurement. Rothberg and Morrison (2012), for example, defined measurement factors for manufacturing firms. They used four perspectives for grouping the factors. Performance is determined based on scores of each factors.

Kagioglou (2001) determined KPIs for construction performance management. Love and Holt (2000) looked into performance measurement from stakeholder perspective in construction.

Navarre and Schaan (1990) assert that, at the project level, success was measured by the project duration, monetary cost and project performance that is called the iron triangle for a good performance. With a wider perspective, Yang *et al*. (2010) claims that different aspects of the project level are the environmental performance, human resource performance, technology innovation, procurement performance, safety performance, design performance, post-occupancy evaluation, maintenance, thermal and air conditioning, participant's satisfaction, cost performance, quality performance, and time performance.

Performance measurement at the organizational level is also important. Owing to the control of many input resources within the construction industry, it becomes more acute to carry out performance measurement at company level. It is addressed that the evolution of performance measurement of construction companies from financial aspects to the mixture of both financial and non-financial aspects (Yang *et al*., 2010). Stadlhofer (2010) adds that matrix which takes into account the organisational perspective (different stakeholders and their needs) and capacity, cost, condition and location as different measurement categories to get a complete picture of real property performance is used for performance measurement.

The relationship among different contracting parties in the construction industry is complicated as it involves many project stakeholders, such as owners, contractors, and consultants. The owner, supervisor, and contractor's performances are significantly related to the criteria of project success. Therefore, measuring the performance of various project stakeholders is all the more important (Yang *et al*., 2010).

A performance measurement framework is a complete set of performance measures and indicators derived in a consistent manner. With the development of performance measurement, the frameworks have become more and more comprehensive and practicable. The primary performance measurement frameworks applied in the construction industry are presented in the following sections.

2.1. European Foundation for Quality Management Excellence Model (EFQM)

The EFQM Excellence Model is the most popular quality tool in Europe, used by more than 30000 organisations to improve performance. It was developed in 1989 by 14 multi-nationals grouped in the EFQM to improve the quality of management in western Europe. It is used to measure and improve the overall quality of an organization according to Yang *et al*. (2010).

One of the essential characteristics of the EFQM excellence model is that the model distinguishes results that an organization has achieved and management of the organization. Although the EFQM model was developed generically, it has been adopted by many construction companies in recent years. Bassioni (2005) developed the construction EFQM excellence model, and defined the enabling criteria as; leadership, customers and stakeholder focus, strategic management, information and analysis, people, partnerships, suppliers, physical resources, intellectual capital, and risk work culture, and process management. The results criteria included: internal stakeholder, project, external stakeholder, and organizational business results.

2.2. Key Performance Indicators Model

The KPI model, which is developed generically, has been widely applied in the construction industry. The KPIs for construction (KPI Working Group 2000) consist of objective and subjective indicators including client service and product satisfaction, defects, cost and time predictability, profitability, productivity, safety, construction cost, and construction time. Yang *et al*. (2010) states that the purpose of the KPI framework is to enable measurement of both project and organizational performance throughout the construction industry. The indicators are divided into two levels, project level and company level.

In Katic's (2009) study, the top ten KPIs in construction projects are given as quality, cost of construction, owners involving in construction, changes in supporting to project, increase of construction time, customer satisfaction, employee satisfaction in company, innovation and learning, time of construction and identification client interest.

The calculation methods of the proposed KPIs are usually divided into two groups. The first group uses mathematical formulae to calculate the respective values, which is called the objective measures. The other group uses subjective opinions and personal judgment of the project stakeholders (Yang *et al*., 2010).

The performance measurement of the project stakeholders is often based on the KPI model. Dainty *et al*. (2003) generated a KPI model composed of nine indicators, to measure the performance of construction project managers. In a study of predicting the performance of project managers in the construction phase of mass house building projects, KPI model is set up to measure the performance of project managers and divided the indicators to be task and contextual performance indicators. The task performance indicators include cognitive ability, job knowledge, task proficiency, and experience while the contextual performance indicators comprise job dedication and interpersonal facilitation (Yang *et al*., 2010).

While BSC and EFQM models are usually used to develop strategic frameworks, the KPI model is applied in the operational level.

2.3. Balanced Scorecard Model

Engineering projects are becoming upsizing and complex, market is changing rapidly. These factors make the traditional performance evaluation system, which were based on costs, processes and quality, could no longer meet the needs of project performance evaluation (Hui, 2010).

Leading organizations do not stop at the gathering and analysis of performance data; rather, these organizations use performance measurement to stimulate improvement efforts and successfully translate strategy into action (Stewart and Mohamed, 2001). Once a focused real estate strategy is developed, a scorecard should reflect it, strengthening priorities for the real estate team, clarifying the corporate real estate mission to stakeholders.

BSC is put forward by Professor Robert S. Kaplan and David P. Norton in their Theory of Performance Evaluation in 1990's, which is recommended by Harvard Business Review as one of the most valuable theory innovation in management among the last 75 years at that time. BSC takes vision and strategy as the core business, starting from finance, customers, inner-business process, study and development, which are interrelated with each other, to establish the performance evaluation system (Kaplan and Norton, 1996).

As Erbaşı and Parlakkaya (2012) state, what makes BSC method different from other performance measurement and evaluation methods is its expressing the strategies and important elements of the real estate development companies that makes projects successful in a variety of score card size and thus it achieves the elimination of the strategies or factors that do not serve any purpose in the upper size. According to the conditions of the elements of success and the strategies, BSC must be determined taking into account the conditions of the industry.

The BSC is internationally recognised and therefore more popular than the excellence model. Also, introducing new systems or ideas such as the excellence model tend to be fraught with difficulties in larger organisations as a result of complex cultural,

human and organisational issues. Last but not least, BSC is more simple (Robinson *et al*., 2005).

The empirical research studies proved that the KPI model can be used at project, organizational and stakeholder level (Yang *et al*., 2010). The EFQM excellence model and the BSC model are the most frequently applied to the organizational level, except that the project excellence model, which is developed from the EFQM excellence model, is applied to the project level (Yang *et al*., 2010). However, there are barriers in the adoption of performance measurement models that are identified as determining and monitoring indicators, lack of data, time, and financial resources (Robinson *et al*., 2005).

The BSC framework, which includes a range of "leading and lagging" indicators, is considered to be clearer and more comprehensive than the EFQM excellence models. It is also the most frequently used model for the performance measurement of the construction companies. Kagioglou *et al*. (2001) studied the strong points and disadvantages of the BSC, and formed a performance management system that construction organizations could adopt. Luu *et al.* (2008) integrated the BSC and strengths-weaknesses-opportunities-threats matrix to evaluate the strategic performance of large construction contractors in Vietnam (Yang *et al*., 2010).

While there are other frameworks for performance measurement implemented within the construction industry, the EFQM excellence model, the BSC model, and the KPIs model are the most frequently used models for performance measurement in construction. It is important to choose a proper performance measurement model under a specific circumstance (Yang *et al*., 2010).
For example Love and Holt (2000) enhanced a model called stakeholder perspective measurement (SPM) for performance improvement. They aligned their factors based on their measurement method.

Awareness of the use of other measurement systems such as the BSC (Kaplan and Norton, 1996) and the excellence model (EFQM, 1999) has increased in construction engineering organisations (Robinson *et al*., 2005).

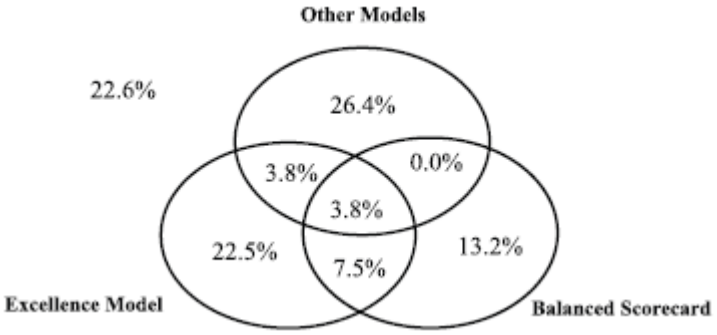


Figure 2.1. Use of performance measurement models (Robinson *et al*., 2005).

Robinson's *et al*. (2005) survey shows that a significant proportion of organisations are now using a range of financial and non-financial measures to assess business performance, and a growing number are adopting the excellence model and/or the BSC to facilitate a structured approach to implementing continuous improvement strategies. They also stated that there is growing evidence that non-financial measures are becoming important to organisations, their clients, investors, and stakeholders.

The BSC does just what the name implies: it balances the performance perspectives of three intangible assets with the management of physical assets (Weston, 2007).

A performance measurement system needs to balance financial and non-financial elements, by considering both external and internal factors which impact the company. BSC provides a medium to translate the vision into a clear set of objectives. These objectives are then further translated into a system of performance measurements that effectively communicate a powerful, forward-looking, strategic focus to the entire organization. The core idea of BSC is "balance", under which its evaluation system does not focus on optimization of partial benefits, but stresses the coordinating and unifying of the whole value chain (Hui, 2010). According to Stewart and Mohamed (2001), the term 'balanced' in the name reflects the balance provided between short- and long-term objectives, between quantitative and qualitative performance measures, between financial and non-financial indicators, between main and secondary indicators, and between different performance perspectives.

Companies that construct a BSC may use specific criteria regarding the company's goals, products and services provided, employees' needs and financial situation. BSC may be considered as another management tool to ensure optimum performance for success. BSCs are constructed to measure certain core business functions that provide feedback to determine an alignment to the ultimate goals and mission of the company. This information may be used to determine a focus for attention and resources (Moore, 2004).

As Schmid-Kleemann (2004) remarks: "The BSC is like the dials in an airplane cockpit: it gives managers complex information at a glance and can help managers link today's actions with tomorrow's goals." (Kaplan and Norton, 1996). It fills a clear need for connecting high-level strategic objectives with measurable day-to-day work activities and it is a crucial means of optimizing productivity and improving performance across all levels (Rothberg and Morrison, 2012).

According to Kaplan and Norton (1996), once the strategy, aims are defined and the drivers are identified, the scorecard influences managers to concentrate on improving or reengineering those factors most critical to the organization's strategic success. That is how the scorecard most clearly links and aligns action with strategy. 'With the BSC', a CEO of an engineering company told, 'I can continually test my strategy. It's like performing real-time research.' (Kaplan and Norton, 1996). Moreover, BSC enables professionals to translate business unit strategies into a measurement system that meshes with companies' entire system of management. It improves the understanding and consistency of strategy implementation (Shaw *et al*., 1995).

BSC allows an organization to translate its vision and strategies by providing a framework that clarifies the organization's strategy through the objectives and measures chosen. Companies' goals are what the company wants to achieve and missions are what the company stands for. The BSC concept reviews the company's goals and mission. The core competencies, that are perspectives of BSC, or main strengths of the companies may be used for the BSC as the major indicators of success and areas for improvement (Moore, 2004). The real benefit comes from making the scorecard concept the cornerstone of the way you run the business. It should be the core of the management system (Shaw *et al*., 1995).

According to Kaplan and Norton (1992), the BSC, on the other hand, is well suited to the kind of organization many companies are trying to become. The scorecard puts strategy and vision of real estate development companies, not control, at the center. It establishes goals but assumes that employees and managers will adopt whatever behaviors and take whatever actions are necessary to arrive at those goals.

2.3.1. Balanced Scorecard Perspectives

Financial performance measures are inadequate in addressing the real value creating mechanisms in today's organization. Most companies' operational ad management control systems are built around financial measures and targets, which bear little relation to the company's progress in achieving long-term strategic objectives (Kaplan and Norton, 1996). The BSC suggested by Kaplan and Norton (1996) supplemented traditional financial measures with criteria that measured performance from three additional perspectives – those of customers, internal business processes, and learning and growth. The scorecard was not a replacement for financial measures, it is their complement. No single measure can provide a clear performance target or focus attention on the critical areas of the business. Managers want a balanced presentation of both financial and operational measures (Kaplan and Norton, 1992).

The BSC framework is used to define the four major frameworks and allows most organizations to look at their performance from four perspectives. As Erbaşı and Parlakkaya (2012) stated they formed these perspectives as finance, customer, internal business functions and learning and development each of which with a wide range of potential sub-measures. Kagioglou *et al*. (2001) has identified the financial measures as lagging indicators and other three ones as leading indicators.

Kaplan and Norton (1992) introduced the BSC as "a management system that enables organizations to clarify their vision and strategy and translates them into action". BSC provides answers to four basic questions. Firstly, the question of 'How do customers see us?' is formed for customer perspective; secondly 'What must we excel at?' question is used for internal one. Companies should decide what processes and competencies they

must excel at and specify important factors for each. ‘Can we continue to improve and create value?’ question is for learning and development perspective and last, ‘How do we look to shareholders?’ is asked for financial perspective.

The overall strategy of the BSC involves balancing these four perspectives. This means that while a firm wants to maximize its performance from all perspectives, it cannot maximize one perspective at the detriment of another; for example, if the firm improved the customer perspective by investing more money in customer service, but this harmed the firm from a financial perspective (Clark, 2010). By combining the financial, customer, internal process, and organizational learning perspectives, the BSC helps managers understand many interrelationships at least implicitly. This understanding can help professionals transcend traditional notions about functional barriers and in the end lead to improved decision making on how they take actions about factors chosen as important for success of projects. The BSC keeps companies looking –and moving- forward instead of backward (Kaplan and Norton, 1992).

The inventors of BSC method, Kaplan and Norton (1993) state that BSC must not be considered as a stereotypical way that can be applied for each industry and firm and they also emphasize that not all the firms have to apply the four sizes which were put forwarded by them (Erbaşı and Parlakkaya, 2012). Kaplan and Norton (1996) also emphasize that the BSC is only a template and must be customized for the specific elements of an organization or industry. Depending on the sector in which a business operates and on the strategy chosen, the number of perspectives can be enlarged, or one perspective can be replaced by the other.

Different market situations, business climates, competitive environments require different scorecards (Liu and Wan). In addition, the BSC concept can be applied to measure, evaluate and guide activities in specific functional areas of a business, and even at the individual project level (Martinsons *et al*., 1999).

The BSC does not provide a technique to estimate quantitatively how much each perspective contributes, either in relative or in absolute terms, nor does it estimate the relative importance of indicators under the same perspective. The consolidation, in

practice, has to be carried out intuitively by the users of the BSC. AHP, can be combined with the BSC to solve the aforementioned problems.

2.3.2. Applications of BSC

The BSC has proven its effectiveness for construction companies of all sizes. It can energize and transform an organization, resulting in significant performance improvement and company success in both the short and long term (Wallca, 2010).

As Erbaşı and Parlakkaya (2012) state, BSC helps evaluating and improving business operations. It is used by several of the most profitable companies in the world, it allows managers to monitor and improve a variety of aspects of a business and its operations. The BSC concept is not difficult to understand and can be fairly easily implemented in a multitude of business environments. When the usage of BSC method is considered, it is seen that firms give much more importance to this method. It is also seen that companies such as Electronic Circuits Inc. (Kaplan and Norton, 1992), General Electric (Davis, 1996), Metro Bank, National Insurance, Pioneer Petroleum, Electrolux, British Airways, Coca-Cola Beverages Sweden, Ericsson, Xerox, British Telecom, Volvo Car Corporation, Motorola have used BSC. There are many other companies that are not mentioned in this research and many public institutions and agencies and non-governmental organizations also use BSC.

There is a big gap in the literature about BSC practices and when BSC application of the firms in Turkey is considered, it is seen that the study is conducted with only 107 of the first 500 largest industrial firm and 64 of these 107 companies never used BSC (0,59), 11 companies used for some departments (0,1), 9 companies used (0,08), 3 companies are getting ready to use (0,02) and 1 company used and then gave up (0,01) this application (Coskun, 2005). Therefore, it can be concluded that BSC applications are not given importance by a majority of the companies (Erbaşı and Parlakkaya, 2012). However, with the companies applied the BSC, it began to be recognized that the scorecard represents a fundamental change in the underlying assumptions about performance measurement.

Kagioglou *et al*. (2001) in their study presents a review of literature of with the aim of transferring best practise into construction. They give points to the factors with the range of 1-5 according to their contribution to their BSC perspectives for performance measurement. In that study which is construction case, there are two additional perspectives, supplier and project. BSC is formed based on original four perspectives with strategic goals like acquiring more customers, reducing non-core activities, cost reduction for desired results in Wallca's paper (2010).

Trevor *et al*. (2006) adapted BSC concept for measuring performance of partnering project. Their perspectives are: benefit, attitudes of project stakeholder, attitudes enhancement process and strategic learning and growth. They aligned objectives and gave points for each.

Hui (2010) produced performance indicator system based on BSC concept, determined factors but did not use any models for calculation.

Thomas (2007) prepared a framework for subcontructor performance appraisal based on BSC. Factors determined are given points for their scales formed for appraisal. Score was defined with the total point.

There are also studies on project scorecards that is wanted to be created for real estate projects in this thesis. Niebecker *et al*. (2008) prepared a project scorecard for cross-company project management performance. They listed their factors but their study does not have any calculation.

Barclay (2008) determined five perspectives based on BSC for preparing a project performance scorecard for information systems (IS). Use, benefit, project process, innovation and learning and quality are the perspectives. They specified objectives grouped under perspectives and with interviews objectives are classified whether they are important.

Jacobsen *et al*. (2002) prepared five scales as excellent, prefered, acceptable, minimal and does not apply for the scorecard that they formed for development projects. They used the scorecard like a check list.

Several studies have been made to assess the success of real estate projects. For example, Lechler *et al*. (2010) used project stages as reference for their success criteria framework for real estate projects. They determined factor according to project stages. Nwachukwu and Emoh's study (2011) designated key factors for project management success for real estate development industry. They explained their factors without any models and concept. Liapis *et al*. (2011) utilized financial methods for real estate project selection. They used net present value, capital assets pricing model and Monte Carlo simulation as evaluation methods.

3. REAL ESTATE PROJECT SUCCESS

This part of the thesis explains the real estate development industry and its success factors.

3.1. Real Estate Development Industry

The real estate developer is the project sponsor, planner, and manager. Coordination of activities and converting on paper ideas into reality are his job. He creates, imagines, funds, controls and orchestrates the process of development from the beginning of the project to the end. Real estate developers usually take the greatest risk in the creation or renovation of real estate - and receive the greatest rewards. Ordinarily, developers purchase a tract of land, determine the marketing of the property, develop the building program and design, obtain the necessary public approvals and financing, build the structure, then lease, manage, and ultimately sell it (Anne and Richard, 2003).

Real estate appraisal focuses on the questions of price and value (Brož, 2003). Determining the vision, mission and the core principles of real estate development industry is vital for designating the performance indicators of projects, hereby the industry. Besides, the general strategies of the industry should be determined based on the vision, mission, main principles (Erbaşı and Parlakkaya, 2012). A comprehensive situation analysis is made in the inner and outer environment of this industry.

3.2 Success

Project success concept is tried to be examined from different researchers' points of view. It is the ultimate goal for every project. However, it means different things to different people. While some writers consider time, cost and quality as predominant criteria, others suggest that success is something more complex (Chan, 2004). With the literature review, many researcher's explanations are given within this chapter.

Songer and Molenaar (1997) considered a project as successful if it is completed on budget, on schedule, conforms to user's expectations, meets specifications, attains quality

workmanship and minimises construction aggravation. Kumaraswamy and Thorpe (1996), in Chan's study (2004), included a variety of criteria in their study of project evaluation. These include meeting budget, schedule, quality of workmanship, client and project manager's satisfaction, transfer of technology, friendliness of environment, health and safety.

Shenhar (1997) gives the project success measurement framework as it includes four distinct dimensions: project efficiency, impact on the customer, direct and business success, and preparing for the future. These criteria are organized by time.

Mohamed (1999, cited in Lim and Zain, 1999) sets a framework to measure project success. In the micro view of project success, as the project construction stage, project success criteria are time, cost, quality, performance, safety. In the macro view of project success, as the whole project life-cycle, project success criteria are completion time, satisfaction of utility and operation. Project life-cycle includes conceptual, planning, design, tender, construction, operation.

Chan *et al*. (2000, cited in Albert *et al*., 2002) give an assessment framework for project success of design/build project. At pre-construction phases, measures are time, cost, quality, technical performance, satisfaction of key project participants. At the construction phase, time, cost, health, safety, quality, technical performance, productivity, satisfaction of key project participants, and conflict management are the measurement elements. At the post-construction phase, objective measure is profitability. Subjective measures are satisfaction of key project participants, end-users and outsiders. And these people's success criteria are completion, functionality, aesthetics, and professional image, educational, social and professional aspects. Final one is environmental sustainability. Freeman and Beale (1992) provided an interesting example of the different points of view of people: "An architect may consider success in terms of aesthetic appearance, an engineer in terms of technical competence, an accountant in terms of dollars spent under budget, a human resources manager in terms of employee satisfaction, and chief executive officers rate their success in the stock market."

Khang and Moe (2007, cited in Do and Tun, 2008) research about success criteria and factors for international development project. They identify project life-cycle as five stages: conceptualizing, planning, implementing and closing/completing, overall project success. They give their division of success criteria in different project life-cycle. In the conceptualizing stage, criteria include make clear target group needs, agency capable, raise key stakeholder interests. In the planning stage, get key stakeholders support, prepare for the resource, team get ready for project start. In the implementing stage, as the plan do the project, inform key stakeholders about the process. In the closing/completing stage, check all the work done, report the results to key stakeholders. Overall project success is good for beneficiaries, good reputation, and good chance as a success, sustainable.

John Wateridge (1990, cited in John, 1997) gives the user's criteria of success is meet users' requirements, happy user, meets budget, meet time, achieve purpose. He also gives project managers' criteria about project success as meeting user requirements, commercial success, meeting quality, budget, achieving purpose.

Wateridge (1994, cited in John, 1997) gives the definition of project success according to different stakeholders. From client view, project is achieve its business purpose and meets its defined objectives, meets quality thresholds, and could make profit for its owner. Project team is happy during the project and with the outcome of the project. Users are happy during the project and with the outcome of the project. Project could make profit for contractors. Stakeholders are happy during the project and with the outcome of the project.

Project success is almost the ultimate goal for every project. However, owners, designers, consultants, contractors have their own project objectives and criteria for measuring success. It means different things to different people (Chan and Chan, 2004).

With reference of Nwachukwu and Emoh's study (2011), a project is termed successful if it passes four success test criteria i.e. the time criterion – completed on time; the cost or money criterion – completed within budget; the effectiveness criterion – completed in accordance with the original set performance and quality standards; and

client’s satisfaction criterion – accepted by the intended users or clients whether the client is internal or from outside the organization.

The review of projects answers how well or poorly the company has done on a particular project. The best post-project reviews include feedback from customers. The review process capitalizes on the “intellectual equity” gained from each project to ensure that “lessons learned” are captured and the information made available to the entire organization (Moore, 2005).

Evaluation of success of a project should include quality of plans and specifications, original cost estimate, project scheduling, material ordering and staging, productivity of the individuals on the team, general contractor responsiveness to requests, job cleanup, warranty, project manager's performance, customer satisfaction (Moore, 2005).

Financial performance should be determined. Personnel strengths and weaknesses should beidentified and opportunities for training and improvement should be defined (Moore, 2005). Communication from upper management through the foreman level should be greatly improved and performed on a consistent and structured basis. Support and communication from the office to the field should be improved. Individual performance should be evaluated, and top performers with promotion potential should be identified for employe satisfaction and permanency (Moore, 2005).

3.3. Success Criteria

Success of real estate development projects is influenced by many factors, such as macro, medium and micro factors, factors of cost, revenue, risk and opportunities, etc. It is impossible to establish an evaluation indices system within all the factors. In this paper, indices which may have huge impact on real estate decision-making are chosen to establish the model (Tang and Li, 2009).

According to Katic (2009); time, cost and quality (iron triangle) are the basic criteria of project performance but they are not enough for balanced view of project performance or success. The project's plans and goals are transformed in success criteria through performance system financial and nonfinancial indicators. For each set of goal has defined critical success factors with appropriate performance measures (Katic, 2009).

Using the ‘right measures’ to measure the ‘right things’ and the relationship between the different measures is important (Kagioglou *et al*., 2001).

It is easy to identify lots of performance indicators to be tracked. For clarity and impact, fewer metrics are always better than more. A good rule of thumb is to narrow the set. Which ones matter most? Indicators with less importance should be eliminated (Jordan *et al*., 2009).

BSC will help focus effort on critical success factors rather than on less vital aspects. The system forces construction executives and managers to focus on the performance metrics that drive success, which are often non-financial metrics (Wallca, 2010).

Elements (factors) are the entities in the systems, which interact with each other. In complex system, which contains a great number of elements, it would be very time consuming to measure relative importance of each element with every single element in the system. Instead, elements that share similar characteristics are usually grouped into cluster (Eğilmezer, 2007).

For the purpose of identifying the factors contributing to project success and thereby success of real estate development companies, an extensive literature survey was conducted and an exhaustive list of variables is prepared.

The project scorecard framework incorporates four dimensions based on the BSC concept:

(i) FINANCIAL

(ii) CUSTOMERS

(iii) VALUE ADDING

(iv) OPERATIONAL

3.3.1. Financial Perspective

This perspecive refers to financial perspective of BSC concept. Protecting the project from loss is needed to be kept in mind. The project has to meet the needs of the investor, it has to make a profit surely. There are many ways to determine what a return should be (cash flow, internal rate of return, debt coverage ratio). The investors want to get their money back with a reasonable initial return (Hui, 2010).

If the financial department of the construction company does not have a cash flow and budget plan, which is updated and reviewed periodically, capital and or asset shortages can not be identified timely. Such a poor financial management will result in a company which is not aware of the income and outcome and can not balance the money in and out of its budget until the debt appear to be much more than the income (Eğilmezer, 2007).

Increasing interest rates, which would increase the cost of borrowed money of a construction company to commence its work, would severely affect the profitability of the construction company. In the same manner of interest rate factor construction cost increase caused by inflation would affect the profitability of the company (Eğilmezer, 2007).

The profitability perspective of a BSC considers the health of the organization from a financial perspective. It considers measurements such as revenues, profits and return on project. As part of an overall BSC strategy, a firm should be financially healthy (Clark, 2010).

Financial goals can be stated simply: to survive, to succeed, and to prosper. Survival was measured by cash flow, success by quarterly sales growth and operating income by division, and prosperity by increased market share by segment and return on equity (Kaplan and Norton, 1992).

3.3.1.1. Accuracy of Cost Estimation. The financial impact on success is easier to measure through cost (Stadlhofer, 2010). Projects most often indicate big financial expenditures. Return from project may be received within a period of time in future. Determining budget items completely, thus estimating project total cost is crucial. Elements, such as risk and uncertainty are necessarily presented in forecasting the budget (Eğilmezer, 2007).

Preparing cost estimates normally requires the use of historical data on construction costs. Historical cost data will be useful for cost estimation only if they are collected and organized in a way that is compatible with future applications. Organizations which are engaged in cost estimation continually should keep a file for their own use. The information must be updated with respect to changes that will inevitably occur. The format of cost data, such as unit costs for various items, should be organized according to the current standard of usage in the organization (Hendrickson, 1998).

Projects' cost estimate should be prepared after site investigations and studies of concept design which is developed to illustrate and define all major systems and should include contingencies and cashflow projections. Project cost estimate can be based on client's broad requirements. This cost estimate may be derived from lump sum or unit costs as identified in the construction cost manual for a similar project. Costs for each contract or value services, costs for values of materials and engineering/ architectural design fees should be obtained (OP, 2001).

The capital cost for a construction project includes the expenses related to the inital establishment of the facility: Land acquisition, planning and feasibility studies, architectural and engineering design, construction, including materials, equipment and labor, field supervision of construction, construction financing, insurance and taxes during construction, owner's general office overhead, equipment and furnishings not included in construction, inspection and testing. The magnitude of each of these cost components depends on the nature, size and location of the project as well as the management organization, among many considerations. The owner is interested in achieving the lowest possible overall project cost that is consistent with its project objectives.

According to Prabhakar's study (2008), accurate initial cost estimate is one of critical success factors. The cost estimates made at the earlier stage are expected to be less accurate, because design decisions made at the beginning stage of a project life cycle are more tentative than those made at a later stage (Hendrickson, 1998). Wrong project cost estimating can be in two different directions, which are over estimating and underestimating (Eğilmezer, 2007).

Errors and omissions in the design, unforeseen conditions, and changes to the project scope which are generally identified as changes to the cost should also be taken into consideration. Because management of changes to the project is critical to maintaining the budget of project.

A direct cost is a rate for labor, plant, materials, and subcontractors excluding the additions for site overheads, head office overheads, and profit. Direct cost rate for each item existing in the bill of quantities has to be established. Determining a direct cost rate involves selecting the appropriate resources of labor, plant and materials for the item of work, selecting the output or usage rates for each resource or determining the elapsed time that each resource will be employed, and combining this with the cost information collected (Demiroğlu, 2002).

In most construction budgets, there is an allowance for contingencies or unexpected costs occuring during construction. This contingency amount may be included within each cost item or be included in a single category of construction contingency. The amount of contingency is based on historical experience and the expected difficulty of a particular construction project (Hendrickson, 1998).

Construction cost constitutes only a fraction, though a substantial fraction, of the total project cost. However, it is the part of the cost under the control of the construction project manager. The required levels of accuracy of construction cost estimates vary at different stages of project development, ranging from ballpark figures in the early stage to fairly reliable figures for budget control prior to construction. Generally, the accuracy of a cost estimate will reflect the information available at the time of estimation (Hendrickson, 1998).

Since the future prices of constructed facilities are influenced by many uncertain factors, it is important to recognize that this risk must be borne to some degree by all parties involved, i.e., the owner, the design professionals, the construction contractors, and the financing institution. It is to the best interest of all parties that the risk sharing scheme implicit in the design/construct process adopted by the owner is fully understood by all. When inflation adjustment provisions have very different risk implications to various parties, the price level changes will also be treated differently for various situations (Hendrickson, 1998).

3.3.1.2. Effectiveness of Cost Control. While simplicity is the foundation of all effective processes, including performance measurement, business today can appear complex with an overwhelming number of variables to track, analyze and adjust. It is easy to conclude that more information is better. Real estate leaders often over-report by crowding excessive data (Jordan *et al*., 2009). They need to get periodic reports for cost control that indicate how the project is doing compared to the initial projection (Hui, 2010).

Budget tracking is making a comparison of the actuals to date to what was budgeted at the beginning of the period. It is wanted to see how the work is done in relation to the expectations. Like a comparative income statement that runs over a period of time with one side (actual) slowly catching up to the other side (budget).

Reporting in a construction project execution includes observing of the work done and comparing the conducted work with the planned to be completed work at a specific time. Monitoring and cost control in a construction project execution involves reporting on budget and schedule, performance control meetings and site inspections (Eğilmezer, 2007). According to Prabhakar's study (2008), monitoring and feedback is one of critical success factors.

Cost control reports should be simple. Communicating too much complexity blurs priorities and obscures what is being done right. When corporate real estate teams use a single spreadsheet to report all their activities, the number of metrics reported can easily top 30 or more, making it difficult for an executive to distinguish key factors from merely

interesting data points. Good analytics give complex ideas the appearance of simplicity (Jordan *et al*., 2009).

Real estate performance measures are typically still based on cost reduction and capital minimisation rather than the understanding of its impact on the corporate well being (Stadlhofer, 2010). Reducing excessive expenses over budget is an important factor. Efficiency and success of projects are determined by comparing the income and expenditure related to implementation of the project (Kazimieras *et al*., 2004).

Subcontractor and supplier production costs comprise a large portion in the total project cost. Properly held management of these third parties will in turn bring cost reductions and increase the speed of work execution (Eğilmezer, 2007). Cost saving will increase the profit of the contractor whereas price reductions will increase the probability of being awarded for new projects (Eğilmezer, 2007).

Management of changes to the project is critical to maintaining the project budget, for controlling the cost. After a purchase order has been issued, construction services should review all changes and processes them through procurement services.

Enabling immediate reporting and receiving feedback that can be counted as reporting has importance for project success. Identifying errors and inconsistencies with reports help gaining favor on maintaining the project budget.

3.3.1.3. Effectiveness of Marketing. Real estate markets today are more competitive than ever before. For many builders and developers, creating an exceptional home or community is easy. The challenge lies in selling those homes and communities before they are physically completed (IFMA, 2010).

Method of sale is one of most strategic driving forces for businesses according to Nourse and Roulac's (1993, cited in Stadlhofer, 2010). In reference to Kazimieras *et al*. (2004), market research and marketing of a commercial object at the moment is one of the most important tools for increasing the competitiveness and success of projects.

Selling the project's vision requires creating a credible, convincing brand that appeals both emotionally and rationally to potential buyers. Through marketing materials, websites, interactive campaigns, strategic property releases, personal tours and sales processes, customers are explained the benefits of buying into this vision (IFMA, 2010).

According to IFMA (2010), successfully marketing real estate projects takes two essential qualities: creativity and strategy. Creativity is an important factor in the development of memorable brands, materials and messaging, as well as the design of homes, amenities and the community plan. But creative work can only succeed when it reaches the right people at the right time, and that is accomplished through effective branding and marketing strategy.

The media is an important part of the sale of a real estate. Advertising sends the sale information to many potential customers. Experts may influence customers with their comments on the project. Any bad news could directly influence the house sale (Lechler *et al*., 2010).

More emphasis on the importance of this business object from the point of view of not only the market but also the whole state.

Increased sales compared with projection shows the success on marketing, besides difficulty in collecting money from the client is as crucial as success on marketing.

Pay-off period is a minimal period of time (from the start of implementation of the project), after which integral effect becomes positive and remains such later on. In other words, this is a period, starting from which the primary investment and other expenditure related to the project are covered by the income from the project (Kazimieras *et al*., 2004). With the successful marketing pay-off period will decrease.

3.3.1.4. Effectiveness of Financial Resources. One of the major hurdles that almost any owner faces in a project is financing the construction and other development costs. More and more, contractors are finding themselves involved in the financing process (The Associated General Contractors of America, 2009). Projects of a constructed facility

represents a cost in the short term that returns benefits only over the long term use of the facility. Thus, costs occur earlier than the benefits, and owners of facilities must obtain the capital resources to finance the costs of construction. A project cannot proceed without adequate financing, and the cost of providing adequate financing can be quite large. For these reasons, attention to project finance is an important aspect (Hendrickson, 1998).

Resource utilization or resource organization can be considered as one of the most important factor in management of a project. Arranging financing may involve a lengthy period of negotiation and review (Hendrickson, 1998). Proper resource arrangement brings higher profit to the organizations by curbing the attrition. Better utilization of resource, which is arranging of the right type of resource for the job means greater operational efficiency and reduced project costs to the organizations (Eğilmezer, 2007).

There are several options to arrange financing that might be considered (Hendrickson, 1998):

- Using corporate equity and retained earnings: The building could be financed by directly committing corporate resources. In this case, no other institutional parties would be involved in the finance. However, these corporate funds might be too limited to support the full cost of construction.
- In construction loan and long term mortgage plan, a loan is obtained from a bank or other financial institution to finance the cost of construction. Once the building is complete, a variety of institutions may be approached to supply mortgage or long term funding for the building. This financing plan would involve both short and long term borrowing. The long term funding would have greater security since the building would then be complete. More organizations might be interested in providing funds and the interest charge might be lower.
- Understanding construction financing can help a contractor provide additional value to its clients and enhance its competitive position. Involvement in the financing process, however, is fraught with risks, which a contractor must understand if it is to protect its profitability (The Associated General Contractors of America, 2009).

Financing plans will typically include a reserve amount to cover unforeseen expenses, cost increases or cash flow problems. This reserve can be represented by a special reserve or a contingency amount in the project budget. In the simplest case, this reserve might represent a borrowing agreement with a financial institution to establish a line of credit in case of need (Hendrickson, 1998).

Bank acts as the payment agent for customers to borrow and lend money. Banks are important players in financial markets and offer financial services such as investment funds. They usually take into account project feasibility, the real estate company's reputation, project IRR, developer's fix assets and developer's present flow before lending money to them (Lechler *et al*., 2010).

A private corporation which plans to undertake large capital projects may use its retained earnings, seek equity partners in the project, issue bonds, offer new stocks in the financial markets, or seek borrowed funds in another fashion. Potential sources of funds would include pension funds, insurance companies, investment trusts, commercial banks and others. Developers who invest in real estate properties for rental purposes have similar sources, plus quasi-governmental corporations such as urban development authorities. Syndicators for investment such as real estate investment trusts as well as domestic and foreign pension funds represent relatively new entries to the financial market for building mortgage money (Hendrickson, 1998).

As the complexity and size of the construction project increases production time will be greater and in conjunction the percentage of this time belongs to the resource supply and arrangement will get longer. Poor resource utilization will increase outsourcing and dependency on third parties in periods of specific resource extinction. Profit margins of project would become less and successful completion of projects may become impossible due to over budget and excess of completion schedule (Eğilmezer, 2007).

For private facilities such as office buildings, it is customary to have completely different financing arrangements during the construction period and during the period of facility use. During the latter period, mortgage or loan funds can be secured by the value of the facility itself. Thus, different arrangements of financing options and participants are

possible at different stages of a project, so the practice of financial planning is often complicated (Hendrickson, 1998).

The project is thought to be taken back with its profit by the completion. As a common method, contractors borrow money from creditors for the initial investment especially for the execution of the projects without advance payment. It is vital to pay the loan taken from the creditors back timely (Eğilmezer, 2007). In essence, the project finance problem is to obtain funds to bridge the time between making expenditures and obtaining revenues. Based on the conceptual plan, the cost estimate and the construction plan, the cash flow of costs and receipts for a project can be estimated (Hendrickson, 1998).

Money collected from client may also be used to finance the project staff as a whole (Eğilmezer, 2007).

Additionally the impact of project delays and late payments that hurt the cash flow cycle will be more severe in combination of raised interest rates and inflation due to economical changes (Kangari, 1988).

Plans considered by owners for facility financing typically have both long and short term aspects. In the long term, sources of revenue include sales, grants, and tax revenues. Borrowed funds must be eventually paid back from these other sources. In the short term, a wider variety of financing options exist, including borrowing, grants, corporate investment funds, payment delays and others. Many of these financing options involve the participation of third parties such as banks or bond underwriters (Hendrickson, 1998).

The options for borrowing by contractors to bridge their expenditures and receipts during construction are relatively limited. For small or medium size projects, overdrafts from bank accounts are the most common form of construction financing. Usually, a maximum limit is imposed on an overdraft account by the bank on the basis of expected expenditures and receipts for the duration of construction. Contractors who are engaged in large projects often own substantial assets and can make use of other forms of financing which have lower interest charges than overdrafting (Hendrickson, 1998).

It is a widely seen event for construction companies to take bank credit to invest in projects, since construction projects need high capital investment in the beginning of the project (Eğilmezer, 2007).

Banks' measurement for project success is to check real estate developer money return situation, so measure project success by return rate (Lechler *et al*., 2010).

Borrowing money to commence a project is almost a rule of thumb in construction business. Any unexpected rise in the interest rates at which company has borrowed money may have a severe effect on the profitability of the companies (Eğilmezer, 2007).

Financial resource arrangement should be done well. While borrowing money cheaply with low interest rates will prevent negative profit out of the project, paying it back in charge of sudden rise of the interest rates may force the company to file bankruptcy since unpaid debt has come out to be much higher than the expected return (Eğilmezer, 2007).

The costs of funds for construction will vary inversely with the risk of a loan. Lenders usually require security for a loan represented by a tangible asset. If for some reason the borrower cannot repay a loan, then the borrower can take possession of the loan security. To the extent that an asset used as security is of uncertain value, then the lender will demand a greater return and higher interest payments. Loans made for projects under construction represent considerable risk to a financial institution. If a lender acquires an unfinished facility, then it faces the difficult task of re-assembling the project team (Hendrickson, 1998).

3.3.1.5. Accuracy of Risk Assessment**.** The idea of risk management is an important and integral part of project management. It is required for construction projects to balance the risk factors with particular contractual, financial and operational requirement (Eğilmezer, 2007).

Risks and uncertainties are associated with all projects in commercial real estate development and they can strongly influence all related progresses at all stages of the

entire lifecycle of properties. Specifically, those risks can occur at initial stage of a project when developers conduct feasibility study, design and planning, bidding and tendering, construction, or even during marketing or handover period, meanwhile, risks existing in initial stage can also influence the use of the property as well (Chen *et al*., 2009).

Risks in each commercial real estate development can be identified at project management level using brainstorming techniques, and risks are generally defined as events that could arise and affect the critical factors of one project (Chen *et al*., 2009).

According to Nwachukwu and Emoh, risk is identified as:

- Where to build, how to build and when to build
- The opportunity cost in choosing to invest in real estate
- Threat of losing financial asset and the risk associated with time value of money
- Environmental challenges that influence or affect demand and supply of building accommodation within a geographical area; for example, flood erosion and gully erosion challenges, insecurity and other natural influences.
- That rate of borrowing financial capital to invest and make profit with time.
- The mode of measuring profit from real estate project; a decreasing profit.

Risk is transferable. Proper risk management should be adapted by past experience. However, relying on only historical performance will not be sufficient to catch overall risk due to the uniqueness of construction projects as well as the rapid change in the construction industry. Eliminating project risks will need a detailed study of the project and a definition of how the project's success will be measured (Eğilmezer, 2007).

According to generic characteristics of commercial real estate, one of the most significant risk and uncertainty towards investment return is the income stream, since the income stream is uncertain, as well as the possible events affecting the income stream and uncertainty as to the probability of the outcomes from these events (Frodsham, 2007).

Both subjective and objective issues are considered to define criteria for risks assessment (Chen *et al*., 2009). He explained four types of risks as environmental, social, economic and technological.

Environmental risk includes adverse environment impacts, climate change; social risks are cultural compatibility, community acceptability; economic risks involve interest rate, property type, market liquidity, brand visibility, area accessibility, buyers and investment return; and as last type of risk, technological risks include site conditions, constructability, duration, durability (Chen *et al*., 2009).

Much attention should be also paid to the risk of project. Risk is an uncertainty related to the rise of unfavorable states or results in the course of implementation of the object. While others state that risk is insufficient quantity or indeterminancy of information about implementation of project, including the related results and conclusions. The following types of risk are pointed out most often: risk related to the instability of laws and economic situation; political risk related to an indefinite political situation and social changes; risk related to fluctuations of market prices and market conjuncture, currency exchange rates, indefinite climatic conditions, possibility of natural disasters; production-technological risk (Kazimieras *et al*., 2004).

Other authors add to the risk above such factors as lack and inaccuracy of information, failure to understand or combine the objectives, interests of project participants.

Management of project risk consists of: estimation and implementation of long-term project strategy; tactical actions carried out within the limits of turnover of financial capacities and strategic solutions (Kazimieras *et al*., 2004).

3.3.2 Customer Perspective

Customers are the owners of the engineering project. To communicate and cooperate with the owner is the key point of whether a project could be successful (Hui, 2010). The customer is the projects ultimate beneficiary. If no one wants to buy from the

project, the project is a complete failure. Before a project is started, the real estate developer has to identify the target customers, their needs. What challenges do customers face? What do customs hope to gain from this project? What goals are they striving to attain? What experience thrills them? Where do they get their information? Who do they trust most? (Lechler *et al*., 2010).

Financial success of an organization is related to customer's value preposition since whether the customers buy their product or services directly affect the income of the organization (Wong *et al*., 2006).

According to Jordan *et al*. (2009), success is incumbent on the ability to ask for, listen to and interpret two inputs: the overriding business objectives and the specific needs and requirements of the customer.

Scorecards are often laden with descriptive metrics that report real estate activity but are not relevant to management. Building a better measurement system cannot begin until the customer and his objectives are known, because that identification process determines the kind of information that will be most valued. "Customer" is defined as the recipient of the process output and/or the funder of an activity (Jordan *et al*., 2009).

Business support organizations typically are funded by corporate budgets. Output recipients are management or staff that have service expectations but may not contribute direct funding. Charge-back models can provide better alignment with a funder, but in their absence, the customer audience is often broadened to include all important stakeholder groups (Jordan *et al*., 2009).

The customer perspective consists of the measures relating to the most desired customer groups. It will include several Standard measures such as customer satisfaction and customer retention though in each case these should be tailored to meet the organizational requirements. Market share, customer value and customer profitability are other key measures that enable an organization to create a clear vision of the customers whom it should target together with an identification of their needs and expectations from the company.

It can be tempting to make assumptions about the customer and his requirements, or worse, use performance measurement to simply justify existing corporate real estate activities without engaging in any meaningful customer dialogue at all (Jordan *et al*., 2009).

Customer perspective of BSC helps companies on determining how the business provides value to customers of company and relationship with customers, also how they serve customers and address their concerns. Customer perspective answers the question of 'how do customers see us' for real estate development companies. It is incumbent to use the language of the customer to attract and hold their attention. Corporate real estate leaders typically have their own performance objectives in mind, yet common ground must be reached with stakeholder expectations. They should bridge the customer group's business expectations, starting with the customer's needs first (Jordan *et al*., 2009). Customers increasingly expect products and services of higher quality at lower price and with quicker delivery (Dey, 2004).

Customer-based measures are important, but they must be translated into measures of what the company must do internally to meet its customers' expectations. After all, excellent customer performance derives from processes, decisions, and actions occuring throughout an organization (Kaplan and Norton, 1992). Even some project meet budget, schedule, scope these objects, and in the end the projects still couldn't fulfill customers' need (Lechler *et al*., 2010). Also, increase in value ability means customers expect the house's price would increase in the future. Except as a living place, house could as an investment method (Lechler *et al*., 2010).

This perspective evaluates the organization from a customer's point of view. It refers to what constitute project success in the view of clients (Wong *et al*., 2006). Metrics that will be used should include persistence of customers, diversity of customers, attracting more sophisticated customers, sensitivity to environment, proper interior systems, on-time delivery, well chosen site location and orderliness of payments. In order for an overall BSC strategy to be successful, the organization must perform well from the customer's point of view (Clark, 2010).

If construction organizations are to remain competitive in the longer term, they need to develop and better understand their relations with their customers, suppliers, employees, lenders and the wider community (Love and Holt, 2000).

3.3.2.1. Level of Customer Satisfaction. BSC stresses the influences of customers' satisfaction degree to the strategic target of the project. It believes that only if the customers are satisfies, could the success be achieved in finance (Hui, 2010). Customers are the owners of the projects. Owners' satisfactory degree of the services and the final deliverables from the real estate development company is an important indicator for the contracting company to evaluate the performance of the project (Hui, 2010).

According to Chan's study (2004), Liu and Walker (1998) consider satisfaction as an attribute of success. Torbica and Stroh (2001) believe that if end-users are satisfied, the project can be considered being successfully completed in the long run.

Client satisfaction in construction works is the best reference in taking new jobs from the same clients and other possible new clients. Good relations with clients will increase the number of projects awarded to construction companies and the company which can take over new projects would have a successful image (Eğilmezer, 2007).

Customer satisfaction as a non-financial aspect of corporate real estate performance positively affects the firm's value (Stadlhofer, 2010). Taking into account customer wishes leads improved end user satisfaction. Also, customer complaints should be highlighted as an area for concern (Rothberg and Morrison, 2012).

Demand of the clients of construction industry can be defined as the timely completion of the project with expected quality and possible most economic solution (Eğilmezer, 2007).

As Kaplan and Norton (1992) state, customers' concerns tend to fall into four categories: time, quality, performance and service, and cost. Products completed in quality, safety and environmental standard improve end users satisfaction (Wong *et al*., 2006).

The question of ‘Are we achieving the customer-desired results on-schedule?’ should be used by determining whether the delivery will be on-time or not (Jordan *et al*., 2009).

3.3.2.2. Functionality of the Space (Proper Interior Systems). Quality could be measured by building standard and building process. Time, cost, and quality are most important performance indicators in real estate projects, but they also include other measurements such as safety, living conditions and function which means all machines work well, such as elevators, and lights (Lechler *et al*., 2010). As Porter (1989) states: ‘If you are skilled in design or in creating new conceptions of projects that you could get higher revenue per square foot or better utilization of the land. ‘

Kometa *et al*. (1995) opine that there would be no point in undertaking a project if it does not fulfil its intended function at the end of the day. The importance of functionality is highlighted. This indicator correlates with expectations of project participant and can best be measured by the degree of conformance to all technical performance specifications (Chan *et al*., 2002).

Interior systems are the choices of designers. Architects seek for the most optimal solutions for projects because clients demand better and better quality of goods and services.

An architect creates the blueprint, although a group of people may design the structure in its entirety. This group is responsible the whole building, inside and outside. There are many factors for considering, including the style of nearby buildings, any special features what the building will be used for, and how tall it could be (Lechler *et al*., 2010).

Reasonable house layout means sitting room, living room, kitchen, bathroom areas are fit for life. The room has enough sunshine. The room is bright enough. Every room area design could be accepted by majority (Lechler *et al*., 2010). Also, the room air needs to be fresh enough. Compared with outdoor air, indoor air can be two to five times more polluted (Max, 2007).Volatile organic compounds commonly found in paints, stains and

glues is the major cause. When these products dry, they release chemicals and continue to do so for years. Using low VOC paint can be a solution which generally cost a few dollars more per container. Providing adequate ventilation ,that is one of ergonomic solutions, by adding a mechanical ventilation system can also improve air quality (Max, 2007).

Ergonomic solutions that are internal enlightening-natural and artificial light, conditioning system, ventilation, floor coverings, maximum effective usage of general space, planning of movement flows, formation of entrance and exit of the building, proper staircases and escalators, formation of economically sustainable level of decoration, necessary supply of information and telecommunication facilities should be thought in determining interior systems of an project wanted to be seen as successful (Kazimieras *et al*., 2004).

3.3.2.3. Attractiveness of Project Location. In the real estate development industry, acquiring land and maintaining liquidity are the two key success factors. If every other factor concerning the business of the development company is just average, but the land is well located and the firm maintains adequate liquidity, the company will do well. Nothing is a greater determinant of success than having the right piece of land (Birnbaum, 2004).

Making highest and best use of a site has long been the goal of both the public and private sectors (Fleissig and Jacobsen, 2002). Real estate developer wants to make sure that the project is feasible.

According to Kazimieras *et al*. (2004), general analysis of the market and economical situation must provide a clear view on conditional attractiveness of the district or specific site location of project object for the inhabitants and the future users of project. Location that can determine the price of the real estate are analysed within this element of project success. First of all it is necessary to clear out general tendencies of the main social-economic characteristics describing the demographic potential of employees and purchasing power of the population as the function of occupation. One must note that the focus of analysis must be chosen depending upon the type of a specific real estate development project object –office, sales, manufacture, etc.

Price of the land lot, density of buildings, possible height of the building, analysis of the existing neighbouring constructions, natural-climatic characteristics of the district, type of the surrounding land ownership, characteristics of territory planning, engineering networks and public utilities, social infrastructure, ecological situation of the district, social reputation-social and criminal situation which is security, green land cover rate, possibility of changes of environment in the future or future economic vision of the district determine whether the site location is good or not (Kazimieras *et al*., 2004).

Land resource should also be good for developing. It includes land geology condition, transportation, electricity, gas, water and infrastructure of communication supply situation (Lechler *et al*., 2010).

Possibilities of parking also important to have a well chosen site location because of restricted parking lots in most cities. The higher possible number of parking lots, with associated access roads, the more attractive is this place (Kazimieras *et al*., 2004). Community utilities is about around area whether there are many schools, hospital numbers, restaurants, supermarkets, play ground for sports. Availability of schools, hospital, banks, shopping centers, bus stations, subway station are plus points for location factor (Lechler *et al*., 2010). According to Fleissig and Jacobsen (2002), one of the most important aspects of any project is access. Access needs to consider all modes of transportation, including the pedestrian.

According to Fleissig and Jacobsen (2002), existing neighborhoods provide some of the critical support for new residential and commercial development -- roads, schools, bus service, water, electrical and sewer capacity may already be available. Projects located away from the urban fabric usually require additional services, new civic amenities, and longer car trips to gain access to these necessities.

Population residing is a significant factor but sometimes this index is ofset by such indices as good flow of public transport or visibility from the main streets.

Presence of equal competitors or presence of similar commercial objects in the residential district can be counted as an indicator within site location element of project

success. It has a certain influence upon the possibilities of business activity and sometimes the presence of competitors even improves possibilities of business activity (Kazimieras *et al*., 2004).

The main facade of the building facing the main street is also important. According to Kazimieras *et al*. (2004), the more the building is visible (illuminated, with advertisement spaces), the more attractive it is.

Location is measure about public transportation situation and whether it is convenient for householders and other to get this place (Lechler *et al*., 2010).

3.3.2.4. Environmental Friendlines. Evidence shows that the property sector accounts for approximately 0,4 of U.S. energy consumption and 0,38 of carbon dioxide emissions. Awareness of these facts has lead to a range of different environmental rating systems for commercial properties worldwide. The labels provide both landlords and tenants with a yardstick as to measure the 'greenness' of properties (Eichholtz *et al*., 2009).

Cultural sensitivity means being responsive to the local history, the culture, and the existing built environment of a given location. This can mean using vernacular designs, purchasing local products and materials, respecting local customs and building proactices, and honoring the cultural fabric of the region. Green developers usually support diversity-cultural diversity, economic diversity, or 'market segment' diversity (Wilson *et al*., 1998).

If you want to leave the smallest footprint you can on the planet, you might choose this type of construction. That means planning construction to minimize the waste of building materials; reducing water consumption by adding low-volume toilets or rainwater filtration systems; and working with products that are sustainable (wool carpeting, bamboo flooring, cotton insulation) or recycled (salvaged wood, steel made with reused rebar, insulation made from paper products) (Max, 2007).

If you were to build a house as green as you possibly could, it might cost you 20 percent to 30 percent more than traditional construction. But that would imply an extreme sense of environmental duty (Max, 2007).

One of the key features of a successful green development is that it establishes and reinforces connections: between people and place, between people and nature, between buildings and nature (Wilson *et al*., 1998).

This process of establishing connections can be seen as the application of ecological thinking to real estate. Ecology describes the interconnections or mutual relations between living things-including humans-and their environment. In social theory, 'ecology' desribes the social and cultural patterns that result from relationships between people and resources. Ecological thinking means looking at things in their whole context, while seeking also to understand the interconnections between parts. It recognizes that nothing exists in isolation; everything is part of a larger system (Wilson *et al*., 1998).

The behavior of corporate tenants can have important implications for the shift to a more sustainable built environment, as increased demand forces real estate suppliers to adapt rapidly to more stringent environmental expectations of tenants. If tenants increasingly prefer to lease green space rather than conventional office space, then a differential in rental rates between green and conventional buildings is bound to develop (Eichholtz *et al*., 2009). There is an identifiable group of tenants willing to pay a premium to lease green space.

The government and government-related organizations, for which non-financial utility is of major importance, are significantly more likely to rent green office space than regular office space (Eichholtz *et al*., 2009). Industry leaders and non-profit organizations (i.e. government) seem to be most willing to pay this rental premium. However, for other firms, leasing green is a result of the preference for high quality buildings, rather than an act of responsible behavior.

Green development is the application of ecological thinking to the business of creating places for people to live and work. These elements described, in its own way, mean of integrating ecology and real estate. Environmental responsiveness is a recognition that a development is part of the ecosystem in which it sits and should respect that position (Wilson *et al*., 1998). A part of the green increment is not only explained by energy

savings. Other factors, such as corporate image, are certainly at work (Eichholtz *et al*., 2009).

The use of green-building materials and renewable resources is a way of mitigating against the environmental impacts of construction and maintenance. The Leeds system developed by the U.S. Green Building Council for commercial projects or the Build Green Program by the Home Builders Association provide a larger set of green criteria (Fleissig and Jacobsen, 2002).

It is analyzed that the economic value of office buildings certified with a green label, and found that these "green" buildings command a premium in rental rates and sales prices over conventional office buildings (Eichholtz *et al*., 2009).

Construction industry has been regarded as a major contributor to environmental impacts. Construction projects affect the environment in numerous ways across their life cycle (Shen *et al*., 2000). For example, 14 million tonnages of waste have been put into landfill in Australia each year, of which 44 per cent came from the construction/demolition industry (Songer and Molenaar, 1997). About 62-86 per cent domestic productions of non-metallic minerals, such as glass, cement, clay, lime are consumed by the construction industry. Projects should be sensitive to environment. Anecdotal evidence shows that green buildings on average use 30 percent less energy as compared to conventional buildings (Eichholtz *et al*., 2009).

Environmental performance of a project which can be evaluated with certifications, is vital for being successful.

3.3.3. Value Adding Perspective

This perspective evaluates the factors that are key to a firm's success. These factors will vary from one organization to the next but can include satisfaction of employees, employee quality, permanency of employees, leadership, creativity and innovativeness and awards that project can have that are important to the business. A firm must have strong

internal factors as part of an overall BSC strategy (Clark, 2010). This perspective aims to answer the question of ‘what must we excel at?’.

3.3.3.1. Level of Satisfaction of Project Employees. In addition to basic criteria of success that are duration, cost and performance, in Chan’s research (2004), measures advocated for project success should also include project psychosocial outcomes which refer to the satisfaction of project team members. Subjective measures such as participants' satisfaction level are known as soft measures.

Organizational human resource management system should include proper incentive systems to encourage workers to do their best for the organizational wellness and success. Such incentive systems may include salary bonuses, new carrier opportunities and any additional fringe benefits for the workers. In addition, less appropriate and faulty actions of the employees should be controlled and monitored regularly and remedial action should be taken immediately (Eğilmezer, 2007).

Kaplan and Norton (1992) explained that companies are understandably reluctant to lay off employees, especially since the employees may have been the source of the ideas that produced the higher quality and reduced cycle time. Permanency of employees is important, because layoffs are a poor reward for past improvement and can damage the morale of remaining workers, curtailing further improvement.

Braindrain is an obvious threat to projects’ success in its activities all through its lifecycle. But especially in crisis and declining periods when the company needs more talented employees carrying the know-how of recovery, braindrain will be damaging for company’s survival chance (Eğilmezer, 2007).

In addition, the high turnover of workers poses a considerable barrier to formal training in the construction industry (International Labour Organization, 2001). Workers in an organization with a poor human resource management system would seek the chance to leave the organization for better opportunities, which will result in first having an outcome less than their capacity would provide and ultimately loss in knowhow and skilled workforce for projects (Eğilmezer, 2007).

3.3.3.2. Level of Employee Competency. According to Kaplan and Norton (1992), employees at each level in the organization have clear targets for actions, decisions, and improvement activities that will contribute to the company's overall mission. To achieve goals on cycle time, quality, productivity, and cost, managers must devise measures that are influenced by employees' actions.

As stated by Weitzel and Johnson (1989), employee commitment is an important factor for successful surveillance. Organizations should supply a uniformed and completely understood overall company mission, goals and strategies within its employees so that they can detect obstacles to the desired outcome and modify their own behaviors to reach the target (Eğilmezer, 2007).

In most developing countries construction skills are still mainly acquired through an informal apprenticeship system. Vocational training schools do exist in most countries, but many workers and contractors see formal training as an unnecessary expense rather than an investment and they prefer restricted learning which is learning by doing. They can only be persuaded to undergo training if they are paid for lost time (International Labour Organization, 2001).

According to Bowen (1996, cited in International Labour Organization, 2001), the subcontractors who are the real employers of labour are small or very small firms, with more limited organizational and technical capacity and lacking the time and resources to invest in human capital development. Research into specialist companies' training needs found that 0.80 had done no training in the past five years and did not envisage doing any in the next three. When asked the reasons, 0.60 said they did not need to train and 0.25 said they did not have time to train.

The informal method of skill acquisition can come under particular strain when there is a sudden or sustained increase in construction activity, or when there is pressure from clients for better quality buildings or more rapid completion. These situations commonly arise during the process of economic growth and social change, as economies industrialize and incomes begin to rise, such as is now happening in the newly industrializing countries (International Labour Organization, 2001). The demand from

clients for higher quality building is also causing concern amongst contractors about lack of skills and leading to a new interest in training (International Labour Organization, 2001).

Employee's capability of learning and growth is one of the project performance indicators (Atkinson and McCrindell, 1997). Companies should continuously train their employees for new technology and new knowledge so as to form up a team of steady and well-trained stuff (Hui, 2010). Training helps employees move from workers to contributors and potential leaders. Companies should be looking to the future and identifying tomorrow's leaders from internal sources. If an internal candidate is promoted, it reduces the cost of bringing on a new manager or executive (McPherson, 2011).

The problem is that a lot of companies look at training as a cost and not as an investment. Is it expense or investment? The truth comes with enlightened view of training and development that is when it is done properly, it helps aligning employee efforts with company initiatives, the same as building in marketing, sales, accounting or product development (McPherson, 2011).

Companies are reluctant to invest on employee because there is a good chance they will lose trained workers to other firms. The companies' reluctance is also based on the fact that training costs money at least in the short run (International Labour Organization, 2001).

There should be a few training and skill development programs in the organization so that the existing employee performance, qualified labor, will be developed in the same direction with the industrial trends and demands. Organizations should have proper recruiting programs to assure the maintenance of sufficient number of qualified personnel (Eğilmezer, 2007).

Insufficient technical and technological capability includes not having experienced technical personnel such as technicians, engineers, skilled labor and necessary construction equipment to execute an undertaken project. Without necessary technical and technological

capability, and without educated employees it is not possible to complete a construction contract successfully (Eğilmezer, 2007).

3.3.3.3 Level of Contribution to Business Value. Added value of projects to increase the value of the firm is the activity or operation that increases directly or indirectly the value of the business compared to the situation where such an activity or an operation is not performed, or is the value over that profit investors are expecting for their investments, or is improving business performance and value to the owners (Lindholm *et al*., 2006).

Value is also increase in shareholder value (better returns to investments), ability to proactively manage the portfolio so that the company can manage and survive in the ever changing environment and improving the core corporation value (Lindholm *et al*., 2006).

An award, being a brand, outstanding leader, social responsibility are factors of contribution on projects to business value. An award recognises construction projects that have demonstrated the highest standards of construction excellence particularly in project management, technical inputs and workmanship. It is a promotion to companies' reputation. Successful projects enhance organizations' image with awards that they win. In this way, targeted customer number increases.

A professional leader can contribute significantly to the growth and prestige of the real estate industry. Supporting organizational image by making the project a brand while marketing from demand created by customers is another contribution.

Both community and cultural sensitivity involve respecting and promoting a sense of place by recognizing the uniqueness that every setting offers. It is praised by the community to have attention to cultural and community issues. Thus, projects have images that contribute to corporate value in the eyes of community (Wilson *et al*., 1998).

3.3.3.4. Level of Innovativeness of the Project. The real estate industry is an industry in which some choices about how competing in the future have to be made. Past modes of behavior probably will not carry projects through the next decade (Porter, 1989).

Construction innovations can provide the critical component for a company's long-term competitive strategy (Slaughter, 2000). Innovation mechanism is identified as another key competitiveness indicator according to Chan *et al*. (2004).

As Kaplan and Norton (1992) stated, intense global competition requires that companies make continual improvements to their existing products and processes and have the ability to introduce entirely new systems with expanded capabilities. Because the targets for success keep changing.

Innovation focuses on the knowledge capabilities that can be garnered from the project. It indicates the gains, advantages and value creating opportunities garnered throughout the project process (Barclay, 2008).

The majority of the owners are no longer satisfied with the traditional business ensuring measures. Many companies today have a corporate mission that focuses on the customer 'to be number one in delivering value to customers' (Kaplan and Norton, 1992). This mission with innovative suggestions leads them to ability of attracting more sophisticated clients and increased unit prices of projects additionally.

Innovations can form the backbone of a company's competitive strategy. A new design or technology may be the means through which a company can achieve the client's objectives for a specific project, or its own objectives across a set of projects for different clients (Slaughter, 2000).

Contractors, designers, including both architects and structural engineers, can be significant sources of innovations (Slaughter, 2000).

Utilization of new materials and equipment, development and use of new construction technology and introduction of new technology standards are three indicators of innovative capability of a project (Hui, 2010).

Maximizing energy efficiency of buildings, using green building materials, using energy/ water conservation systems, protecting, preserving, and/or restoring any on-site

natural features i.e. wetlands, riparian corridors, watersheds, steep slopes, significant grasslands, prairies, etc., using local vegetation on site to minimize impact on local habitats & to minimize water consumption and establishing recycling programs are critical features (Fleissig and Jacobsen, 2002). Also, the use of green-building materials and renewable resources as another way of mitigating against the environmental impacts of construction and maintenance.

A company's ability to innovate, improve, and learn ties directly to the company's value. That is, only through the ability to launch new products, create more value for customers, and improve operating efficiencies continually can a company penetrate new markets and increase revenues and margins – in short, grow and thereby increase shareholder value (Kaplan and Norton, 1992). Innovation capability presents a new approach for the business managers to improve business competitiveness by utilising organisation resources more effectively (Zhang, 2010).

Given the cost-competitive nature of the construction industry in most markets, the common expectation is that reducing design and construction-related costs is the main focus of most innovative activity (Duke, 1988). However, recent research indicates that a large portion of the innovations suggested and accepted within the construction industry actually improve the performance of either the design, construction process or the performance of the completed facility itself (Johnson and Tatum, 1993).

Additionally technology usage in a proper extend will bring a competitive advantage to construction companies in a manner of faster project completion which is a definite value to the client according to Warzawski, 1996 (cited in Eğilmezer, 2007). For example, a reinforcing steel bar with a raised profile represents an innovation with a modest expected improvement in performance from increased interaction surfaces with the concrete. Self-compacting concrete, which eliminates the vibration and consolidation stage of placing concrete is another example of innovation. Developing a reputation for being willing to try new products, processes and systems can increase the potential market for a construction company, particularly in the higher value or performance projects (Slaughter, 2000). However, different types of innovation may require different levels of training to effectively use them, and the sources of the training can differ (Slaughter, 2000).

As Lorange and Nelson (1987) state in their study, technical innovation especially in a growing niche will provide companies in charge an "extraordinary competitive advantage" whose returns are heavy demand, no in-kind competition and high profitability.

Strategy is not a static matter (Kaplan and Norton, 1992). Instead, project strategies and working procedures require continuous revisions in order to suit the changing environment (Wong *et al*., 2006).

Although many construction innovations are considered with respect to a specific project, they can provide benefits to the company as a whole as well (Goodman and Griffith, 1991). Under certain conditions, the act of innovating itself can provide strategic benefits and the successful implementation of an innovation can enhance a company's reputation (Christensen and Rosenbloom, 1995).

3.3.4. Operational Perspective

Operational perspective refers to internal business processes perspective and seeks to identify 'How well the business is performing.' and 'The internal processes that the company must be improved if it is to achieve its objectives.'.

Potential goals for the internal perspective include improving core competencies, improvements in technology, manufacturing excellence, quality performance and quality. Metrics based on this prospective allow the managers to know how well their business is running.

3.3.4.1. Effectiveness of Leadership. According to Verma (1995), leadership is one of vital components of effective management of project human resources and are necessary to accomplish project objectives successfully. According to Young and Samson (2004), people management drives project success more than technical issues do.

Most industries are dynamic in nature and the construction industry is no exception. Its environment has become more dynamic due to the increasing uncertainties in technology, budgets, and development processes. Temporary, fragment and short-term are

also significant characteristics inherent in the construction industry. Such characteristics greatly affect the effectiveness of project team, especially the project managers. The concept of project success is developed to set criteria and standards by which project managers can complete projects with the most favourable outcomes (Chan, 2004).

Project management action is the key position for the success of a project. Since the project leader should be the key person between different parties such as suppliers, contractor's labors, clients, subcontractors etc., he should satisfy effective coordination among the parties. He should develop a common goal of understanding among the project participants (Baker et. al., 1983, cited in Eğilmezer, 2007).

Project manager can be defined as the person who is effectively in charge of the project and has sufficient authority, personality, and reputation to ensure that everything needs to be done for the benefit of the project is done (Eğilmezer, 2007).

The project managers role arises from the need for a technical expert to take charge, control of events on the project implementation process, someone who understands the intricacies of co-ordinating, controlling, organizing and directing the efforts and activities of the professional team and the physical problems of implementation process with the needs in the decision making process. The success of any project implementation process in the construction industry in the public and private sectors depend largely on the project manager's concept on staff appointments and control, strict monitoring of time, cost, material, quality and environmental constraints (Nwachukwu and Emoh, 2011).

According to Nwachukwu and Emoh (2011), a project manager's role include co-ordinating and supervising all aspects of the work program and ensuring that quality is maintained. Below are the key issues that a project manager should be paying attention to:

- that works or various activities are completed on time and at the right budget
- he combines all the parties involved in the project including the developer and the development team
- directing and controlling the contractors and sub contractors to curb the excesses, wastage, delay and unnecessary foot dragging

- he advises on design and cost, and with his experience in value management or engineering analyses he is able to attain set goals without sacrificing standards and quality
- he advises on taxation and legal matters taking percussion in ensuring that the project meets the budget
- site assembling and procurement of professionally acceptable feasibility studies
- determines type of funding arrangement, negotiates for funds and procure funds for the project execution in line with feasibility studies
- monitors cash flow during period of construction and makes adjustment where necessary
- create a cordial working environment among consultants, contractors and every other worker on site.

Costruction manager is at another key point to have a successful project. He is responsible for assisting in the preliminary planning and design of the project which reflects the needs of the community, identifying and incorporating socio-economic opportunities, advising on schedules, budget cost control and economics of various methods and material selection, coordination of the trades, labour and supplies, project planning an scheduling activities of the trades and overall project risk assessment and management (OP, 2001).

Construction technical manager should manage all activities related in the procedure concerning the construction aspects of the project.He shall be the focal point for all construction matters. He is responsible to ensure that the quality of the work is maintained**.** He contributes towards the quality plan for the project, in particular, the quality performance requirements of construction (Nwachukwu and Emoh, 2011).

A professional construction manager which is the owner's agent and should not be one of the sub-contractors or suppliers involved in the project, is selected by the owner through a proposal selection process, retained by the client on a fixed fee/ reimbursable expense basis, and is responsible for the completion of the project (OP, 2001).

Many studies have solely focused on the manager's aspects for a successful performance. The performance of the managers is the most significant factor to project success as it is the people they manage who deliver the projects. Effective project management can be seen to be dependent upon the project manager's competency and authority. Performance of the managers can be predicted by their job knowledge, dedication, time management, ability to solve conflicts, and approachability and voluntary acumen. Performance criteria for construction project managers, includes team building, leadership, decision making, mutuality and approachability, honesty and integrity, communication, learning, understanding, and application, self-efficacy, and external relations (Yang *et al.*, 2010). As Stadlhofer (2010) indicated communication, strategic thinking, consulting and financial/analytical skills as main skills are required from a successful corporate real estate manager.

Leaders must be capable of interpreting the regular reports on organizational performance as well as external environmental changes. They should have the foresight to be ready for possible problems on the organizational performance in terms of sufficient interest or resource to address the deficiency (Eğilmezer, 2007).

Starbuck et. al. (1978) point out that success is a danger for the organization because it causes the leaders the sense that their organization is capable of managing any work with its current assets, so that the organization becomes blind to the needs of its relevant constituents. Especially in situations stated by Starbuck et. al. (1978) personal characteristics of the leader affect his interpretation of organizational scanning results (Eğilmezer, 2007).

Leaders of construction companies are commonly individuals with a past experience as an engineer or team or department leader which is not sufficient to ensure a business success. He states that the company leader must satisfy experience in other major activities of business such as finance, purchasing, selling and production. In lack of these, the enterprise will go into a gradual failure like the leaders with lack of managerial experience that is lack of training and knowledge of managing people effectively will fail in reorganizing the business, which will be crucial for a successful turnaround (Eğilmezer, 2007).

3.3.4.2 Effectiveness of Construction Schedule. According to Lechler *et al*. (2010), project success is related with time. Time refers to the duration for completing the project (Chan, 2004). A workable project schedule is time saving activity and absolutely essential for a successful project. It should be prepared by the general contractor with input from major subcontractors and suppliers. Failures to meet schedule requirements hurt all members of the team (The Associated General Contractors of America, 2003).

Planning and scheduling of the activities which is conducted all through the execution of a construction project will supply the project team to recognize and understand the nature of the project that they are dealing with. Planning means the completion of a project on paper. For this purpose the planning team should prepare method statements defining particularly how they are going to manage risk carrying activities and seemingly difficult ones (Eğilmezer, 2007).

Eğilmezer (2007) continued in her thesis as scheduling will help the project team simply to sequence the activities into a calendar by determining activity durations and critical activity interactions. This will also be helpful in resource utilization planning as well as cash flow arrangement for the organization.

Poor planning and scheduling will result in uncertainties during tender submissions or other contractual negotiations and as a result will increase the project risk of being over budget, schedule and under quality of the product (Eğilmezer, 2007).

A network diagram showing the critical path and clearly showing when each subcontractor is to start and complete the various portions of its work is a valuable tool. The general contractor and each subcontractor should be sure to understand the particular schedule used. Conflicts in the project schedule should be discussed when they arise. Resolution frequently necessitates compromise (The Associated General Contractors of America, 2003). A properly though out schedule allows a contractor and owner to properly coordinate the work and resources that are needed to timely complete the project (William, 2002).

The schedule should be continuously monitored, updated and issued to all project participants on a periodic basis (weekly or monthly depending on project size and complexity). When a schedule change is made, each subcontractor affected should be notified immediately. Dates for delivery and installation of heavy equipment should appear on the project schedule. Access for such equipment installation should be maintained accordingly (The Associated General Contractors of America, 2003).

Construction planning is a fundamental and challenging activity in the management and execution of construction projects. It involves the choice of technology, the definition of work tasks, the estimation of the required resources and durations for individual tasks, and the identification of any interactions among the different work tasks. A good construction plan is the basis for developing the budget and the schedule for work. Developing the construction plan is a critical task in the management of construction, even if the plan is not written or otherwise formally recorded. In addition to these technical aspects of construction planning, it may also be necessary to make organizational decisions about the relationships between project participants and even which organizations to include in a project. For example, the extent to which subcontractors will be used on a project is often determined during construction planning (Hendrickson, 1998).

The nature of the project schedule will normally depend on the cost of the project. A bar chart is are usually used on smaller projects. A bar chart simply indicates when specific activities will start date, their duration and finish date. The activities are plotted on a time scale. Since each specific activity on a bar chart is depicted as a straight line on the schedule, a bar chart is easy to understand (William, 2002). As the cost of the project increases owner’s start to demand a schedule that is based on a critical path method network (William, 2002).

Planning technique is vital at all the stages of a project life cycle. It is a continuous process because of the prevailing need to keep track of progress changes, delays or changes in technical conditions. Delays and changes in project implementation are controlled by the application of critical path methods (Nwachukwu and Emoh,2011).

It is important to understand the relationship between the commencement and completion of the various activities which comprise a construction project. Over the years, the CPM has become the common construction network schedule.

The basic steps in creating a CPM schedule include: (1) identification of the basic tasks or activities that must be performed to complete the project; (2) estimation of the duration of the specific activities; (3) making a determination of the logical flow of the work, which includes a determination of which activities must be completed before the subsequent ones can commence; and (4) inputting the information into the computer so that it can make the numeric calculations that lead to the formulation of the schedule (William, 2002). Scheduling softwares automatically completes calculations of the critical path then prepares a report with the dates and a graphic network portrayal of the schedule (William, 2002).

In developing a construction plan, it is common to adopt a primary emphasis on either cost control or on schedule control. Some projects are primarily divided into expense categories with associated costs. In these cases, construction planning is cost or expense oriented. The schedule must also indicate the costs and resources necessary to perform each activity. The contractor is required to breakout within each activity the separate values assigned to specific resources such as labor, equipment, and materials (William, 2002).

Within the categories of expenditure, a distinction is made between costs incurred directly in the performance of an activity and indirectly for the accomplishment of the project. For example, borrowing expenses for project financing and overhead items are commonly treated as indirect costs. For other projects, scheduling of work activities over time is critical and is emphasized in the planning process. In this case, the planner insures that the proper precedences among activities are maintained and that efficient scheduling of the available resources prevails.

Most complex projects require consideration of both cost and scheduling over time, so that planning, monitoring and record keeping must consider both dimensions. In these

cases, the integration of schedule and budget information is a major concern (Hendrickson, 1998).

A well thought out schedule are a valuable tool for organizing and coordinating the project work. The schedule also is used in determining when construction project resources, such as manpower and materials, will be required. If a project encounters delays, a well designed as-planned schedule will be the basis for analyzing what events impacted the completion of the project (William, 2002).

After the project is completed, "as-planned" versus "as-built" comparison can be done with selection of specific time periods when major delays occurred. It helps the analysis of how each delay period impacted the critical path activities, thus the project. Contractors must prove that the delay was excusable, compensable, critical, and non-concurrent for recovery for delay costs (William, 2002). Moreover, continuous data, rather than monthly or quarterly calculation, is often more useful for performance analysis and improvement. To report on-time delivery, for example, a group might be inclined to create a "percent late" metric showing what percent of deliveries on a monthly basis are late (Jordan *et al*., 2009).

3.3.4.3. Efficiency of Design. In Chua et. al.'s (1999) study, it is concluded that adequacy of plans and specifications for a proper design is the most outstanding critical success factor in construction projects.

All owners, architects and other design professionals are urged to uniformly accept responsibility for design related plans and specifications applying to construction projects. This design responsibility includes drafting complete specifications for inclusion in project bidding documents, initiating or approving all design-related additions, deletions and changes to project specifications and accepting ultimate responsibility for the safety and utility of all project design elements with decreased number of design errors. For design-build projects, the responsibility for the plans and specifications must be extended to the design-build entity in order to ensure project success (The Associated General Contractors of America, 2003).

The owner and architect must specify all performance and design criteria that professional services such as curtain walls and elevators, must satisfy. All such services must be specifically required in the contract documents and not be in violation of any applicable law. The architect, or other owner designated design professional, must approve all design related work performed by others and coordinate the overall design integration, safety of the public, compliance with codes and other legal or owner requirements as contracted.

Contractors and subcontractors must not be held responsible for the adequacy of the performance or design criteria indicated by the contract documents (Gibbs and Hunt, 2011).

The use of inappropriate or unclear specifications ordinarily increases costs to the owner. Higher bid prices, frequent change orders, and lost time usually result when design documents lack clarity or fail to adequately integrate the work of individual trades.

Review and approval of contractor submittals by the designer is another area that can create distress for the project team. Some designers will approve a submittal with an approval stamp that contains language absolving the designer of responsibility for any mistakes in the review process. During contract negotiations and initial meetings between the owner, designer, and construction team, this issue should be frankly discussed. Long experience demonstrates that a clear division of responsibility between the architect, as designer, and the contractor, as builder, offers an effective way to achieve fast, safe, and economical construction results (The Associated General Contractors of America, 2003).

3.3.4.4. Subcontractor Effectiveness. Subcontractors could contribute to as much as 0.9 of the total project value (Matthews *et al*., 1997), and the performance of subcontractors could inevitably affect the productivity and quality of a project (Hsieh, 1998). Personal particulars, for example their job title, number of years of experience in the engineering industry, type of organisation they are working for, and the size of their companies shows the level of performance of subcontractor (Thomas NG, 2007).

A contractor, is an individual or a group that contracts with another individual or organization for the construction, renovation or demolition of a building, road or other

structure. A general contractor is defined as the builder of the prime construction contract for the project (Lechler *et al*., 2010).

Several influential industry reports have pointed out that a decline in construction quality and productivity could be attributed to the performance of subcontractors who are entrusted to complete the actual works (Thomas, 2007).

As Lechler *et al*. (2010) states, the general contractor is responsible for the means and methods to be used in the execution of the project in accordance with the contract documents. A general contractor is usually responsible for supplying all material, labor, equipment, (engineering vehicles and tools) and services necessary for the construction of the project. The general contractor often subcontract part of the work to other persons and companies that specialize in these types of work. General contractors conducting work for government agencies are typically referred to as prime contractors.

The general contractor should only require a subcontractor on site when the project is ready for that subcontractor's work. The general contractor should strive to coordinate the project in such a manner as to permit subcontractors' work to proceed in a reasonable and logical sequence and manner (The Associated General Contractors of America, 2003).

Selection of right subcontractor and suppliers for a particular project is another critical issue for successful completion of the project. Any change in the suppliers and subcontractors during the project execution will cause losses in workforce, equipment and time. Selection process will include weighing up the importance of value for money, quality, reliability and service based on the project priorities and objectives. Having a strategic approach in supplier and subcontractor selection will also help companies to understand possible needs of potential customers. This will in turn provide more satisfied clients and increased industry reputation (Eğilmezer, 2007).

After completion of project, developers should evaluate performance of subcontractors for future projects. They ought to express their opinions for large-scale skilled subcontractors and they indicate their perception of the target level and baseline level for each quantitative indicator for subcontractors (Thomas, 2007).

3.3.4.5 Efficiency on Coordination and Communication Between Project Participants

Coordination mechanism is identified as one of key competitiveness indicators according to Chan *et al*.(2004).

Effective coordination among developers, professionals, specialist contractors and labours are critical to the successful project management (Wong *et al*., 2006).

BSCs provide a means of forming connections and ensuring that all departments are coordinated and working together toward the achievement of company goals. They also ensure that strategic objectives are clearly understood below the executive level, thereby making it possible for departments to align their operations with high-level goals (Rothberg and Morrison, 2012).

The need for adequate communication channel is extremely important in creating an atmosphere for successful implementation of a building project. Communication could best be described as the life wire of any project implementation success. There should be prompt communication to the building or project mission, good information flow with the top management, the building or project scheduled plan, always consulting the client, adequate communication to personnel issues like recruitment, motivation and training etc, good understanding of the technical task and staff, sequential monitoring of all work and processes given feedback to the stakeholders, always active in communication with trouble shooting indicators, communicating with the client at all times sensitizing him with every issue that will enable him to accept the product after execution (Nwachukwu, 2011).

Communication and teamwork are vital components of effective management of project human resources and are necessary to accomplish project objectives successfully (Verma, 1995).

Coordination and communication between employees of a project is one of most important elements of successful projects. Time spent on re-work and number of conflicts arising from lack of coordination between project participants affect the state of affairs of project crucially.

Documentation of schedule and a communication plan must be comprehensive. Every tier of contractor, subcontractor and supplier must have access to complete plans,

specifications, and the project schedule to be fully informed of risks involved in non-performance. Any subsequent variation to the projected schedule must be communicated up and down the project ladder. Without this communication, significant risk in project expansion or contraction is assumed by those who do not communicate (The Associated General Contractors of America, 2003).

Everyone who is involved in the achievement of the targets set, must have a clear understanding of his/her part in the achievement of the target. This will create motivation among employees and will lead to a more effective and efficient work, since everyone is directed to certain tasks. A good communication plan must be created to inform all employees about the elements of the BSC. It is also necessary to inform stakeholders about the BSC, and convince them about the positive outcomes of it.

Communication within an organization may be either horizontal or vertical. Horizontal communication is the communication within a single level in the organizational hierarchy; that is within managerial level, institutional level, etc. Vertical communication on the other hand occurs between different levels including departmental information flow. Both means of communication have utmost importance to maintain the delivery of the right information to the right target at right time (Eğilmezer, 2007).

According to Weitzel and Johnson (1989), lower level workers such as customer – service personnel, sales personnel can monitor change in expectations of customers, availability of resources and level of competitive advantage of the company much before than the upper level management. This makes sense since these personnel are the ones directly in contact with the third parties such as the customers and suppliers. Upper management will be aware of the current situation after the severe conditions; if exists, appear on the financial records (Eğilmezer, 2007).

3.3.4.6. Effectiveness of Consultancy Services. Effectiveness criteria for consultancy services proves to be very useful for assessing the quality of a project.

A company which having the qualification to supervise the real estate project is chosen as supervisor. It ensures that real estate developer and the contractor adhere to the

contract. Supervisors make sure the project is on planning schedule and within budget. They guide and supervise the developer handing the project. When the project is completed, they test the quality (Lechler *et al*., 2010).

Real estate brokers and sales agents are important part of real estate planning and saling sales. They do the macroeconomic market survey, competition project survey, the expert interview, and the target customer interview. They communicate frequently with real estate developer. After that, they devise the details of a sale strategy. They then select an advertising company to market the product, and, sometimes, recruit new employees to sell the product. Brokers also help the prospective buyer to arrange any financing they need (Lechler *et al*., 2010).

Work with an experienced real estate attorney is needed to represent the manager and project (Hui, 2010).

It is distinguished five phases in consultancy assignments in Caluwe's article (2004). The entry phase, in which contact is made and contracts are negotiated between the client (system) and the consultant. This phase results in an assignment/ contract or not. The next phase is the diagnostic phase, in which the problem is explored, data are gathered, and a common definition of the problem develops. In the next phase solutions are developed, alternatives are considered and a decision is made about one approach/ solution. The fourth phase is implementation; in this phase the involvement of the consultant can vary: not involved to high committed. The fifth phase is the end: evaluation, follow-up and/or report.

Phillips (2000) distinguishes six performance indicators for consultants. The satisfaction /reaction directly involved in the consulting intervention, the actual learning taking place for those individuals who must implement or support the process, the success of implementation and the utilisation of the consulting intervention solution, the change in the business impact measures directly related to the consulting intervention, the actual cost versus benefits of the consulting intervention and important intangible benefits not utilised in the benefit-cost formula (knowledge base, job satisfaction, work climate, co-operation, customer complaints, decisiveness etc.).

According to Caluwe (2004), the important criteria can be arranged as, objectives achieved, involvement in assignment, frequent communication, solution found, expertise of consultant, learning by the client system, creativity, budget frame followed, time frame followed, cooperation improved, equivalence of principal and consultant, working more efficiently and carried out required sources. As Caluwe mentiones, consultant is one of important element for a project.

3.3.4.7. Level of Compliance with Government, with Laws and Regulations**.** Each company is established in a particular country and region, which is directly effective on its organizational operations and productions. Key environmental effects on the organization can be in different dimensions such as administrative/legal, political, economical and social (Eğilmezer, 2007).

Government might pay attention to whether the contracting company has followed the local laws and legislations and what influences the contracting company has brought to local environment, economics and society. So the satisfactory degree indicators of this part could include environmental protection investment rate (money amount of environmental protection/ project costs), development and operation of pollution methods, recourse conservation and using rate, social and economical affects to local area, and the abidance condition of the project to local laws and legislations (Hui, 2010).

The government is the body outside any organization has the authority to make and to enforce laws, regulations, and rules. Recently, there has been increasing awareness of the role of government in business. For example, in China, when a real estate project is carried out, the developers must obtain permission from many government agencies: the Land and Resource Bureau, Demolition and Remove Bureau, Urban Construction Bureau, Environmental Protection Administration, Development and Reform Commission, Urban Planning Bureau, House and Land Bureau, Administration of Industry and Commerce Bureau. They are responsible for purchasing the land, protesting the environment, preserving history of the area, city development planning, assuring the housing legalities and protecting the customer's benefits (Lechler *et al*., 2010).

Relations of company with government is very important for the progress of the real estate project. According to Dikmen *et al*. (2010), construction industry is highly fragmented and very sensitive to economic recessions. General national economic situation, level of industry, policy of the government, inflation, unemployment are the factors that real estate development companies should research before commencing to invest.

At the planning stage, real estate developer and bank are the key stakeholders of project. Developer should get the permission from government. If they can't get the permission, project can't be carried out. After they do this, they have to complete the land resource, prepare for starting the project. At this stage, water supply, electricity supply, transportation connection should be complete. Then make the land flat to ready for construction (Lechler *et al*., 2010).

Change in politics will also affect the overall economy of the country. For example, for a specific company awarded profitable projects by the government using its good relations with the politicians, forthcoming elections would be a disadvantageous event in case of change in politics (Eğilmezer, 2007).

3.3.4.8 Performance on Technology Usage. Technology is one of most strategic driving forces for businesses according to Nourse and Roulac's (1993, cited in Stadlhofer, 2010).

In this ever-changing world, information technology (IT) is a must for the survival of a company, and the functions of IT department is becoming increasingly important. Information technology (IT) involves computers, software and services, but good IT must synthesize these elements to achieve the goal of an organization. As a demand to collect, process, store, and disseminate information grows, the functions of IT department is becoming increasingly important (Lee *et al*. 2008).

Dikmen *et al*. (2005) concluded in their research that besides experience, technical resources and their effective usage within the construction company such as effective IT

systems are key determinants of organizational effectiveness for construction companies (Eğilmezer, 2007).

Stewart and Mohamed (2001) argue that construction organizations are under constant pressure to invest in and implement state-of-the-art IT tools to more effectively manage their construction projects. Information technology systems provide coordination between project participants via server and help on accessibility to files easily. Liu and Wan added that information technology support is provided to handle, manage and analyze the data.

Performance measurement is frequently misperceived as a technical issue requiring an elaborate technology infrastructure. Corporate real estate leaders may become sidetracked by how, rather than what, to measure and overwhelm themselves with the need to build an IT solution to instigate the system. In this way many measurement programs end before they begin (Jordan *et al*., 2009).

3.3.4.9. Achievement on Health and Safety on Site. The construction industry is one of the world's major industries. Its achievement in rebuilding areas devastated by both natural and man-made disasters, and in providing power, services and communications to meet the rising needs and expectations of people throughout the world, has conferred great benefits on the human race. Despite mechanization, construction remains a major employer of labour – it often employs between 0.09 and 0.12 of a country's working population, and sometimes as much as 0.20 (International Labour Organization, 1995).

In this major industry, success is a hard and important point for prosperity of companies. It would be a mistake to underestimate the importance of health and safety in construction for a successful project.

Safety organization, site planning and layout, personal protective equipment, first aid, working environment (noise, lighting, hazardous substances, chemical substances), electrical equipment, ergonomy, movement of materials, vehicles are subjects of safety, health and welfare on construction site (International Labour Organization, 1995).

Due to the dangerous nature of construction work, the safety legislation that has been put in place contains harsh penalties for the most serious offenders. In order to protect the workers and the employers, managers and workers must follow uniform safety procedures so that everyone is safe. A breakdown in adherence to safety procedures can result in worker injury and even death (Bianca, 2007).

Contributing to the high rate of accidents are those characteristics of the industry which distinguish it from the rest of the manufacturing sector. These are (International Labour Organization, 1995):

- the high proportion of small firms and of self-employed workers;
- the variety and comparatively short life of construction sites;
- the high turnover of workers;
- the large numbers of seasonal and migrant workers;
- exposure to the weather;
- the many different trades and occupations.

Because it is hard to create safe work zones in dynamic job sites, workers have to be doubly cautious to observe all safety practices on the job (Bianca, 2007). The best and most common way to ensure preventing accidents is by creating a construction safety plan for the project. The plan is supposed to detail the potential dangers on site and the measures that are going to be taken in order to minimise or completely remove dangers.

The safety of the general public is also important because many construction job sites occur in busy public areas. For example, in the street construction zone, motorists, pedestrians and bicyclists are depending on safe conditions. If workers are not following safety protocols such as how to direct traffic around the work zone safely, lives of innocent bystanders are at risk as well as construction worker lives (Bianca, 2007).

3.3.4.10 Benefiting from Past Project Experience. Transferring construction experience between projects can make significant contributions to achieving the project objectives of cost, shedule, quality and safety. The knowledge gained allows construction teams to repeat the successful techniques and avoid the problems of previous projects. Without

transferring experience, the construction industry does not learn and improve as it can and should (Reuss and Tatum, 1993).

Project experience includes all aspects of project development, beginning with the identification of new business opportunities and continuing on through design, management and construction.

As Woodcock (2004) states: “The capture, analysis and transfer of knowledge known as knowledge management, gained throughout the project life-cycle, as an aid to adding value and improvement to overall project planning and delivery”.

Construction experience is knowledge based on methods to perform construction, field operations and results of prior projects. This knowledge provides technical, operational, contractual, or administrative guidance for subsequent projects. Construction experience transfer is the use of knowledge from lessons learned on prior projects to maximize achievement of current project objectives (Reuss and Tatum, 1993).

To transfer experience between similar projects, construction professionals have used techniques ranging from formal annual meetings to impromptu telephone calls to the home office. These forums can be effective but have inherent limitations related to timeliness and broad scope in the former case and to the individual’s capacity for recollection in the latter case. Recent efforts to transfer experience include ‘project closeout’ or ‘lessons learned’ reports to capture and retain information, in both text and graphic form (Reuss and Tatum, 1993).

Data collection for documentation must be made as simple as possible (Chan, 2004). Document transfer and handling, archiving, information transfer about subcontractors about projects completed are important factors for benefiting from past project experience.

Many firms including Bechtel, Chevron and Fluor Daniel are using programs for transferring information for future projects. Bechtel Corporation, for example, has a corporate Constructability Lessons Learned Program which involves collecting information from individual pojects and entering the lessons into a corporate database for

storage and subsequent retrieval. The database exists in three different formats. These include text files that are searchable by key word, a PC based database that allows searching by project type, discipline and other key fields, and a new Online Reference Library that will permit storage and retrieval of both text and graphical data (Reuss and Tatum, 1993).

To transfer experience between projects, managers often transfer people. Many operations and project managers strongly desire new methods. They can easiily identify many examples of beneficial transfer of construction experience between projects, but are very frustrated that intercention by senior management is often required to make this happen (Reuss and Tatum, 1993).

The researchers located and reviewed available types of documentation regarding experience on specific projects and the types of information needed for construction experience transfer. This information included feedback to design from engineer-constructors, technical issues described by design-build contractors, experience in contract management in owner's organizations, and experience with risk management, new materials, and difficult installations from management contractors (Reuss and Tatum, 1993).

The project should be assessed to determine if the proposed benefits were delivered and what the impact of the project was on the business. Lessons should be documented for future reference (Lechler *et al*., 2010).

4. RESEARCH METHODOLOGY

In the model, there are various factors contribute to project success and they are classified in a hierarchical network. Due to this fact, the methodology to be used is needed to be effective in analyzing the data on a hierarchical interaction. The most applicable tool to analyze the model of the study has come out to be ANP, because of the hierarchical network of the research model and the existing interdependencies between top level criteria and the lower level factors.

According to Saaty (1996), ANP enables dependencies both within a cluster which is a main criteria (inner dependence) and between clusters (outer dependence) while AHP does not allow interdepencies between the main components of the model. AHP is the general form of ANP. It is a comparison method which allows subjective as well as objective factors to be considered and uses pair-wise comparisons of the performance indicators based on their relative performance against the criteria (Dey, 2004).

AHP structures the multivariate decision making problems into a hierarchical structure and analyze the factors contributing to the problem systematically within the hierarchy to determine the priorities of the factors relative to each other. In doing so, the most important feature of AHP is that it accepts that there is no interaction among the factors located in the same level of the hierarchy; that is, the model does not take into account the influences among the same level elements (Eğilmezer, 2007). That is why ANP is utilized for this research.

The ANP is the most comprehensive framework that allows one to include all the factors and criteria, tangible and intangible that has bearing on making a best decision. In brief, ANP model consists of the control hierarchies, clusters, elements, interrelationship between elements, and interrelationship between clusters (Saaty, 1996).

4.1. Analytic Hierarchy Process

According to Yurdakul (2003), the main task of multicriteria approaches is to determine the relative importance of areas of success in the long term performance of a project or a firm. Without applying a multicriteria approach, it is not possible to overcome

the problem of heterogeneity of the measurement units that makes it difficult to assess whether a project successful or not.

AHP which was developed by Saaty (1980) is used for the simultaneous technical, environmental, and socio-economic analysis (cited in Dey, 2004). AHP was used for as a part of the project analysis model because (Dey, 2004):

- The factors that lead to project selection are both objective and subjective.
- The factors are conflicting, achieving of one factor may sacrifice others.
- Some objectivity should be reflected in assessing subjective factors .

AHP is based on comparisons that are used to define the importance value of the contribution factors that affect the project success using a predefined comparison scale (Erbaşı and Parlakkaya, 2012).

BSC concept can be intergated to AHP. BSC applies the AHP theory to structure the hierarchy and relative weightings of developed performance perspectives and indicators (Stewart and Mohamed, 2001).

According to Lee *et al*. (2008), the procedures of the AHP involve six essential steps:

1. Define the unstructured problem and state clearly the objectives and outcomes.
2. Decompose the complex problem into a hierarchical structure with decision elements.
3. Employ pairwise comparisons among decision elements and form comparison matrices.
4. Use the eigenvalue method to estimate the relative weights of the decision elements.
5. Aggregate the relative weights of decision elements to obtain an overall rating for the alternatives.

The AHP is a theory of measurement through pairwise comparisons and relies on the judgements of experts to derive priority scales. The comparisons are made using a scale

of absolute judgements that represents, how much more, one element dominates another with respect to a given attribute (Saaty, 2008).

The AHP provides by Saaty (1980) a flexible and easily understood way of analyzing complicated problems. AHP is based on the following three principles: decomposition, comparative judgment, and synthesis of priorities. According to Baker *et al*. (2001), the AHP is a systematic procedure for representing the elements of any problem, hierarchically. It organizes the basic rationality by breaking down a problem into its smaller and smaller constituent parts and then guides decision makers through a series of pairwise comparison judgements to express the relative strength or intensity of impact of the elements in the hierarchy. These judgements are then translated to numbers (ratio scale estimates).

Dyer and Forman (1992) describe the advantages of AHP in a group setting as follows:

- both tangibles and intangibles, individual values and shared values can be included in an AHP-based group decision process;
- the discussion in a group can be focused on objectives rather than alternatives;
- the discussion can be structured so that every factor relevant to the discussion is considered in turn; and
- in a structured analysis, the discussion continues until all relevant information from each individual member in a group has been considered and a consensus choice of the decision alternative is achieved.

AHP is a useful and a suitable technique to aid in the prioritization of elements (Barclay, 2008). It is suitable for decisions with both quantitative and qualitative criteria. It puts them in the same decision context by relying on relative comparisons instead of attempting to define absolutes (Baker *et al*., 2001).

4.2. Analytic Network Process

ANP is a new tool for multi-criteria decision-making but can also be applied in academic research to prioritize factors or criteria (Cheng and Li, 2007). The ANP that can accommodate interactions among the model parameters is selected as the most appropriate tool for this research. ANP is the generalised form of the AHP, which is known as a powerful and flexible method to assist decision-makers. The ANP is utilised to compute the importance weights of variables on project success through interviews and discussions with experts (Dikmen *et al*., 2010).

The ANP is the most comprehensive framework that allows one to include all the factors and criteria, tangible and intangible that has bearing on making a best decision. It provides a way to input judgments and measurements to derive ratio scale priorities for the distribution of influence among the factors and groups of factors in the decision. Since it allows including the interaction among the factors within the factors in the same level appearing in the same or different sub-factors of a higher-level criteria, it was the best model that would be utilized in analyzing the research data. The ANP allowed analyzing the research model in a hierarchical structure containing inner interdependencies, which was crucial to reach the most comprehensive and correct result (Saaty, 1996).

The ANP is formed of two parts. The first one includes a control hierarchy or network of criteria and sub criteria that controls the interactions in the system under study. The second is the network of influences among the elements and the clusters. In the network, a component may influence other elements in the same component which is called as the inner dependence and those in other components which is called as the outer dependence with respect to each of several properties. In the end of the analysis, it is desired to determine the overall influence of all the elements .

ANP uses a supermatrix to deal with the relationship of feedback and interdependence among the criteria. If no interdependent relationship exists among the criteria, then the pairwise comparison value would be 0. If an interdependent and feedback relationship exists among the criteria, then such a value would no longer be 0, and an unweighted supermatrix would be obtained (Tseng, 2010). According to Tseng (2010), the

evaluation of performance evaluation can be considered as a decision-making problem of complex dependences and interactions.

The ANP approach, also called System-with-Feedback (SWF) and Supermatrix in the literature, can incorporate feedback and interdependent relationships among and within the levels of components (Yurdakul, 2003).

The determination of relative weights in ANP is based on the pairwise comparison as in the standard AHP (Saaty, 1980). With respect to any criterion pairwise comparisons are performed in two levels, the factor level comparison and the cluster level comparison.

According to Dikmen *et al*. (2010), ANP is a general theory of relative measurement used to derive composite priority ratio scales from individual ratio scales representing relative measurements of the influence of elements that interact with respect to control criteria. ANP can be used as an effective tool in those cases, where the interactions among the elements of a system form a network structure. So, each variable on each level should be defined together with its relationship with other elements in the system.

A conceptual ANP model is designed in the thesis based on BSC perspectives with its new form. The first step was to construct a conceptual model based on a comprehensive literature review. Factors of similar nature are grouped under four categories which are chosen as BSC pespectives.

Categorisation of the variables leads to a two-level hierarchy, where the top-level elements (criteria) are decomposed into lower-level attributes (nodes) and as mentioned above, top-level criteria are composed of four groups of parameters.

4.3. Applications of AHP and ANP

In construction industry, AHP has been often used for technical assessment, construction safety, project evaluation, project risk analysis, and intelligent building design evaluation.

AHP is utilized for assessment of the risk involved in international projects, used to determine the first and second level weights on calculation of the construction safety index and an accompanying set of tools that can be used to audit the effectiveness of a construction firm's safety management system. It helps on analysis of the selection of intelligent building systems for which two surveys are designed, a general survey, and an AHP survey, to achieve the objectives. The first general survey aimed to collect general views from intelligent building experts and practitioners to identify the perceived critical selection criteria, while the AHP survey was conducted to prioritize and assign the important weightings for the perceived criteria in the general survey. AHP as an example, studied bridge risk assessment which involves multiple assessment criteria, such as safety, functionality, and sustainability (Sipahi and Timör, 2010).

Researchers use AHP in various industrial applications. Partovi *et al*. (1990) used it for operations management decision-making. Dey *et al*. (1994) used it in managing the risk of projects. Korpela and Tuominen (1996) and Dey (2002) used AHP for bench marking logistic operations and project management, respectively. Dey (2004) applied AHP for deriving risk-based maintenance method for oil pipelines. In this study, an AHP-based approach to evaluate and select projects has been demonstrated.

The AHPs has been used in various settings to make decisions (Saaty, 2008) as follows:

- In (2001), it was used to determine the best relocation site for the earthquake devastated Turkish city Adapazari.
- A company used it in 1987 to choose the best type of platform to build to drill for oil in the North Atlantic. A platform costs around 3 billion dollars to build, but the demolition cost was an even more significant factor in the decision.
- In 1999, the Ford Motor Company used the AHP to establish priorities for criteria that improve customer satisfaction. Ford gave Expert Choice Inc, an Award for Excellence for helping them achieve greater success with its clients.
- The AHP has been used in student admissions, military personnel promotions and hiring decisions.

- Applications of AHP have been dominant in manufacturing, followed by the environmental management and agriculture field, power and energy industry, transportation industry, construction industry, and healthcare. Other remarkable application fields include education, logistics, e-business, IT, R&D, telecommunication industry, finance and banking, urban management, defense industry and military, government, marketing, tourism and leisure, archaeology, auditing, and the mining industry (Sipahi and Timör, 2010).

Selection, evaluation, benefit-cost analysis, allocations, planning and development, priority and ranking, decision making, forecasting, and health and related fields are application categories of AHP (Omkarprasad and Sushil, 2006).

AHP has been used as a managerial decision tool in many industries for strategy evaluation, performance assessment, product and process design, risk evaluation, system selection, cost/benefit analysis, quality evaluation, and measurement of objectives (Sipahi and Timör, 2010).

Although ANP is not as widespread as AHP, it has recently been applied to several problems in construction including contractor qualification, evaluation of the environmental impact of various project alternatives (Chen *et al*., 2005), selection of project locations (Cheng *et al*., 2005) and performance assessment of construction alliances (cited in Ozorhon *et al*., 2007).

As Yurdakul (2003) states, a disadvantage of the application of the ANP approach is that it requires more calculations and formation of additional pairwise comparison matrices compared with the application of AHP alone. One has to keep track of matrices and comparisons carefully.

As Sipahi and Timör (2010) state, a great interest in the study of AHP and ANP is obvious in the area of manufacturing. Supplier selection, supply chain evaluation, location selection, system selection or evaluation, and strategy evaluation are the most common problems tackled in the manufacturing area. For example, by using AHP, the importance of four categories of success factors of conflict management in collaborative new product

development, namely relationship management, conflict handling system, new product development, process management, and communication are prioritized.

According to Sipahi and Timör (2010), during the years 2005-2009, use of the AHP technique has increased exponentially. However, they expect that ANP will gain more popularity in the future, as the benefits of ANP become better understood.

In the application of the AHP and ANP approaches, information is decomposed into a hierarchy of components and subcomponents. They differ from other multiattribute approaches in the calculation of weights (importance) of components within the hierarchy (Yurdakul, 2003).

The ANP method may transform qualitative judgments into quantitative values. This method has had only a few applications in academic literature. It has been applied to project selection, production planning, and strategic decision (Tsai and Chou, 2009).

As an example, it is proposed an integrated process that allows manufacturing systems to construct a performance measurement model. Performance criteria from the literature and an expert questionnaire were utilized prior to building the performance measurement model. AHP and ANP were utilized to determine the weight of each criterion when generating the performance model for manufacturing systems (Sipahi and Timör, 2010).

According to the results of Sipahi and Timör (2010), AHP in health is used for cost/benefit analysis, hospital location selection, nutrition, risk assessment, and rehabilitation problems. It is used in power and energy industries also, for project evaluation and selection. For example, AHP i used on evaluation of the impact of non-radioactive emissions in the most commonly used types of power plants to synthesize objective and subjective criteria. Besides, in transportation industry AHP has been utilized to conduct studies on improving ship registry, passenger security checks in airports, port security, and transportation investments such as for identifying important factors to improve passenger security checks at airports. The researchers prepared a survey questionnaire to gather data from experienced screeners and supervisors working at

screening points around the airport. The gathered data was analyzed by using the AHP methodology to formulate a model.

ANP, have been utilized by many researchers as the analyzing tool. Dikmen et. al. ,2005 used ANP in their study on international market choice, whereas Dağdeviren et. al. (2005) formed a model to identify total work load level of employees by ANP. Niemira et. al (2004) made use of ANP in their study of forecasting financial crisis. Chen and Wong (2005) utilized ANP in developing a model for environmentally conscious construction planning. As a last example of ANP utilization in literature, Cheng and Li's (2005) study on project selection in construction industry by ANP can be indicated (Eğilmezer, 2007).

Cheng and Li (2007) presented a method for applying ANP in process models decision-making. It involves the formation of the super-matrix that specifies the relationships between elements within the process model and the generation of limit matrix that prioritizes the relative weights for the elements and Dey (2006) utilized AHP for project selection as a decision-making method.

Chen and Khumpaisal (2009) determined criteria and valuation elements and made use of ANP for risk assessment. Dikmen *et al*. (2010) specified factors governing business failure and used ANP. They grouped factors according to resembling each other without any concept like BSC.

Yurdakul (2003) in his paper, provides a multicriteria performance measurement model to measure a manufacturing firm's performance in terms of areas of success. He used ANP for hierarchical structure of the performance measurement model. His model provides not only the performance scores, but also weights of the areas of success with the help of ANP.

4.4. Applications Integrated With BSC

Tseng's study (2010) conducted a review of the literature to generate 22 criteria along with four BSC aspects to measure performance evaluations of universities. Also, it integrated ANP to analyze the proposed BSC evaluation model that prioritizes the relative

weights of BSC aspects and criteria. With the BSC, universities can evaluate their management in terms of their effectiveness in creating value for students, developing internal capabilities, and investing in the people and systems that are necessary to improve future performance. In his case study, four aspects of BSC for a private university of science and technology in Taiwan will be evaluated: the financial aspect, student aspect, internal operations aspect and learning and growth aspect.

Ravi *et al*.(2005) analyze alternatives in reverse logistics for end-of life computers by an ANP and BSC approach. The ANP structures the problem related to options in reverse logistics in a hierarchical form, and the dimensions of reverse logistics are taken from four perspectives derived from the BSC approach. With the ANP, the interdependencies among criteria, sub-criteria and determinants for the options can be considered. With the BSC, financial and non-financial, tangible and intangible, internal and external factors can be linked. As a result, a combination of BSC and ANP-based approach provides a more realistic, accurate and holistic framework for the problem.

Stewart and Mohamed (2001) propose a tiered BSC framework for IT/IS performance evaluation in construction by applying AHP and multi-attribute utility theory (MAUT). The AHP is used to structure the hierarchy and relative weightings of performance perspectives, indicators and measures, and MAUT is adopted to facilitate the obtained performance measurements to commensurable units.

Lee *et al*. (2008) used four original BSC perspectives for evaluating performance of IT department in the manufacturing industry with the help of FAHP (fuzzy analytic hierarchy process) to calculate importance weihts of 14 performance indicators.

Erbaşı and Parlakkaya (2012) identified business strategies and classified them based on BSC perspectives. They listed performance indicators and used AHP for solution with comparisons.

Tsai and Chou (2009) searched for selecting optimal management systems for sustainable development in small and medium enterprises through four management systems (ISO 9001, ISO 14001, OHSAS 18001, and SA 8000) and employed ANP to

obtain the criterion weights. They used BSC perspectives to define the criteria and 4 alternatives on ANP which in their research was proposed to overcome the problem of dependence and feedback among criteria or alternatives.

Mathematical programming, quality function deployment (QFD), meta-heuristics, SWOT analysis, and data envelopment analysis (DEA), decision tools that were commonly combined with AHP, were emphasized in Ho's (2008) article.

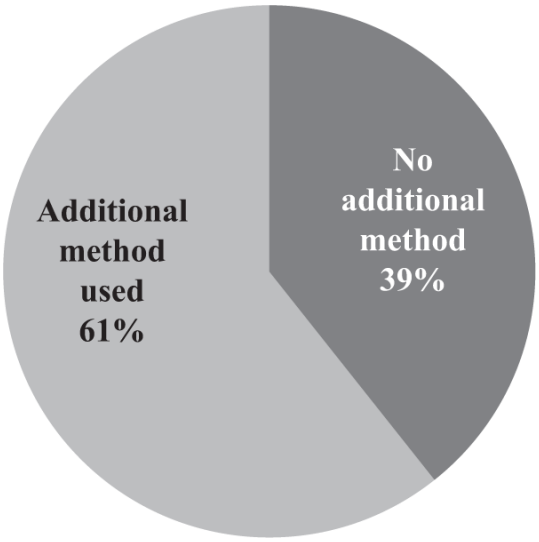


Figure 4.1. Percentages of integrated methods (Ho, 2008).

Tools that were commonly combined with AHP were goal programming, DEA, Delphi method, BSC, factor analysis, fuzzy logic model, genetic algorithm, and SWOT Analysis (Sipahi and Timör, 2010).

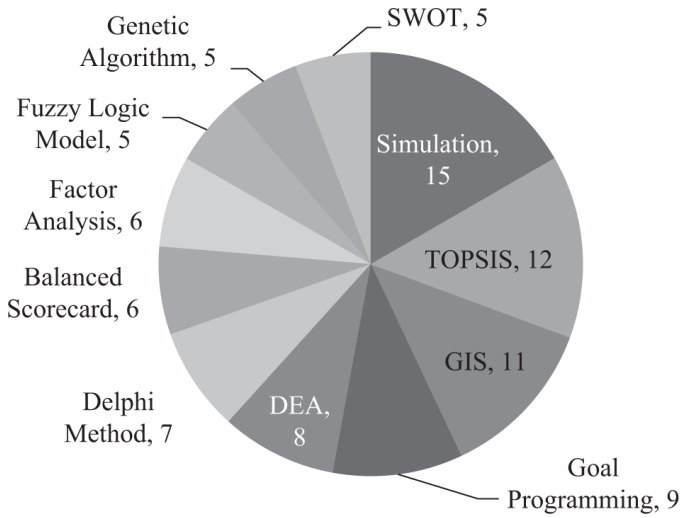


Figure 4.2. Integrated methods used (Sipahi and Timör, 2010).

4.5. Proposed Balanced Scorecard Model

The BSC is a multi-criteria evaluation concept that highlights the importance of performance measurement (Tseng, 2010). Project scorecard (PSC) is based on technical specification requirements and the requirements related to project management. PSC is a way to manage and implement the project through a set of measurable project's goals essential to the project success. These measurable goals are determined through a set of KPIs (Katic, 2009).

The PSC can be structured into three elements: levels, cause-and-effect relationships, and indicators. The levels are business strategies, strategic project goals, project objectives (scope, quality, time, and costs), project processes and project potentials (team members, infrastructure, external service provider) (Niebecker *et al*., 2008).

4.5.1. Model Construction

The initial aim of this research was to identify the factors contributing to success of real estate projects. For this purpose, an comprehensive literature survey was conducted and an detailed list of variables is prepared.

BSC has, in its original form, four perspectives as Financial, Customer, Internal Business Processes and Learning and Growth. In the thesis these perspectives are converted to fit the features of real estate projects. Parallel factors are grouped under four categories namely the “Financial”, “Customers”, “Value Adding”, and “Operational” perspectives.

Categorization of the identified variables leads to a two-level hierarchy, where the top level elements (cluster) are decomposed into lower level attributes (node). As mentioned above, top level criteria which is “Project Success” is composed of four groups of parameters including “Financial”, “Customers”, “Value Adding”, and “Operational”. Based on the concept of the BSC, review of real estate projects performance evaluation literature, a real estate project success factor hierarchy is constructed as in Table 4.1.

Table 4.1. Success Evaluation Hierarchy of Real Estate Projects.

Goal	Perspective	Success Criteria
Success of a real estate project	Financial	Accuracy of cost estimation
		Effectiveness of cost control
		Effectiveness of marketing
		Effectiveness of financial resources
		Accuracy of risk assessment
	Customer	Level of customer satisfaction
		Functionality of the space
		Attractiveness of project location
		Environmental friendliness
	Value Adding	Level of satisfaction of project employees
		Level of employee competency
		Level of contribution to business value
		Level of innovativeness of the project
	Operational	Effectiveness of leadership
		Effectiveness of construction schedule
		Efficiency of design
		Subcontractor effectiveness
		Efficiency on coordination and communication between project participants
		Effectiveness of consultancy services
		Level of compliance with government, with laws and regulations
		Performance on technology usage
		Achievement on health and safety on site
		Benefiting from past project experience

4.5.2. Data Collection

Although the BSC conceptual framework has been widely accepted in the business community, the proper method of implementing the framework remains an issue. For instance, Leung *et al*. (2006) incorporated a wider set of non-financial attributes into the measurement system of a firm by using the AHP and its variant, the ANP, to facilitate the implementation of the BSC.

The initial aim of this research was to identify the factors contributing to success of real estate projects. For this purpose, an comprehensive literature survey was conducted and an detailed list of variables is prepared. The factors are classified under four

perspectives like in BSC concept. After the framework based on this concept is formed, then a team of ten experts was established to determine the interrelations among the model parameters. Evaluation of the relative importance weights is made by adopting ANP approach. Final model is achieved through brain storming sessions.

The method used for the purpose of data collection is the brain storming sessions that brings all of respondents together to have consensus for the scoring of matrices. To reach a common values, experts were brought together to assess the matrices. The use of brain storming sessions in this study, as an aid to ANP, was to achieve a more reliable model through consensus among experts.

The data which is used in ANP is obtained with the help of respondents. Respondents were preferred to be experienced civil engineers who had completed real estate projects through their career. Respondents are a project manager, two project coordinators, a technical office chief, two technical office engineers, and two site engineers.

The importance weights computed by ANP are used to designate the success of ten completed real estate projects and the findings are discussed. The ANP can be used as an effective tool in those cases, where the interactions among the elements of a system form a network structure (Saaty, 1996). In the current research study, ANP has been chosen as the most appropriate method as the project success model contains a number of interrelated criteria. The ANP based model involves three steps including data collection and model construction; pairwise comparison matrices of interrelated variables; and supermatrix formation and importance weights of the nodes and clusters. Finally, ten completed real estate projects are tested as case projects to determine their success to examine the performance of the research. Each step is discussed in detail below.

A simple network contains clusters, nodes, and connections or links. When a parent node is linked to nodes in another cluster, these are known as its children nodes. The children nodes are to be compared with respect to the parent node. When a parent node is linked to children nodes in another cluster, a line or link appears between the clusters with

an arrow on it from the cluster containing the parent node. When the parent node and children are in the same cluster there will be a self-loop on that cluster.

4.5.3. Pairwise Comparison Matrices of Interrelated Variables

As defined by Saaty (1996), ANP is a general theory of relativistic computation which is utilized to compute priority ratio scales from separate scales representing relative measurements of the influence of elements that interact with respect to control criteria. Comparisons between nodes, among clusters are performed in this step.

In ANP model, elements are dependent and responding to each other, so that the structure is a dependent and feeding-back network. Thus, it is needed to compare two elements with each other (Tang and Li, 2009). The experts were requested to determine the interrelations among the model parameters.

The hierarchy diagram which is prepared as the result of the literature review was presented to experts as the first part. The diagram and the BSC concept were explained to them. They were asked to determine the factors that influence on other factors based on their own experiences before they examine the matrices. Determining the interaction among the factors was the requirement for the ANP application for pairwise priority decision matrices to be prepared.

Pairwise relation decision matrix formed based on node connections in the hierarchy was wanted to be filled by the experts who will participate to the study with the help of their real estate project experiences.

The matrix was formed of the nodes as the column and the row elements. In the matrix, for each row element it was asked to the respondent whether the row element was effective on the column element. The matrix was filled with plus signs. The plus signs were required to be placed to the intersection of a row element and a column element where the row element is effective on the column element. To explain the matrix filling, an example below was provided to the respondents.

Table 4.2. Example Matrix.

Pairwise Relation Decision Matrix	**A**	**B**	**C**
A			+
B	+		+
C			

Explanation of the matrix: According to the matrix above, factor A is effective on the column factor C. Row factor B is effective on both of the column factors, whereas the row factor C is not effective on the any column factor. Factors were not examined for influence on itself. In the matrix, indirect influence will not be presented by plus sign, only direct influences will be shown in matrices.

This step aims to perform pairwise comparisons among the clusters, as well as pairwise comparisons between nodes, as they are interdependent on each other. In ANP, like AHP, pairwise comparisons of the elements in each level are conducted with respect to their relative importance towards their control criterion.

Experts that are respondents of the study were asked in second meeting to assess the relative importances of factors.

To make comparisons, it is needed a scale of numbers that indicates how many times more important or dominant one element is over another element with respect to the criterion or property with respect to which they are compared (Saaty, 2008).

The pair-wise comparisons are made using a nine-point scale as seen in Table 4.3. A point of 1 indicates that two components contribute equally to the objective, where 9 has an explanation as the importance of one over another affirmed on the highest possible order.

Table 4.3. Nine-Point Scale (Saaty, 2008).

1	Equal Importance	Two activities contribute equally to the objective
2	Weak or slight	
3	Moderate importance	Experience and judgement slightly favour one activity over another
4	Moderate plus	
5	Strong importance	Experience and judgement strongly favour one activity over another
6	Strong plus	
7	Very strong or demonstrated importance	An activity is favoured very strongly over another; its dominance demonstrated in practice
8	Very, very strong	
9	Extreme importance	The evidence favouring one activity over another is of the highest possible order of affirmation

Matrices are developed wherein each criterion is compared against the others. If Criterion A is strongly more important compared to Criterion B (i.e. a value of "5"), then Criterion B has a value of 1/5 compared to Criterion A. Thus, for each comparative score given, the reciprocal is awarded to the opposite relationship. The "priority vector" (i.e. the normalized weight) is calculated for each criterion and relative importance for each criterion is determined by comparing them one to another. The calculations are easily set up in a spreadsheet, and commercial software packages are available (Baker *et al*., 2001). As an explanation to clarify the process, see the example below:

Table 4.4. Example Priority Decision Matrices.

A	B	C
B		
C		

Asked question is : Given A as the parent element what is the influence of B relative to C with respect to A?

A	B	C
B		1/3
C	3	

The answer of this question is supplied to be “1/3”. It means that factor C is “a bit more effective” than factor B on the parent element A (since it is stated in Table 4 that 3 = moderate importance). In the interpretation of 1/3, 1 is the weight of row factor with respect to the column factor and 3 is vice versa.

As can be seen in the example above and in the priority decision matrices shown in Appendix B page 118, the blue colored parts in the matrices were not required to be filled by the respondents. It is obvious since influence of C relative to C with respect to A will be “1”, that is having the same priority. As a result of this step, relative priorities of each factor with respect to a parent element were defined.

Table 4.5. Functionality of the Space Matrix.

Functionality of the space	Efficiency of design	Benefiting from past project experience
Efficiency of design		1/2
Benefiting from past project experience	2	

In the Table 4.5, it means that ‘Benefiting from past project experience’ is 2 times more effective than ‘Efficiency of design’ on the parent element ‘Functionality of the space’.

After all the scores for matrices were collected, final Pairwise Priority Comparison Matrices were obtained.

Experts were brought together to assess the matrices. Experts were asked by one by to score the matrices according to the priorities. After the answers of the respondents were collected, their answers were compared with each other and they meet on common values. The method used for the purpose of data collection is the brain storming sessions that brings all of respondents together to have consensus for the scoring of matrices.

4.5.4. Supermatrix Formation and Importance Weights of the Attributes

Computation of the magnitudes of influence of each factors on the project success is the last step of the analysis. After the respondents evaluated 24 matrices among clusters and nodes of the model, matrices are formed by the final valuation and matrices are entered to the ANP software called “Super Decisions”. To use the program in the analysis, first of all the network hierarchy model of the research with its clusters, nodes and node connections was entered into the program as shown in Figure 4.3.

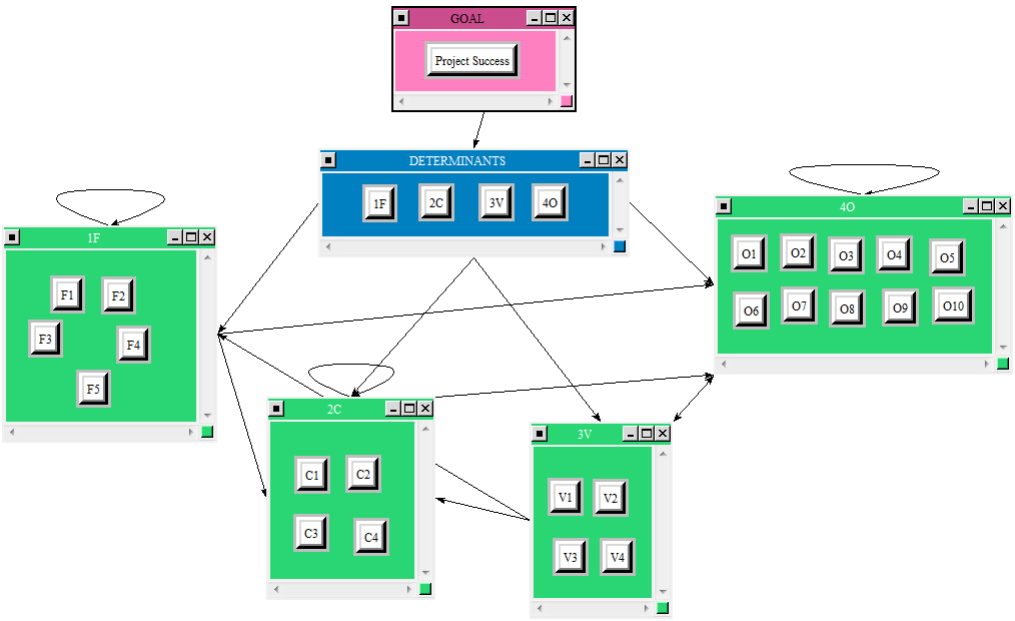


Figure 4.3. Network hierarchy model out of Superdecision software.

The last step of the analysis is to compute the magnitudes of influence of each node on the project success. The influence diagram among the clusters have come out to be as in Figure 4.4 given below:

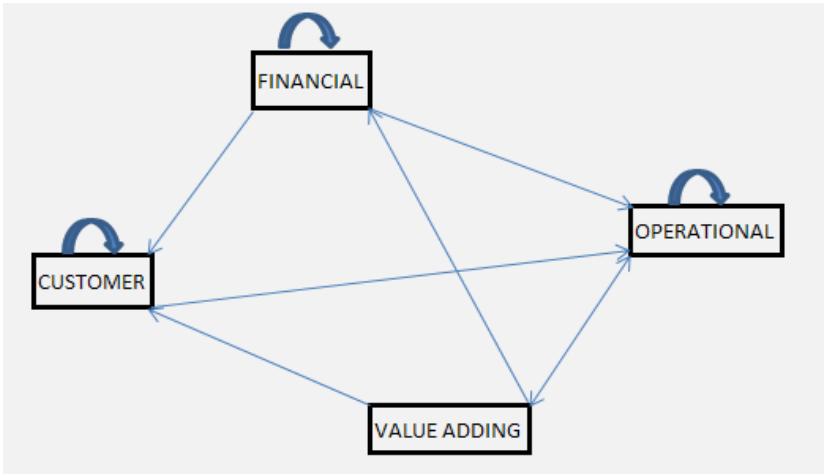


Figure 4.4. Influence diagram.

Pairwise comparison matrices are combined by the program to form a synthesized matrix called the "supermatrix" that is constructed for the analysis of relationships between the nodes and clusters of the ANP model. A supermatrix that is formed of 24 small matrices is computed in three-step calculation; the unweighted supermatrix is formed based on scorings of pairwise comparison matrices among interacting elements as the first

step, then the program calculates the weighted supermatrix by multiplying the values of the unweighted supermatrix with cluster weights on which nodes connect, and as last step a limiting supermatrix is achieved by raising the weighted supermatrix to powers until all the columns corresponding to any node concentrate on the same values.

In the software, data is entered in matrix format since throughout the study the priority matrices were obtained. Matrix format is simple and efficient for the study, because they are already ready.

The matrix form used can be seen in the Figure 4.5 given below:

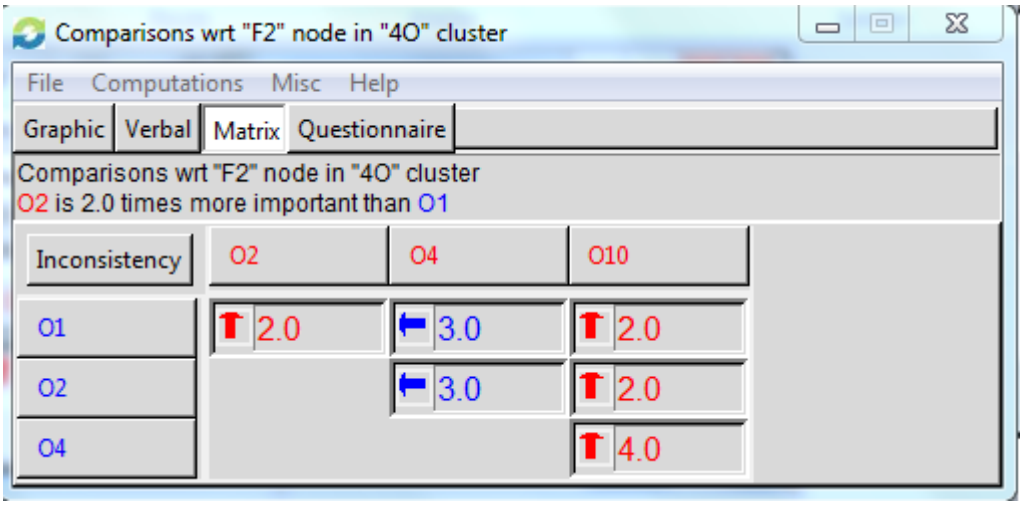


Figure 4.5. Matrix format in Superdecisions.

The software asks whether the comparison is complete for a particular matrix or not. When the data entry for a particular matrix is over, to be directed to the following matrix in the analysis "Yes" button should be ticked in the program menu as in the Figure 4.7 below:

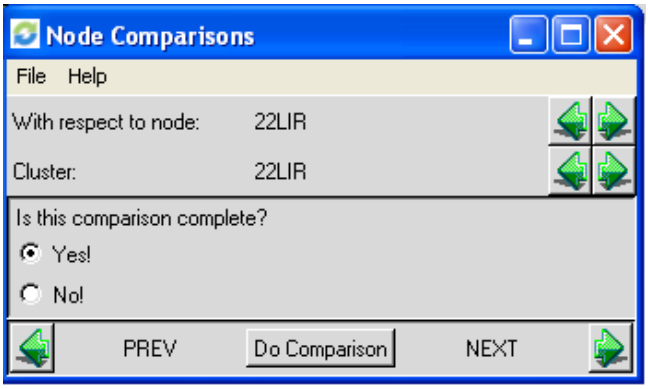


Figure 4.6. Node comparison in Superdecisions.

After all of the priority matrices were filled with the data obtained through data collection, the network was ready to be analyzed.

After the program calculates unweighted supermatrix and then weighted supermatrix, last step is the creating the limiting supermatrix. The values in the limiting supermatrix are equal to the resultant priorities of the network elements. After the limiting supermatrix was reached, the data analysis process came to an end. As a result for each factor in the network the priorities with respect to their contribution to project success were defined.

Table 4.6. Weighted Rates of Clusters and Nodes to Project Success.

No	Code in ANP Structure	Cluster and Node Names	Limiting
1	**1F**	**FINANCIAL**	**0.34213**
1.a	F1	Accuracy of cost estimation	0.29218
1.b	F2	Effectiveness of cost control	0.25166
1.c	F3	Effectiveness of marketing	0.17919
1.d	F4	Effectiveness of financial resources	0.03915
1.e	F5	Accuracy of risk assessment	0.23782
2	**2C**	**CUSTOMERS**	**0.28186**
2.a	C1	Level of customer satisfaction	0.28945
2.b	C2	Functionality of the space	0.15132
2.c	C3	Attractiveness of project location	0.48114
2.d	C4	Environmental friendliness	0.07809
3	**3V**	**VALUE ADDING**	**0.31597**
3.a	V1	Level of satisfaction of project employees	0.09057
3.b	V2	Level of employee competency	0.20924
3.c	V3	Level of contribution to business value	0.42417

Table 4.6. Weighted Rates of Clusters and Nodes to Project Success (cont.).

3.d	V4	Level of innovativeness of the project	0.27602
4	**4O**	**OPERATIONAL**	**0.06004**
4.a	O1	Effectiveness of leadership	0.10366
4.b	O2	Effectiveness of construction schedule	0.08478
4.c	O3	Efficiency of design	0.15106
4.d	O4	Subcontractor effectiveness	0.02017
4.e	O5	Efficiency on coordination and communication between project participants	0.01288
4.f	O6	Effectiveness of consultancy services	0.06701
4.g	O7	Level of compliance with government, with laws and regulations	0.03545
4.h	O8	Performance on technology usage	0.00653
4.i	O9	Achievement on health and safety on site	0.00755
4.j	O10	Benefiting from past project experience	0.51091

By multiplying the limiting weights of nodes with the limiting weights of their related cluster, the relative weights of effectiveness of each node on project success goal was calculated with the values in Table 4.6.

For example, the value for the node C1 can be taken from Table 4.6 as 0.28945, and the cluster on the node depend ‘Customer’ has the value 0.28186. As a result, to calculate the influence weight of C1 on project success the following formulation should be utilised:

C1 in Project Success = % C1 in Customer x % Customer in Project Success

= 0.28945 x 0.28186

= 0.0815

By conducting this calculation for each of the nodes, weights are obtained. The importance weights of clusters and nodes are given in Table 4.7 and Table 4.8, respectively.

Table 4.7. Importance Weights of Clusters.

No	Code in ANP Structure	Cluster Name	Limiting
1	1F	Financial	0.34213
2	2C	Value Adding	0.31597
3	3V	Customer	0.28186
4	4O	Operational	0.06004

Table 4.8. Importance Weights of Nodes.

No	Code in ANP	Factor Name	Normalized to Goal
1	C3	Attractiveness of Project Location (Customer)	0.135614
2	V3	Level of Contribution to Business Value (Value Adding)	0.134024
3	F1	Accuracy of Cost Estimation (Financial)	0.099963
4	V4	Level of Innovativeness of the Project (Value Adding)	0.087214
5	F2	Effectiveness of Cost Control (Financial)	0.086100
6	C1	Level of Customer Satisfaction (Customer)	0.081584
7	F5	Accuracy of Risk Assessment (Financial)	0.081365
8	V2	Level of Employee Competency (Value Adding)	0.066113
9	F3	Effectiveness of Marketing (Financial)	0.061306
10	C2	Functionality of the Space (Customer)	0.042651

Table 4.8. Importance Weights of Nodes (cont.).

11	O10	Benefiting from Past Project Experience (Operational)	0.030675
12	V1	Level of Satisfaction of Project Employees (Value Adding)	0.028617
13	C4	Environmental Friendliness (Customer)	0.022010
14	F4	Effectiveness of Financial Resources (Financial)	0.013394
15	O3	Efficiency of Design (Operational)	0.009069
16	O1	Effectiveness of Leadership (Operational)	0.006223
17	O2	Effectiveness of Construction Schedule (Operational)	0.005090
18	O6	Effectiveness of Consultancy Services (Operational)	0.004023
19	O7	Level of Compliance with Government, with Laws and Regulations (Operational)	0.002128
20	O4	Subcontractor Effectiveness (Operational)	0.001211
21	O5	Efficiency on Coordination and Communication Between Project Participants (Operational)	0.000773
22	O9	Achievement on Health and Safety on Site (Operational)	0.000453
23	O8	Performance on Technology Usage (Operational)	0.000392

4.6. Findings

According to cluster weights, “Financial” perspective factors are most influencial factors to project success, followed by “Value Adding” and “Customer” perspective factors.

The first three factors that are mostly associated with the project success belong to different three perspective “Customer”, followed by “Value Adding” and “Financial”.

“Operational” group is found to be the least important criterion in the model. When the nodes are analyzed, it is observed that the success in real estate projects is governed by the “Attractiveness of Project Location”, “Level of Contribution to Business Value” and “Accuracy of Cost Estimation”.

Factors listed under “Operational” including efficiency of design, effectiveness of leadership, effectiveness of construction schedule, effectiveness of consultancy service, level of compliance with government, with laws and regulations, subcontractor effectiveness, efficiency on coordination and communication between project participants, achievement on health and safety on site and performance on technology usage are found to be least important factors for a project to be successful at complete. This is not confusing because these factors are effective during operation of project, in fact, they are important factors but effect completion of project in indirect way.

Factors listed under “Customer” involving Attractiveness of Project Location and Level of Customer Satisfaction, arranged under “Value Adding” including Level of Contribution to Business Value and Level of Innovativeness of the Project, listed under “Financial” including Accuracy of Cost Estimation and Effectiveness of Cost Control are found to be the dominant determinants of project success. It should also be noted that the model is limited by the experiences of the 10 experts who participated in this study. Therefore, the conclusions are not generic and they only reflect the subjective evaluations of these experts.

‘‘Attractiveness of Project Location’’ is expected to be most important factor for project success because in literature review it is regarded as one of leading key success factors in the real estate development industry. If every other factor concerning the business of the development company is just average, but the land is well located, the company will do well. Nothing is a greater determinant of success than having the right piece of land (Birnbaum, 2004).

Factors ‘‘Level of Contribution to Business Value’’ and ‘‘Level of Innovativeness of the Project’’ constitute two of first four leading factors for success of projects. If people say to a project ‘successful’, this mostly arises from project image and being innovative.

According to Prabhakar's study (2008), accurate initial cost estimate is one of critical success factors as seen in result of analysis. ''Accuracy of Cost Estimation'' and ''Effectiveness of Cost Control'' are in five most important factors to effect success because the financial impact on success is easier to measure through cost (Stadlhofer, 2010).

4.7. Testing of the Model

After the results were obtained, it was required to test the applicability of the result with case studies. For this purpose, a table was prepared and presented to the respondents (see Table 4.9). This time it was requested them to score their completed projects for 23 factors and for project success.

Table 4.9. Evaluation of Projects.

Evaluation of Projects		Score (1-100)
1	Accuracy of Cost Estimation	
2	Effectiveness of Cost Control	
3	Effectiveness of Marketing	
4	Effectiveness of Financial Resources	
5	Accuracy of Risk Assessment	
6	Level of Customer Satisfaction	
7	Functionality of the Space	
8	Attractiveness of Project Location	
9	Environmental Friendliness	
10	Level of Satisfaction of Project Employees	
11	Level of Employee Competency	
12	Level of Contribution to Business Value	
13	Level of Innovativeness of the Project	
14	Effectiveness of Leadership	
15	Effectiveness of Construction Schedule	
16	Efficiency of Design	
17	Subcontractor Effectiveness	
18	Efficiency on Coordination and Communication Between Project Participants	
19	Effectiveness of Consultancy Services	
20	Level of Compliance with Government, with Laws and Regulations	
21	Performance on Technology Usage	
22	Achievement on Health and Safety on Site	
23	Benefiting from Past Project Experience	

Ten experts were selected for the model justification step. The team composed of ten civil engineers who worked in completed real estate projects throughout their careers. Members of the expert team evaluated a completed project of their companies in order to test the performance of the model. All of the team members work for medium to large sized real estate companies. Taking into account the characteristics of each project, each respondent was required to assign a rating to the availability or success of each determinant and the level of success of real estate projects using the points from 1 to 100.

The estimated "project success" values assigned by the experts are compared with the values calculated using the importance weights derived from the ANP analysis. Results that are summarized in Table 4.10. suggest that the accuracy of model is satisfactory.

Table 4.10. Testing of the ANP Model to Real Projects.

Parameter	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Accuracy of Cost Estimation	70	95	40	95	80	100	75	65	60	70
Effectiveness of Cost Control	60	95	80	85	80	90	75	65	50	75
Effectiveness of Marketing	80	90	70	100	60	90	65	55	50	60
Effectiveness of Financial Resources	70	80	70	90	60	100	60	60	65	60
Accuracy of Risk Assessment	65	40	85	80	70	95	70	65	70	70
Level of Customer Satisfaction	80	50	95	95	80	85	75	65	65	80
Functionality of the Space	85	50	95	95	90	100	90	70	65	80
Attractiveness of Project Location	90	30	100	100	90	90	85	80	70	75
Environmental Friendliness	60	90	90	95	90	95	80	75	70	80
Level of Satisfaction of Project Employees	80	10	40	95	75	90	75	75	75	75
Level of Employee Competency	90	35	20	95	80	90	80	70	75	70
Level of Contribution to Business Value	90	70	70	95	95	100	95	70	70	90
Level of Innovativeness of the Project	90	90	65	90	80	95	75	75	70	80

Table 4.10. Testing of the ANP Model to Real Projects (cont.).

.-

Effectiveness of Leadership	80	80	65	90	90	85	80	75	60	85
Effectiveness of Construction Schedule	70	80	60	90	75	100	70	70	75	75
Efficiency of Design	70	85	80	95	75	85	75	75	80	75
Subcontractor Effectiveness	70	70	70	90	70	90	70	70	70	65
Efficiency on Coordination	65	50	30	85	70	85	70	70	65	70
Effectiveness of Consultancy Services	80	70	70	90	50	90	50	50	50	50
Level of Compliance with Regulations	80	90	95	95	50	80	50	50	50	50
Performance on Technology Usage	80	90	90	95	60	90	60	60	80	60
Achievement on Health and Safety on Site	90	30	80	85	70	85	70	75	80	70
Benefiting from Past Project Experience	80	85	95	90	85	85	85	85	70	80
Project Success (Actual)	80	70	85	90	85	95	82	80	70	85
Project Success (Estimated)	79	64	72	93	81	93	79	69	65	75
% Error = $\left[\frac{\lvert \text{Estimated} - \text{Actual} \rvert}{\text{Actual}}\right] \times 100\%$	0.3	7.8	14.2	3.4	4.24	1.89	3.66	12.88	6.00	10.7

The precision for prediction is found to be around ± 0.065. The model may serve real estate companies as an assessment model and guide them in taking actions to have successful projects.

5. CONCLUSION

There have been a high number of research studies that focus on project success. Project success is a controversial topic, although many researchers have talked about this, and although success has been widely discussed, there is no concensus until now. Definition of project success depends on the characteristics of the project, external conditions and stakeholder expectations. No single indicator is sufficient to define and measure project success, therefore a set of indicators and a systematic approach is necessary for accurate performance measurement. In order to assess the success of real estate projects, an ANP model is proposed in this research. In this context, firstly the factors associated with real estate project success are identified and then these are grouped under four perspectives namely, “Financial”, “Customer”, “Value Adding”, and “Operational”.

Within the context of this thesis, a total of 23 factors associated with real estate project success are listed based on an extensive literature review. Despite the existence of a high number of studies that have investigated the factors for evaluating success of projects, these studies are found to have not quantified the improtance weights of those factors. The thesis helps fill the knowledge gap in the studies of assessing real estate project success. The necessity of having indicators of project success led to the development of several organizational performance measurement models, one of which is the BSC Framework developed by Kaplan and Norton in 1992. The BSC concept has inspired the success perspectives used in this study.

Following the preparation of success factors list, the factors are grouped under four categories based on the BSC concept. In the success model porposed in this study, “financial” and “customer” perspectives are kept the same as in the original BSC model; but the “internal” perspective is converted into “operational” and “learning and growth” is converted into “value adding”. Considering the characteristics of the real estate projects, the model has some interdependencies among the model parameters. The interrelations between model parameters are determined and pairwise comparisons are done by a team of experts based on brainstorming sessions. The importance weights of each attribute are then calculated using a software package.

The analysis results derived from the model suggest that “attractiveness of project location”, “level of contribution to business value”, “accuracy of cost estimation”, “level of innovativeness of the project”, “effectiveness of cost control”, “level of customer satisfaction”, “accuracy of risk assessment” and “level of employee competency” are the most important determinants of success in real estate projects. These factors relate to the financial objectives, customer satisfaction, and value adding perspectives of real estate projects. Operational perspective on the other hand, is not found to be as effective as the other three perspectives. For example, “level of compliance with government, with laws and regulations”, “subcontractor effectiveness”, “efficiency on coordination and communication between project participants”, “achievement on health and safety on site” and “performance on technology usage” are found to be least important ones and all of these factors are grouped under the operational cluster. Factors included in operational perspective are in fact beneficial for project success but their impact is at the short-term, rather than contributing in the long-run. Based on the research findings, it may be concluded that respondents favor those factors that contribute to the companies in the long-run, rather than those factors that indicate the success of that particular project only.

The findings of the model are found to be consistent with the literature. Attractiveness of project location is important one of key success factors according to literature. Respondents also found location a more improtant factor over the others and therefore, the analysis results indicate that it is the most important factor. The performance of the model has been tested on ten completed projects to assess their success and the results are found to be satisfactory.

This study has not been free of challenges. The main difficulty was related to data collection. The ANP models have some shortcomings in terms of problem structuring and pairwise comparisons. As the number of the attributes and interactions among them get higher, model construction and assessment of the matrices by the respondents may become impractical. The experts were brought together and asked to participate in discussions during the pairwise comparison exercise. Reaching a consensus has not been so easy, however group decision making is expected to provide more reliable results. An alternative to this could be using the Delphi method. The accuracy of the model may be improved by collecting data from more experts and the performance can be tested on more cases. There

is another disadvantage. Real estate industry changes continuously and the number of the success factors can decrease or increase in time depending on the competitive conditions in the market.

This study proposed a framework to assess real estate project success based on a modified version of the BSC concept. It also considers the interrelations among a high number of both objective and subjective indicators. In this respect, the model may be considered to have a novel approach to assessing real estate project success. The real estate companies can benefit from this model to estimate the performance of their projects and to rethink their project and corporate management behavior.

Project location is crucial for a project to be successful. Therefore, as an recommendation, leaders should focus on location when sthey tart a new project. Innovation is a new concept for the industry and the attention on innovation is getting higher day by day. Project leaders should provide innovative solutions within their projects. Cost estimation, cost savings are important for finance department for companies and it is shown that experts also think that these factors have influence on project success. This thesis could help real estate leaders assess their projects more successfully and could help them focus on important factors during their projects. The framework proposed in the thesis is a new framework, therefore it is expected to be useful for both researchers and practitioners. Although the results are mostly valid for the Turkish real estate companies, similar models may be developed for companies operating in other countries and industries.

APPENDIX A

DATA COLLECTION



BOĞAZİÇİ UNIVERSITY

THE INSTITUTE OF SCIENCE AND ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

CONSTRUCTION MANAGEMENT MASTER'S THESIS

ADVISOR : ASSIST. PROF. BELİZ ÖZORHON

PREPARED BY : DİDEM ERDEM

ASSESSING REAL ESTATE PROJECT SUCCESS USING THE ANALYTIC NETWORK PROCESS

- PAIRWISE RELATION DECISION MATRIX –

REQUESTED:

Please examine the Pairwise Relation Decision Matrix that is formed based on relations between factors effecting project success.

The aim of the matrix is to determine the relations between project success factors.

Row elements in matrix are questioned whether they effect on the column element or not.

" + " means, that row element has effect on the column element as seen in example below.

Example:

Pairwise Relation Decision Matrix	**A**	**B**	**C**
A		**+**	**+**
B			
C		+	

Explanation: According to the example above, factor A affect factors B and C; factor B has no influence on factors A and C; factor C is effective for the factor B, but not for factor A.

Requested: Please put + sign where you think the row element has effect on the column element on 23x23 matrix table. Purpose of this is to determine the relations between factors based on your experience.

Effect of factors on oneself is not the case. It is important that direct effect will be used as base.

FACTORS AFFECTING THE SUCCESS OF PROJECTS	
1	Accuracy of cost estimation
2	Effectiveness of cost control
3	Effectiveness of marketing
4	Effectiveness of financial resources
5	Accuracy of risk assessment
6	Level of customer satisfaction
7	Functionality of the space
8	Attractiveness of project location
9	Environmental friendliness
10	Level of satisfaction of project employees
11	Level of employee competency
12	Level of contribution to business value
13	Level of innovativeness of the project
14	Effectiveness of leadership
15	Effectiveness of construction schedule
16	Efficiency of design
17	Subcontractor effectiveness
18	Efficiency on coordination and communication between project participants
19	Effectiveness of consultancy services
20	Level of compliance with government, with laws and regulations
21	Performance on technology usage
22	Achievement on health and safety on site
23	Benefiting from past project experience

Explanations :

1 Accuracy of cost estimation

Accuracy of the first estimation that is done at the start of the project.

2 Effectiveness of cost control

Keeping the project cost under control, reporting, making cost savings.

3 Effectiveness of marketing:

Success on sales/renting.

4 Effectiveness of financial resources:

Accurate financing plans, credibility, success on receiving payments.

5 Accuracy of risk assessment:

Financial risks, risks arising from location, being feasible.

6 Level of customer satisfaction:

Satisfaction of customer during or at the end of the project.

7 Functionality of the space:

Functional design, ergonomic solutions.

8 Attractiveness of project location:

Beside attractiveness of project location, social situation of project location, purchasing power of that district.

9 Environmental friendliness:

Being environmental friendliness, being sustainable.

10 Level of satisfaction of project employees:

Satisfaction level of employee.

11 Level of employee competency:

Employee are project employee or workers on site.

12 Level of contribution to business value:

Power of the project to add value to the company with awards or regards.

13 Level of innovativeness of the project:

All kinds of innovation is mentioned.

14 Effectiveness of leadership:

Leader is project manager or site chief.

15 Effectiveness of construction schedule:

Using accurate and efficient schedule during project.

16 Efficiency of design :

Being erectable.

17 Subcontractor effectiveness:

Effectiveness or contribution of subcontractors to project.

18 Efficiency on coordination and communication between project participants:

Efficiency on coordination and communication between project participants.

19 Effectiveness of consultancy services:

Effectiveness of consultancy services

20 Level of compliance with government, with laws and regulations:

Level of compliance with government, with laws and regulations during project.

21 Performance on technology usage:

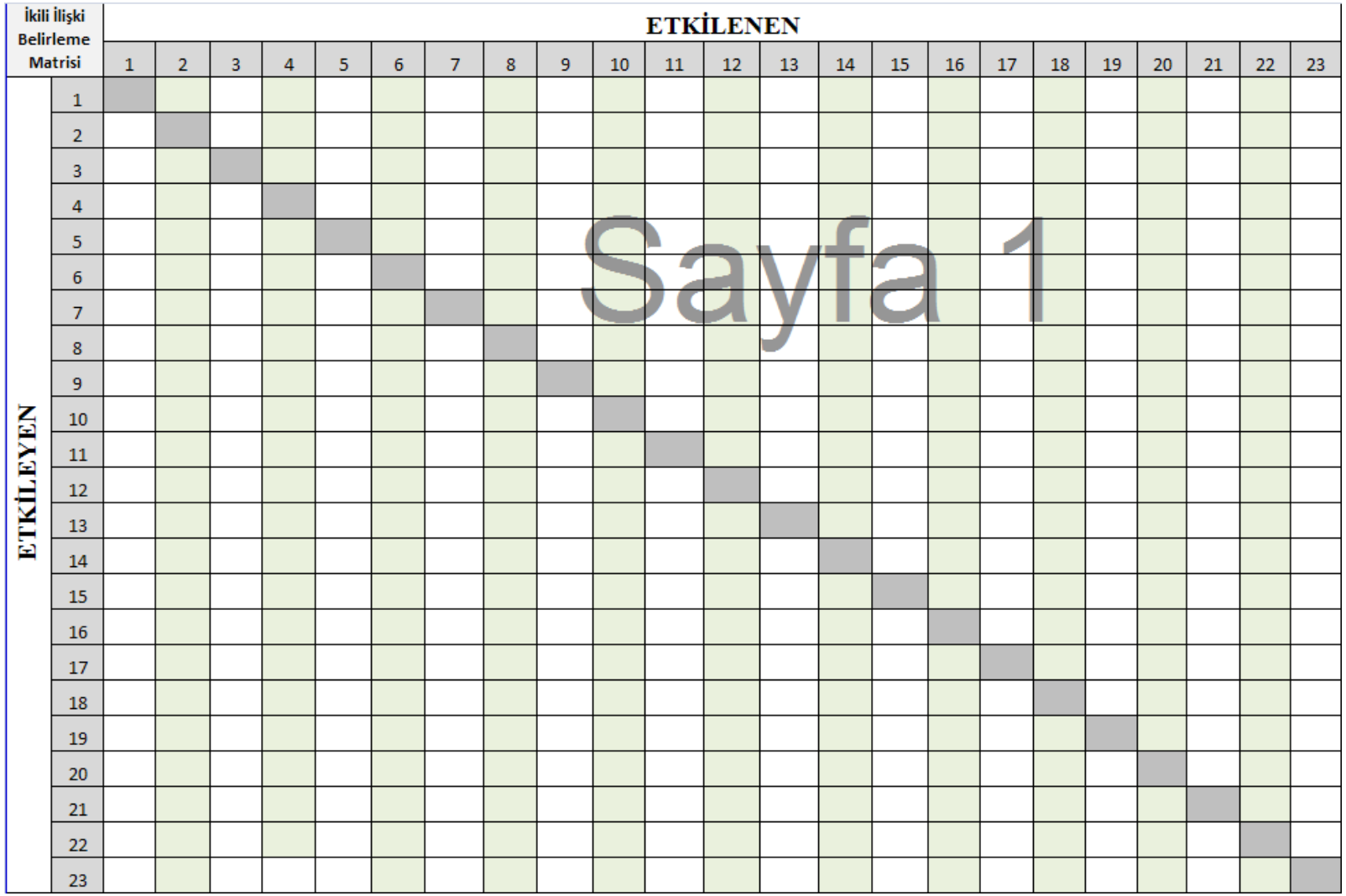
Using accurate and adequate IT. (computers, server, softwares etc.)

22 Achievement on health and safety on site:

Success on decreasing the accident rate during project.

23 Benefiting from past project experience:

Having similar experiences and efficiency of making use of it.


İkili İlişki Belirleme Matrisi
ETKİLENEN
ETKİLEYEN
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Sayfa 1

APPENDIX B

DATA ANALYSIS

Table B.1. Example Comparison Matrices.

Functionality of the space	Efficiency of design	Benefiting from past project experience
Efficiency of design		1/2
Benefiting from past project experience	2	

Level of contribution to business value	Effectiveness of cost control	Effectiveness of marketing
Effectiveness of cost control		2
Effectiveness of marketing	1/2	

Effectiveness of construction schedule	Level of satisfaction of project employees	Level of employee competency
Level of satisfaction of project employees		1/5
Level of employee competency	5	
Effectiveness of financial resources	Effectiveness of leadership	Effectiveness of construction schedule
Effectiveness of leadership		1/3
Effectiveness of construction schedule	3	

Efficiency of design	Effectiveness of consultancy services	Benefiting from past project experience
Effectiveness of consultancy services		1/4
Benefiting from past project experience	4	

Effectiveness of marketing	Effectiveness of cost control	Accuracy of risk assessment
Effectiveness of cost control		1/2
Accuracy of risk assessment	2	

Subcontractor effectiveness	Effectiveness of leadership	Efficiency of design
Effectiveness of leadership		2
Efficiency of design	1/2	

Level of satisfaction of project employees	Effectiveness of leadership	Achievement on health and safety on site
Effectiveness of leadership		6
Achievement on health and safety on site	1/6	

Efficiency on coordination and communication between project participants	Effectiveness of leadership	Performance on technology usage
Effectiveness of leadership		2
Performance on technology usage	1/2	

Level of contribution to business value	Level of customer satisfaction	Attractiveness of project location	Environmental friendliness
Level of customer satisfaction		1/4	5
Attractiveness of project location	4		5
Environmental friendliness	1/5	1/5	

Achievement on health and safety on site	Efficiency of design	Subcontractor effectiveness	Benefiting from past project experience
Efficiency of design		3	1/3
Subcontractor effectiveness	1/3		1/3
Benefiting from past project experience	3	3	

Accuracy of cost estimation	Effectiveness of construction schedule	Efficiency of design	Benefiting from past project experience
Effectiveness of construction schedule		1/2	1/4
Efficiency of design	2		1/3
Benefiting from past project experience	4	3	

Level of compliance with government, with laws and regulations	Effectiveness of leadership	Effectiveness of consultancy services	Benefiting from past project experience
Effectiveness of leadership		1/3	1/4
Effectiveness of consultancy services	3		1/3
Benefiting from past project experience	4	3	

Level of customer satisfaction	Functionality of the space	Attractiveness of project location	Environmental friendliness
Functionality of the space		1/4	4
Attractiveness of project location	4		4
Environmental friendliness	1/4	1/4	

Effectiveness of marketing	Functionality of the space	Attractiveness of project location	Environmental friendliness
Functionality of the space		1/4	3
Attractiveness of project location	4		5
Environmental friendliness	1/3	1/5	

Effectiveness of cost control	Effectiveness of leadership	Effectiveness of construction schedule	Subcontractor effectiveness	Benefiting from past project experience
Effectiveness of leadership		1/2	3	1/2
Effectiveness of construction schedule	2		3	1/2
Subcontractor effectiveness	1/3	1/3		1/4
Benefiting from past project experience	2	2	4	

Effectiveness of financial resources	Accuracy of cost estimation	Effectiveness of cost control	Effectiveness of marketing	Accuracy of risk assessment
Accuracy of cost estimation		1/3	3	3
Effectiveness of cost control	3		4	3
Effectiveness of marketing	1/3	1/4		3
Accuracy of risk assessment	1/3	1/3	1/3	

Accuracy of risk assessment	Effectiveness of construction schedule	Efficiency of design	Effectiveness of consultancy services	Level of compliance with government, with laws and regulations	Benefiting from past project experience
Effectiveness of construction schedule		1/3	1/3	1/3	1/4
Efficiency of design	3		3	3	1/4
Effectiveness of consultancy services	3	1/3		1/3	1/4
Level of compliance with government, with laws and regulations	3	1/3	3		1/3
Benefiting from past project experience	4	4	4	3	

Effectiveness of construction schedule	Effectiveness of leadership	Efficiency of design	Subcontractor effectiveness	Efficiency on coordination and communication between project participants	Benefiting from past project experience
Effectiveness of leadership		1/3	3	1/3	1/3
Efficiency of design	3		3	1/3	1/3
Subcontractor effectiveness	1/3	1/3		3	1/3
Efficiency on coordination and communication between project participants	3	3	1/3		1/4
Benefiting from past project experience	3	3	3	4	

FINANCIAL	Accuracy of cost estimation	Effectiveness of cost control	Effectiveness of marketing	Effectiveness of financial resources	Accuracy of risk assessment
Accuracy of cost estimation		2	3	4	2
Effectiveness of cost control	1/2		2	3	1/2
Effectiveness of marketing	1/3	1/2		3	3
Effectiveness of financial resources	1/4	1/3	1/3		1/3
Accuracy of risk assessment	1/2	2	1/3	3	

CUSTOMER	Level of customer satisfaction	Functionality of the space	Attractiveness of project location	Environmental friendliness
Level of customer satisfaction		4	3	5
Functionality of the space	1/4		1/4	3
Attractiveness of project location	1/3	4		6
Environmental friendliness	1/5	1/3	1/6	

VALUE ADDING	Level of satisfaction of project employees	Level of employee competency	Level of contribution to business value	Level of innovativeness of the project
Level of satisfaction of project employees		1/3	1/4	1/4
Level of employee competency	3		1/4	1/3
Level of contribution to business value	4	4		2
Level of innovativeness of the project	4	3	1/2	

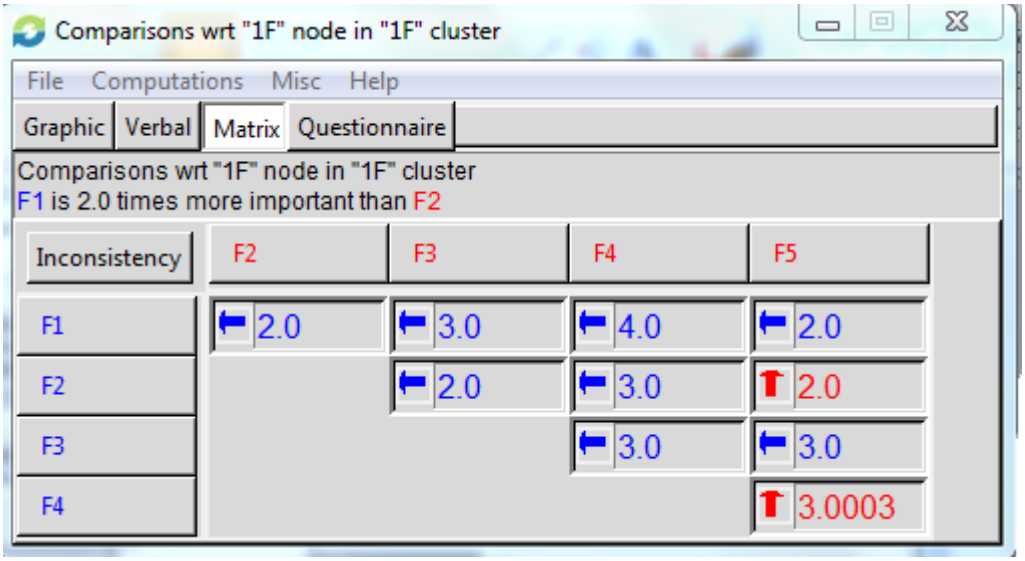
PROJECT SUCCESS	FINANCIAL	CUSTOMER	VALUE ADDING	OPERATIONAL
FINANCIAL		4	1/3	4
CUSTOMER	1/4		3	3
VALUE ADDING	3	1/3		4
OPERATIONAL	1/4	1/3	1/4	

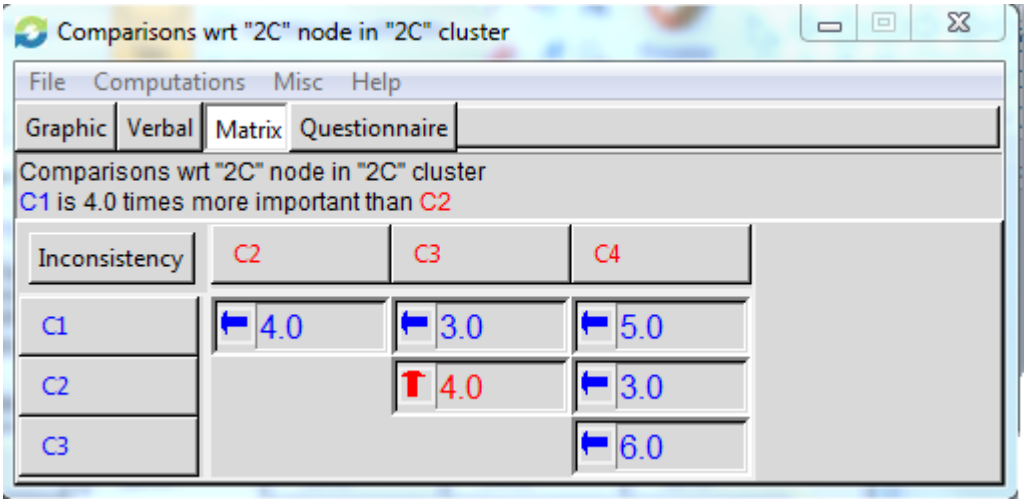
OPERATIONAL	Effectiveness of leadership	Effectiveness of construction schedule	Efficiency of design	Subcontractor effectiveness	Efficiency on coordination and communication between project	Effectiveness of consultancy services	Level of compliance with government, with laws and regulations	Performance on technology usage	Achievement on health and safety on site	Benefiting from past project experience
Effectiveness of leadership		4	4	4	5	3	3	5	5	1/2
Effectiveness of construction schedule	1/4		3	1/2	2	1/2	2	4	5	1/3
Efficiency of design	1/4	1/3		1/2	1/3	1/3	1/3	3	3	1/4
Subcontractor effectiveness	1/4	2	2		1/2	1/3	1/3	2	3	1/4
Efficiency on coordination and communication	1/5	1/2	3	2		1/2	1/2	1/4	5	1/3
Effectiveness of consultancy services	1/3	2	3	3	2		2	5	7	1/3
Level of compliance with government, with laws and regulations	1/3	1/2	3	3	2	1/2		4	6	1/2
Performance on technology usage	1/5	1/4	1/3	1/2	4	1/5	1/4		5	1/3
Achievement on health and safety on site	1/5	1/5	1/3	1/3	1/5	1/7	1/6	1/5		1/9
Benefiting from past project experience	2	3	4	4	3	3	2	3	9	

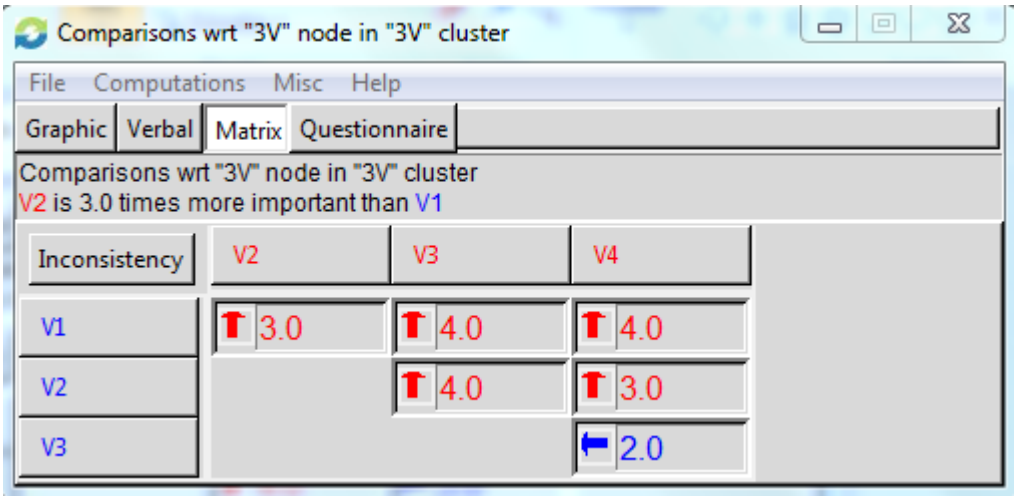
Pairwise Relation Decision Matrix

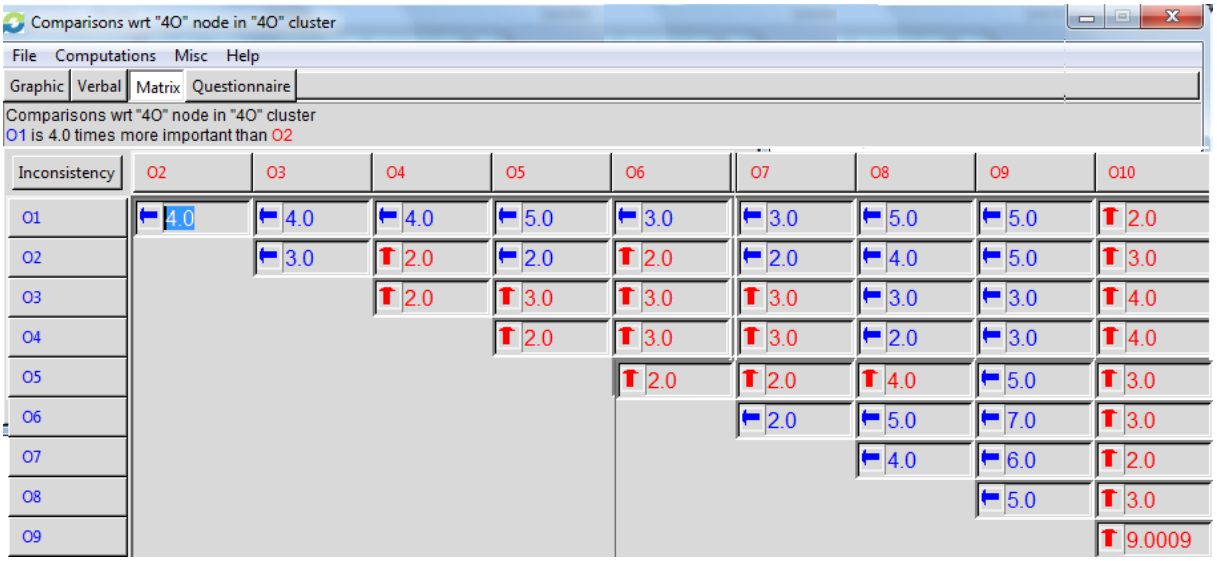
	F1	F2	F3	F4	F5	C1	C2	C3	C4	V1	V2	V3	V4	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10
F1				+																			
F2			+	+								+											
F3				+								+											
F4																							
F5			+	+																			
C1												+											
C2			+			+																	
C3			+			+						+											
C4			+			+						+											
V1															+								
V2															+								
V3																							
V4																							
O1		+		+						+					+		+	+		+			
O2	+	+		+	+																		
O3	+				+		+								+		+					+	
O4		+													+							+	
O5															+								
O6					+											+				+			
O7					+																		
O8																		+					
O9										+													
O10	+	+			+		+							+	+	+				+		+	

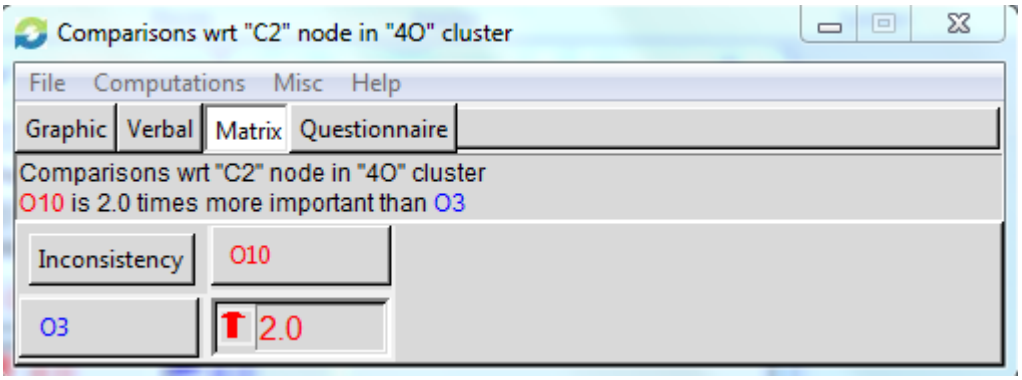
Table B.2. Screenshots from Superdecisions.

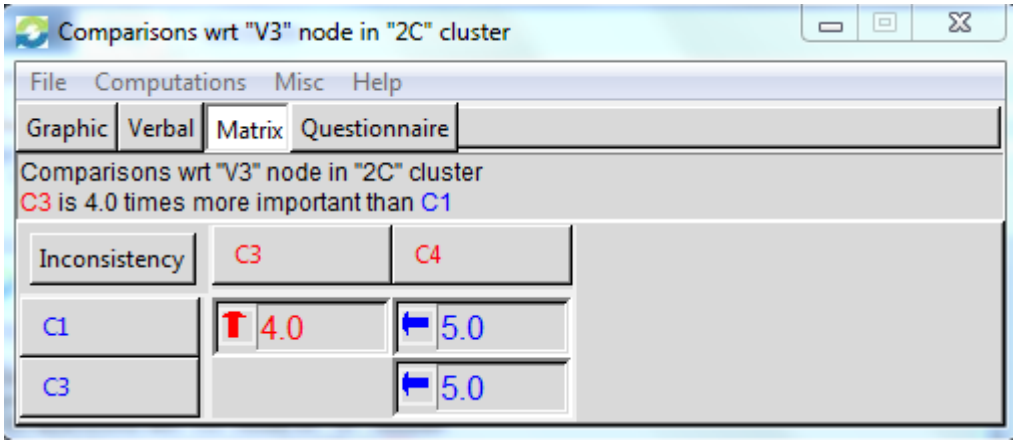


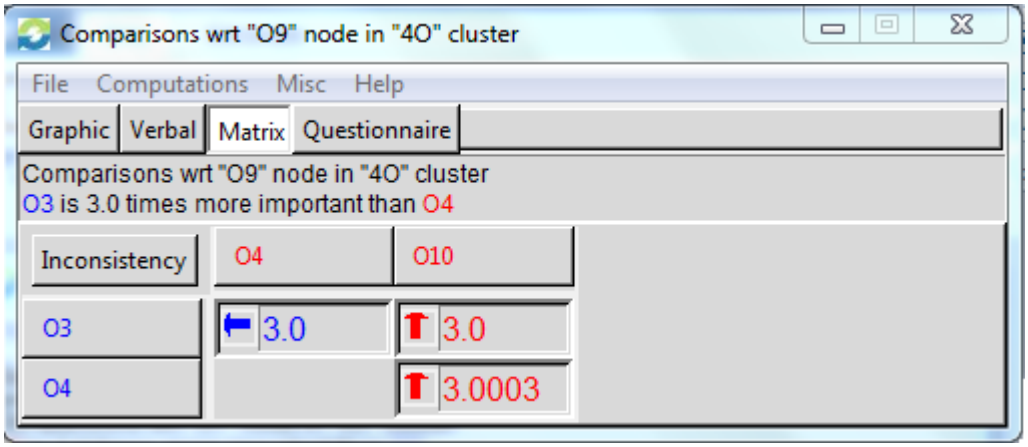


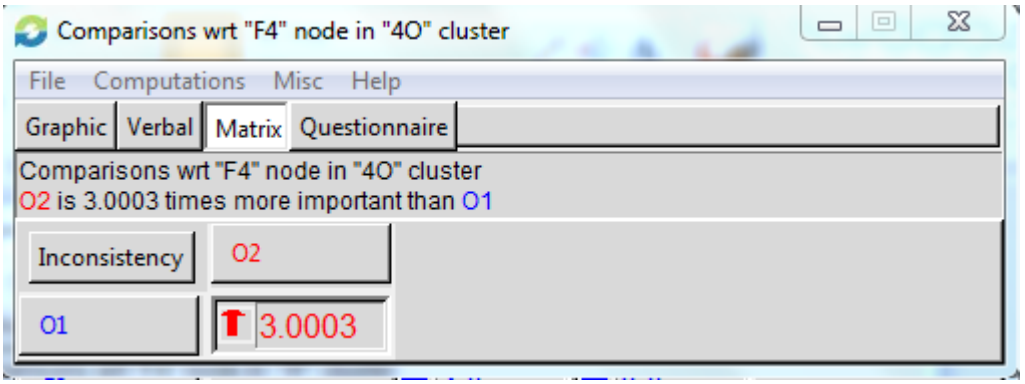


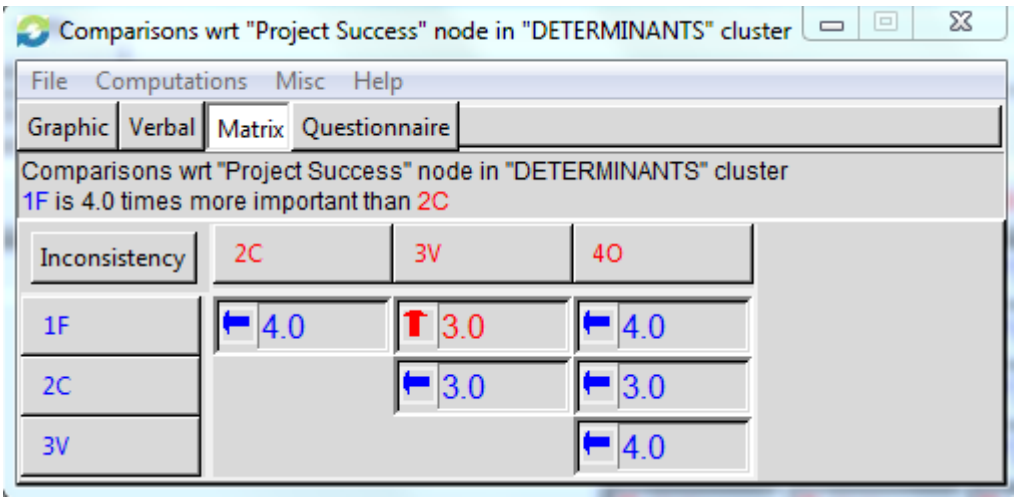

Comparisons wrt "4O" node in "4O" cluster
File Computations Misc Help
Graphic Verbal Matrix Questionnaire
Comparisons wrt "4O" node in "4O" cluster
O1 is 4.0 times more important than O2
Inconsistency O2 O3 O4 O5 O6 O7 O8 O9 O10
O1 4.0 4.0 4.0 5.0 3.0 3.0 5.0 5.0 2.0
O2 3.0 2.0 2.0 2.0 2.0 4.0 5.0 3.0
O3 2.0 3.0 3.0 3.0 3.0 3.0 4.0
O4 2.0 3.0 3.0 2.0 3.0 4.0
O5 2.0 2.0 4.0 5.0 3.0
O6 2.0 5.0 7.0 3.0
O7 4.0 6.0 2.0
O8 5.0 3.0
O9 9.0009


Comparisons wrt "C2" node in "4O" cluster
File Computations Misc Help
Graphic Verbal Matrix Questionnaire
Comparisons wrt "C2" node in "4O" cluster
O10 is 2.0 times more important than O3
Inconsistency O10
O3 2.0


Comparisons wrt "V3" node in "2C" cluster
File Computations Misc Help
Graphic Verbal Matrix Questionnaire
Comparisons wrt "V3" node in "2C" cluster
C3 is 4.0 times more important than C1
Inconsistency C3 C4
C1 4.0 5.0
C3 5.0


Comparisons wrt "O9" node in "4O" cluster
File Computations Misc Help
Graphic Verbal Matrix Questionnaire
Comparisons wrt "O9" node in "4O" cluster
O3 is 3.0 times more important than O4
Inconsistency
O4
O10
O3
3.0
3.0
O4
3.0003


Comparisons wrt "F4" node in "4O" cluster
File Computations Misc Help
Graphic Verbal Matrix Questionnaire
Comparisons wrt "F4" node in "4O" cluster
O2 is 3.0003 times more important than O1
Inconsistency
O2
O1
3.0003


Comparisons wrt "Project Success" node in "DETERMINANTS" cluster
File Computations Misc Help
Graphic Verbal Matrix Questionnaire
Comparisons wrt "Project Success" node in "DETERMINANTS" cluster
1F is 4.0 times more important than 2C
Inconsistency
2C
3V
4O
1F
4.0
3.0
4.0
2C
3.0
3.0
3V
4.0

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