A CONCEPTUAL PERFORMANCE MEASUREMENT FRAMEWORK FOR CONSTRUCTION INDUSTRY

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ABSTRACT

A CONCEPTUAL PERFORMANCE MEASUREMENT FRAMEWORK FOR CONSTRUCTION INDUSTRY

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Business perceptions of the construction industry have changed significantly during the last decades. Due to increasing competition and globalization issues, the parameters of the project environment have been enriched by several new concepts. The performance assessment done by objective measures have now been replaced with subjective measures. Within the context of this research; interdependencies between a construction company's "resources and capabilities", "project management capabilities", "strategic decisions", "strength of relationships with other parties" and "external factors" with "project performance" and "company performance" were investigated from a resource based perspective which put forward intangible assets of the company. To achieve the objectives, a questionnaire survey was administered to

73 Turkish contractors and the data obtained from 354 projects that were held during the last five years were analyzed using structural equation modeling (SEM). It was hypothesized in this study that construction company performance is influenced by the resources and capabilities within the company, the long-term and short-term strategies adopted by the company, the strength of the relationships of the company with other parties involved in construction projects, external factors and project management competencies. A structural equation model was set up to measure the seven latent variables (resources and capabilities, project management competencies, strength of relationships with other parties, strategic decisions, external factors, project performance and company performance) through their constituent variables and to see if the hypothesized relationships exist. Based on the findings of this study, it can be concluded that, this research has introduced a method to measure performance both in subjective (qualitative) and the objective (quantitative) terms. The strong path coefficients between the constructs of the model are an indication that, after decades in pursuit of finding ways to improve the performance of construction companies, subjective dimensions of performance have proven to be as effective as the traditional objective dimensions.

Keywords: Performance measurement, strategic management, critical success factors, project performance, company performance.

ÖZ

İNŞAAT SEKTÖRÜNDE PERFORMANS ÖLÇÜMÜ İÇİN KAVRAMSAL BİR MODEL

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İnşaat şirketleri arasında giderek artan ve küreselleşen rekabet, şirketlerin performans değerlendirmesinde finansal ölçütlerin ötesinde niteliksel ölcutlerinde de kullanılmasını zorunlu kılmıştır. Niteliksel ölçütlerin ölçme sistemlerine katılması ile birlikte bu ölçutlerin araştırılması ve değerlendirilmesi de önemli bir araştırma sahası olarak belirginleşmiştir. Geleneksel performans yönetimi ilkeleri ve ölçümleme teknikleri, şirketleri geçmişe dönük olarak değerlendirmekte iken, bu konudaki yeni yaklaşımlar çağdaş şirket ve proje performansı ölçümlemesinin şirket adına yeni stratejiler ve hedefler belirlemede sistematik bir katkısı olacağı yönündedir. Bu bağlamda; yeni nesil performans değerlendirmesi ve yönetimi, şirketler için stratejik yönetimin başlıca unsurlarindan biri, karar destek sistemlerinin bir önkoşulu olarak değerlendirilmelidir. Bu araştırmada, inşaat şirketlerinin performansının, şirket içerisindeki kaynaklar ve yeterliklerin yanısıra şirketin kısa ve uzun vadeli stratejileri, inşaat projesine dahil tüm taraflar ile olan ilişkilerin gücü, dış faktörler ve proje yönetimi yeterliklerinden etkilendiği tezi savunulmaktadır. Bu tezden yola çıkarak

ölçütler arasındaki ilişkileri tayin eden bir model hazırlanmış ve bunun sonrasında ise belirlenen ölçütleri değerlendirmeye sunan bir anket çalışması Türkiye'de aktif halde bulunan 73 insaat şirketine uygulanmıştır. Belirlenen performans ölçütlerinin önem ve uygulanma derecelerinin yanısıra, şirketlerin gerçekleştirdiği 354 projeden elde edilen veriler yapısal eşitleme modeli (YEM) adı verilen bir istatiksel yöntem ile analiz edilmiştir. Araştırmanın bulguları neticesinde, performans ölçümünde kullanılabilir niceliksel ve niteliksel ölçütler arasındaki ikilem ortadan kaldırılmıştır. YEM analizi uyarınca elde edilen güvenilir istatistiksel sonuçlar, varsayılan modelin doğruluğunu kanıtlamış, inşaat şirketlerinin performansının arttırılması için gerekli niteliksel ölçütlerin en az niceliksel (finansal vs.) ölçütler kadar etkili olduğunu göstermiştir.

Anahtar Kelimeler: Performans ölçümü, stratejik yönetim, kritik başarı faktörleri, proje performansı, şirket performansı.

To my mother and the memory of my beloved father

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LIST OF ABBREVIATIONS

ADF	Asymptotically distribution free
BPR	Business process reengineering
B-P-O	Behavior to Performance to Outcome
BSC	Balanced Scorecard
CBPP	The Construction Best Practice Program
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
CSF	Critical success factor
Dof	Degrees of Freedom
EFQM	European Foundation for Quality Management
EP2M	Effective progress and performance measurement
ET	Error term
GDP	Gross domestic product
GLM	Genetal linear model
GLS	Generalized least squares
HRM	Human Resources Management
ICJV	International Construction Joint Venture
IJV	International Joint Venture
IPMF	Integrated performance measurement framework
IPMS	Integrated performance measurement system
IT	Information Technology

JIT	Just in time
JV	Joint Venture
KPI	Key performance indicator
MBNQA	Malcolm Baldridge National Quality Award
ML	Maximum likelihood
NFI	Normed fit index
NNFI	Non-normed Fit Index
PM	Project management
PMBOK	Project management book of knowledge
PMPCF	Performance measurement process conceptual framework
RMSEA	Root Mean Square Error of Approximation
R&D	Research and Development
SEM	Structural Equation Modeling
SMART	Strategic measurement analysis and reporting technique
TCA	Turkish Contractors Association
TCEA	Turkish Construction Employers Association
TLI	Tucker-Lewis index
TQM	Total Quality Management
UK	United Kingdom
US	United States
USD	United States Dollar
WCM	World class manufacturing
$\chi 2$	Model chi square

CHAPTER 1

INTRODUCTION

Performance measurement has become subject of considerable interest over the last 20 years. Traditionally, businesses have measured the performance in financial terms, profit, turnover, etc. These financial measures of performance have been the sole measures of a company's success. However, performance measurement that has been based around financial measures can not cope with the recent changes occurring in the industry, particularly due to the emergence of new technologies and increased intensity of competition (Kaplan and Norton, 1992).

Various industries have developed and used conceptual models as well as measurement systems in order to quantify, compare and manage their performance. Increased level of competition in the business environment and higher customer requirements forced also construction industry to create a new philosophy to measure its performance beyond the existing financial-based performance indicators and quantitative determinants of project success such as cost, duration etc. Devoted to this new philosophy, research on performance measurement in the construction industry has increased considerably throughout the last decades.

1.1 Research background

Advancements on performance measurement mainly rely on seven reasons which were mentioned by Neely (1999). The changing nature of work, increasing competition, specific improvement initiatives, national and international quality awards, changing organizational roles, changing external demands, and the power of information technology can be listed as the main reasons responding to why performance

measurement is now on the management agenda. All of these points are relevant to the construction industry. However in order to understand the relevancy of the concepts related to manufacturing and construction industry, background of the research should be considered separately before setting up a relation in between.

1.1.1 Performance management in general

Gaining competitive advantage became one of the major targets for the organizations recently. Accordingly, companies made several attempts to gain and sustain competitive advantage in the relevant industry all over the world (Kaplan and Norton, 1996b; Kagioglou et al., 2001). This often resulted in the adoption of new philosophies such as concurrent engineering, lean production and many others such as just-in-time (JIT), total quality management (TQM), benchmarking, business process re-engineering (BPR) in manufacturing and service sectors (De Wilde de Ligny and Smook, 2001). The main driver behind those philosophies was the optimization of an organization's performance within its market and also rethinking of performance management systems through effective performance measurement as well as gaining competitive advantage (Kagioglou et al., 2001).

Performance of a company should be managed in line with its corporate and functional strategies and objectives (Bititci et al., 1997). This is the main stream of performance management system process. The main objective of this process is to provide a "proactive closed-loop control system" where the corporate and functional strategies are deployed to all business processes, activities and tasks. Finally, the feedback is obtained through a performance measurement system. Therefore, this process supports and coordinates the process of sytematic management, decision-making and taking action throughout the organization (Schalkwyk, 1998).

Performance measurement process determines how successful organizations or individuals have been attaining their objectives and strategies. In this process the outputs of organizational strategies and operational strategies are measured in quantifiable form to monitor the qualitative signs of an organization (Kagioglou et al., 2001). Thus as suggested by Bititci et al. (1997), it can be said that the performance measurement system is the information system which is at the heart of the performance management process and it is of critical importance to the effective and efficient functioning of the performance management system.

There is a criticism that the traditional performance measurement systems rely only on financial measures such as return on investment, sales per employee, profitability, efficiency, etc. (Sommerville and Robertson, 2000; Love and Holt, 2000; Amaratunga et al., 2000). Organizations that rely only on financial measures can identify their past performance but not what contributed to achieve that performance (Kagioglu et al., 2001).

It has also been observed that exclusive reliance on these financial indicators or measures in management systems promoted only short term behavior. This short term focus was causing organizations to disregard long term viability issues (Kaplan and Norton, 2000). The problems associated with the performance measures were discussed by numerous authors (Kagioglu et al., 2001; Kaplan and Norton, 2000 and Love and Holt, 2000). The traditional financial measures of performance encourage short-termism; are retrospective and hence are always to some extent out of date; do not accurately reflect the interests of stakeholders; fail to provide information on what customers really want and what they are actually getting; do not identify how competitors are performing; lack strategic focus and fail to provide data on quality, responsiveness and flexibility; give misleading signals for continuous improvement and innovation activities; encourage local optimization; and report on outcomes but do not communicate the derivers of future performance.

It has been suggested that business performance measurement should look beyond traditional financial measures and embrace essential business drivers that determine and influence a company's future business (Love and Holt, 2000).

According to Neely (1999), in today's business environment, where organizations compete on the basis of non-financial factors, they need information on how well they are performing across a broader spectrum of dimensions, not only financial but also operational.

1.1.2 Performance management and strategic management in construction

During the last two decades, a metamorphosis in business perceptions of construction industry was unavoidable. As well as various researchers commented on poor performance and the inefficiency of the industry (Anumba et al., 2000; Beatham et al., 2004), a general decline in the performance of construction companies was also observed in US construction industry (Larson and Gobeli, 1989; Yasamis et al., 2002). In the meantime, the government in UK published The Egan Report (1998) explaining the targets for improvement in construction industry. All comments and the recommendations for improvement were stressing the fact that determination of the performance measures was inevitable for sustainable improvement. Measuring the performance was seen as a way to bypass the current sitation. Since then performance improvement and measurement became a requirement in construction industry mainly due to its role as a strategic tool in the pursuit of success and sustained improvement. Companies needed to know their status in the industry, what they had to improve and how to influence their subordinate's behaviour (Neely, 1999). Accordingly, as mentioned before, Neely (1999) summarized the reasons for measuring the performance. All of these reasons were also pertinent to construction industry (Beatham et al., 2004). After cognition of the reasons and the importance of measuring performance, a new research area arised for the investigation of the factors affecting

performance. As a result of this, new concepts related with performance including, performance measures, performance drivers, key performance indicators (KPIs), critical success factors, success criterias, project success / failure, project managment performance, project performance, company performance added into the literature. Although majority of these developments were in manufacturing industry, increased globalization and the detection of poor performance thrusted also construction industry and construction management researchers to search new ways for performance improvement.

Traditionally the construction industry was focused mainly on project performance (Ward et al., 1991; Mohsini and Davidson, 1992). Moreover, the performance of projects and contractors were assessed on the extent to the client's objectives like cost, time and quality achieved on those projects (Ward et al., 1991; Mohsini and Davidson, 1992; Smallwood and Venter, 2001). Although these three measures provide an indication of the success or failure of a project they do not, in isolation, provide a balanced view of the project's performance, and their implementation in construction projects is apparent only at the end of the project. Therefore as suggested by Kagioglou et al. (2001), these three measures can only be classified as "lagging" other than "leading" indicators of performance. International research also supports this arguement, which indicates that performance relative to cost, quality and schedule is influenced by other factors like health and safety, productivity, performance relative to the environment, and employee satisfaction (Smallwood and Venter, 2001).

Ward et al. (1991) mention that the evaluation of projects, contractors, professionals or procurement methods solely according to the client's objectives is problematic. Essentially because they mention the parameters associated with client's objectives unreliable. The bias of the client, wrong attitudes in measuring intangibles and invisible aspects, establishing priorities among objectives, effects of procurement processes that are needed to accomplish those objectives, effects due to external

factors (such as adverse weather conditions and business environment), and ultimately the question of whether the goals were set at an appropriate level (setting unrealistic objectives, interdependencies between objectives and the like) are the problems that were mentioned. Additionally, they pointed out the importance of good relationship management in construction, in addition to cost, time and quality, enriched by the special features of harmony, trust and goodwill, to be successful in the market (Ward et al., 1991)

To sustain competitiveness and to survive in a national and international market, construction companies should properly understand how they are currently performing and how they need to perform in the future. However, as in other industries, performance measurement primarily focuses on traditional bottom-line performance measures such as efficiency, return on capital employed, and profitability which were defined as retrospective before. Hence, they fail to assess the true performance of construction projects and organizations (Kagioglou et al., 2001). The result obtained from such a financial performance measurement system also provides limited use for the long-term strategic construction business planning (Love and Holt, 2000). According to Langford and Male (2001), in international construction the stakeholder satisfaction would gain value and this would lead companies to pose fresh challenges in strategy-making process. This statement supports the earlier view of Love and Holt (2000) and also implies the need for an appropriate wider performance measurement/management system concerned about not only paying customers but also other stakeholders all being critical for business viability in the short and longer terms. The results derived from the wider performance measurement process may be used as inputs for a continuous strategic management process in order to form a competitive base in a fiercely competing construction business environment. This will be highly beneficial for construction organizations criticized for a lack of long-term strategic planning and management (Veshoskyi, 1994; Chinovsky and Meredith, 2000).

1.2 Research problem definition

The research problem can therefore be stated as follows:

Increasing competition is forcing companies to make strategic decisions in the long term. A successful performance management process which can be implemented through a comprehensive performance measurement system is a way for organizations to see their status in the business environment and therefore make appropriate strategic decisions. However, comprehesive performance measurement systems are lacking in construction industry. Moreover, the results achieved from the existing financial based performance measurement systems can not be used to derive future performance. In the absence of a comprehensive performance measurement system, it is impossible to substantiate the status of the organization. Therefore, a comprehensive performance measurement system consisting of both qualitative and quantitative measures is needed for construction industry. The proposed performance measurement system should be able to assess the performance of a construction company considering the performance of the projects operated, from different aspects of a project environment in line with the company and the project characteristics.

1.3 Objectives of the research

The research is mainly concentrated on the design of a comprehensive performance measurement system which has the ability to assess the performance both in project and corporate level. In order to achieve this, the most appropriate performance measures as well as the performance indicators will be determined, and validity of the measures and the relationships between them will be justified. The validity of the model will be tested by using a statistical technique called structural equation modeling (SEM) based on data collected through a questionnaire study.

Since construction management literature was focused on project performance rather than company performance, proposal of such a framework has considerable contributions to the performance measurement/management research in construction. It will provide a multiple faceted performance measurement system with determined measures and indicators valid for all situations in a construction project and a company. Moreover, this meaurement system will be helpful to construction professionals in assessing the status of their company, performance of their on going project or post project appraisal. This model aims to help companies to be aware of the performance of their company and decide on long-term strategies accordingly.

In this respect, following are the objectives of this research:

- Discussion of the need for performance measurement in construction industry and its use in strategic decision making.
- Determination of the measures and indicators of construction industry performance in line with an in depth literature review.
- Development of a performance measurement framework for the construction industry
- Hypothesis development and testing based on the performance measures.
- Hypothesis development and testing based on the relations among performance determinants.
- Analysis of the whole model and exploration of the inter-relationships between model parameters.
- Analysis of the performance measures and indicators with experiments on special models.

1.4 Research methodology

A questionnaire consisting of questions about performance measures and indicators was designed to analyse their influence on project and company performance in construction industry. The questionnaire was administered via e-mail and face-to-face interviews to 73 construction companies established in Turkey. The data collected from 73 respondents and 354 construction projects were analyzed using structural equation modeling (SEM) technique. By using SEM, validity of the hypothetical relationships and the proposed measures were tested.

1.5 Limitation of the research

The limitations related to the research mainly based on the data collection process. Data were collected from medium to large size construction companies established mainly in Turkey. Although most of the respondent companies work internationally, measures were determined according to their availability in Turkish construction industry since respondents were Turkish companies. Importance and rating levels of some the measures as well as the relations between them would be somehow different if the questionnaire was administered in a different country.

1.6 Organization of the thesis

The thesis is comprised of seven chapters.

In the first chapter, introductory information has been given related to the background of the research as well as the definition of the problem, objectives and limitations.

In the second and third chapters an in-depth literature review on performance issues in general and in construction industry was given respectively.

In the fourth chapter research methodology and proposed model was presented as well as the determined measures and the indicators.

In the following fifth chapter, descriptive statistics of the collected data were given and a comprehensive statistical analysis of the proposed model was explained in detail in line with a review of the Structural Equation Modeing (SEM) technique used

In the sixth chapter, determinants of performance were discussed and analysed in special models which also have the ability to assess the effects of some measures of performance on others.

Finally, the discussions and the conclusions of the research were elaborated in the seventh and the eight chapter.

CHAPTER 2

PERFORMANCE MEASUREMENT – GENERAL VIEW

In this part of the thesis, definitions related with performance measurment concept in general will be presented to set the theoretical background of the research. The current state of the knowledge about performance measurement measurement was emerged from the management literature, therefore the literature related to performance concept in construction will be the subject of the following chapter.

2.1 Definition of concepts related with performance

Literally, the performance management process is seen as a closed loop control system which deploys policy and strategy, and obtains feedback from various levels in order to manage the performance of the business. A performance measurement system is an information system which is at the heart of the performance management process and it is of critical importance to the effective and efficient functioning of the performance management system (Bititci et al., 1997). Performance measurement can also be defined as the process of quantifying the efficiency and effectiveness of an action (Amaratunga et al., 2000). Therefore, performance measurement is the process of determining how successful organizations or individuals have been in attaining their objectives and strategies (Evangelidizs, 1992).

Performance measurement has also been defined as “the systematic assignment of numbers to entities” (Zairi et al., 1994). Churchman (1959) further suggests that the function of measurement is to “develop a method for generating a class of information that will be useful in a wide variety of problems and situations”.

In general, the definition of performance in any given context requires,

1. Combination of criteria (not a single measurement)
2. Level of analysis (such as end-users, employees, etc.)
3. Certain focus (perspective)
4. Time frame (short or long range)
5. Measurement system (quantitative versus qualitative, objective versus subjective) (Szilagyi, 1988).

2.1.1 Performance measures and indicators

Performance measures have been defined as characteristics of outputs that are identified for purposes of evaluation. Hronec (1993) defines performance measures as the vital signs of the organization, which "quantify how well the activities within a process or the outputs of a process achieve a specified goal". Performance measures help us understand, manage and improve what our organizations do. Effective performance measures can let us know, how well we are doing, if we are meeting our goals, if our customers are satisfied, if our processes are in statistical control, and if and where improvements are necessary.

Performance indicators are defined as measurable characteristics of products, services, processes and operations that an organization uses to track performance (Bititci et al., 1997). An effective performance management system will greatly depend on the performance indicators used to define the performance of the organization from a number of perspectives. Therefore, it is very important to design those indicators so that they relate directly to the various perspectives that an organization decides to adopt (Samson and Lema, 2002).

2.1.2 Performance measurement system and framework

A performance measurement system refers to the measurement system implemented by a company, while a performance measurement framework is a general theoretical framework developed in research, that can act as the basis for a company's performance measurement system (Bassioni et al., 2004).

Performance measurement systems provide a mechanism to focus on wider business performance measures, which enable organizations to implement business improvement. The drive for implementing performance measurement models is gaining momentum as a result of market conditions forcing organizations to change, clients, investors and other stakeholders demanding continuous improvement (Robinson et al., 2005).

Performance measurement systems aim to "integrate organizational activities across various managerial levels and functions" (McNair et al., 1990). The need for integration is supported by Hronec (1993), who defines a performance measurement system as a "tool for balancing multiple measures (cost, quality, and time) across multiple levels (organization, processes and people)". Maskell (1989), offers seven principles of performance measurement system design:

1. The measures should be directly related to the firm's strategy.
2. Non-financial measures should be adopted.
3. It should be recognized that measures vary between locations – one measure is not suitable for all departments or sites.
4. It should be acknowledged that measures change as circumstances do.
5. The measures should be simple and easy to use.
6. The measures should provide fast feedback.
7. The measures should be designed so that they stimulate continuous improvement rather than simply monitor.

2.2 Importance and benefits of performance measurement

In a time of globalization and an increasingly competitive environment, measuring performance has become critical to business success. Performance measurement aligns organizational resources, activities and processes to the major objectives of the organization. It focuses on the long-term goals and cultivates a long-term strategic view of the organization and therefore produces meaningful measures. It has a wide variety of useful applications. It is useful in benchmarking, or setting standards for comparison with best practices in other organizations, provides consistent basis for comparison during internal change efforts and indicates results during improvement efforts.

It is obvious that performance measurement alerts companies during negative performance and leverage opportunities. However, it also increaeses company-wide understanding of corporate vision and strategy. Stronger communication is provided through the measurement processes. Moreover, information overload is avoided since only the most important measures are considered. The issues related to the long-term targets and strategic objectives are underlined. Improved organizational alignment and employee performance and actions according to the identified strategy is a common result of a successfully implemented performance management system. The competencies needed and available in the company are determined and accordingly a continuous change management and strategic planning is provided. Alerts to negative performance and leverage opportunities for growth

Performance measurement helps companies to decide on their objectives clearly, therefore optimizes operations in the company since objectives and results are more closely aligned. It cultivates a change in perspective from activities to results, supports ongoing communication, feedback about organizational objectives. Performance is

seen as an ongoing strategy making process, rather than a one-time event, it focuses on the need and satisfaction of customers. Performance measurement produces specificity in commitments and resources it provides, specificity for comparisons, direction and long-term planning.

2.3 Development of conceptual frameworks and process models

Performance measurement is a very fertile subject of interest that various researchers have added new works to the literature during the last two decades. Keegan et al. (1989) proposed a balance between financial and non-financial measures; Maskell (1989) advocated the use of this approach based on World Class Manufacturing (WCM) measures such as quality, time, process and flexibility.

During the 1990s, there has been some interest in 'emerging' techniques and philosophies to measure and manage performance, such as total quality management (TQM), benchmarking, business process re-engineering (BPR) and business process management.

McNair et al. (1990) described a pyramid of measures which integrates performance through the hierarchy of the organization; and Cross and Lynch (1988) developed SMART model of strategic measurement analysis and reporting technique as a part of measurement process.

Brignall et al. (1991) applied the nonfinancial concept to the service industry and suggested the idea of dividing performance criteria into determinants and results. Ward et al. (1991) considered the problems associated with the identification and use of project-related objectives held by a project-owning, client organization. Azzone et al. (1991) promoted the importance of the time criterion in their matrix for time-based companies. Fitzgerald and Moon (1991) distinguished the difference between the results and their determinants.

Kaplan and Norton (1992) introduced the relationship between the four perspectives of their "balanced scorecard". The balanced scorecard of Kaplan and Norton (1996) promoted as a strategic performance management system. Like Kaplan and Norton (1992), Cooper et al. (1992) also defined four perspectives from which the business should be measured. Adams and Roberts (1993) offered another model, which they call EP^2M (effective progress and performance measurement) (Olve et al., 1999).

All previous frameworks pointed out the fact that performance measurement should be translated from strategy. However Neely and Adams (2001) asserted that, while measuring performance, stakeholders' needs and contributions have the first priority beyond the strategies, processes, and capabilities.

There are many types of PMS frameworks as mentioned above. Here, only a few of them, which are among the most widely used frameworks will be explained in detail.

2.3.1 The balanced scorecard

A new approach to strategic management was developed in the early 1990's by Drs. Robert Kaplan and David Norton. The seeking of new strategies and business models to measure and improve performance was essential in the market-driven competitive business world. They named this system as the balanced scorecard (BSC). BSC as a performance measurement system includes financial measures that show the results of the actions already taken, and it complements the financial measures with operational measures on customer satisfaction, internal processes, and the organization's innovation and improvement activities. Recognizing some of the weaknesses and vagueness of previous management approaches, BSC approach provides a clear prescription as to what companies should measure in order to balance the financial perspective.

The BSC is a management system (not only a measurement system) that enables organizations to clarify their vision and strategy and translate them into action. It provides feedback around both the internal business processes and external outcomes in order to continuously improve strategic performance and results. When fully deployed, the BSC transforms strategic planning from an academic exercise into the nerve center of an enterprise.

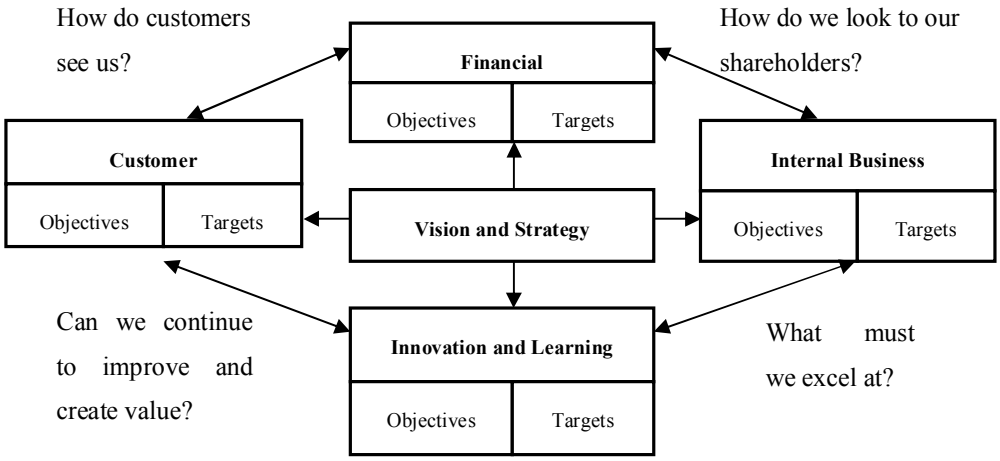


Figure 2.1 The Balanced Scorecard

Kaplan and Norton (1992) first devised the balanced scorecard (BSC) as a measurement framework for strategic, operational and financial measures. The concept aims to align corporate values with operational objectives, customer satisfaction, shareholder value and expectations, and individual employees' objectives, competencies and aspirations (Kaplan and Norton, 1996a). The balanced scorecard allows managers to look at the business from four important perspectives. It provides answers to four basic questions as shown in Figure 2.1.

The pioneering ideas of the BSC are actually quite straight forward (Olve et al., 1999): (i) A compact structure for communicating strategy. (ii) The cause-and-effect relationships among different factors and the strategic hypothesis underlying the course of action. (iii) A systematic procedure for conducting the course of action, so that they replace traditional planning and control of an almost purely financial nature.

2.3.2 The performance pyramid

The strategic measurement analysis and reporting technique (SMART) system (also known as the performance pyramid) was developed as a result of dissatisfaction with traditional performance measures such as utilization, efficiency, productivity and other financial variances (Cross and Lynch, 1988).

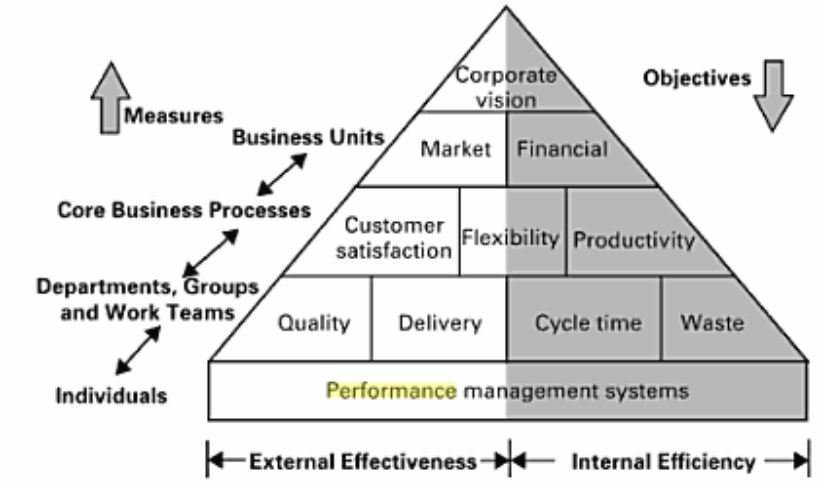


Figure 2.2 Smart system (Cross and Lynch, 1988)

The basic principle is a customer-oriented model linked to the company's overall strategy, with financial figures supplemented by several other key ratios of a non-

financial nature (Olve et al., 1999). A representation of the SMART system is depicted in Figure 2.2.

At the corporate vision or strategy level, management assigns a corporate portfolio rle to each business unit and allocates resources to support them. At the second level, objectives for each business unit are defined in market and financial terms. At the third level, more tangible operating objectives and priorities can be defined for each business operating system in terms of customer satisfaction, flexibility and productivity. At the fourth level, being the department level; customer satisfaction, flexibility and productivity are represented by specific operational criteria in terms of quality, delivery, process time and cost.

2.3.3 International key quality awards

In recognition of substantial improvements in business performance that many organizations have achieved, a number of national and international awards have been established. The criteia used in qualifying organizations for such prestigious awards provide better guidance for performance improvement initiatives in construction organizations by identifying key performance parameters and also performance measures.

2.3.3.1 Malcolm Baldridge National Quality Award (MBNQA)

Critical success factors that have been incorporated into the criteria for the Malcolm Baldridge National Quality Award (MBNQA) as indicated by McCabe (2001) are, leadership, information and analysis, strategic planning, human resources development and management, process management, business results, and customer focus and satisafction.

However higher weighting is given to the customer, business results, human resource development and management, and process management factors. The criteria based on Porter and Tanner (1996) were originally followed by critical success factors such as: continuous improvement and learning, fast response to environemental changes and customer requirements, long-range view of the future, management by fact, partnership development, and results orientation.

2.3.3.2 The EFQM excellence model

The European Foundation for Quality Management (EFQM) was founded in 1988 and is committed to promoting quality as the fundamental process for continuous improvement within a business (Figure 2.3). It is dedicated to stimulating and assisting management in applying innovative principles of Total Quality Management (TQM) suited to the European environment (Watson and Seng, 2001).

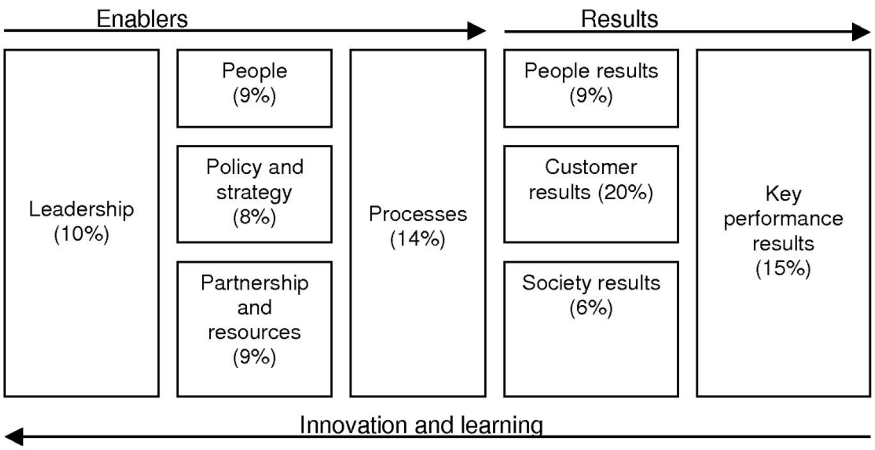


Figure 2.3 EFQM excellence model

The EFQM Excellence Model, a non-prescriptive framework based on nine criteria, can be used to assess an organisation's progress towards excellence. The model recognizes that there are many approaches to achieving sustainable excellence in all aspects of performance.

At the heart of the model lies the "radar" logic. The elements of "radar" are results, approach, deployment, assessment and review. The elements of approach, deployment, assessment and review are used when assessing "enabler" criteria and the results element is used when assessing "results" criteria (Watson and Seng, 2001).

2.3.4 Feedbacks from the implementation of the performance frameworks

Companies use different strategies to strengthen organizational competence by emhasizing on planning, learning and continuous improvement, technology, corporate culture, employee empowerment and innovation, creating mutual trust and strategic partnership, and flexibility. Customer satisfaction is the focus of nearly all companies and so the frameworks built to analyse and improve performance. Companies realized that customer satisfaction has become an essential ingredient to achieve success against competititon.

2.3.5 Shortcomings of existing frameworks

Performance measurement frameworks and excellence models in general indicate that they have one or more of the following shortcomings:

1. Determination of performance criteria.

2. Determination of relations between the performance criteria.

3. Lack of a systematic measurement design.

4. Lack of implementation gudielines for the performance measurement systems in practice

5. Adaptation of the framework according to the changing environment in the long-term (Bassioni, 2004).

2.3.6 Problems related to implementation and recommendations

The shortcoming most frequently found when implementing performance measurement systems were the rejection to performance measurement due to lack of visualization of their benefits and rejection due to fear of punishment.

In order to facilitate the implementation of performance measurements, the objectives of the system should be defined and communicated clearly. The participation of personnel in the design of the measurement system should be promoted and the benefits which can be obtained should be illustrated.

CHAPTER 3

PERFORMANCE MEASUREMENT IN CONSTRUCTION INDUSTRY

Affected by previously mentioned studies which were derived from the observations in manufacturing industry, construction management literature was also enriched with the recent studies regarding performance.

3.1 Previous studies on performance in construction

Robertson (1997) introduced a construction company's approach to business performance measurement with a model constructed with two levels of outcome developed from the fundamental Behavior to Performance to Outcome (B-P-O) cycle in industrial/ organizational psychology. Bititci and Turner (2000) examined the use of information technology (IT) based management tools as a self-auditing PM system. As a result a dynamic performance measurement system was developed in line with the integrated performance measurement system (IPMS) reference model (Bititci et al. 1997). Medori and Steeple (2000) also developed an integrated performance measurement framework (IPMF).

Baldwin and McCaffer (2001)'s approach provides valuable guidelines for contractors who intend to implement such a measurement system in their companies. Initially, selected project managers are asked to give their opinions about the measures that they think could be used to measure organizational performance. The measures identified with the opinion of the project managers are forwarded to senior managers for their opinions/comments. Subsequently top management review the list of measures as agreed on by project managers and senior managers, and a final list of performance

measures are established. The responsibilities for performance measurement are allocated to relevant divisions of the company.

As a result of Egan (1998) report, "Rethinking Construction", The Construction Best Practice Program (CBPP) launched the KPI (key performance indicators) for performance measurement (CBPP-KPI, 2005). Kagioglu et al. (2001) proposed a performance measurement process conceptual framework for construction firms (PMPCF). Alarcon and Ashley (2002) proposed a contractor selection system that incorporates the contractor's performance prediction as one of the criteria for selection. Yasamis et al. (2002) introduced an alternative theory developed of what constitutes quality, client satisfaction, performance and their interrelationships in the context of the construction industry. Tang and Ogunlana (2003) stated that an organization's overall performance is influenced by the existing organization structure that is inherently complex with many interrelated components and modeled the dynamic performance of a construction organization. Introduced by Pheng and Hui (2004), implementation of Six Sigma concept to construction provided a statistical indicator to measure the performance of processes or products against customer requirements.

Upon the principles of the balanced scorecard and business excellence models, Bassioni et al. (2005) built a conceptual framework for measuring business performance in construction. Pun and White (2005) developed a model for integrating strategy formulation and performance measurement in organizations. Phua (2006) introduced a framework that combines resource-based and institutional perspectives for identifying the industry and company-specific factors that affect construction company performance. El-Mashaleh et al. (2006) examined the effect of information technology on company performance and found a positive association between them. Yu et al. (2007) developed a performance measurement system for construction companies by using the BSC perspective. Elyamany et al. (2007) developed a

performance evaluation model using the financial, economic and industrial characteristics of companies. The applicability of the mentioned systems to construction was supported by Nudurupati et al. (2007) by using empirical data.

3.2 Investigation of performance measures and indicators

The literature reveals that there are several important factors that influence the success of a construction company. Identification of these performance parameters is essential as they are the cornerstones of building an effective performance measurement system. Table 3.1 summarizes the recommendations with regard to the design of performance measures compiled by Neely et al. (1997).

Table 3.1 Determination of performance measures (Neely et al., 1997)

Recommendation	**References**
Performance measures should be derived from strategy.	Dixon et al., 1990; Kaplan and Norton, 1992
Performance measures should be simple to understand.	Maskell, 1989
Performance measures should provide timely and accurate feedback.	Dixon et al, 1990; Fortuin, 1988
Performance measures should be based on quantities that can be influenced, or controlled, by the user alone or in co-operation with others.	Globerson, 1985; Lynch and Cross, 1991
Performance measures should reflect the "business process".	Lynch and Cross, 1991
Performance measures should relate to specific goals (targets).	Globerson, 1985; Fortuin, 1988
Performance measures should be relevant.	Lynch and Cross, 1991; Azzone et al., 1991
Performance measures should be part of a closed management loop.	Kaplan and Norton, 1992; Globerson, 1985
Performance measures should be clearly defined.	Globerson, 1985

Table 3.1 Determination of performance measures (Neely et al., 1997) (continued)

Performance measures should have visual impact.	Lea and Parker, 1989; Fortuin, 1988
Performance measures should focus on improvement.	Lea and Parker, 1989; Lynch and Cross, 1991
Performance measures should be consistent.	Fortuin, 1988
Performance measures should have an explicit purpose.	Globerson, 1985
Performance measures should be based on an explicit formula and source of data.	Globerson, 1985
Performance measures should employ ratios rather than absolute numbers.	Globerson, 1985
Performance measures should use data.	Globerson, 1985
Performance measures should be reported in a simple consistent format.	Lynch and Cross, 1991
Performance measures should be based on trends rather than snapshots.	Lynch and Cross, 1991
Performance measures should provide fast feedback.	Maskell, 1989
Performance measures should be precise – be exact about what is being measured.	Fortuin, 1988
Performance measures should be objective – not based on opinion.	Fortuin, 1988
Performance measures should provide information.	Fortuin, 1988

According to PMBOK Guide (2007), the mostly used performance measures can be grouped into one of the following six general categories:

1. Effectiveness: A process characteristic indicating the degree to which the process output (work product) conforms to requirements (Are we doing the right things?)
2. Efficiency: A process characteristic indicating the degree to which the process produces the required output at minimum resource cost. (Are we doing things right?)

3. Quality: The degree to which a product or service meets customer requirements and expectations.
4. Timeliness: Measures wheter a unit of work was done correctly and on time. Criteria must be established to define what constitutes timeliness for a given unit of work. The criterion is usually based on customer requirements.
5. Productivity: The value added by the process divided by the value of the labor and capital consumed.
6. Safety: Measures the overall health of the organization and the working environment of its employees.

Research under this category is directed towards identification of performance measures beyond the traditional performance measures like cost, time and quality, specific to projects and investigation of key performance indicators (KPIs).

Benchmarking process can also be used as a way of determining critical success factors or performance measures of company. Benchmarking is the systematic and continuous process of measuring and comparing a company's business performance against leaders in the field and determining best adaptable improvement practices (Poister, 2003).

It requires an understanding of critical success factors and then measuring performance according to these factors. For the determination of effective measures, it is necessary to make comparisons. The comparisons may evaluate progress in achieving given goals or targets, assess trends in performance over time, or weigh the performance of one organization against another (Poister, 2003). The factors that may be associated with potential future problems and the aspects of project management that need special attention to ensure project success in the long term can be identified.

3.2.1 Construction performance measures in use

There is a correlation between effective performance measures and effective performance management (Drucker, 1995). The effectiveness of any given performance measure depends on how it will be used. According to Sommerville and Robertson (2000) the operational performance scorecards should comprise of customer, people, processes and resources, financial and business results perspectives with a range of measures and sub-measures on each area as quality of work, achievement of time scales, standard of communication, impact on society and good practice for customer view; employee satisfaction, employee involvement, training and development, safety for people view; target zero time delays, work won on value, criteria and waste efficiency for processesand resources view; Risk management, return on capital and profitability for financial view; market value, growth, project site contribution for business results view.

McCabe (2001) has mentioned that business performance scorecards also should be comprised of other critical areas of success in construction, such as innovation, partnering, supply chain management, and teamwork and leadership, which would lead them to become a world-class construction organization. According to McCabe (2001), most of the international construction companies used performance indicators such as cost predictability, time predictability, defects, accidents, number of employee suggestions implemented, number of continuous improvement projects completed, number of ISO 9001 non-conformities, plant breakdown, number of customer complaints, energy consumption rate, numer of environmental reportable incidents, etc. in benchmarking the company's performance.

The report by Construction Task Force in London introduced five fundementals to the construcion process, namely leadership, focus on customers, integration of the process and the team around the product, quality-driven agenda and commitment to people. It is also recommended that the industry should put in place a means of measuring

progress towards its objectives and targets. Key performance indicators (KPI) currently being used in the UK construction industry can be effectively used by clients and supply chain organizations for benchmarking against best practices within or outside the construction industry. A detailed view of the key performance indicators is explained in the following part.

3.2.1.1 Key performance indicators

Key performance indicators are compilations of data measures used to assess the performance of a construction operation (Cox et al., 2003). KPIs give information on the range of performance being achieved on all construction activities and they include the criteria represented on Table 3.2 (CBPP-KPI, 2005). The CBPP in UK which was recognised as the leading organization for determining KPIs launched eight criteria in 2007.

Table 3.2 Key Performance Indicators (CBPP-KPI, 2005)

Project Performance	**Company Performance**
Client satisfaction – product	Profitability
Client satisfaction – service	Productivity
Defects	Safety
Predictability – cost	
Predictability – time	
Construction - cost	
Construction – time	

These KPIs are intended for use as benchmarking indicators for the whole industry (Kagioglou et al., 2001). Companies should only use the industry KPIs as indicative of industry performance and use their own measures for internal benchmarking and

improvement (Beatham et al., 2004). It is evident that these peormance indicators make sense through their capture of narrowly defined aspects of value.

3.2.2 Critical success factors

It is generally accepted that the major goals in a construction project are cost, time and quality, although there are other more specific objectives, such as safety consideration and market entry, depending on the nature of the project and company. A variety of factors determine the success or failure of projects in terms of these objectives. The identification of the critical success factors (CSFs) for these objectives will enable limited resources of time, manpower, and money to be allocated appropriately.

According to Chan et al. (2002), the mostly investigated and used critical success factors by researchers (eg. Larson, 1995; Chan, 1996; Shenhar et al., 1997; Liu and Walker, 1998; Chua et al., 1999; Atkinson, 1999; Brown and Adams, 2000 etc.) are "time and cost", "budget/financial performance/profitability", "health and safety", "quality", "meeting technical performance specifications", "project objectives/goal attainment", "completion", "functionality", "productivity/efficiency", "satisfaction of client/customer/contractor/project manager/team", "expectation/aspiration of client/contractor/customer/project manager/team", "dispute resolution satisfaction/ conflict management", "absence of conflicts/ legal claims", "professional image", "aesthetics", "educational, social, and professional aspects" and "environmental sustainability".

CHAPTER 4

RESEARCH METHODOLOGY AND THE PROPOSED PERFORMANCE MODEL

There is a general agreement among researchers and industry professionals that one of the major obstacles to promote improvement in construction companies and successful construction projects is the lack of appropriate performance measurement. For continuous and sustainable improvement, it is necessary to have a well designed measurement system with valid performance measures and indicators which has the ability to check and monitor performance as well as providing long-term strategic decisions for the company. In the light of this approach, a multi-faceted performance measurement model with a bunch of appropriate performance measures and indicators was constructed. In order to test its convenience for use, a questionnaire survey was designed and administered to construction industry professionals.

4.1 Construction company performance framework

A comprehensive review of existing literature was carried out in order to identify the performance measures at both company and individual project levels. Besides, validity of the determined performance measures and the model was justified consulting to some industry professionals. Hence, the the model was redesigned optimizing the theoretical background of the subject with practical requirements of construction industry (Figure 4.1).

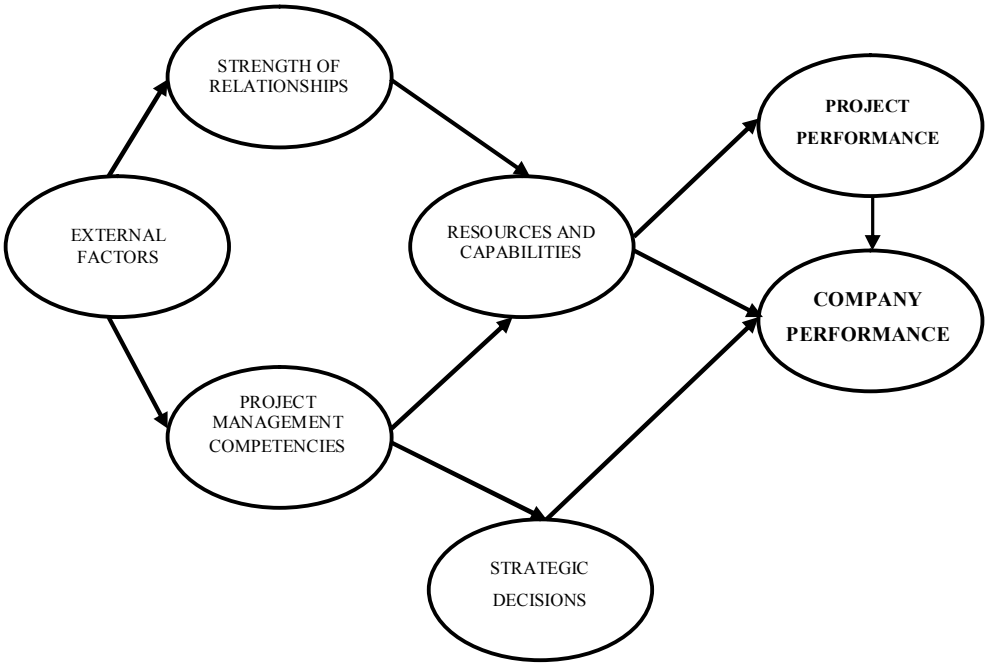


Figure 4.1 Proposed performance measurement model

4.2 Rationale for the questionnaire

The rationale of the questionnaire was established relative to the performance measures and indicators of the measurement model which were determined and decided to be used with respect to an in depth literature review and the experiences of the industry professionals. Performance measures and indicators to be used in the research were presented in Table 4.1.

Table 4.1 Performance measures and indicators

RESOURCES AND CAPABILITIES	**EXTERNAL FACTORS**
Financial resources	International relations
Technical competency	Macro-economic conditions
Leadership	Political conditions
Experience	Socio-cultural conditions
Company image	Legal conditions
R&D capability	Intense rivalry between companies
Innovation capability	New entrants to the market
STRENGTH OF RELATIONSHIPS	Supply power
Relations with client	Client power
Relations with government	Demand
Industrial relations	
PROJECT MANAGEMENT	**STRATEGIC DECISIONS**
Schedule management	Differentiation strategies
Cost management	Market selection strategies
Quality management	Project selection strategies
Human resources management	Client selection strategies
Risk management	Partner selection strategies
Supply chain management	Project management strategies
Claims management	Investment strategies
Knowledge management	Organizational management strategies
Health and safety management	**COMPANY PERFORMANCE**
PROJECT PERFORMANCE	Financial perspective
Project profitability	Learning and growth perspective
Client/user satisfaction	Internal business perspective
Long-term contributions to company	Customer perspective

4.3 Design of the questionnaire

Given the model and the measures identified in the preceding sections, five variables namely, “project management competencies”, “strength of relationships”, “resources and capabilities”, “strategic decisions”, “external factors” were developed to measure “project performance” and “company performance”. A questionnaire survey was then developed consisting of questions that inquire about the performance determinants that measure the latent variables. Each question was associated with constituent variables of the latent variables. The descriptions of those determinants of performance will be detailed in the following parts.

4.3.1 General information about the respondent companies

The questionnaire was administered via e-mail to 185 construction companies established in Turkey, describing the objective of the study, inquiring about their willingness to participate in the study and requesting a face-to-face interview with an executive of the company. The target construction companies were all members of the Turkish Contractors Association (TCA) and the Turkish Construction Employers Association (TCEA). Forty seven questionnaires were completed, the majority of which were administered by face-to-face interviews. The rate of response was 25%. However, considering the fact that there were other construction companies in the industry which were not members of TCA or TCEA but showing similar characteristics with the member companies of these two associations in terms of size and type of work undertaken, a decision was made to expand the survey by including 26 additional similar companies selected individually through personal contacts. At the end of the extended survey, there were 26 more completed questionnaires, bringing the total number of respondents to 73.

4.3.2 Performance measures

A company is a complex structure, consisting of different interrelated components that influence its performance (Tang and Ogunlana, 2003). These components include the resources and the capabilities of the construction company, its project management competencies, the strength of its relationships with other parties, and the long-term and short-term strategies of the company.

4.3.2.1 Resources and capabilities

A company's resources and capabilities may be defined as its tangible and intangible assets. They include the company's financial resources, technical competencies, leadership characteristics, experience, and image in the industry, research and development capabilities, and innovation tendencies.

- ***Financial resources*** indicate a company's strength in the market in terms of its capacity to carry out projects. Adequate financial resources ensure the company can get into risky situations that have a prospect of high returns. As a company's financial strength increases, its credibility and reputation also increases among clients and suppliers (Warszawski, 1996). Profitability and turnover can be used as indicators of financial strength, but generally the financial strength of a company is measured by examining the ratio of its liabilites to equities. The majority of construction projects are funded by the owner who pays the contractor periodically, who in turn pays the subcontractors, the suppliers and other parties of the project for services rendered. A portion of the periodic payments is normally held by the owner as retainage. The success of this routine depends on the financial strength of the owner as well as of the contractor (Gunhan and Arditi, 2005).

- ***Technical competency*** refer to the physical assets of a company such as machinery and equipment and the extent of technical knowhow available that is necessary to undertake specific projects. Shenhar and Dvir (1996)'s project management theory is based on two dimensions which are technological uncertainty and system complexity. Fulfillment of technological specifications and uncertainties are one of the major factors in the achievement of success in a project (Shenhar, 1998; Raz et al, 2002). According to Warszawski (1996), a company's technical competency can be assessed by analyzing the company's preferred construction methods, the experience of its technical staff, the productivity and speed of its construction activities and the quality of the company's output.

- ***Leadership*** involves developing and communicating mission, vision, and values to the members of an organization. A successful leadership is expected to create an environment for empowerment, innovation, learning and support (Shirazi, 1996). Researchers have examined the links between leadership styles and performance (Bycio et al. 1995; Howell and Avolio. 1993). Fiedler (1996), have emphasized the effectiveness of a leader as a major determinant in success or failure of a group, organization, or even an entire country. It is argued that the negative effects of external factors in a project environment can be decreased by the training end equipping of leaders with different skills (Darcy and Kleiner, 1991; Hennessey, 1998; Saari et al. 1988). Leadership is also an enabling activity of EFQM in which organisations are assumed to require leadership factor for any of their decisions or actions (Beatham et al., 2004).

- ***Experience*** is highly related to a company's knowledge management competency. Organizational learning can be effective only if the lessons learned from completed projects are kept in the organizational memory and used in future projects (Kululanga and McCaffer, 2001). Organizational learning is difficult for companies

because of the fragmented and project-based structure of the industry. This difficulty can be altered by knowledge management activities and provision of a continuous organizational learning culture (Ozorhon et al., 2005).

- ***The image of the company*** compared with its competitors is important. As in all market-oriented industries, contractors also need to portray an image that fits the needs of the market and the clients targeted. It gives an impression of the products, services, strategies, and prospects compare to its competitors (Fombrun and Shanley, 1990). Contractors in construction industry have to portray an image that address the expectation and demand of the clients and users, like in all other market oriented indutries. Moreover, image of a company may enable higher profitability by attracting better clients and investors and increasing the value of the product (Fombrun, 1986).

- ***Research and development capability*** is a response to increased industry requirements that occurred as a result of globalization and competition between the companies. Developments occur in all phases of the construction process and technologies emerge that are deemed to have a positive impact on competitive advantage. In contrast to the traditional conservative stance of the industry, construction companies are forced to develop and adopt new technologies in order to survive.

- ***Innovation capability*** constitutes the link between the company and the dynamic environment of the industry (Pries and Janszen, 1995). The construction industry is no more static and introverted. Globalization and higher rates of competition between companies forced construction companies to change. Innovation capability is an important factor in achieving cost leadership, focus, and differentiation, hence enhancing competitiveness as stated in Porter (1980). A

company's ability to innovate is related to the industry in which it operates. The traditional characteristics of the construction favor cost leadership obtained through lowest bids and focus obtained through specialization (e.g., tall buildings, sewage systems etc.) as the predominant competitive advantages. However, the dynamic changing nature of construction has thrust forward differentiation strategies too. Innovation capability is an important factor in achieving cost leadership, focus, and differentiation, hence enhancing competitiveness. According to Arditi et al. (1997) innovations are rather incremental than radical in construction industry. The construction is a supplier dominated industry. Construction companies are dependent on other industries for innovations such as construction materials, equipment other than the technological innovations such as new construction processes and methods. Alternative corporate structures, financing methods etc. can also be added as the potential innovation areas in construction industry (Arditi et al. 1997).

Resources and capabilities are inevitably influenced by project management competencies as construction companies are characterized by a project-based structure; and by the strength of the company's relationships with third parties as construction companies operate in a multi-party environment that includes owners, sub-contractors, financial institutions, surety companies, material dealers, equipment manufacturers, etc.

4.3.2.2 Project management competencies

The construction industry is a project-based industry since contractors survive and grow based on the success they achieve in their projects. Each construction project is unique but the managerial process is normally uniform across projects in a company. As the project is at the core of the construction business, project management

competencies cannot be dissociated from overall company performance. Project management knowledge areas and skills have been investigated by many researchers (PMBOK Guide, 2007; Hendrickson and Au, 1989 etc.). The most common of these factors adopted for this research are presented below.

- ***Schedule management*** is the competency of reasoning backward, since in the execution of all projects there is a target date to finish and deliver the job (Hendrickson and Au, 1989). It is a major enabler of the project to complete on time by the use of a series of processes. These processes are activity definition, sequencing, resource estimating, duration estimating, schedule development and schedule control (PMBOK-2007). The timely accomplishment of a project is dependent on the experience of the project managers. A project manager has to be familiar with several parameters in a project environment for making accurate estimates on what may be the cause of a potential delay, or completion of the project on or ahead of schedule.

- ***Cost management*** activities include planning, estimating, budgeting, and controlling of the project (PMBOK-2007). All these activities ensure the lowest possible overall project cost consistent with the owner's investment objectives.

- ***Quality management*** refers to the activities in an organization that determine quality policies, objectives, and responsibilities and represents solutions in response to the complex and non-standardizeable nature of construction projects that makes it difficult to manage quality. The processes of a quality management system are quality planning, quality assurance, and quality control (PMBOK-2007).Even minor defects may require re-construction and may impair the facility's operations. Poor quality in constructed facilities can be corrected only at a cost and may cause

delays (Davis et al., 1989; Kanji and Wong, 1998). Construction companies are incrementally implementing TQM for improving customer satisfaction, obtaining better quality products and higher market share. The main needs in implementing TQM is the commitment of top management with leadership for the application of quality principles and moreover to change the quality culture (Kanji and Wong, 1998).

- ***Human resources management*** is an inevitable dimension of project management since it is people who deliver projects. People are the predominant resource in an organization and there is a positive association between human resources management practices and achievement of outstanding performance (Pfeffer, 1994; Delaney and Huselid, 1996). Organizing and managing the project team are the main duties of human resources management.

- ***Risk management*** processes and techniques have to be implemented properly in order to increase the performance of a project (Raz et al., 2002). These processes include planning, identification, analysis, responses, monitoring and control of a project. Considering the complex, dynamic and challenging nature of construction projects, risk in a construction project is unavoidable and affects productivity, performance, quality and budget significantly. However risk can be transferred, accepted, minimized, or shared (Latham, 1994). Proper management of risk have the potential to decrease the effects of unexpected events (Kangari, 1995).

- ***Supply chain management*** is the network of different parties, processes and activities that produce products or services (Christopher, 1992). The owner, consultants, contractor, subcontractors and suppliers constitute the supply chain in construction. Higher performance can be achieved by increasing the quality of communication between different parties and team operation among different

parties (Kanji and Wong, 1998). It has a strong correlation with project performance. A number of public sector construction initiatives in the UK, including the Latham Report (1994) and the Egan Report (1998) identified the areas of underperformance amongst suppliers and government clients. These initiatives have emphasized the benefits of improving supply chain management.

- ***Claims management*** is of particular importance because the construction activity involves a large number of parties, an environment conducive to conflicts. Documentation, processing, monitoring and management of claims are a part of contract life cycle (PMBOK, 2007). Claims and disputes between construction owners, contractors and other participants can be avoided by clearly stated contractual terms, early nonadversarial communication, and a good understanding of the causes of claims (Semple et al., 1994).

- ***Knowledge management*** is essential in accessing information relevant to best practices, lessons learned, historical and schedule data, and any other information necessary to run an efficient project. It can be defined as a vehicle fuelled by the need for innovation and improved business performance and client satisfaction (Kamara et al., 2002; Egan, 1998; Egbu et al., 1999).The capability of a company to cope with sophisticated projects is the result of a successful knowledge management (Warszawski, 1996).

- ***Health and safety management*** has a human dimension as accidents during the construction process can result in personal injuries and/or fatalities. Accidents also cause an increase in indirect costs such as the cost of insurance, inspection and conformance to regulations (Ringen et al., 1995). Strict health and safety management regulations can reduce the number of accidents and accidents' effects

on project costs (Ringen et al., 1995). Important issues found to be as potential solutions to health and safety problems on site are the provision of safety booklets, provision of safety equipment, providing safety environment, appointing a trained safety representative on site, site safety, health planning and management, education and training of workers and supervisors, new technologies, federal regulation, workers' compensation law and medical monitoring (Ringen et al., 1995; Sawacha et al., 1999).

4.3.2.3 Strength of the relationships with other parties

The performance of construction companies is influenced by the strength of their relationships with the parties involved in typical construction projects such as public or private clients, regulatory agencies, subcontractors, labor unions, material dealers, surety companies, and financial institutions. The strength of these relationships is related to the mutual satisfaction of the parties, i.e., the realization of the expectations of the parties. The primary relationships that are of more importance than others include relationships with construction owners (both public and private), labor unions, and regulatory agencies because of the reasons discussed in the following sections.

- ***Relationships with clients*** concern the traditional rivalry between clients and contractors. Even though the importance of cooperation and trust between clients and contractors has been understood somewhat better (Bresnen and Marshall, 2000), a strong relationship between clients and contractors is still difficult to achieve. In this sense, client satisfaction comes into question. In order to have good relations with clients, contractors should recognize clients' basic expectations relative to cost, time and quality (Ahmed and Kangari, 1995). On the other hand, good relationships are characterized by timely payments on the part of the owner, fewer claims on the part of the contractor, and the absence of legal disputes.

- ***Relationships with labor unions*** concern employment policies and practices and relates to the management of the human resources of the company. For example, if a company decides to cut cost, and along the way reduces its labor force, labor unions may show their dissatisfaction by threatening to strike (Arthur, 1992). Smooth labor relations pave the way to a dispute-free environment where the likelihood of strikes, slowdowns, and jurisdictional disputes is minimized.

- ***Relationships with the government*** are governed by the effects of government policies and the implementations of regulatory agencies on the construction industry. The construction industry constitutes a large portion of the economy of a country, forcing governments to accommodate construction companies accordingly. In general terms, bureaucratic obstacles set by regulatory agencies to maintain standards in companies' day-to-day operations (e.g., codes, inspections, approvals, etc.), and companies' difficulties in obtaining preferential financial support are some of the government-induced problems. On the other hand, tax incentives, and relaxation of customs duties to allow the import of some materials and to prevent shortages are encouraging government actions (Oz, 2001).

4.3.2.4 Strategic Decisions

The literature on strategic decision-making is spread over a wide range from an individual strategist's perspective to strategic management techniques, to the implementation of these techniques in real situations (Globerson, 1985; Letza, 1996; Warszawski, 1996; Neely et al., 1997). The strategies selected for this study (see below) represent the characteristics of the construction industry as a project-based organization.

- ***Differentiation strategies*** refer to the differentiation of products or services that provides competitive advantage and allows a company to deal effectively with the threat of new entrants to the market (Porter, 1979). Many new construction companies enter the industry every year because starting a new company does not require a large investment; consequently the construction industry becomes more competitive and forces existing companies to seek advantages over competitors by means of differentiation strategies.

- ***Market, project, client and partner selection strategies*** are related to the characteristics of construction projects such as the location and complexity of the project, environmental conditions, availability of competent subcontractors, availability of materials, equipment and know-how locally, financial stability of the client, and potential partners that have capabilities that the company does not possess.

- ***Project management strategies*** can be developed by referring to the mission of the company and the company's business environment. The managerial functions of a project include activities such as planning, cost control, quality control, risk management, safety management, to name but a few. In order to achieve project goals, adequate strategies have to be set up relative to these functions.

- ***Investment strategies*** occur along several dimensions such as capabilities of the company (resources), pricing (financial decisions), product (construction project related factors), and finally research and development (Spence, 1979).

- ***Organizational management strategies*** involve decisions pertaining to the company's reporting structure, planning, controlling and coordinating systems, as

well as the management of the informal relations among the different parties within the company (Barney, 1991).

4.3.2.5 External factors

Traditionally, external factors refer to variables that are beyond the control of an organization. There is no doubt that market conditions (composed of international relations, macro-economic, political, socio-cultural, and legal conditions, the state of competitiveness in the marketplace, supply, demand, and client power) constitute exogenous factors that are solely influenced by outside parties. The effect of market conditions on company success was discussed by many researchers (e.g., Prescott, 1986; Chan et al., 2004). Managing the positive and negative effects of external factors has the power to reshape corporate wide characteristics. The factors described below are the key factors that drive the efficiency of performance.

- ***International relations*** have the power on the companies established in the relevant countries. The companies mostly invest in to a market according to the strength of international relations since there is always a possibility of suspension of the economic activities between countries. Besides, close international relations provides companies to act in relevant country's market more confident in the long-term thereby facilitates and shortens the times of activities.

- ***Macro-economic conditions*** refer to indicators such as national income, output growth, price indices, inflation, unemployment rates, etc. The construction industry is one of the most dynamic moderators of the overall economy in a country. The industry's contribution to the nation's GDP is a key measure in this sense.

- ***Political conditions*** in a country have the power to impact the overall economy which in turn affects all industries. Government changes, coups d'etat, the strength of international relationships, etc. can be considered as potential factors affecting the political stability of a country.

- ***Socio-cultural conditions*** refer to the social environment and wealth in a country that determines the demand. Oliff et al. (1989) state that factors such as national ideology, international joint ventures, attitudes toward construction industry, achievement and work, class structure, information based management, risk, and the nature and extent of nationalism compose the structure of socio-cultural conditions.

- ***Legal conditions*** govern the bureaucracy. The amount of paper work varies depending on the legal requirements and the rate of legal requirements are different in each country. Understanding the legistlation of a country should be obligatory for a manager since the majority of the delays in a project are caused by the disputes.

- ***Intense rivalry between companies*** refers to positioning the company according to the company's strengths/weaknesses such as its tangible and intangible assets and its managerial competencies. According to Kale and Arditi (2003), a company's environment hosts competitive forces and a company's strategic performance is closely related with its ability to handle the effects of competition.

- ***New entrants to the market*** means the increase in market share with substantial resources which serve as a disadvantage to the existing companies but in the mean

time brings new capacity. Economies of scale, product differentiation, capital requirements, cost disadvantages, access to distribution channels and government policy are the main barriers which new companies should face with while entering into a new market (Porter, 1980).

- ***Supply power*** refers to the impact of suppliers of materials and equipment that are needed in the execution of projects. The quality and cost of materials and equipment and the speed of procurement have significant effects on the performance of projects. The number of suppliers in the industry has the potential to affect a project's budget and quality. According to Porter (1980), power of a supplier group depends on the uniqueness of its product, its concentration on the industry and the product it sells, pricing and R&D activities which keeps products to catch new technologies.

- ***Client power*** refers to the financial stability, connections, and political clout of the construction owner and may enhance the continuity of the project.

- ***Demand*** governs the macro-level environment of the industry. The volume of construction depends on the general demand. While developing countries concentrate on infrastructure projects, industrialized countries emphasize industrial/heavy construction as well as high rise buildings and rehabilitation of existing facilities.

4.3.3 Performance indicators

The performance measurement variables described above were selected as being potential measures of indicators whicr are "project perfoemance" and "company performance" described in the following parts.

4.3.3.1. Project performance

A variety of different projects constitute the structure of the construction industry. Inspite of the fact that a similar set of processes are performed, each project is unique and considered as a prototype (Wegelius-Lehtonen, 2001). Thus, it can be inferred that while measuring performance project level is more characteristic than the organizational level (Love and Holt, 2000; Kagioglou et al. 2001). The construction industry is a very dynamic industry in which accomodates different uncertainties regarding new technologies, budgets, and development processes (Chan et al., 2004). In order to cope with these uncertainties, different interrelated components that influence performance should be considered.

In the current study three indicators which were assumed to carry more importance then the other criteria were selected in order to cover factors affecting project performance.

- **Project profitability** is essential for a company's survival and growth in the business cycle (Akintoye and Skitmore, 1991) and financial success of a company can easily be understood by looking at this indicator (Parfitt and Sanvido, 1993). Regarding the value chain of Porter, investigating different parts of a company can provide competitive advantage among the rivals. A company's activities are divided into technological and economical parts and their difference gives the source of competitive advantage in the value chain. From that point of view profitability can be defined as the difference between the value and cost of a product or service (Porter, 1980; Betts and Ofori, 1992). Profitability is measured as the total net revenue over total costs (Norris, 1990). Nowadays, in order to make a project profitable companies have the conscious that necessary attention has to be given to improve project

management competencies and the project should be managed properly (Parfitt and Sanvido, 1993).

- **Client/user satisfaction** describes the level of achievement of the expectations in a project. The key participants in a project can be expanded such as the client, architect, contractor, various subcontractors, surveyors and engineers, end-users (Chan et al., 2002). According to Liu and Walker (1998) satisfaction of the client is a characteristic of success. Furthermore, Torbica and Stroh (2001) claim that the project can be considered successfully in the long-term if the expectations of the end users are achieved. Satisfaction is considered as the cumulative memory of the clients. Therefore in order to accomplish a project successfully and fulfill the memory of the clients positively, this criterion should be assessed in all phases of the project from the beginning to post-construction. (Chan et al., 2002) and construction companies must add user systems to their services to discover, create, improve and deliver value to the client. Client satisfaction is also one of the key elements of Total Quality Management (TQM) in which the requirements of the clients have great importance and should be determined accurately. In construction works, expectations of the clients and end users are the fulfillment of required technical characteristics of a project, conformance to specifications and completion of the facility within planned cost and time. Other main factors affecting client satisfaction are quality, client orientation, communication skills and response to complaints (Ahmed anad Kangari, 1995).

- **Long-term contributions of the project to the company** refer to a long-term strategic management process for gaining competitive advantage. According to Child (1972) organizations can achieve higher organizational performance by adopting different strategic decisions. Strategic decision-making in

construction requires definition of the current position, definition of the future position, reducing of the gap between the current and expected situation and elaborating the necessary plans (Venegas and Alarcon, 1997).

Long-term strategies do not have to be bring profit to the company in the short-term (Kaplan and Norton, 1996b). Besides, in the dynamic environment of the construction industry companies have to behave farsighted in order to survive. Tactical considerations which are short-term have to be replaced with long-term and strategic decisions (Betts and Ofori, 1992). Porter (1980) has developed two major dimensions for competitive positioning which are scope and mode of competition. These dimensions have inspired researchers studying competitive positioning and considered as a link between competitive positioning and organizational performance. Scope of competition in construction companies can be adopted either as a narrow or broad market and product/service approach. First approach provides the company to concentrate on its resources and efforts to refine the competencies and gaining experience from the market segment. In accordance to the subject, here the broader scope of competition is investigated. The use of company's resources in different projects and situations provides the company long-term opportunities. These opportunities can be related to entering into new market segments by using positive reputation gained in another market segment. Moreover, competing in the broad market enables a firm to spread its risks across the different markets and reduce the negative effects of externa factors in an individual market (Kale and Arditi, 2002)

4.3.3.2 Company performance

The BSC perspective was adopted in this study because of its established status and its common use in the industry. It is a framework for measuring the strategic, operational

and financial characteristics of a company. It combines four perspectives to assess the performance of an organization.

- ***The financial perspective*** indicates the success of the company measured in terms of indicators such as profitability, turnover, etc. The financial performance measures indicate wheter the company's strategy, implementation and execution are contributing to bottom-line improvement. Typical financial goals have to do with profitability, growth, and shareholder value (Kaplan and Norton, 1992). The scorecard tells the story of the strategy, starting with the long-term financial objectives, and linking them to the sequence of actions that must be taken with financial processes, customers, internal processes and finally employees and systems to deliver the desired long-term economic performance. The financial objectives reflect the financial performance expected from the strategy and also serve as the ultimate targets for objectives and measures of all the other scorecard perspectives. Measures of financial performance of a company are: increase in revenues and profitability, maret value, cost reduction, productivity improvement, enhancement of asset utilization/profit per total assets, uncompleted work in hand, economic value added, reliability of performance and reduction in risk (Kaplan and Norton, 1996b; Liebowitz and Suen, 2000). Howveer it is argued that overemphasis on financial leads to an "unbalanced" situation with regard to other perspectives. Schneiderman (1999) states that companies that really benefit from a scorecard process would inevitably move the focus of tgheir attention to the non-financial scorecard metrics. It is understandable that overemphasis on achieving and maintaining short-term financial results can cause companies to overinvest in short-term fixes and to underinvest in long-term value creation, particularly in the tangible and intellectual assets that generate future growth (Kaplan and Norton, 1996b).

- ***The learning and growth perspective*** refers to the progress achieved by a company and its growth potential. Organizational learning capacity and the achievements of the organization in such areas as company image or various competencies are also taken into account in this perspective.

  The learning and growth perspective of the BSC identifies the infrastructure that the organization must build to create long-term growth and improvement. The predominant element within this perspective is wheter the organization possesses the required capabilities to improve and create future value for its stakeholders. This perspective looks at the ability of employees, the quality of information systems, infrastructure, and practices in supporting accomplishment of organizational goals (Amaratunga et al., 2000). This perspective constitutes the essential foundation for success (both current and future) of any knowledge-worker organization.

  According to Kaplan and Noron (1996b and 2000) the following are the main objectives in this perspective:

  1. Objectives pertaining to employees developing core competencies (reskillimg employees, training, personnel development etc.), employees satisfaction, retention and productivity, creating the appropriate climate for action (strategic awareness, alignment, teamwork for synergies, empowerment, reawarding, interaction with knowledge workers), and
  2. Objectives pertaing to systems and procedures: developing the company's technical infrastructure to enable continuous learning, and enhance knowledge management capabilities such as information systems, databases, tools and networks.

  Prusak and Cohen (2001) also support the above suggestions by saying that investing in social capital (building stronger relationships among employees) by

means of making connections (also stressed by Geus, 1997), enabling trust and fostering co-operation would greatly contribute to business success. This is because businesses run better when people within an organization know and trust one another; deals move faster and more smoothly; teams are more productive; and people learn more quickly an perform with more creativity (Prusak and Cohen, 2001).

In the case of innovation, Kim and Mauborgne (1997) found that in high-growth companies (irrespective of the type of industry) the strategic emphasis was on value innovation, not on willful competition or retaining of customers. Their strategy was also built on the powerful commonalities in the features that customers value and provide the total solution customers seek. They also found that value innovators go beyond traditional offerings.

Widely used performance measures in this perspective include level of awareness of existing knowledge, accessibility to existing knowledge and strategic information, infrastructure available to facilitate knowledge management processes, employee satisfaction rating, employee flexibility, level of trust, employee empowerment index, number of employee suggestions, employee absenteeism and turnover, number of innovations made and under way, time taken to adopt to a new system, investment in innovation and learning, number of quality and effective partnerships and research leadership (Kaplan and Norton, 2000; Ahmad et al., 1998; McCabe, 2001; Cebon et al., 1999; Liebowitz and Suen, 2000; Prusak and Cohen, 2001).

- ***The internal business perspective*** is an indicator of the success and efficiency of the operational and managerial activities in the company.

Through the use of BSC, the key processes in an organization are monitored to ensure that outcomes will be satisfactory and thus it serves as a mechanism through which performance expectations of both customers and the organization are achieved. It is further argued that this perspective reveals two fundamental differences between the traditional and BSC approaches to performance measurement. The traditional approaches attempt to monitor and improve existing business processes whereas the BSC approach identifies entirely new processes at which the organization must excel to meet customer and financial objectives. The second important difference is that BSC incorporates innovation processes, which often may result in the development of nw products or services (Amaratunga et al., 2000).

The key objectives of an organization's internal processes are: understanding customer needs, shaping customer requirement, creating innovative products and increasing customer value, providing responsive service, tender effectiveness, risk management, quality service, safety/loss control, supplier chain management, joint ventures and partnerships, and good corporate citizenship. Therefore performance measures used in the internal processes are: defect rates, non-conformance to specification/standards, rework/value of rework, productivity and cost reduction, adherence to schedule and budget, cost and time predictability, environmental and safety incidents, ethical incidents, corporate quality performance, investment in technology, and research and development and IT expenses per employee (Kaplan and Norton, 1996b and 2000; McCabe, 2001; Kagioglou et al., 2001; Sommerville and Robertson, 2000; Enderle and Tavis, 1998; Cebon et al., 1999 and Liebowitz and Suen, 2000).

- ***The customer perspective*** considers the satisfaction of the different participants in the project such as the client and ultimate users. Many organizations today have

corporate missions which focus on their customers because of an increasing realization of the importance of customer focus and customer satisfaction in any industry. How an organization is performing through the eyes of its customers has therefore become a priority for business managers and this perspective captures the ability of the organization to provide quality goods and services, and achieve overall customer satisfaction (Amaratunga et al., 2000). Research by Robson and Prabhu (2001) revealed that leaders in the service industry are good at customer orientation (listening to customers, establishing quality values, etc.) meeting customer requirements (service delivery and quality, etc.) and performance measurement. Earlier researchers concluded that customer orientation is positively associated with performance of the company (Appiah-Adu and Singh, 1998). According to Kaplan and Norton (1993 and 1996b), an organization should be aimed at following objectives such as value for money, competitive price, hassle free relationship, high-performance professional image and reputation, an innovation, in order to be perceived as the best in the industry among both current and potential customers. Therefore the customer perspective on the Balanced Scorecard enables an organization to be highly customer oriented by offering products and services that are valued by customers. The core outcome measures in this perspective include customer satisfaction, customer retention, repeated businesses, average customer duration, loyalty, new customer acquisition, customer claims, complains, customer profitability, annual income per customer, short lead times, delivery on time, and market and account share in targeted segments (Kaplan and Norton, 1996b and 2000; Sommerville and Robertson, 2000; and McCabe, 2001)

In this study, it was hypothesized that performance of a company is influenced by resources and capabilities, strategic decisions, project management competencies and strength of the company's relationships with other parties as well as the external factors and the project performance. The reasoning in the model and the causality of

the interrelationships are investigated and verified by means of data collected from 73 Turkish construction companies.

4.4 Hypothesis regarding the relations between the factors

Given the model and the performance measures with the indicators, there are a number of 17 hypotheses in the proposed performance model on the way to measure the performance of a construction company and the individual project.

H_1: A model consisting of seven constructs were designed in order to understand their effects on performance.

H_2: "Resources and capabilities" construct of the model has a direct effect on "project performance" and "company performance".

H_3: "Strategic decisions" has a direct effect on "company performance".

H_4: "Strength of relationships with other parties" has a direct effect on "resources and capabilities".

H_5: "Project management competencies" has a direct effect on"resources and capabilities".

H_6: "Project management competencies" has a direct effect on "strategic decisions".

H_7: "External factors" has a direct effect on "strength of relationships with other parties".

H_8: "External factors" has a direct effect on "project management competencies".

H_9: "Strength of relationships with other parties" has an indirect effect on "project performance".

H_{10}: "Strength of relationships with other parties" has an indirect effect on "company performance".

H_{11}: "Project management competencies" has an indirect effect on "project performance".

H_{12}: "Project management competencies" has an indirect effect on "company performance".

H_{13}: "External factors" has an indirect effect on "project performance".

H_{14}: "External factors" has an indirect effect on "company performance".

H_{15}: "External factors" has an indirect effect on "strategic decisions".

H_{16}: "External factors" has an indirect effect on "resources and capabilities".

H_{17}: "Project performance" has a direct effect on "company performance".

The validity of these hypotheses will be analysed and discussed in the next chapter.

CHAPTER 5

ANALYSIS OF THE PERFORMANCE MEASUREMENT MODEL

In this chapter, an in depth statistical analysis of the acquired data will be explained. After examing the descriptive statistics regarding the characteristics of the respondent companies and the projects, literature related to structural equation modeling (SEM) will be given and the analysis results held by SEM will be explained comprehensively.

5.1. Descriptive statistics

In search of the characteristics of the respondent companies, descriptive statistical analysis were performed according to the general information obtained from the respondents. Accordingly, the mean, standard error, median, mode, standard deviation, sample variance, kurtosis, skewness, range, minimum, and maximum values of the gathered data were calculated. Following are some important information about the profile of respondents and characteristics of the projects. The rest of the descriptive statistics of data can be found in Appendix B.

5.1.1. General information about the respondent companies

The target construction companies were all members of the Turkish Contractors Association (TCA) and the Turkish Construction Employers Association (TCEA). The 185 companies received an e-mail describing the objective of the study, inquiring about their willingness to participate in the study and requesting a face-to-face interview with an executive of the company. Forty seven questionnaires were completed, the majority of which were administered by face-to-face interviews. The

rate of response was 25%. However, considering the fact that there were other construction companies in the industry which were not members of TCA or TCEA but showing similar characteristics with the member companies of these two associations in terms of size and type of work undertaken, a decision was made to expand the survey by including 26 additional similar companies selected individually through personal contacts. At the end of the extended survey, there were 26 more completed questionnaires, bringing the total number of respondents to 73.

5.1.1.1. Number of years of experience

The distribution of the number of years of experince of the companies are presented in Figure 5.1. The average age of the respondent companies is 28,49.

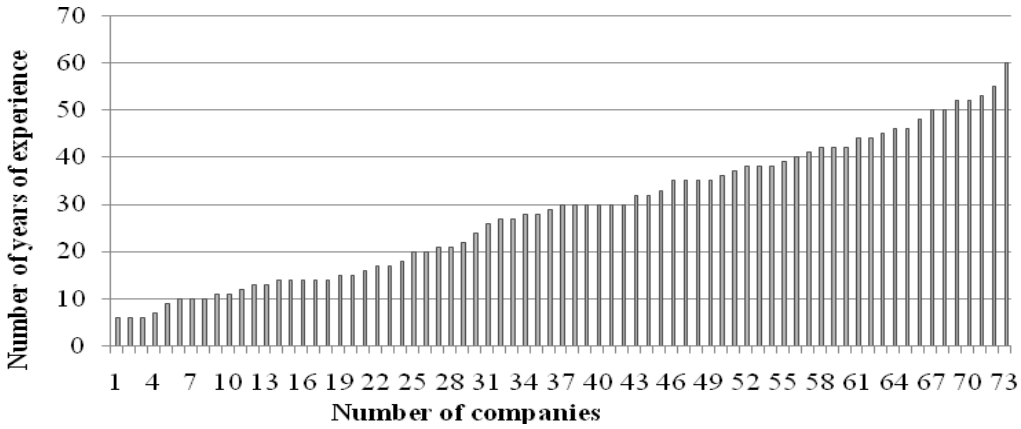


Figure 5.1 Number of years of experience

5.1.1.2 Specified fields of experience

The respondent companies are specialized mainly on buildings (0.84, 0.80), transport (0.80, 0.60), infrastructure (0.73, 0.56), hydraulic (0.62, 0.32) and industrial (0.47, 0.48) construction. Figure 5.2 shows the distribution of companies in terms of their specialized fields of experience while Figure 5.3 shows the comparative percentage ratio of specialized fields of experience. For Figure 5.2 While %84 of the member companies do building construction works , %80 of the non-member companies do the same thing. For Figure 5.3 the percentage of "building" construction works between all member companies compared to "other" construction works is %24 .

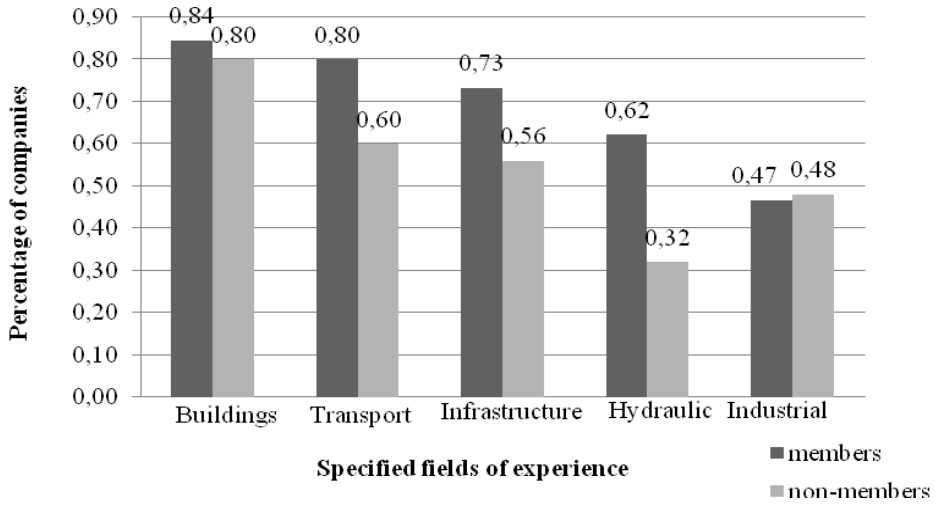


Figure 5.2 Distribution of companies in terms of specialized fields of experience.

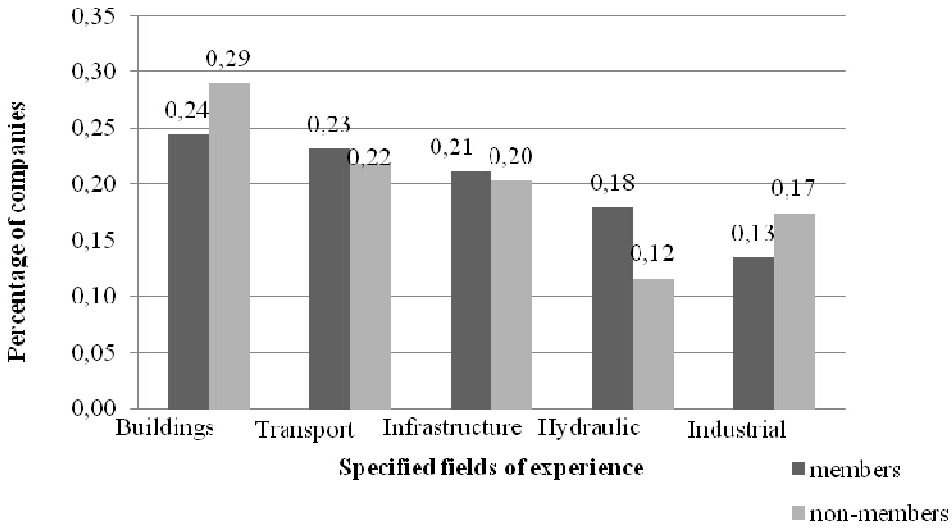


Figure 5.3 Comparative percentage ratio of specialized fields of experience

5.1.1.3 The turnover of the companies

The average turnover of the companies for the last five years is presented in Figure 5.4. Looking at the pie chart, it can be said that, the non-member companies which constitutes 53% of all companies participated into the survey have a total of $626,165,581.04 turnover while the member companies which constitutes the 47% of the respondent companies have $551,179,543.18. The total turnover of both groups is, $1,177,345,124.22.

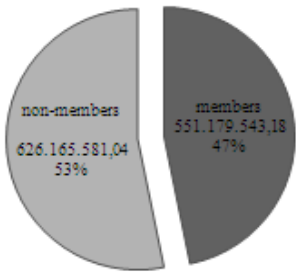


Figure 5.4 Turnover of the companies

The distributions of domestic and international turnovers of the companies are presented in Figure 5.5 and Figure 5.6 respectively.

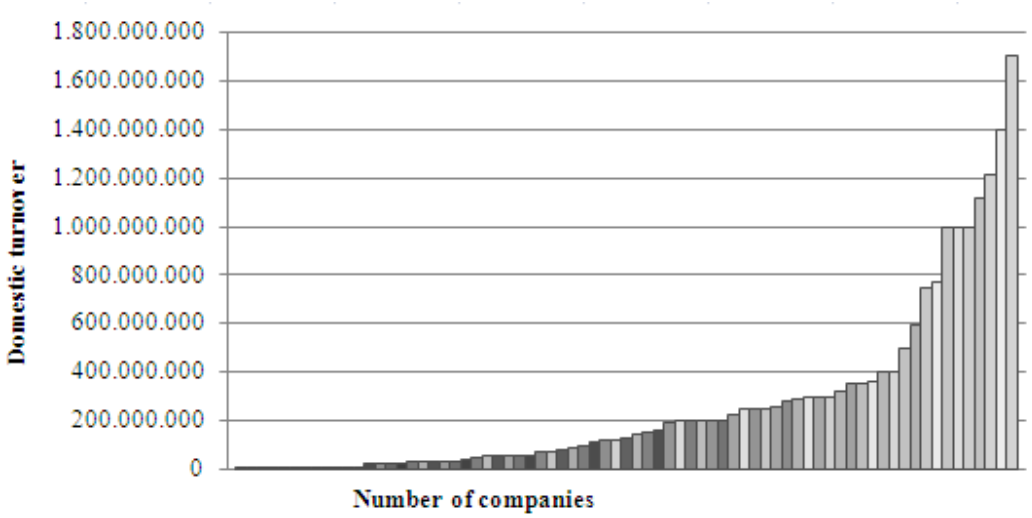


Figure 5.5 Distribution of companies in terms of domestic turnover

Figure 5.6 Distribution of companies in terms of international turnover

5.1.1.4 The market strategy

The market distribution of the companies were divided into three groups which are:

1. Construction: The construction company only focuses on its own business.

2. Construction and construction related: The construction company operates its construction works and at the same time, it follows a related diversification strategy and develops new service and products within the same industry.

3. Construction, construction related and construction unrelated: The construction company operates its construction works, follows a related diversification strategy and at the same time implement an unrelated diversification to share the risks of the market.

Figure 5.7 shows the market distribution of respondent companies.

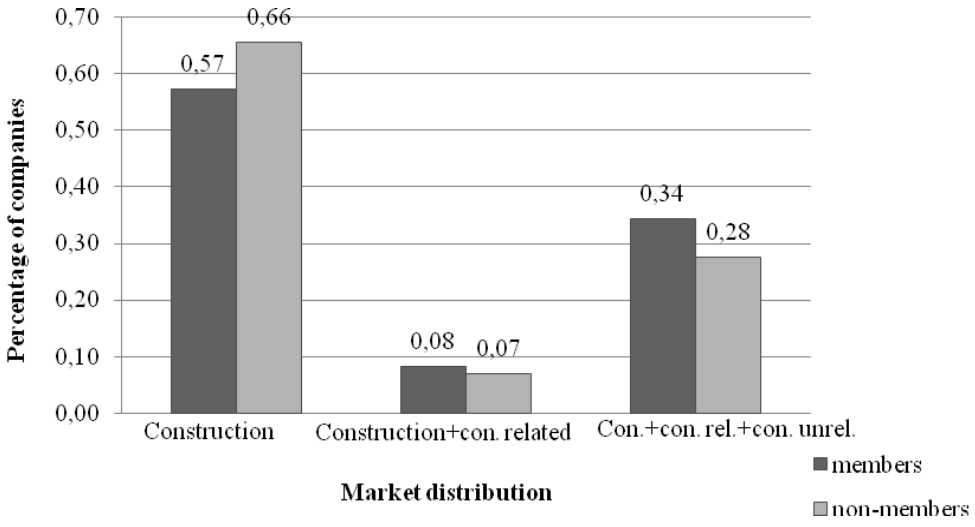


Figure 5.7 Market distributions of the companies

5.1.1.5 International vs. domestic market distribution

The rates of international working companies vs. domestic working companies are presented in Figure 5.8. The 89% of member of TCA and TCEA operates internationally while 11% operated domestically. 72% of non-member companies operate internationally while 28% operates domestically. Number of host countries per company in which the companies have operated are presented in Figure 5.9

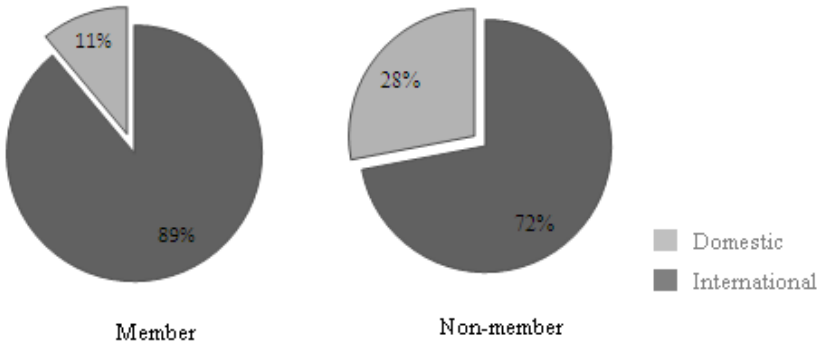


Figure 5.8 Rate of international working companies vs. domestic ones.

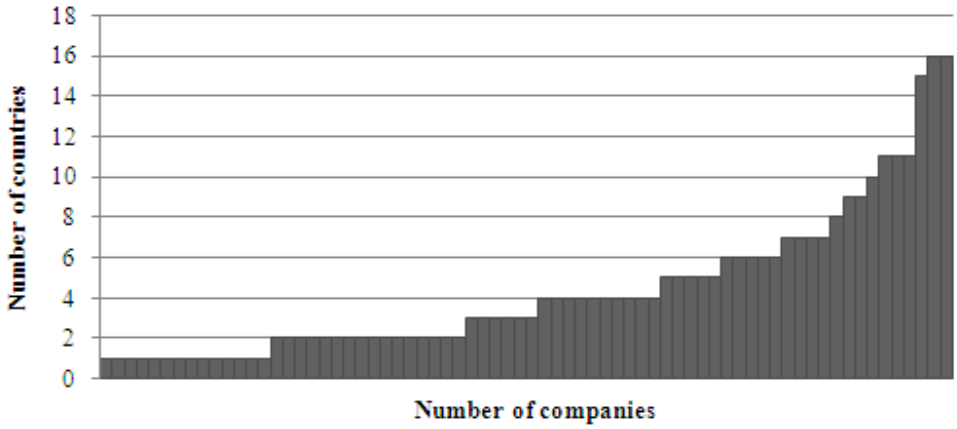


Figure 5.9 Number of host countries per company.

5.1.2 General information about the projects

The number of projects operated over the last five years and selected to have the respondent companies' reference points for the questionnaire was 354. Figure 5.10 and Figure 5.11 show the distribution of the projects, from which it can be understood that 89%, corresponding to a number of 315 projects operated by the companies were medium to large size. Having information on the turnover of the companies was found to be sufficient that the size of the projects were not asked in financial terms.

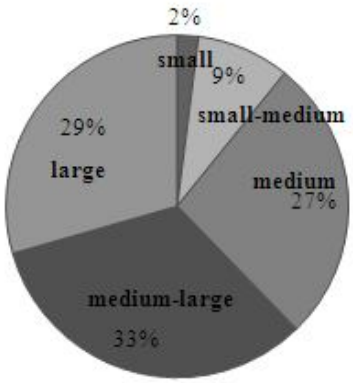


Figure 5.10 Ratio of the size of the projects

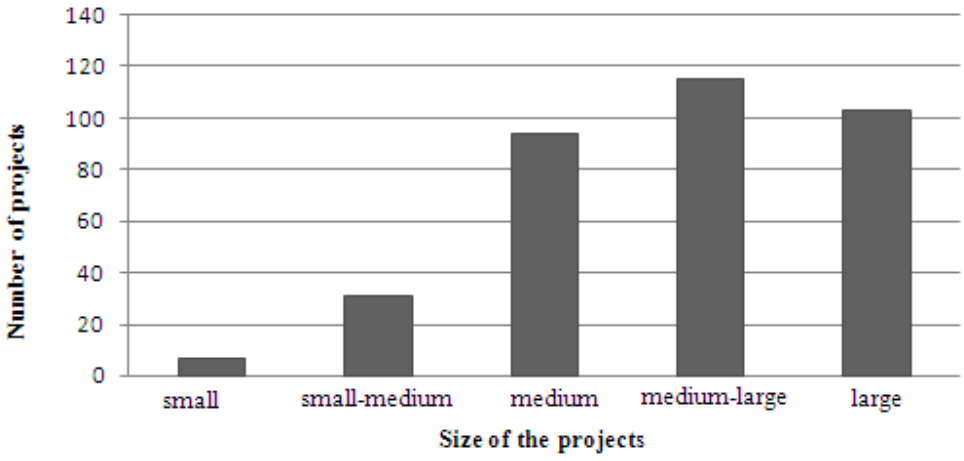


Figure 5.11 Size of the projects in terms of turnover

5.1.3 Distribution of importance and rating levels of performance parameters

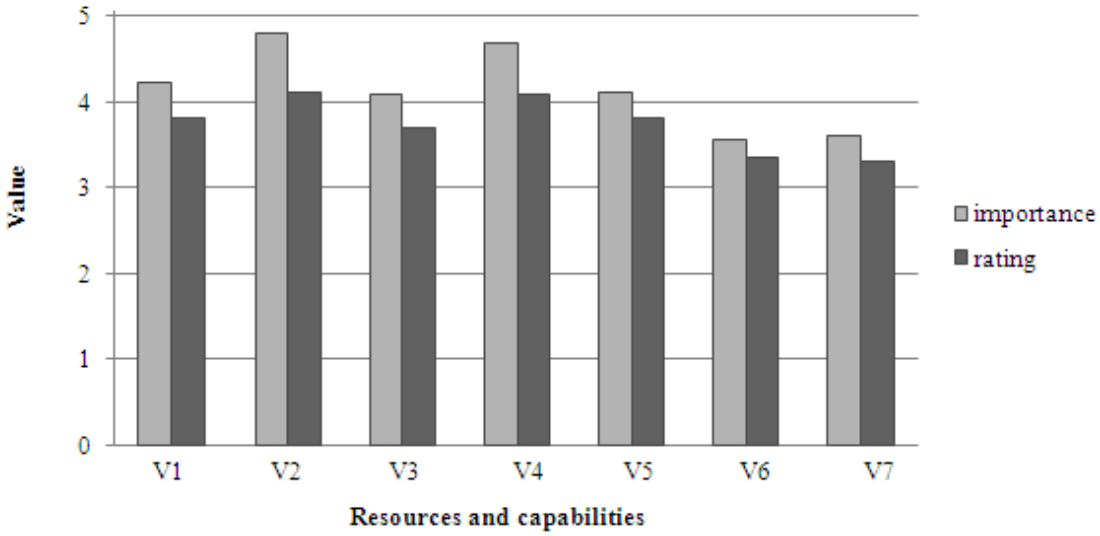
The parameters selected as being the measures and the indicators of performance were investigated through their importance levels as well as their ratings in the respondent companies. The Figures 5.12, 5.13, 5.14, 5.15, 5.16, 5.17 and 5.18 in the following parts present the importance weights and rating values of the parameters. The figures also demonstrate that all parameters were found to be highly important based on the respondents' perceptions.

However, the statistical results indicate the importance level of all parameters was higher than their ratings in the respondent companies. It means that, the parameters were found to be important by the companies in theory but they were disregarded in practice somehow. This finding consolidates the aim of the study which was the satisfaction of a need in the construction industry for a comprehensive performance measurement framework that can help companies to measure and improve their performance whereby develop new business strategies.

5.1.3.1 Resources and capabilities

According to Figure 5.12, "technical competency" and "experience" parameters were found to be the most important among others even exceeding a major factor such as the "financial resources". However, the output of a construction project cannot be adequate without the existence of a technically competent team of people. In fact, the lessons learned from the previous experiences can be applied to new projetcs with a successful association of technical know how and financial resources.

The least important parameter of the "resources and capabilities" of a company was found to be "research and development capability" which can be explained with the introverted structure of the construction industry.



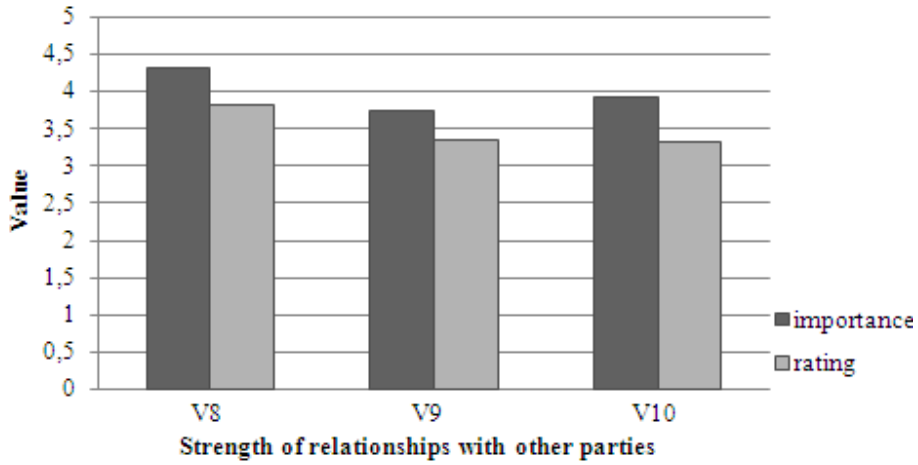
Resources and capabilities	Legend
Financial resources	V1
Technical competency	V2
Leadership	V3
Experience	V4
Company image	V5
Research and development capability	V6
Innovation capability	V7

Figure 5.12 Distribution of importance and rating values of "resources and capabilities".

5.1.3.2 Strength of relationships with other parties

"Relations with client" was found to be the most important parameter not surprisingly as the client is the major customer in a construction project (Figure 5.13). Relations

with labor unions also deserve special emphasis as the man power is the main driver for the course of construction operations. The possible strikes should be prevented by qualifying the labor and setting up good relations with labor unions.



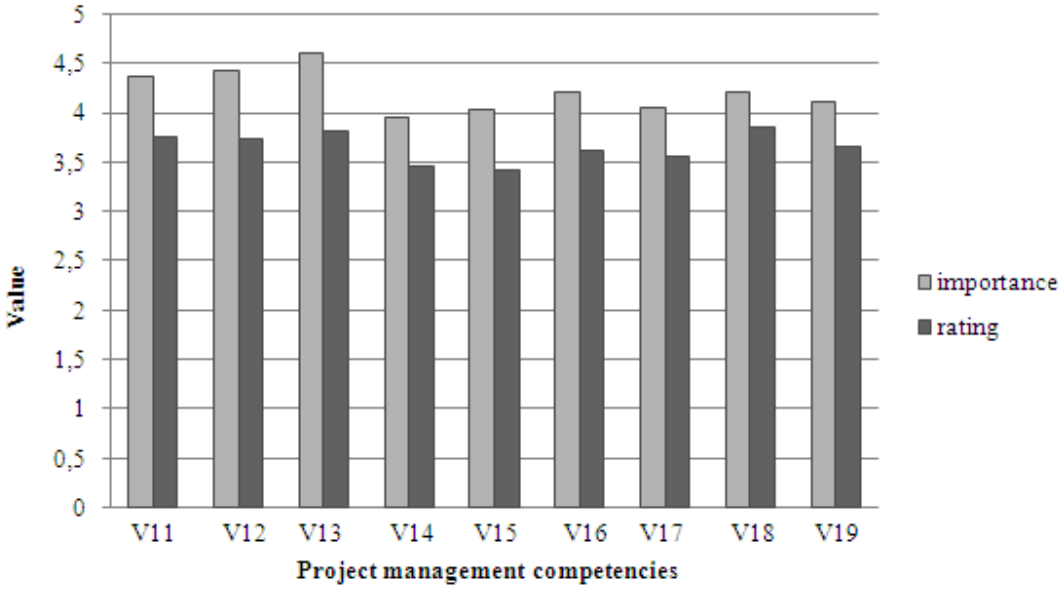
Strength of relationships with other parties	Legend
Relations with client	V8
Relations with government	V9
Relations with labor unions	V10

Figure 5.13 Distribution of importance and rating values of "strength of relationships with other parties".

5.1.3.3 Project management competencies

The well known triangle of project management comprised of "cost, schedule and quality" was arised as the most important parameters among the competencies in project management in Figure 5.14. They also rated as the highest considering their level of extent in the respondent companies. "Knowledge management" and "health

and safety management" competencies are also discriminated with their high values of importance and ratings.

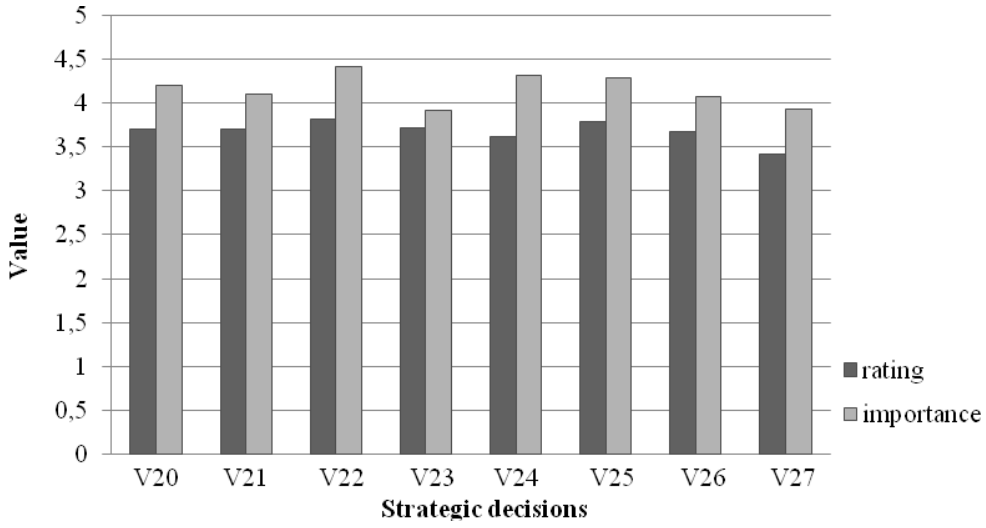


PROJECT MANAGEMENT	Legend
Schedule management competency	V11
Cost management competency	V12
Quality management competency and	V13
Human resources management competency	V14
Project risk management competency	V15
Project procurement management competency	V16
Claims management	V17
Project knowledge management competency	V18
Health and safety management competency	V19

Figure 5.14 Distribution of importance and rating values of pm competencies".

5.1.3.4 Strategic decisions

Looking at the Figure 5.15, it can be said that, all variables have nearly the same importance levels and ratings with an exception in "project, client and partner selection strategies". "Project selection" was rated as the highest of all variables while "client selection" was rated as the lowest.

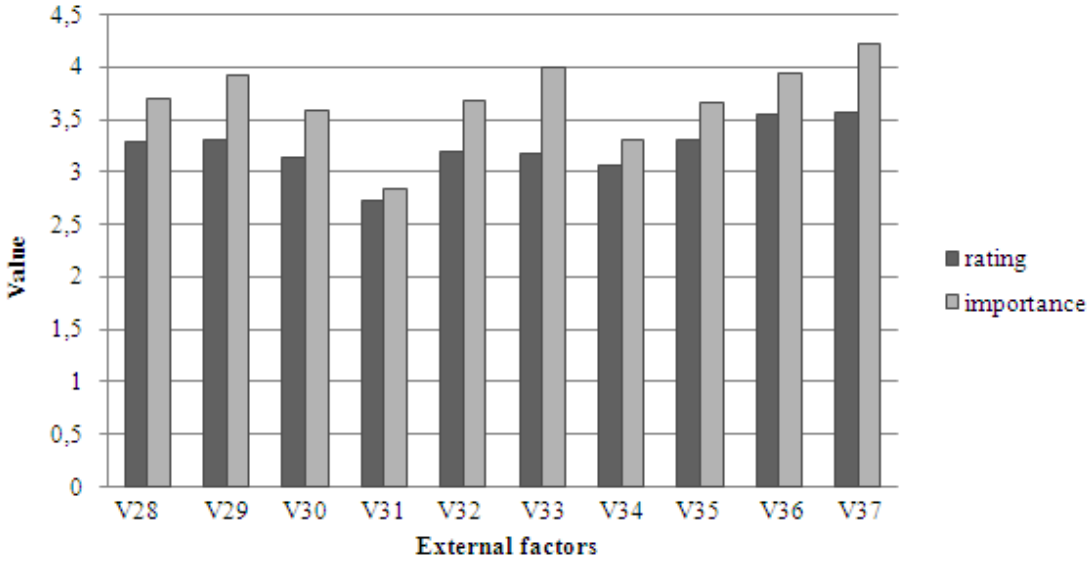


STRATEGIC DECISIONS	Legend
Differenatiaiton strategy	V20
Market selection strategies	V21
Project selection strategies	V22
Client selection strategies	V23
Partner selection strategies	V24
Project management strategies	V25
Investment decisions	V26
Organizational management strategies	V27

Figure 5.15 Distribution of importance and rating values of "strategic decisions".

5.1.3.5 External factors

"Intense rivalry between companies", "demand", "client power" and "macro economic conditions" are the highest rated among others while "socio cultural conditions" of the host country rated as the lowest (Figure 5.16).

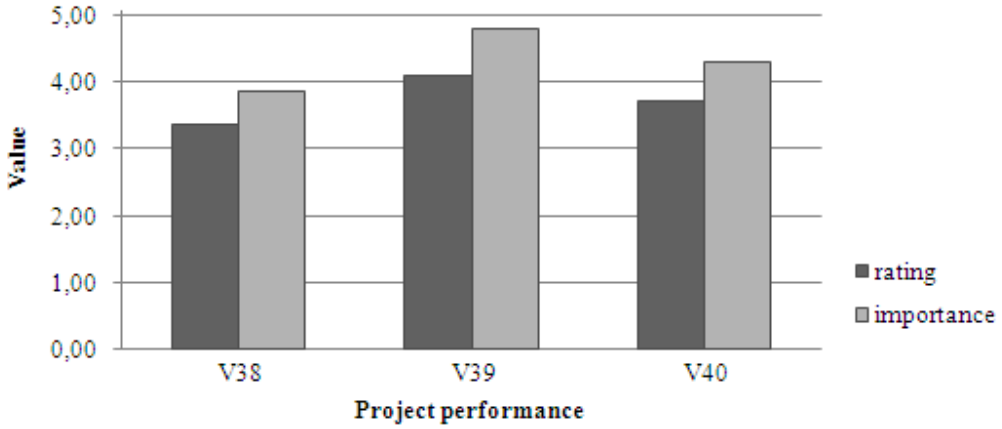


EXTERNAL FACTORS	Legend
International relations	V28
Macro-economic conditions	V29
Political conditions	V30
Socio-cultural conditions	V31
Legal conditions	V32
Intense rivalry between companies	V33
New entrants to the market	V34
Supply power	V35
Client power	V36
Demand	V37

Figure 5.16 Distribution of importance and rating values of "external factors".

5.1.3.6 Project performance

Project performance is a three dimensional factor consisting of indicators which are almost equally important in order to survive a project and develop future strategies. In Figure 5.17, a relative supremacy of "client satisfaction" was observed followed by the "long term contributions of the project to the company" and "project profitability".



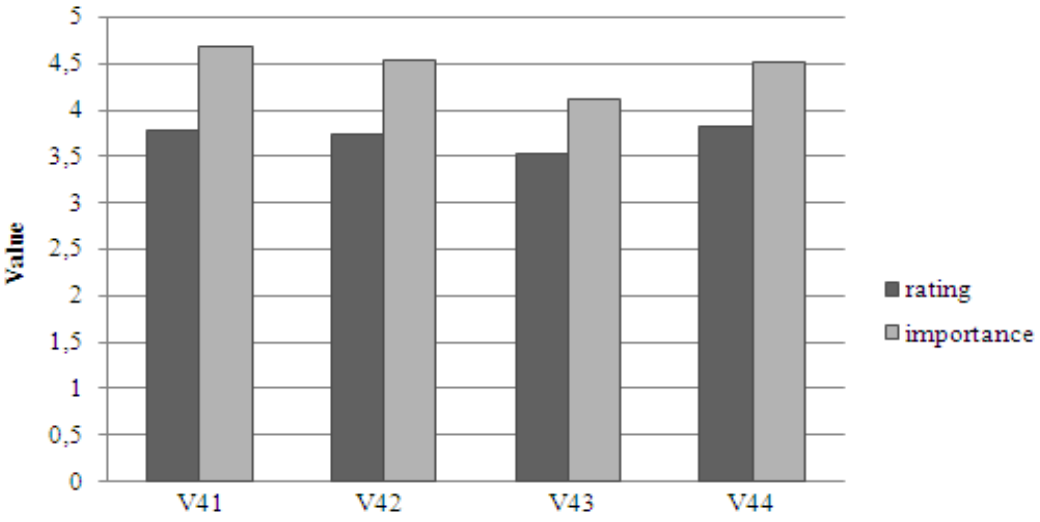
PROJECT PERFORMANCE	Legend
Project profitability	V38
Client / user satisfaction	V39
Long-term contributions of the project to the company	V40

Figure 5.17 Distribution of importance and rating values of "project performance".

5.1.3.7 Company performance

The importance level and ratings of the indicators of "company performance" denote the expected final status of the respondent companies. In this sense, status of a company was examined by four dimensions of the very well known "balanced scorecard". As seen in Figure 5.18, a realistic result was obtained and, "financial

perspective" was found to be most important, followed by "learning and growth", "customer" and "internal business" perspectives.



COMPANY PERFORMANCE	Legend
Financial perspective	V41
Learning and growth perspective	V42
Internal business perspective	V43
Customer perspective	V44

Figure 5.18 Distribution of importance and rating values of "company performance".

After giving the descriptive statistics on the general status of the respondents companies and their perceptions on the importance and ratings of the performance measures in general, the technique, that is called Structural Equation Modeling (SEM) used in this study to analyse the effects of those measures on the performance of a construction company is going to be explained in the next part.

5.2 Structural equation modeling (SEM)

The complicated prediction processes has been attempted to model by many types of statistical analysis methods. The major aim of these models was to fit and cover the relevant research characteristics such as performance measures and indicators in this research. Typically, statistical methods provide a causality of the analysis results in the form of statistically reliable figures.

Stuctural equation modeling (SEM) is superior to other methods since it combines a measurement model (confirmatory factor analysis) and a structural model (regression or path analysis) in a single statistical test. It recognizes the measurement error, and further offers an alternate method for measuring prime variables of interest through the inclusions of latent variables and surrogate variables. SEM is also referred to as causal modeling, causal analysis, simultaneous equation modeling, and analysis of covariance structures, path analysis, or confirmatory factor analysis (Kline, 1998; Mueller, 1996; Garver and Mentzer, 1999).

5.2.1 Key concepts and terms in SEM

A review of the terminology and graphics used should be covered first in order to understand the discussion about SEM and the explanation of the analysis results.

5.2.1.1 Definition of the terms

- *Observed variables* are also called as *measured*, *indicator*, and *manifest*, and researchers traditionally use a square or rectangle to symbolize them graphically as in Figure 5.19.
- SEM models commonly include variables that have not been directly measured and whose existence is deduced on the relationship of a set of measured

variables. These variables are referred to, in SEM, as *unobserved variables* so called *latent factors, factors* or *constructs*. They are symbolized graphically with circles or ovals as can be seen in Figure 5.19.

- In SEM, the terms *independent* and *dependent variables* are abandoned; instead variables are referred to as *exogenous* or *endogenous*. Endogenous variables are those modeled as dependent on other variables, while exogenous are not dependent on other variables.

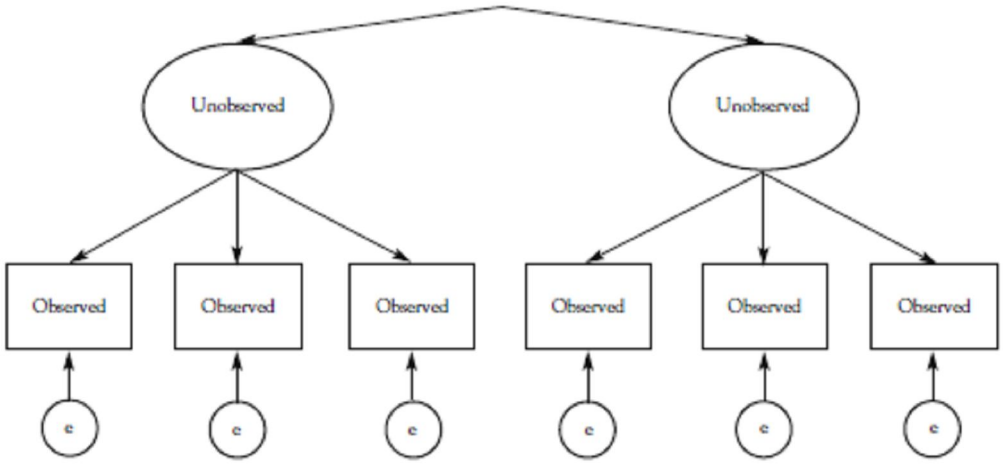


Figure 5.19 Generic example of a confirmatory factor analysis

5.2.1.2 Regression, path, and structural equation models

SEM is used primarily to implement models with *latent variables*, also, it is possible to run *regression models* or *path models*. In regression and path models, only observed variables are modeled, and only the dependent variable in regression or the endogenous variables in path models have error terms. Independents in regression and exogenous variables in path models are assumed to be measured without error.

Path models are like regression models in having only observed variables without latents. Path models are like *structural equation models* in having circle-and-arrow causal diagrams, not just the star design of regression models. Using SEM for path models instead of doing path analysis using traditional regression procedures has the benefit that measures of model fit indices.

5.2.1.3 Measurement model

The measurement model is the part of a structural equation model which deals with the latent variables and their indicators. A pure measurement model is a confirmatory factor analysis (CFA) model in which there is unmeasured covariance between each possible pair of latent variables. There are straight arrows from the latent variables to their respective indicators and also again straight arrows from the error and disturbance terms to their respective variables, but there are no direct effects (straight arrows) connecting the latent variables. Note that "unmeasured covariance" means one almost always draws two-headed covariance arrows connecting all pairs of exogenous variables unless there is strong theoretical reason not to do so. The measurement model is evaluated like any other SEM model, using "model fit indices". There is no point in proceeding to the structural model until one is satisfied the measurement model is valid.

5.2.1.4 Confirmatory factor analysis

CFA determines if the number of factors and the loadings of measured variables on them conform to what is expected on the basis of pre-established theory. Indicator variables are selected on the basis of prior theory and factor analysis is used to see if they load as predicted on the expected number of factors. The researcher's assumption is that each factor is associated with a specified subset of indicator variables. A

minimum requirement of confirmatory factor analysis is that one hypothesize beforehand the number of factors in the model, but usually also the researcher will posit expectations about which variables will load on which factors (Kim and Mueller, 1978). The researcher seeks to determine, for instance, if measures created to represent a latent variable really belong together.

The *factor loadings* are the correlation coefficients between the variables and factors. The squared factor loading is the percent of variance in that indicator variable explained by the factor. To get the percent of variance in all the variables accounted for by each factor, add the sum of the squared factor loadings for that factor and divide by the number of variables. This is the same as dividing the factor's eigenvalue by the number of variables.

The *Cronbach's alpha* is a commonly used measure, testing the extent to which multiple indicators for a latent variable belong together. The Cronbach's alpha coefficient is calculated using Equation 1.

$$\alpha = \frac{Np}{\left[1 + p\left(N - 1\right)\right]} \qquad \text{(Eq.1)}$$

where N is the number of items and p is the mean inter-item correlation. It can be interpreted from the equation that higher inter-item correlations indicate statistical agreement among the items; as N increases, the probability of correlation decreases (Cronbach and Meehl, 1955). It varies from 0 to 1.0. A common rule of thumb is that the indicators should have a Cronbach's alpha of 0.7 to judge the set reliable (Nunaly, 1978). Alpha may be low because of lack of homogeneity of variances among items, for instance, and it is also lower when there are fewer items in the factor.A higher Cronbach's alpha coefficient indicates higher reliability of the scale used to measure the latent variable.

5.2.1.5 Structural model

It may be contrasted with the measurement model. It is the set of exogenous and endogenous variables in the model, together with the direct effects (straight arrows) connecting them, any correlations among the exogenous variable or indicators, and the disturbance terms for these variables (reflecting the effects of unmeasured variables not in the model). Sometimes the arrows from exogenous latent constructs to endogenous ones are denoted by the Greek character gamma, and the arrows connecting one endogenous variable to another are denoted by the Greek letter beta.

5.2.1.6 Model fit indices

In order to evaluate the model fit, model fit indices are used. There are dozens of model fit indices described in the SEM literature, and new indices are being developed all the time. It is up to the properties of data to decide as to which particular indices and which values to report (Kenny and McCoach, 2003; Marsh et al., 1996).
Described next is a minimal set of fit indices that is going to be reported and interpreted when reporting the results of SEM analysis of this research. The fit indices that are least effected by sample size were selected. These statistics include (1) the model chi-square, (2) the root mean square error of approximation (RMSEA; Steiger, 1990) with its 90% confidence interval, (3) the comparative fit index (CFI; Bentler, 1990), and (4) the non-normed fit index (NNFI).

Model chi square (χ^2)

This statistic is here referred to as the model chi-square; it is also known as the likelihood ratio chi-square or generalized likelihood ratio. The value of $\chi^2$for a just-identified model generally equals zero and has no degrees of freedom. If χ^2= 0, the

model perfectly fits the data. As the value of χ^2 increases, the fit of an overidentified model becomes increasingly worse. The only parameter of a central chi-square distribution is its degrees of freedom.

Root mean square error of approximation (RMSEA)

The RMSEA is a parsimony-adjusted index in that its formula includes a built-in correction for model complexity. This means that given two models with similar overall explanatory power for the same data, the simpler model will be favored. It does not approximate a central chi-square distribution. The RMSEA instead approximates a noncentral chi-square distribution, which does not require a true null hypothesis. In this case it means that fit of the researcher's model in the population is not assumed to be perfect. The RMSEA measures the error of approximation. The value of zero indicates the best fit and higher values indicate worse fit. The RMSEA estimates the amount of error of approximation per model degree of freedom and takes sample size into account. A rule of thumb is that RMSEA ≤ 0.05 indicates close approximate fit, values between 0.05 and 0.08 suggest reasonable error of approximation, and RMSEA ≥ 0.10 suggests poor fit (Browne and Cudeck, 1993).

Comparative fit index (CFI)

The CFI is one of a class of fit statistics known as incremental or comparative fit indexes, which are among the most widely used in SEM. All these indexes assess the relative improvement in fit of the researcher's model compared with a baseline model. The latter is typically the independence model also called the null model which assumes zero population covariances among the observed variables. When means are not analyzed, the only parameters of the independence model are the population variances of these variables.

Non-normed fit index (NNFI)

It is sample-based and parsimony-adjusted. The value can fall outside of range 0–1.0. NNFI is also called the Bentler-Bonett nonnormed fit index, the Tucker-Lewis index, (TLI). NNFI is similar to NFI, but penalizes for model complexity. It is one of the fit indexes less affected by sample size.

5.2.1.7 Basic steps of SEM

SEM has been described as a combination of exploratory factor analysis and multiple regressions (Ullman, 2001). We like to think of SEM as CFA and multiple regressions because SEM is more of a confirmatory technique, but it also can be used for exploratory purposes. However, SEM, in comparison with CFA, extends the possibility of relationships among the latent variables and encompasses two components as a measurement model and a structural model.

Within the context of structural modeling, exogenous variables represent those constructs that exert an influence on other constructs under study and are not influenced by other factors in the quantitative model. Those constructs identified as endogenous are affected by exogenous and other endogenous variables in the model.

Basic steps in structural equaton modeling technique are, 1) specification of the model, 2) estimation and identification of the model, and 3) evaluation of the model fit.

In the SEM process, initially, the measurement model must be validated through confirmatory factor analysis (CFA). While conducting CFA, construct validity should be satisfied by using content validity and empirical validity tests. Once the measurement model is validated, the structural relationships between latent variables are estimated (Anderson and Gerbing, 1988; Garver and Mentzer, 1999). These steps will be explained extensively in the following parts.

5.2.1.8 SEM software packages

There are several different computer programs for SEM that run on personal computers such as AMOS, the CALIS procedure of SAS/STAT, EQS, LISREL, MPLUS, MX GRAPH, the RAMONA module of SYSTAT, and the SEPATH module of STATISTICA. They differ mainly in their support for more advanced types of analysis and ways of interacting with the program. The specific features or capabilities of computer programs can change quickly when new versions are released, therefore a description of the computer programmes is not going to be available except for the analysis results of the model and a brief description of the output.

Within the context of this research, EQS was selected to perform the statistical analysis of performance data.

5.2.1.9 Benefits of SEM

SEM serves purposes similar to multiple regression, but in a more powerful way which takes into account the modeling of interactions, nonlinearities, correlated independents, measurement error, correlated error terms, multiple latent independents each measured by multiple indicators, and one or more latent dependents also each with multiple indicators. SEM may be used as a more powerful alternative to multiple regression, path analysis, factor analysis, time series analysis, and analysis of covariance. That is, these procedures may be seen as special cases of SEM, or, to put it another way, SEM is an extension of the general linear model (GLM) of which multiple regression is a part.

Advantages of SEM compared to multiple regression include more flexible assumptions. The use of confirmatory factor analysis to reduce measurement error by having multiple indicators per latent variable, the attraction of SEM's graphical modeling interface, the desirability of testing models overall rather than coefficients

individually, the ability to test models with multiple dependents, the ability to model mediating variables rather than be restricted to an additive model, the ability to model error terms, the ability to test coefficients across multiple between-subjects groups, and ability to handle difficult data (time series with autocorrelated error, non-normal data, incomplete data). Moreover, where regression is highly susceptible to error of interpretation by misspecification, the SEM strategy of comparing alternative models to assess relative model fit makes it more robust.

According to Hair et al. (2006), compared with other types of multivariate-data analysis methods, SEM has three distinct characteristics, which are as follows:

- It has the ability to estimate multiple and interrelated dependence relationships;
- It has the ability to represent unobserved concepts in these relationships and to correct measurement errors in the estimation process; and
- It has the ability to define a model explaining the entire set of relationships.

5.3 Analysis of the performance measurement model

In order to structure the casual relationship between the 44 variables which were selected as being the key measures and the indicators of performance as described in the previous chapter, seven latent variables namely, “resources and capabilities”, “strength of relationships with other parties”, “project management competencies”, “strategic decisions”, “external factors”, “project performance” and “company performance” were hypothesized. The data obtained from the 73 construction companies and 354 projects were analyzed by using the SEM software package called EQS 6.1. In this part of the thesis, after testing the validity of the measurement model, the analysis results of the structural model will be presented.

5.3.1 Validity of the performance measures and the indicators

Testing the construct validity of performance measurement variables provides the degree to which a latent variable measures what it intends to measure. Construct validity testing is comprised of numerous sub-dimensions, all of which must be satisfied to achieve construct validity. These sub-dimensions include: "content validity", "scale reliability", "convergent validity", and "discriminant validity".

5.3.1.1 Content validity testing of performance measures

Content validity tests rate the extent to which a constituent variable belongs to its corresponding construct. Since content validity cannot be tested by using statistical tools, an in-depth literature survey is necessary to keep the researcher's judgment on the right track (Dunn et al., 1994). An extensive literature survey was conducted to specify the variables that define latent variables.

Table 5.1 Results of content validity testing

RESOURCES AND CAPABILITIES	**EXTERNAL FACTORS**
Financial resources	International relations
Technical competency	Macro-economic conditions
Leadership	Political conditions
Experience	Socio-cultural conditions
Company image	Legal conditions
R&D capability	Intense rivalry between companies
Innovation capability	New entrants to the market
STRENGTH OF RELATIONSHIPS	Supply power
Relations with client	Client power
Relations with government	Demand
Industrial relations	

Table 5.1 Results of content validty testing (continued)

PROJECT MANAGEMENT	**STRATEGIC DECISIONS**
Schedule management	Differentiation strategies
Cost management	Market selection strategies
Quality management	Project selection strategies
Human resources management	Client selection strategies
Risk management	Partner selection strategies
Supply chain management	Project management strategies
Claims management	Investment strategies
Knowledge management	Organizational management strategies
Health and safety management	**COMPANY PERFORMANCE**
PROJECT PERFORMANCE	Financial perspective
Project profitability	Learning and growth perspective
Client/user satisfaction	Internal business perspective
Long-term contributions to company	Customer perspective

As well as an in-depth literature review, pilot studies with industry professionals were conducted to assure the validity of the constituents of the latent variables. At the end of the pilot studies, variables were finalized as in Table 5.1 and the content validity was thus achieved. Empirical validity tests such as “scale reliability”, “convergent” and “discriminant validty” follow content validity.

5.3.1.2 Scale reliability testing of performance measures

The scale reliability is the internal consistency of a latent variable and is measured most commonly with a coefficient called Cronbach’s alpha. The purpose of testing the reliability of a construct is to understand how each observed indicator represents its correspondent latent variable.

According to the EQS analysis results, as seen in Table 5.2, Cronbach's alpha values were 0.926 for "project management competencies", 0.833 for "resources and capabilities", 0.775 for "strength of relationships with other parties", 0.870 for "decisions and strategies", 0.834 for "external factors", 0.723 for "company performance" and 0.879 for "project performance". These reliability values are satisfactory since the Cronbach's alpha coefficients are all above 0.70, the minimum value recommended by Nunally (1978).

Table 5.2 Cronbach's alpha coefficients of the latent variables

Latent Variables	**Cronbach's alpha values**
Resources and capabilities	0.833
Strength of relationships with other parties	0.775
Project management competencies	0.926
Strategic decisions	0.870
External factors	0.834
Project performance	0.879
Company performance	0.723

5.3.1.3 Convergent validity testing of performance measures

Convergent validity is the extent to which the latent variable correlates to corresponding items designed to measure the same latent variable. Ideally, convergent validity is tested by determining whether the items in a scale converge or load together on a single construct in the measurement model. Dunn et al. (1994) state that if the factor loadings are statistically significant, then convergent validity exists. Since sample size and statistical power have a substantial effect on the significance test, this statement needs expanding. To assess convergent validity, the researcher should also assess the overall fit of the measurement model, and the magnitude, direction, and statistical significance of the estimated parameters between latent variables and their indicators.

The model parameres were assessed and all factor loadings were found to be significant at $\alpha=0.05$ as in Table 5.3. An assesment of the overall fit of the measurement model is going to be held after presenting the specified model.

Table 5.3 Latent and constituent variables of the model with factor loadings

	MODEL VARIABLES	**Factor loadings**
F1	**RESOURCES AND CAPABILITIES**	
V1	Financial resources	0.551
V2	Technical competency	0.560
V3	Leadership	0.690
V4	Experience	0.595
V5	Company image	0.698
V6	R&D capability	0.741
V7	Innovation capability	0.744
F2	**STRENGTH OF RELATIONSHIPS**	
V8	Relations with client	0.608
V9	Relations with government	0.619
V10	Industrial relations	0.776
F3	**PROJECT MANAGEMENT**	
V11	Schedule management	0.681
V12	Cost management	0.702
V13	Quality management	0.699
V14	Human resources management	0.782
V15	Risk management	0.655
V16	Supply chain management	0.675
V17	Claims management	0.659
V18	Knowledge management	0.754
V19	Health and safety management	0.726

Table 5.3 Latent and constituent variables of the model with factor loadings (continued)

	MODEL VARIABLES	Factor loadings
F4	**STRATEGIC DECISIONS**	
V20	Differentiation strategies	0.674
V21	Market selection strategies	0.649
V22	Project selection strategies	0.767
V23	Client selection strategies	0.733
V24	Partner selection strategies	0.743
V25	Project management strategies	0.695
V26	Investment strategies	0.658
V27	Organizational management strategies	0.614
F5	**EXTERNAL FACTORS**	
V28	International relations	0.362
V29	Macro-economic conditions	0.430
V30	Political conditions	0.403
V31	Socio-cultural conditions	0.736
V32	Legal conditions	0.553
V33	Intense rivalry between companies	0.356
V34	New entrants to the market	0.334
V35	Supply power	0.539
V36	Client power	0.419
V37	Demand	0.488
F6	**PROJECT PERFORMANCE**	
V38	Project profitability	0.849
V39	Client/user satisfaction	0.789
V40	Long-term contributions of the project to	0.912
F7	**COMPANY PERFORMANCE**	
V41	Financial perspective	0.522
V42	Learning and growth perspective	0.717
V43	Internal business perspective	0.605
V44	Customer perspective	0.670

5.3.1.4 Discriminant validity testing of performance measures

Discriminant validity is the extent to which the items representing a latent variable discriminate that construct from other items representing other latent variables. For discriminant validity, we need to verify that scales developed to measure different constructs are indeed measuring different constructs. This is particularly important when constructs are highly correlated and similar in nature. In essence, items from one scale should not load or converge too closely with items from a different scale. Different latent variables that correlate too highly may indeed be measuring the same construct rather than different constructs. Relatively low correlations between variables (constructs) indicate the presence of discriminant validity.

Table 5.4 Intercorrelations for the variables of "Resources and capabilities"

F1	**V1**	**V2**	**V3**	**V4**	**V5**	**V6**	**V7**
V1	1,0000	0.4880	0.2813	0.2375	0.5160	0.2888	0.4404
V2	0.4880	1,0000	0.3090	0.4961	0.3593	0.3864	0.3836
V3	0.2813	0.3090	1,0000	0.3894	0.4616	0.6537	0.5524
V4	0.2375	0.4961	0.3894	1,0000	0.4482	0.4546	0.3388
V5	0.5160	0.3593	0.4616	0.4482	1,0000	0.4329	0.4890
V6	0.2888	0.3864	0.6537	0.4546	0.4329	1,0000	0.6747
V7	0.4404	0.3836	0.5524	0.3388	0.4890	0.6747	1,0000

Table 5.5 Intercorrelations for the variables of "Strength of relationships"

F2	**V8**	**V9**	**V10**
V8	1,0000	0.4589	0.4454
V9	0.4589	1,0000	0.4795
V10	0.4454	0.4795	1,0000

Table 5.6 Intercorrelations for the variables of "Project management competencies"

F3	V11	V12	V13	V14	V15	V16	V17	V18	V19
V11	1,0000	0.6895	0.4664	0.5463	0.4628	0.4485	0.5045	0.5472	0.4030
V12	0.6895	1,0000	0.6032	0.5806	0.5277	0.4837	0.5673	0.6089	0.5968
V13	0.4664	0.6032	1,0000	0.6363	0.4378	0.4790	0.4974	0.6251	0.7741
V14	0.5463	0.5806	0.6363	1,0000	0.6236	0.6294	0.5891	0.7306	0.6074
V15	0.4628	0.5277	0.4378	0.6236	1,0000	0.6087	0.5297	0.6030	0.5348
V16	0.4485	0.4837	0.4790	0.6294	0.6087	1,0000	0.6227	0.5734	0.5306
V17	0.5045	0.5673	0.4974	0.5891	0.5297	0.6227	1,0000	0.6386	0.5276
V18	0.5472	0.6089	0.6251	0.7306	0.6030	0.5734	0.6386	1,0000	0.5966
V19	0.4030	0.5968	0.7741	0.6074	0.5348	0.5306	0.5276	0.5966	1,0000

Table 5.7 Intercorrelations for the variables of "Strategic decisions"

F4	V20	V21	V22	V23	V24	V25	V26	V27
V20	1,0000	0.5101	0.5208	0.4349	0.4989	0.4533	0.3879	0.4684
V21	0.5101	1,0000	0.5913	0.4133	0.5242	0.3491	0.4409	0.3095
V22	0.5208	0.5913	1,0000	0.6674	0.6903	0.3955	0.4518	0.3539
V23	0.4349	0.4133	0.6674	1,0000	0.5347	0.5657	0.4766	0.2983
V24	0.4989	0.5242	0.6903	0.5347	1,0000	0.4555	0.4203	0.4660
V25	0.4533	0.3491	0.3955	0.5657	0.4555	1,0000	0.5751	0.5114
V26	0.3879	0.4409	0.4518	0.4766	0.4203	0.5751	1,0000	0.5851
V27	0.4684	0.3095	0.3539	0.2983	0.4660	0.5114	0.5851	1,0000

Table 5.8 Intercorrelations for the variables of "External factors"

F5	V28	V29	V30	V31	V32	V33	V34	V35	V36	V37
V28	1,0000	0.3188	0.1979	0.3190	0.1987	0.0483	0.0413	0.1523	0.1238	0.2206
V29	0.3188	1,0000	0.3641	0.1884	0.0997	0.2891	0.2408	0.1673	0.1428	0.1299
V30	0.1979	0.3641	1,0000	0.3804	0.2487	0.3134	0.2766	0.1230	0.0048	0.4333
V31	0.3190	0.1884	0.3804	1,0000	0.5845	0.2837	0.1942	0.4008	0.2466	0.3849
V32	0.1987	0.0997	0.2487	0.5845	1,0000	0.2670	0.0479	0.4653	0.3112	0.1885
V33	0.0483	0.2891	0.3134	0.2837	0.2670	1,0000	0.5059	0.0359	0.0783	0.3604
V34	0.0413	0.2408	0.2766	0.1942	0.0479	0.5059	1,0000	0.1782	0.2250	0.1677
V35	0.1523	0.1673	0.1230	0.4008	0.4653	0.0359	0.1782	1,0000	0.5709	0.1362
V36	0.1238	0.1428	0.0048	0.2466	0.3112	0.0783	0.2250	0.5709	1,0000	0.1824
V37	0.2206	0.1299	0.4333	0.3849	0.1885	0.3604	0.1677	0.1362	0.1824	1,0000

Table 5.9 Intercorrelations for the variables of "Project performance"

F6	V38	V39	V40
V38	1,0000	0.6828	0.7783
V39	0.6828	1,0000	0.7142
V40	0.7783	0.7142	1,0000

Table 5.10 Intercorrelations for the variables of "Company performance"

F7	V41	V42	V43	V44
V41	1,0000	0.3940	0.3110	0.3472
V42	0.3940	1,0000	0.4687	0.5432
V43	0.3110	0.4687	1,0000	0.3013
V44	0.3472	0.5432	0.3013	1,0000

The correlation matrices calculated for all constructs show that all intercorrelations are below 0.90, suggesting that there is no multicollinearity (Hair et al., 1998) but indicating that the constructs have discriminant validity. These correlations provide evidence that the variables are different from each other (Tables 5.4 - 5.10) and that they are complementary.

5.3.2 Analysis of the structural performance model with SEM

The selection of SEM for use in this research was based on the structure of the proposed model that is composed of a number of direct and indirect interdependencies between the independent and dependent variables. Steps of SEM were mentioned before as 1. Specification of the model, 2.Estimation and identification of the model and 3.Evaluation of the model fit. The analysis of the performance model will be explained in this part, in sequence with these aforementioned steps.

5.3.2.1 Specification of the model

The researcher's hypotheses are expressed in the form of a structural equation model.

A series of literature reviews and expert intervies were conducted to develop a conceptual model that shows how the 5 variables affect "project performance" and "company performance" directly and indirectly as well. The model was tested in a pilot study administered to industry professionals and academicians. Based on the input of these subjects, the model was restructured as in Figure 5.20, eliminating some of the variables and adding recommended ones.

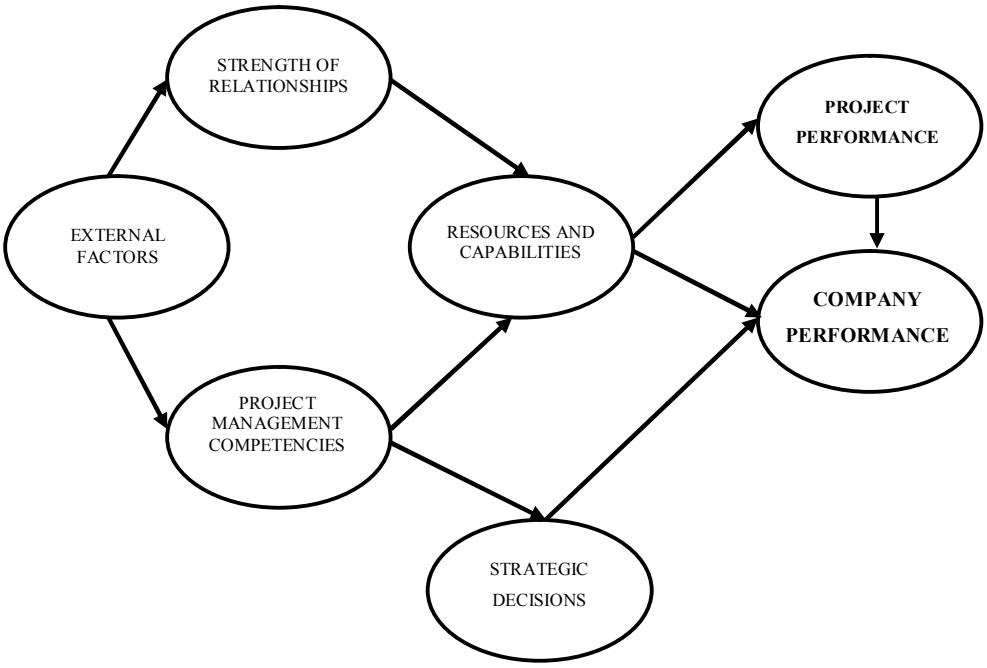


Figure 5.20 Casual relationships between the latent variables of the model

The model prepared for this purpose assumed that "company performance" is influenced by "resources and capabilities", "strategic decisions", "project performance", as suggested by most researchers (e.g., Jaselskis and Ashley 1991; Chua et al., 1999; Brown and Adams, 2000; Cooke-Davies, 2002; Chan et al., 2004). Moreover, it was hypothesized that "strength of relationships with other parties" impacts "resources and capabilities", while "project management competencies" effect "resources and capabilities" and "strategic decisions". "External factors" was deemed to have an exogenous effect on all factors directly or indirectly by having its first direct effects on "strength of relationships" and "project management competencies".

Although many researchers begin the process of specification by drawing a diagram of a model using a set of symbols, the model can alternatively be described as a series of equations. These equations define the model's parameters, which correspond to preassumed relations among observed or latent variables that the computer eventually estimates with sample data. The value of any compound path is the product of its path coefficients.

This model is specified by the following direct path equations:

- Company performance = path coefficient 1*project performance + path coefficient 2*resources and capabilities + path coefficient 3*strategic decisions + error term 1
- Project performance = path coefficient 4*resources and capabilities

  + error term 2
- Strategic decisions = path coefficient 5*project management competencies

  + error term 3
- Resources and capabilities = path coefficient 6*strength of relationships + path coefficient 7*project management competencies

  + error term 4
- Strength of relationships = path coefficient 8*external factors

  + error term 5
- Project management competencies = path coefficient 9*external factors

  + error term 6

5.3.2.2 Estimation and identification of the model

It means that it is theoretically possible for the computer to derive a unique estimate of every model parameter. Different types of structural equation models must meet certain requirements in order to be identified. If a model fails to meet the relevant identification requirements, the attempts to estimate it may be unsuccessful.

There are several methods of model estimation. Some frequently utilized methods include *maximum likelihood (ML)*, *generalized least squares (GLS)*, *asymptotically distribution free (ADF)* estimator, and *robust* statistics.

The term *maximum likelihood (ML)* describes the statistical principle that underlies the derivation of parameter estimates: the estimates are the ones that maximize the likelihood (the continuous generalization) that the data (the observed covariances) were drawn from this population. That is, ML estimators are those that maximize the likelihood of a sample that is actually observed (Winer et al., 1991). It is a normal theory method because ML estimation assumes that the population distribution for the endogenous variables is multivariate normal. Other methods are based on different parameter estimation theories, but they are not currently used as often. In fact, the use of an estimation method other than ML requires explicit justification (Kline, 1998).

The strength of *robust* method is that the normality is not required. In this method, the chi-square and standard errors are corrected to the non-normality situation. The chi-square test is corrected in the conceptual way described by Satorra and Bentler (1994). Also, robust standard errors developed by Bentler and Dijsktra (1985) are provided as an output of the robust analysis, and they are correct in large samples even if the distributional assumption regarding the variables is wrong (Bentler, 2006). Although these robust statistics are computationally demanding, they have been shown to perform better than uncorrected statistics where the assumption of normality fails to hold and performs better than ADF (Chou et al. 1991; Hu et al. 1992). One important

caveat regarding the use of robust statistics is that they can be computed only from raw data (Byrne, 2006).

The selection of estimation method depends on the sample size and distribution of the data. Therefore a quick assesment on non-normality and sample size of the data should be covered at this point.

SEM generally hypothesizes the multivariate normality of data. According to Mardia (1970), if the estimated z-score is over ± 1.96 in a 0.05 confidence interval, normality hypothesis is rejected. Data in this study was found to be non-normal (Mardia's coefficient = -25). Therefore, due to the small sample size and nonnormality conditions, robust methodology was used. When the data are not normal, the Satorra-Bentler (1994) robust methodology that is developed in EQS 6.1 is recommended as mentioned before.. Moreover, the robust model fit indices such as NNFI, CFI and RMSEA are provided in the analysis report.

5.3.2.3 Evaluation of the model fit

It means to determine how well the model as a whole explains the data. Once it is determined that the fit of a structural equation model to the data is adequate, performance measurement model is completed.

However, it seems that the concern for overall model fit is sometimes so great that little attention is paid to whether estimates of its parameters are actually meaningful (Kaplan and Norton, 2000). Considering this issue, model fit indices for all constructs of performance measurement model were analysed.

The model fit indices for each construct was assessed through non-normed fit index (NNFI), comparative fit index (CFI), the root mean square error ofapproximation (RMSEA), and the ratio of χ^2 per degree of freedom (dom). Model fit indices analysis results for each construct can be seen in Tables 5.11-5.17.

Table 5.11 Model fit indices for “Resources and capabilities”.

Fit indices	**Allowable range**	**Overall**
Non-normed fit index (NNI)	0 (no fit)-1 (perfect fit)	0.888
Comparative fit index (CFI)	0 (no fit)-1 (perfect fit)	0.931
RMSEA	< 0.1	0.081
χ^2/ degree of freedom	< 3	1.72

Table 5.12 Model fit indices for “Strength of relationships with other parties”.

Fit indices	**Allowable range**	**Overall**
Non-normed fit index (NNI)	0 (no fit)-1 (perfect fit)	0.974
Comparative fit index (CFI)	0 (no fit)-1 (perfect fit)	0.977
RMSEA	< 0.1	0.080
χ^2/ degree of freedom	< 3	1.74

Table 5.13 Model fit indices for “Project management competencies”.

Fit indices	**Allowable range**	**Overall**
Non-normed fit index (NNI)	0 (no fit)-1 (perfect fit)	0.952
Comparative fit index (CFI)	0 (no fit)-1 (perfect fit)	0.965
RMSEA	< 0.1	0.078
χ^2/ degree of freedom	< 3	1.42

Table 5.14 Model fit indices for “Strategic decisions”.

Fit indices	**Allowable range**	**Overall**
Non-normed fit index (NNI)	0 (no fit)-1 (perfect fit)	0.909
Comparative fit index (CFI)	0 (no fit)-1 (perfect fit)	0.938
RMSEA	< 0.1	0.096
χ^2/ degree of freedom	< 3	1.63

Table 5.15 Model fit indices for “External factors”.

Fit indices	**Allowable range**	**Overall**
Non-normed fit index (NNI)	0 (no fit)-1 (perfect fit)	0.815
Comparative fit index (CFI)	0 (no fit)-1 (perfect fit)	0.821
RMSEA	< 0.1	0.095
χ^2/ degree of freedom	< 3	1.76

Table 5.16 Model fit indices for “Project performance”.

Fit indices	**Allowable range**	**Overall**
Non-normed fit index (NNI)	0 (no fit)-1 (perfect fit)	0.992
Comparative fit index (CFI)	0 (no fit)-1 (perfect fit)	0.992
RMSEA	< 0.1	0.080
χ^2/ degree of freedom	< 3	1.23

Table 5.17 Model fit indices for “Company performance”.

Fit indices	Allowable range	Overall
Non-normed fit index (NNI)	0 (no fit)-1 (perfect fit)	0.997
Comparative fit index (CFI)	0 (no fit)-1 (perfect fit)	0.999
RMSEA	< 0.1	0.020
χ^2/ degree of freedom	< 3	1.03

According to the analysis of the model fit indices for the constructs of the model, it is certified that all variables fit to its latent variable well beyond the recommended values mentioned also in the figures. Reliability values of the constructs were also calculated and presented in the previos parts of the analysis results.

Having obtained reliable constructs and constitutent variables with significant factor loadings and goodness of fit indices within the allowable ranges for each construct, the structural model was assessed next.

The initial model with path coefficients is presented in Figure 5.21. The overall model fit indices listed in Table 5.18 interpreted a relatively good fit of the data since all findings were within the allowable ranges. In Figure 5.21, the path coefficients marked on the arrows can be interpreted similar to regression coefficients that describe the linear relationship between two latent variables (Matt and Dean, 1993). Although, model fit indices of the structural model were within allowable ranges, it was observed that one of the path coefficients was not significant at α=0.05. Moreover, the insignificant path coefficient was surprisingly between the constructs, “project performance” and “company performance” which is actually considered as an undeniable significant relation both in theory and practice. Nevertheless, this finding required the investigation of different relationships between the constructs of the model. Perhaps more oftenly, researchers’ initial models do not fit the data very well.

When this happens, the model should be respecified. Hence, the model was respecified and the fit of the model was reevaluated as well.

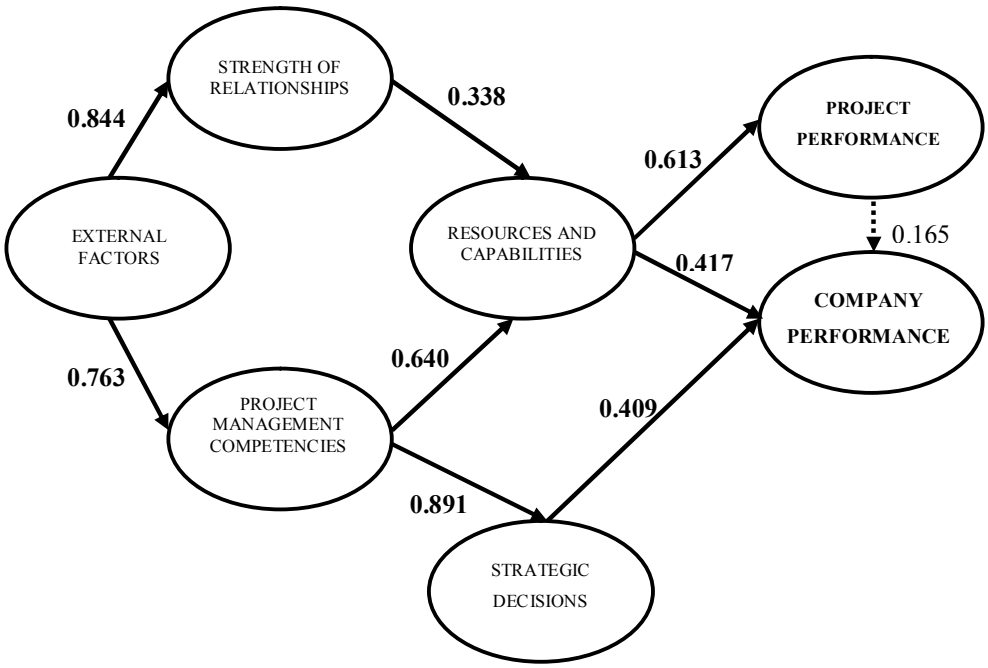


Figure 5.21 Initial model with path coefficients.

Table 5.18 Fit indices for the initial model

Fit indices	**Allowable range**	**Overall**
Non-normed fit index (NNI)	0 (no fit)-1 (perfect fit)	0.749
Comparative fit index (CFI)	0 (no fit)-1 (perfect fit)	0.765
RMSEA	< 0.1	0.080
χ^2/ degree of freedom	< 3	1.46

An equivalent respecified model explains the data just as well as the researcher's preferred model but does so with a different configuration of hypothesized relations. An equivalent model thus offers a competing account of the data. For a given structural equation model, there may be many and in some cases infinitely many equivalent variations; thus, it is necessary for the researcher to explain why his or her preferred model should not be rejected in favor of statistically equivalent ones.

In the respecified model, insignificant path coefficient between "project performance" and "company performance" constructs was eliminated (Figure 5.22). However, as mentioned before, the relation between the "project performance" and "company performance" is inevitable. Thus, it was decided to consider this strong relationship in an additional structural model which is going to be presented later.

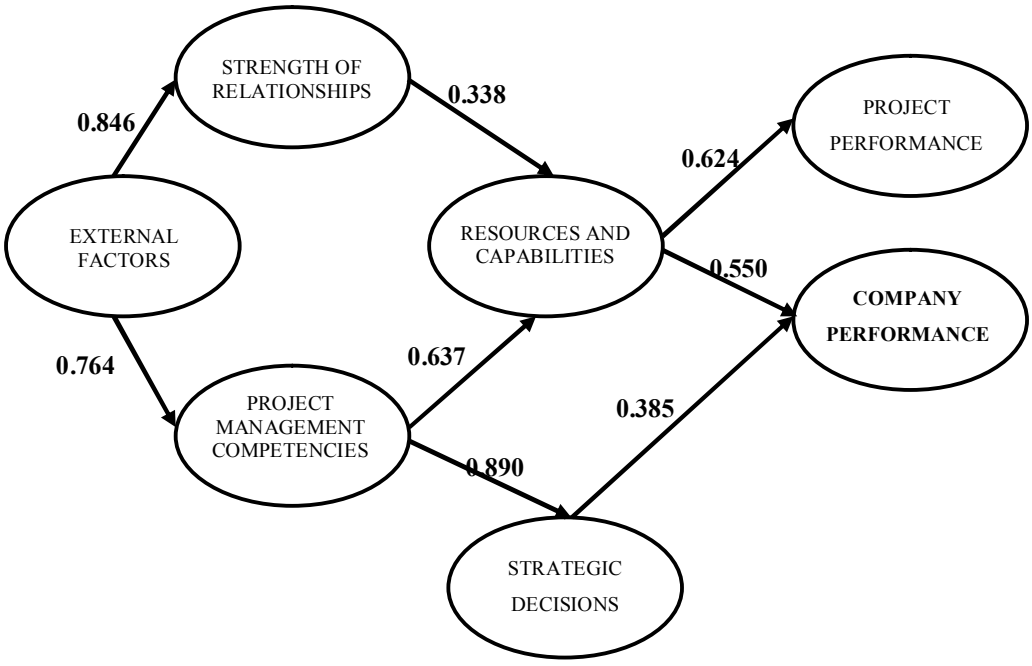


Figure 5.22 Respecified model with path coefficients

Table 5.19 Fit indices for the respecified model

Fit indices	Allowable range	Final model
Non-normed fit index (NNFI)	0 (no fit)-1 (perfect fit)	0.811
Comparative fit index (CFI)	0 (no fit)-1 (perfect fit)	0.807
RMSEA	< 0.1	0.080
χ^2/ degree of freedom	< 3	1.46

The comparison of the fit indices of the initial model with the specified model presented in Table 5.19 indicates that the fit of the final model was enhanced after respecification.

The respecified model presents the effects of latent variables, "Resources and capabilities", "Strength of relationships with other parties", "Project management competencies", "Strategic decisions" and "External factors" on "project performance" and "company performance" at the same time. Therefore, a structural measurement model to assess "project performance" and "company performance" at one time in a single test was constructed by this way. The respecified model is quite satisfactory indeed since all indices are close enough to the recommended perfect values. Table 5.19 indicate that, the χ^2 to dof ratio was satisfactory as it was smaller than 3, and RMSEA implied a good fit with a value smaller than 0.1, the thresholds suggested by Kline (1998).

However, considering the structure of the construction industry and the construction companies as project based organizations, a model in which the structural relationship between the "project performance" and "company performance" not seen is quite confusing. Therefore, the model was respecified again eliminating the project performance construct from the overall model. Assuming the inevitable effect of project performance on company performance, an additional model which shows the

relation between project performance and company performance was also specified as aforementioned.

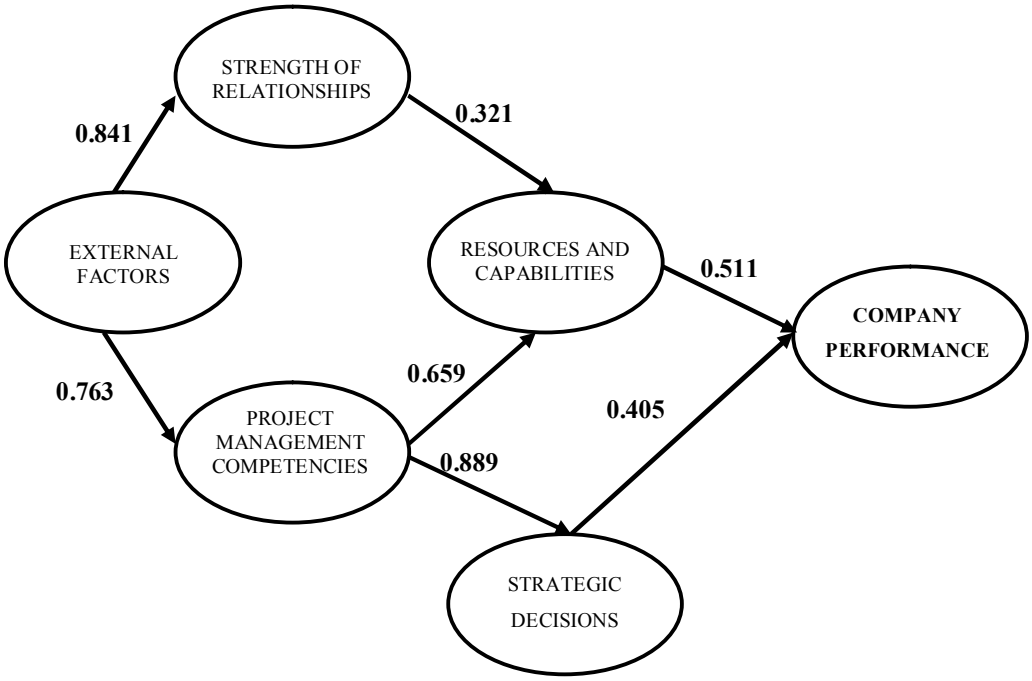


Figure 5.23 Final model with path coefficients

Table 5.20 Fit indices for the final model

Fit indices	**Allowable range**	**Final model**
Non-normed fit index (NNFI)	0 (no fit)-1 (perfect fit)	0.895
Comparative fit index (CFI)	0 (no fit)-1 (perfect fit)	0.887
RMSEA	< 0.1	0.065
χ^2/ degree of freedom	< 3	1.44

The model fit indices (Table 5.20) of the respecified model (Figure 5.23) indicate that considering "project performance" construct in a later structural model (Figure 5.24) was a convenient decision. The comparison of the fit indices for the initial, respecified and the respecifed final model in Table 5.21 reveals that, although the findings were quite satisfactory in all three models, eliminating "project performance" raised the value of the model fit indices significantly in a more satisfactory way. Identical with Kline (1998)'s suggestions for better fit indices, NNFI and CFI approximated a better fit since it went closer to the perfect fit value of 1 while the value of RMSEA and χ^2/ dof decreased.

Table 5.21 Comparison of the model fit indices

Fit indices	Allowable range	Initial model	Specified model	Final model
NNFI	0 (no fit)-1 (perfect fit)	0.749	0.811	0.895
CFI	0 (no fit)-1 (perfect fit)	0.765	0.807	0.887
RMSEA	< 0.1	0.080	0.080	0.065
χ^2/ dof	< 3	1.46	1.46	1.44

Effect of "Project performance" on "Company performance"

The effects of project performance on company performance was investigated through their constituent variables. Project performance was indicated by three factors (project profitability, client/user satisfaction and long-term contributions of the project) in the model which summarize the critical success factors of a project. The indicators of company performance were taken from the perspectives of the Balanced Scorecard of Kaplan and Norton (1992), namely, "Financial perspective", "Learning and growth perspective", "Internal business perspective" and "Customer perspective" (Figure 5.24).

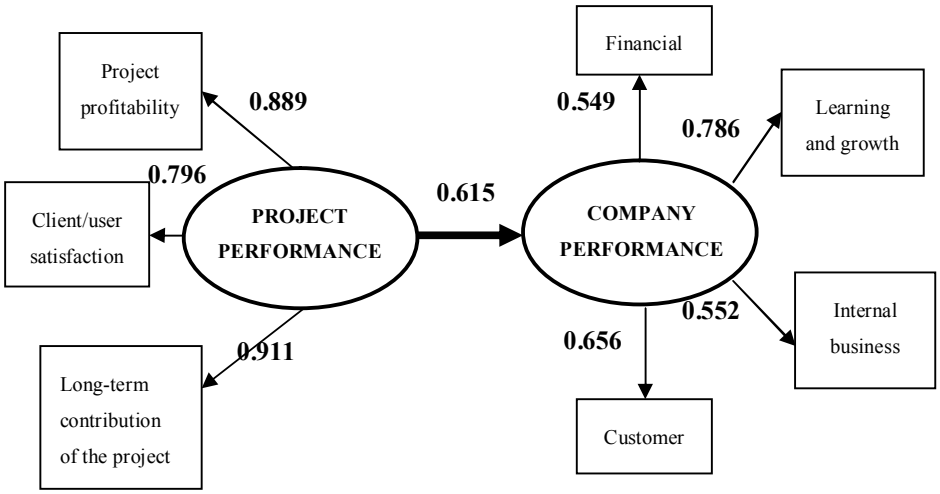


Figure 5.24 Effect of project performance on company performance

The structural model was analysed and the model fit indices were found to be very close to perfect values of recommended ranges as can be seen in Table 5.22 which can be considered as an evidence of the strength of relationship between two constructs.

Table 5.22 Model fit indices for "project to company performance"

Fit indices	**Allowable range**	**Final model**
Non-normed fit index (NNFI)	0 (no fit)-1 (perfect fit)	0.991
Comparative fit index (CFI)	0 (no fit)-1 (perfect fit)	0.995
RMSEA	< 0.1	0.075
χ^2/ degree of freedom	< 3	1.30

Within the structural model, for every unit "project performance" goes up, "company performance" also goes up 0.615 points on a 5 point scale. Moreover, the effects of

measures of projet performance on company performance indicators can also be analysed such as,

(e.g. Project profitability*0.889*0.615=0.549*Financial perspective,

that is Project profitability*0.996=Financial perspective,

Client user satisfaction*0.796*0.615=0.549*Financial perspective,

that is client user satisfaction*0.892=Financial perspective.)

The rest of the equations which have the ability to evaluate the effects of "project performance" on "company performance" indicators are shown in Table 5.23.

Table 5.23 Effect of project performance measures on company performance indicators

Project profitability	*0.996	= Financial perspecitve
Client/user satisfaction	*0.892	= Financial perspecitve
Long-term contributions of the project	*1.021	= Financial perspecitve
Project profitability	*0.696	= Learning and growth perspective
Client/user satisfaction	*0.622	= Learning and growth perspective
Long-term contributions of the project	*0.713	= Learning and growth perspective
Project profitability	*0.990	= Internal business perspective
Client/user satisfaction	*0.887	= Internal business perspective
Long-term contributions of the project	*1.014	= Internal business perspective
Project profitability	*0.833	= Customer perspective
Client/user satisfaction	*0.746	= Customer perspective
Long-term contributions of the project	*0.854	= Customer perspective

5.3.2.4 Overall view of the analysis results

Data collected from 73 construction companies and 354 projects held by those 73 companies participated into the survey were analysed in order to determine the key performance measures and the indicators of performance in construction industry both from the project and the company perspectives.

The main objective was to define a conceptual framework to demonstrate all relationships between determined measures and the indicators. In order to set the goals, structural equation modeling technique was used to assess the validity of the measurement model and the structural model in a single test. An SEM programme package called EQS 6.1 was used for the statistical analysis.

According to the analysis results, all Cronbach's alpha values were well beyond 0.7 which was the treshold suggested by Nunally (1978) (Table 5.2). All factor loadings for the indicators of latent variables were found to be significant at α=0.05 (Table 5.3). Moreover, goodness of fit indices for each construct were in the recommended ranges of Kline (1998) (Tables 5.11-5.17).

Having obtained reliable latent variables and indicators, hypothetical structural relationships between the latent variables were specified. The structural model was assessed in order to eliminate the relations with insignificant path coefficients and imrove it with new hypothetical relations. Accordingly, the initial model (Figure 5.21) was rejected due to the insignificancy in some paths. In order to improve the model fit with significant path coefficients, the model was respecifed eliminating some of the constructs. Finally, three models were obtained which have the ability to measure performance from different perspectives.

In the first model, effects of determined measures of performance were shown on both project performance and company performance which makes it a single tool to

measure project performance and company performance in a single measurement model (Figure 5.22).

In the second model, neglecting the effects of performance measures on project performance, their effects on company performance were only considered (Figure 5.23).

In the last and the final partial model, the effects of project performance on company performance were investigated (Figure 5.24). This very well known relationship was evaluated from the measures of project performance to the indicators of company performance which were taken as the perspectives of balanced scorecard. The effects of each variable on each perspective of company performance were demonstrated in mathematical equations.

Goodness of fit indices for all three models were found to be quite satisfactory as mentioned in Tables 5.21-5.22 earlier.

Acquisition of three different models, with valid variables and significant paths, which have the potential to be used in construction industry in order to measure the performance of construction companies and the projects as well, completed the analysis of performance data.

CHAPTER 6

ANALYSIS AND DISCUSSION OF PERFORMANCE MEASURES IN SPECIAL MODELS

In this chapter, special models were constituted to observe the different aspects of performance measures and indicators. In the first part, impact of corporate strengths/weaknesses on project management competencies was criticized. In the second part, exogenous factors were digged out and their effects on strategic decisions of a construction company were outlined.

6.1. Effect of "corporate strengths/weaknesses" on project management competencies

All criteria including Cronbach's alpha values, factor loadings, path coefficients and goodness of fit indices which were used to measure the reliability and fit of the model were found to be highly satisfactory as shown in Table 6.1 and Figure 6.1. The hypothesis set in the study that "corporate strength/weaknesses" which is defined by "company resources and capabilities", "strategic decisions" and "strength of relationships with other parties" is a key factor in the development of "project management competencies" is therefore verified by the findings. The influence of the determinants that take a project to success or failure has been investigated by several researchers (e.g., Chan et al., 2004; Chua et al., 1999; Larson and Gobeli, 1989; Brown and Adams, 2000; Cooke-Davies, 2002), the majority of whom pointed out the importance of "project management competencies" among other criteria. Based on the findings, it can be stated that "corporate strengths/weaknesses" plays an important role on the success of projects since it has a direct and significant influence on "project

management competencies". The positive influence of company wide charateristics on project management competencies is also supported by other studies. According to the strategic management literature, company wide characteristics are defined as the strengths of a company and the strengths of a company have the potential to be translated into an opportunity for the company as well (Barney, 1991; Porter, 1981).

6.1.1. Effect of company "resources and capabilities" on project management competencies

"Company resources and capabilities" which is one of the determinants of "corporate strengths/weaknesses" with a factor loading of 0.94 depends on the size of the company and the competitive environment in which the company operates. In order to have a positive impact on project success, company resources and capabilities should be valuable, rare, inimitable, and should lack of substitutes (Barney, 1991; King and Zeithaml, 2001). Based on their higher factor loadings in Figure 6.1, it can be stated that "leadership", "company image", "research and development capability" and "innovation capability" are important resources and capabilities. While leadership is of importance in the execution of all project management activities, "company image", receptiveness to "innovation" and "research and development capability" can be considered as sources of competitive advantage. Leadership in developing and using innovative management techniques is expected to affect project management competencies in "schedule management", "cost management" and "knowledge management".

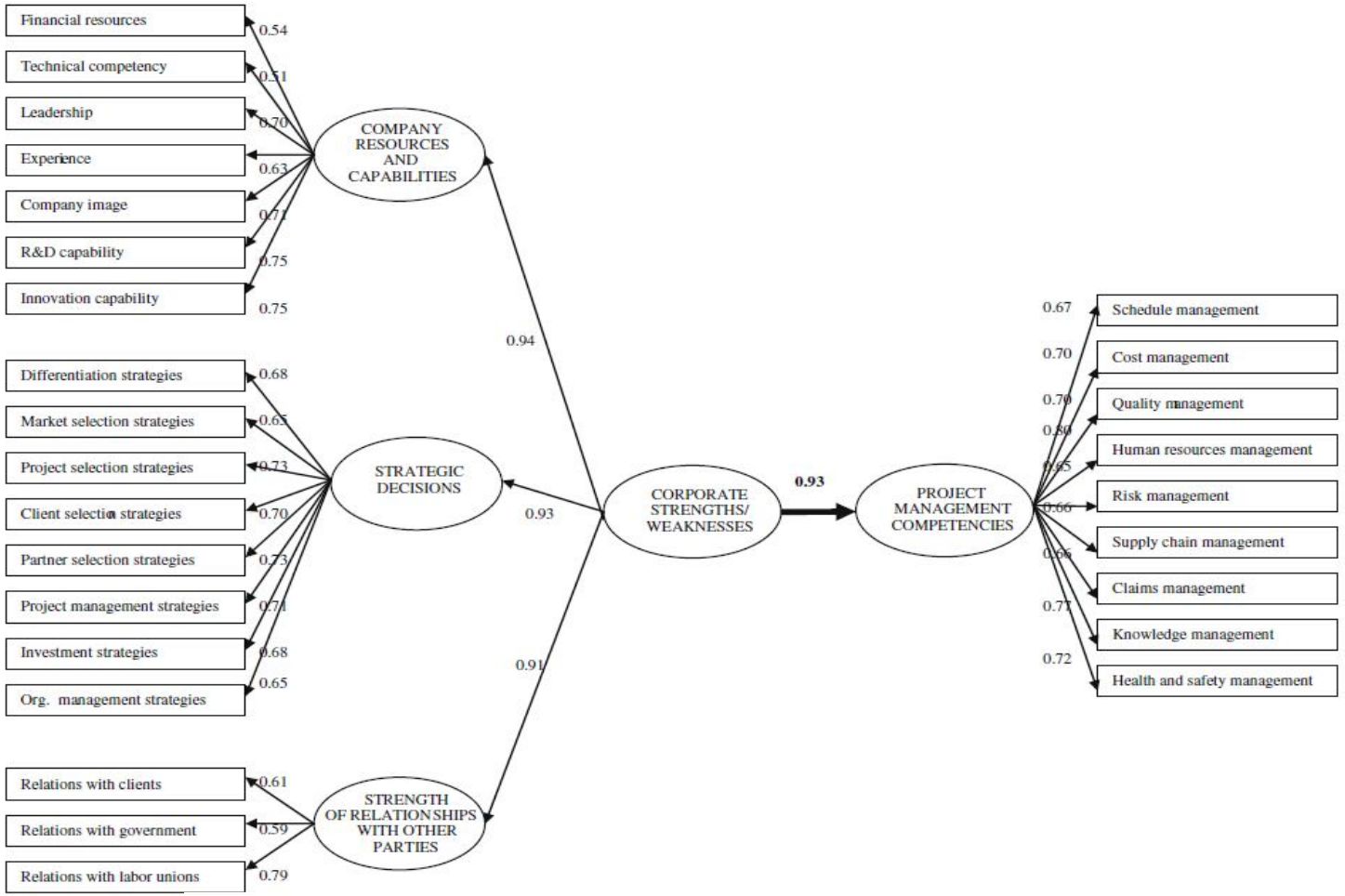


Figure 6.1 Effect of corporate strengths and weaknesses on project management compatencies

6.1.2. Effect of "strategic decisions" on project management competencies

"Strategic decisions", with a factor loading of 0.93 is a major indicator of "corporate strengths/weaknesses", and in turn impacts project management competencies significantly. Emphasizing the importance of strategic decisions, Child (1972) states that companies can achieve higher organizational success by adopting different competitive positioning alternatives based on strategic decisions. The strategic decisions construct in the study was represented by eight constituent variables, all closely related to competition. All have the power to manipulate the course of action in a project. Market/project/client/partner selection strategies conducted along with differentiation, investment and organizational management strategies can constitute important corporate strengths (or weaknesses), which in turn can impact project management competencies. For example, differentiation strategies that add uniqueness and value to a company's competitive arsenal (Kale and Arditi, 2002) can have an impact on almost all project management competencies. Market, project, client, partner selection is likely to impact project management competencies such as knowledge management, risk management, claims management and cost management. The influence of investment strategies on cost management is obvious. Similarly, the effect of organizational management strategies on the human resources and knowledge management competencies of project management is well established.

6.1.3. Effect of "strength of relationships with other parties" on project management competencies

"Strength of relationships with other parties" was also found to be loading significantly on "project management competencies". The positive influence of strong relationships with other parties was also discussed and confirmed in the literature (e.g., Hausman, 2001; Pinto and Mantel, 1990; Dissanayaka and Kumaraswamy, 1999; Dainty et al., 2003). The strength of the relationships between the contractor and the

client facilitates the operations and helps to achieve better performance. According to Pinto and Mantel (1990) and Dissanayaka and Kumaraswamy (1999), good relationships between a construction management firm and the client's representatives expedite the operations and help to achieve success. Considering the sophisticated nature of the industry and the cultural values of the society, the relationship of a construction company were assessed not only with the client, but also with government agencies and labor unions. On this account, the communication and negotiation skills of company executives have to be stressed. The strength of a company's relationships with other parties is expected to impact project management competencies such as quality management, claims management, human resources management.

6.1.4. Conclusion on the effect of corporate strengths/weaknesses on project management competencies

The impact of corporate strength/weaknesses on project management competencies was investigated in this study. According to the model presented in Figure 6.1, corporate strengths/weaknesses are defined by the latent variables "company resources and capabilities", "strategic decisions" and "strength of relationships with other parties". It was hypothesized that "corporate strengths/weaknesses", so defined, impacts "project management competencies". In order to test this hypothesis, a questionnaire survey was administered to 73 Turkish construction companies. A two-step SEM model was set up to measure the five latent variables (project management competencies, company resources and capabilities, strategic decisions, strength of relationships with other parties, and corporate strengths/weaknesses) through their constituent variables and to see if the hypothesized relationship holds (Figure 6.1).

According to the findings of the SEM analysis (Table 6.1) Cronbach's alpha coefficients of all the latent variables were well over the 0.70 minimum set by Nunally

(1978) which indicated that the internal reliability of the individual constructs was quite high. The internal reliability of the overall model was also found to be 0.95 which is an excellent result. CFA showed that all factor loadings presented in Figure 6.1were significant at α=0.05. The goodness of fit indices presented in Table 6.1 consistently indicated a good fit, considering the recommended values. As a result, it can be concluded that the hypothesis set at the beginning of the study was verified by the statistically significant (α=0.05) and very strong path coefficient (0.93) shown in Figure 6.1.

Beyond the success criteria commonly mentioned in previous research on project management (e.g., Chan et al., 2004; Munns and Bjeirmi, 1996; Chua et al., 1999; Brown and Adams, 2000; Cooke-Davies, 2002; Atkinson, 1999), the considerable influence of corporate strengths/weaknesses was confirmed by the finding of this study. This finding adds a different perspective to success criteria in project management, and is particularly important since construction is largely project based. Based on the findings of the study, it can be stated that companies should adjust their resources and capabilities, their long-term strategies and their relationships with other parties to better serve the needs of the individual projects. Indeed, in the dynamic environment of the construction industry, companies have to behave farsighted in order to survive. Ample leadership qualities should be acquired in addition to being open to innovation and fostering research and development. Tactical considerations which are short-term have to be complemented by long-term and strategic decisions. Finally, strong relationships (may be exploring partnering relationships) should be developed with prospective clients, unions, and government.

Table 6.1 Model fit indices

Fit indices	Allowable range	Final model
Non-normed fit index (NNFI)	0 (no fit)-1 (perfect fit)	0.871
Comparative fit index (CFI)	0 (no fit)-1 (perfect fit)	0.863
RMSEA	< 0.1	0.08
χ^2/ degree of freedom	< 3	1.43

6.2. The role of exogenous factors in the strategic decisions of construction companies

The strategic performance of a company is a multifaceted phenomenon that combines financial, operating and strategic measures in order to translate strategies into deliverable results for the company and gauge how well the company meets its targets. Strategic performance can be explored both from the point of view of resource-based and market-based perspectives. The neoclassical approach to strategy formulation is resource-based and consists of the appraisal of endogenous factors such as resources and competencies (Peteraf, 1993). Indeed, as Barney (1991) argues, a company may gain advantages by analyzing information about the assets it already controls and by adjusting its performance accordingly. But for sustainable competitive advantage, a company should also consider market-based factors that are beyond the control of the company. Indeed, according to Prescott (1986), Porter (1980) and Scherer (1980), the strategic performance of a company is greatly affected by the environment in which it operates. According to Porter (1980), environment is the primary determinant of performance. But uncertainties are an inherent part of environment as company executives have hardly any impact on any environmental issue. The uncertainties in a project environment are caused by politics, macroeconomic conditions, policies of the

government, social risks, competitiveness and the power of the project participants such as the suppliers and the client as well as the risks associated with the operation of the project and the strength of the strategic interrelationships with the other participants of a project. An efficient strategic plan needs to be put in place in order to cope with these uncertainties. Strategic performance became important in the construction industry mainly because of its role in the pursuit of company success, and its capability to cope with uncertainties and to provide sustained improvement. Various researchers such as Anumba et al. (2000) and Beatham et al. (2004) commented on the existing poor performance of construction companies. Some researchers suggested that correctly determining the factors effecting performance is needed for rehabilitation (Egan, 1998; Larson and Gobeli, 1989; Yasamis et al., 2002). Developing strategic performance measures including financial and non-financial measures, is seen as a way to bypass the current situation and cope with the increasing competitiveness between companies.

This study promotes the understanding of the role of exogenous factors in the strategic performance of construction companies, where "exogenous factors" is defined as a two-dimensional construct reflecting on the one hand the market environment relative to macro-economics, political conditions, socio-cultural structure, legal conditions, competitiveness, supply power, client power, demand and on the other hand, the strategic interrelationships of the company with other parties including clients, the government and labor unions. It is hypothesized that exogenous factors (so defined) influence the strategic decisions of a construction company. Whether this hypothesized relationship exists or not is assessed by using structural equation modeling (SEM). A questionnaire survey was administered to a number of construction companies to obtain data for the analysis.

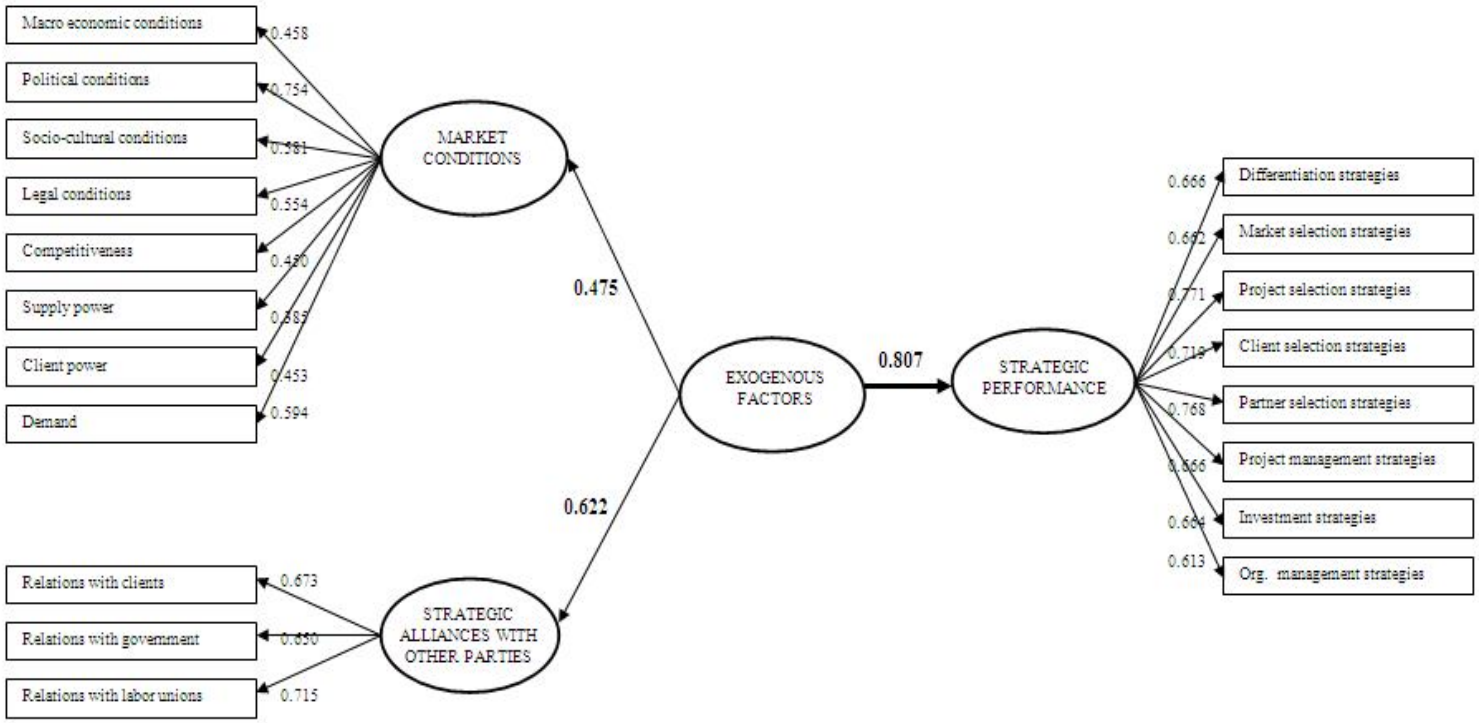


Figure 6.2 Effect of exogenous factors on strategic decisions of a company

A structural equation model was set up in order to assess the role of exogenous factors in the strategic performance of construction companies. All criteria including Cronbach's alpha values, factor loadings, path coefficients and goodness of fit indices which were used to measure the reliability and fit of the model were found to be highly satisfactory as shown in Tables 6.2 and Figure 6.2. Based on the findings, it can be concluded that the hypothesis set in the study that exogenous factors influence strategic performance is verified. In this model "exogenous factors" is a two-dimensional construct composed of the "market conditions" and the "the strength of strategic alliances". Judging from the factor loadings in Figure 6.2 , it appears that "the strength of strategic alliances" contributes more (0.622) to "exogenous factors' than "market conditions" (0.475). A discussion of "market conditions" and "strength of strategic alliances" relative to "strategic performance" follows in the next two parts.

6.2.1. Market conditions

The influence of market conditions on strategy was investigated in the strategic management literature by many researchers such as Prescott (1986), Porter (1980), and Scherer (1980). The findings of this study are supported by Prescott's (1986) research that states that the environment modifies the strength and form of the relationship between strategy and performance. Miles and Snow (1978) suggested that regardless of its characteristics, the market environment has the power to influence strategies through managerial perceptions and objective dimensions of industries' structure. Moreover Scherer (1980) stated that the factors affecting the performance of a company such as the pricing policies, investment policies or research and development emphasis are mainly dependent on the structure of the industry environment. Finally, Porter (1980) emphasized the role of industrial factors which include the threat of new entrants and substitutes, the bargaining power of suppliers and buyers, and the rivalry among existing firms, while defining the competitive rules of strategy in his well known model. The findings of our study indicate that the macro-economic, political,

legal, socio-cultural conditions and the level of competition and demand are expected to impact primarily differentiation strategies, and market/project/partner selection strategies. Political conditions turned out to be the factor with the highest factor loading (0.754) and tend to suggest that it is difficult to make strategic decisions in developing countries like Turkey where political stability is often questionable.

6.2.2. Strategic alliances

The influence of strategic alliances was also discussed in the literature extensively (e.g., Hausman, 2001; Pinto and Mantel, 1990; Dissanayaka and Kumaraswamy; 1999; Dainty et al., 2003). According to Pinto and Mantel (1990) and Dissanayaka and Kumaraswamy (1999), good relationships between a construction management firm and the client's representatives expedite the operations and help to achieve success. Considering the sophisticated nature of the industry and the cultural values of the society, the relationship of a construction company were assessed not only with the client, but also with government agencies and labor unions. On this account, the communication and negotiation skills of company executives have to be stressed. But, the subtle difference between favoritism and strong relationships has to be distinguished since the strength of business relationships is an important phenomenon in Confucian societies like China, Hong Kong, Taiwan, Japan and Korea. It is generally called "guanxi" which means "connection" in Chinese. While western societies regard "guanxi" as favoritism or nepotism, Confucian societies regard it as an inevitable asset while doing business (Yeung and Tung, 1996). Turkey, located between the west and the east carries both sides' characteristics. The findings certainly indicate that contractors' strategic performance is enhanced by strong relationships in the Turkish setting.

The quality of the relationships with government agencies and clients is expected to influence client/project/market selection strategies, while the quality of the

relationships with labor unions may affect the ability to differentiate by using innovative construction methods, materials and equipment.

6.2.3. Conclusion on the role of exogenous factors in the strategic decisions of a construction company.

A questionnaire survey was administered to 73 construction companies and the collected data were analyzed using structural equation modeling (SEM). A conceptual model was proposed where the strategic performance of construction companies was influenced by exogenous factors which were represented by a two-dimensional construct covering the market environment and strategic alliances with the other participants of the project. A two step SEM model was set up to measure the latent variable "exogenous factors". According to the findings of the SEM analysis, the Cronbach's alpha coefficients of all the latent variables (market conditions, strategic alliances, exogenous factors and strategic performance) were well over the 0.70 minimum set by Nunally (1978) which indicated that the internal reliability of the individual constructs was quite high. The internal reliability of the overall model was also found to be 0.86 which is an excellent result. CFA showed that all factor loadings presented in Figure 6.2 were significant at α=0.05. Limitations due to the small sample size were overcome by using robust methodology and the goodness of fit indices presented in Table 6.2 consistently indicated a good fit, considering the recommended values.

As a result, it can be concluded that the hypothesis set at the beginning of the study was verified by the statistically significant (α=0.05) and very strong path coefficient (0.81) shown in Figure 6.2 between "exogenous factors" and "strategic performance".

It is likely that endogenous factors such as company resources, capabilities and project management competencies also impact strategic performance as evidenced by research conducted by Porter (1981), Barney (1991), and Beatham et al. (2004). However,

based on the findings of the study it can be stated that, strategic performance is also impacted by exogenous factors that involve market conditions and strategic alliances. The findings of this study benefits construction company executives in that they should be cognizant of the market environment and attach particular importance to alliances with other parties. While market conditions are beyond the control of construction executives, relationships with other parties are well within their sphere of influence.

Table 6.2 Model fit indices

Fit indices	**Allowable range**	**Final model**
Non-normed fit index (NNFI)	0 (no fit)-1 (perfect fit)	0.91
Comparative fit index (CFI)	0 (no fit)-1 (perfect fit)	0.89
RMSEA	< 0.1	0.07
χ^2/ degree of freedom	< 3	1.37

CHAPTER 7

DISCUSSION OF THE FINDINGS

In this chapter major findings of the research will be investigated and discussed in comparison with the findings of the similar previous researches.

7.1. Company performance

The construction industry has mainly aimed to measure its performance in financial terms at the project level. However, recently, the need for construction companies to measure their performance at the corporate level has increased, as well the need for additional performance measures other than financial ones. From this perspective a structural model which includes "company performance" as its major objective alongside the other criteria was built.

A few of the previous studies in the construction management literature adopted the BSC perspective (Kagioglou et al., 2001; Bassioni et al., 2004; Yu et al., 2007) for investigating the relationship between the drivers, measures, and indicators of performance. In these studies, reasonable results were obtained which encouraged the adaptation of the BSC perspective in this study. In this study, "financial performance", "learning and growth", "efficiency in internal business" and "customer satisfaction" were used as the general indicators of company performance in place of "cost, time and quality", i.e., the "iron triangle" as called by Atkinson (1999). The reason for selecting BSC was its established status in the literature. By combining "financial performance", "learning and growth", "efficiency in internal business" and "customer satisfaction", "company performance" indicators help managers understand and

surpass traditional concepts about functional barriers and lead to improved decision making and problem solving.

As a result of SEM, factor loadings relative to "company performance" were found to be 0.522 for "financial perspective", 0.717 for "learning and growth perspective", 0.605 for "internal business perspective" and 0.670 for "customer perspective". It can be argued from this finding that, "learning and growth perspective" with the highest factor loading value under this construct has the potential to be effected by performance measures and indicate the performance level of the company much more than the other factors. "Customer perspective", "internal business perspective" follows this variable respectively. Finally, it is seen that "financial perspective" loads as the slightest of all variables. The findings of the analysis generally show that, construction industry is also open to new perceptions of management such as the increasing importance of intangible assets of a company compared to its tangible assets. Despite the supposed traditional structure of construction industry, all qualitative perspectives of balanced scorecard were loaded higher than the financial perspective. This finding supported and reinforced the objective of the study which was the investigation of non-financial factors effecting performance. Looking at the descriptive statistics of data, financial based and customer based performance measures identify the parameters that the companies consider most important for success. However, the targets for success keep changing. Given today's business environment, it is questionable that if the managers should look at the short term financial indicators in order to measure their performance. Increasing global competition in construction industry forces companies to make continuous improvements in their service, processes and products. A company's ability to innovate, learn and grow is directly related to its own value. Only through these abilities, can a construction company penetrate into new markets, operate more complex projects and increase profit in short terms; grow and thereby increase shareholder value in the long term.

7.2. Project performance

Project performance was evaluated from three different views which were selected as being the most critical and covering the primarily used measures. Project managers understood that, measuring performance in traditional terms such as profit or turn over can give misleading signals for the future strategies. Therefore, "project performance" construct in this study was designed including "client/user satisfaction" and "long term contributions of the project to the company" alongside "project profitability". The factor loadings of these variables were found to be as 0.848 for "project profitability, 0.789 for "client/user satisfaction" and 0.912 for "long-term contributions of the project to the company". Considering the significant higher loading of "long-term contributions of the project to the company" it can be inferenced that long term and strategic decisions should displace short term acquisitions. As Kaplan and Norton (1996b) mentioned, long-term strategies do not have to bring profit to the company in the short-term. This finding is complementary with "company performance" in which "learning and growth perspective" was deemed to rate more than the other variables. Therefore, the increasing importance of qualitative performance measures which provide companies to be capable of problem solving and decision making in the long-term while measuring their performance was revalidated. Even though, the main aim was to design an untraditional measurement model dealing with the relationships between the qualitative measures of performance, a measurement model without the existence of financial terms is of no significance, therefore "project profitability" was also included. Having obtained a high loading of 0.848 is no surprising given the high importance level of project profitability observed from the descriptive statistics of the data. "Client/user satisfaction" rated relatively low compared to other variables of this factor even thogh it can still be considered as high with a factor loading of 0.789, in fact it was deemed to be the most important variable by the respondent companies according to the descriptive data. Many companies today have a corporate mission that focuses on customer which corresponds to "client" and the "end user" in construction

industry. Customer's concern mainly rely on four categories which are time, quality, performance and service (Kaplan and Norton, 1996b). Accordingly, the success of a project depends on the satisfaction of the expectation of the customer in these terms.

7.3. Effect of resources and capabilities on performance

"Resources and capabilities" was found to be most influential on performance. The critical importance of the resources and capabilities of a company was also emphasized in the literature**.** According to the strategic management literature "resources and capabilities" are defined as the strengths of a company and the strengths of a company have the potential to be translated into an opportunity for the company as well (Barney, 1991; Porter, 1981). The resources and capabilities in a company differ from each other depending on the size of the company and the competitive environment that the company enrolled in. In order to have a positive impact on performance, King and Zeithaml (2001) and Barney (1991) have identified the preferable characteristics of resources of a company as valuable, rare, inimitable, and lack of substitutes. Given the competitive environment among the rivals, resources and capabilities cannot be assumed to be identical in every company (Porter, 1980; Barney, 1991). These characteristics are inevitable and only if these conditions are met, can resources and capabilities be transformed into a source of competitive advantage (Barney, 1991). It follows that a construction company's equipment, manpower, technical and managerial know-how, should be efficient, cost-effective, rare and sophisticated enough to prevent imitation by competitors.

Regarding the highly satisfactory results of the analysis, it can be asserted that "leadership" in a company can be efficient in the execution of all project management activities, "research and development capability" can be considered as a source of competitive advantage which has the potential to show itself in means of innovative scheduling techniques, cost estimation methods, contract types or keeping

organizational memory for managing knowledge and strategy related components of resources have the tendency to manipulate the course of actions in a project that are conducive to effect the performance of a project significantly.

7.4. Effect of strength of relationships with other parties on performance

Even though the effects of "project management competencies" on company success have always been considered to be inevitable, (e.g., Jaselskis and Ashley 1991; Chua et al., 1999; Brown and Adams, 2000; Cooke-Davies, 2002; Chan et al., 2004), the "strength of relationships with other parties" has rarely been discussed in the construction management literature. In one of the few examples, variations of relationships were discussed in Hausman's (2001) study where a strong relationship's positive effect was confirmed. According to Pinto and Mantel (1990) and Dissanayaka and Kumaraswamy (1999), good relationships between a construction management firm and the client's representatives expedite the operations and help to achieve better performance. Dainty et al. (2003) pointed out the importance of managing client relationships in a positive way that encourages long-term successful relationships.

The strength of a company's relationship with other organizations constitutes a social dimension of performance measurement, a dimension associated with the people in the construction environment (Kendra and Taplin, 2004). Considering the sophisticated nature of the industry and the cultural values of the society, it made sense to assess companies' relationships not only with the client, but also with government agencies and labor unions. On this account, the communication and negotiating skills of company executives have to be stressed. But, the subtle difference between favoritism and the strength of relations has to be distinguished. Relationship strength in business is an important phenomenon in Confucian societies like China, Hong Kong, Taiwan, Japan and Korea. It is generally called "guanxi" which means "connection" in Chinese. While western societies regard "guanxi" as favoritism or nepotism,

Confucian societies regard it as an inevitable asset while doing business (Yeung and Tung, 1996). Turkey as a connection point between the west and the east carries both sides' characteristics. The findings certainly indicate that contractors' performance is enhanced by strong relationships in the Turkish setting.

The responsibility for developing beneficial relationships between the manual, salaried, and clerical work force in the construction industry were generically described as "industrial relations" and were found to be having the highest factor loading with a value of 0.776, under this construct. Industrial relations is important to the contractor in all areas of operation that dissatisfaction of labor unions may even cause the termination of a project. Barrie and Paulson (1992) state that, having good relationships with labor unions may bring some advantages such as a pool of skilled labor, fixed wages and uniform conditions through negotiations. Also, unions may stabilize their own members and may help control the actions of irresponsible contractors. Nevertheless, labor unions are also criticized with their restrictive work rules that decrease productivity, no incentive upon the individual worker to be innovative or productive since everyone gets the same pay and little loyalty to the employer, which results in less management opportunities for innovation and development of a team spirit to improve both production and work-life quality. Jurisdictional disputes are another disadvantage for the companies that can result in high damages even though there is no fault of the contractor.

7.5. Effect of project management competencies on performance

The influence of determinants that take a project to success or failure have been investigated by several researchers (e.g., Larson and Gobeli, 1989; Chua et al., 1999; Brown and Adams, 2000; Cooke-Davies, 2002; Chan et al., 2004), the majority of whom pointed out the importance of "project management competencies" among other criteria. Pinto and Mantel (1990) have also identified managerially controllable

factors as the causes of project failure. Jaselskis and Ashley (1991) have associated project management with the competencies of a project manager and suggested that the probability of success may depend on the optimal allocation of project management resources. Research on the linkage between project performance and company performance is limited but it can be assumed that in a project-based industry like construction there's a direct link between project and company performance (Cooke-Davies, 2002). Contrary to previous studies, the results of the current study revealed an *indirect* influence of "project management competencies" on company performance. It appears that "project management competencies" have a strong and direct effect on company "resources and capabilities" and "strategic decisions", which in turn affect positively company performance.

7.6. Effect of strategic decisions on performance

"Strategic decisions" was found to have a direct and almost similar influence on company performance with "resources and capabilities". Strategy is defined as a plan, pattern, position, perspective and ploy (Mintzberg et al., 1998). Its significant effect on performance is demonstrated empirically in the literature (Porter, 1980). Sun Tzu, in his famous "Art of War" which was written in the fourth century B.C. emphasizes the importance of strategy for success by stating: *"All men can see the tactics whereby I conquer, but what none can see is the strategy out of which victory is evolved"* (Sun Tzu, 2003). Emphasizing the importance of strategic decision, Child (1972) also states that companies can achieve higher organizational performance by adopting different competitive positioning alternatives based on strategic decisions. The strategic decision construct in the study was represented by eight constituent variables, all closely related to competition. What makes this latent variable in the model more prominent than the others is the increasingly competitive environment in the construction business. Since this factor in the model affects performance of a company

directly and as much as its resources and capabilities, disadvantages associated with strategic planning should also be considered as well as its advantages. According to Mintzberg et al. (1998), for every advantage of strategic planning there is also a disadvantage. Strategy sets direction for the course of actions of a company however if the direction is set upon a weak discretion, it would cause unintended consequences. Considering the variables with high factor loadings (e.g. project selection strategies-0.767, partner selection strategies-0.743) under this construct, it can be inferred that disadvantages of strategic decisions would cost to a construction company with huge financial damages. High loading values of "project management strategies" and "organizational management strategies" interpret that the coordination of activity is another advantage of strategic decision. If the coordination is not provided, chaos would follow this and the strategic focus would be scattered. Strategy provides the company to be defined more precisely so that the understanding of the organizational activities would be simpler. Increasing the understanding of "project and organizational management strategies" would also make the problem simpler. Considering the organization as a living organism, in this case, the complex structure would possibly lose its own unpredictable value. Nevertheless, ambiguity is an undesirable situation in business environment and consistency in an organization can only be provided by a regular strategic planning programme. The remarkable effect of "strategic decision" on "company performance" emphasizes the importance of strategic thinking and recommends managers to set up strategic plans for their organizations. However, creativity should never be disregarded and stereotyping should be avoided while setting up the control of activities according to a convenient strategic plan.

7.7. Effect of external factors on performance

The “external factors” were positioned in the model as the exogenous latent variable as being affected by none of the other factors but affecting all with direct or indirect relationships. It was designed of ten constituent variables which were related to the political, socio cultural, economical, legal conditions of the country where the project is operated as well as the competitiveness between the companies in the market. Demand, supply power and the client power were also deemed as the complementary variables of this latent variable as being important factors shaping the business environment.

According to the results of the analysis, “external factors” affect “project management competencies” with a path coefficient of 0.764 while it affects “strength of relationships with other parties” with a coefficient of 0.846. Its remarkable direct effect on both factors and indirect effects on other factors justify that without being able to handle with market conditions, neither project success can be accomplished nor company performance can be increased. “International relations” of a country has the potential to effect the “partner, project and market selections” of a company as well as its “investment strategies” through transforming its “project management competencies” into a decision making tool. “Macro economic and political conditions” require good relationships with the government so that bureaucratic barriers may be overcome in a chaotic economical or political environment. “Socio cultural conditions” of a country effects the performance of a project and a company in international projects where companies from different nations operate in a host country. The mutual understanding of the companies with the government and society of the host country should be provided such that it shouldn’t provoke the relationships with labor unions of the host country.

7.8. Overall discussion on the structural relations between the variables

Given the very strong path coefficients, the hypothesis set forward in this study appears to have held. Not only do “resources and capabilities” and “strategic decisions” have a direct impact on company performance, but “project management competencies”, “strength of the relationship with other parties” and the “external factors” also appear to have an indirect impact on company performance.

Based on the findings of this study, it can be concluded that, this research has been introduced a method to measure performance both in the subjective (qualitative) and the objective (quantitative) terms. The strong path coefficients between the constructs of the model are an indication that, after decades in pursuit of finding ways to improve the performance of construction companies, subjective dimensions of performance have proven to be as effective as the traditional objective dimensions.

CHAPTER 8

CONCLUSIONS

Globalisation brought more capacity and resources to construction companies, expanded the market areas, variety of projects and partners and thereby increased a major driver of improvement called competitiveness. However, as a result of globalisation, unexpected economical fluctuations both in national and global level including unforeseen difficulties and risks brought also threats to construction companies as well as the opportunities. Consequently, performance measurement and management of companies and projects as a strategic decision making tool became an important subject of interest during the last decades. It became an integral part of planning and controlling of organizations (Neely, 1999).

Neely (1998) asserted that managers measure performance for two main reasons; one to influence the subordinate's behavior and second to know their current position in the market. Thus performance measurement assists the managers to move towards the correct direction, to revise the business goals and to reengineer the business process if needed (Kuwaiti and Kay, 2000; Van Hoek, 1998). A study carried out by Martinez, 2005) revealed positive effects from performance measurement such as improved customer satisfaction and company image, increased productivity and business improvement. Considering these, it can be said that performance measurement is important for companies to evaluate its actual objectives against the predefined goals and to make sure that they are doing well in the competitive environment.

Despite the fact that, performance measurement has numerous benefits to the companies, Halachmi (2002) asserted that sometimes the cost of introducing and implementing performance measurement exceeded the potential benfits of it. Martinez

(2005) also experienced similar results and was revelaed that the use of complicated performance measures has created negative effects due to the considerable consumption of time, investments, and the commitment of people. Further in some occasions the use of PM systems have limited the freedom of managers due to its rigidity. It appears that the use of performance measurement sytems have both negative and positive effects on the company but in the mean time it can easily be argued that the solution is not to avoid the use of performance measurement systems but to design and materialize a system of which measures and indicators of performance are properly selected with a comprehensive review of the literature and the judgements of the industry professionals.

Hence, considering the needs of the industry and the potential benefits, a performance measurement model including five latent variables, namely "resources and capabilities", "strength of relationships with other parties", "project management competencies", "strategic decisions" and "external factors" were determined to evaluate the "company performance" and the "project performance". All latent variables had their constituent variables with a total numer of 44 variables.

In order to collect information about those mentioned seven latent variables and their constituent 44 variables, a questionnaire survey was administered to 73 construction companies, a majority of which were the members of TCA and TCEA and established in Turkey. With this purpose, importance level of the variables and their extent to be used in the companies were asked (in a 1-5 Likert scale) to the respondents who were at the managerial level of those companies. The questions of the survey related to the "project performance" variable was also asked for the projects that were held within at most last five years working period of the companies and data related to 354 projects held by respondent companies were acquired as well.

Statistically analysing the general information on the 73 respondent companies, it was seen that the average age was 30 with an average total turnover of $562,304,369

($284, 224, 989 in domestic and $287,206,983 in international markets) considering the last five years of operation. Average number of countries that these companies operated in was 7.25. They were specialized mainly on buildings (82%), transport (70%), infrastructure (65%), hydraulic (47%) and industrial (0.47%) construction. The market distribution of the companies were divided into three groups which were, construction (62%); construction and construction related (8%); construction, construction related and construction unrelated (31%).

- Information statistically analysed related to the characteristics of the respondent companies justified their reliability taking into consideration their long term stable structure and success in the construction industry.

Data collected from the companies were analysed using a statistical technique called Structural Equation Modeling (SEM) to examine the validity of the measures and to construct valid interrelationships within the measures and the indicators of the model. Eventually, a performance measurement model was specified showing the interrelationships and their path coefficients between the predetermined measures of performance. Hypotheses which were set at the beginning of the study were therefore validated. The major findings of the research were in line with the aforementioned hypotheses.

- A model consisting of seven constructs were designed in order to understand their role in performance measurement. Validity of the constructs and the constituent variables were verified with content and construct validity testings. The final model which has a potential to be used in construction companies is extremely close to the needs and the requirements of the industry as all

redundant measures were eliminated and the mostly used and proper ones were added as measures and the indicators. Traditional quantitative performance measures were reduced and the qualitative measures of contemporary construction performance measurement were put forward as demanded by current managerial status of the companies. Analysis results also verified the validity of the constructs.

- "Resources and capabilities" construct of the model has a direct effect on "project performance" and "company performance". This finding revealed that, there is no point in making elaborate plans if the resources in the form of both tangible and intangible assets are not there to supply them. Considering the factor loadings of the constructs, "innovation capability" and "research and development capability" were found to be more prominent than the other variables which justified the fact that adaptation of a company to the challenging nature of the business environment and improving technological requirements was extremely essential.

  To cope with these challenges, it is essential to transform the construction output in an economically, socially, and environmentally acceptable manner by raising "innovation capability". In this regard "research and development" plays a key role to raise the profile of the construction industry. Innovatively effective and efficient construction processes, advance technologies and managerial structures would satisfy the requirements of the stakeholders. Further, successful implementations of "research and development" and "innovation" activities create the opportunity for the construction organizations to be competitive in the international market.

  Despite the importance of "research and development" and "innovation" for the construction industry, there are number of issues which hinder their

successfulness. Evaluation of the successfulness of research activities, effective coordination of research activities can be identified as vital factors for successful "research and development" activities. Moreover, other resources and capabilities of a company such as "technical competency", "financial resources" and assembling of skilled people under a successful "leadership" frame should also be in line with research and development activities. Better performance results both in project and company level rely on management built on a confident team lead by a good manager. In order to refer to "leadership" skills, managers should be people of experience, understanding and vision, confidence to take responsibility, stand by decisions and instill discipline (Harris and McCaffer, 2001).

- It was also stated before that companies can achieve higher performance by adopting different competitive positioning alternatives based on strategic decisions (Child, 1972). Higher factor loadings of the construct interpret that competitive positioning of a company is mostly effected by "project" and "partner" selection strategies respectively. A company should evaluate its proficiency in "resources and capabilities" as well as "project management competencies" while attempting to operate a project. Otherwise it is inevitable to face with fail. Besides, as a matter of fact, complex projects such as power stations, airports, oil refineries etc. are difficult to manage in total also for large size companies. As a result, partnering of companies emerges as a solution for those kinds of complex projects. Partnering, while lowering costs and improving efficiency, reduce delays and ensure completion of projects on time within budget and in required quality. However making such a strategic arrangement brings its threats as well as the opportunities. The conflicts could eventually emerge concerning strategy and management style if a partner

financially unstable or less capable in project management activities is selected. Moreover, even during partnering, controlling and monitoring of risks and levels of commitments of each parties, together with establishing business and management relations would be essential for the sustainability of the partnering.

Another prominent variable which is effective on performance is "project management strategies". It reveals that a challenging but achievable project management strategy in line with resources and capabilities should be established by the company to form a systematic control of the activities.

- The analysis of the current study pointed out the considerable impact of "strength of relationships" on "resources and capabilities" and also the indirect impact on "project performance" and "company performance" as well. Positive influence of strong relationships was discussed and confirmed also in the literature (Hausman, 2001; Pinto and Mantel, 1990; Dissanayaka and Kumaraswamy; 1999; Dainty et al., 2003). Strength of the relationships between the contractor and the client facilitate the operations and help to achieve better performance which means that "strength of relationships" with other parties in a project environment can be considered as a prerequisite for the effective use of "resources and capabilites".

- Even though most researchers associate project management competencies directly with company performance, it was found that, "project management competencies" enhance company capabilities such as "finances" through "profitable-projects", "leadership" and "company image" through successful project performance and "technical competency" and corporate "experience"

through the exercise of project management expertise. Moreover, the results of the analysis indicated that, “Project management competencies” enhance “strategic decisions” such as “differentiation” and “market/project selection” strategies through appropriate “knowledge management” obtained from a variety of projects; and “organizational management strategies” through unified “claims management” and “supply chain management” across projects.

- “Macro-economic” and “political conditions” of a country influence a government’s policy on its investments for government funded construction projects. On the other hand, considering the Turkish setting, the findings certainly indicate the influence of strong relationships on performance. Integrating those two findings of the survey, it can easily be inferred that external factors such as “international relations” and “socio cultural conditions” enhances the performance of project and a company indirectly, effecting the strength of relationships with the government of the host country thereby lowering the bureaucracy and eliminating causes related to “legal conditions”.

  The positive correlation between the “client power” and the “strength of relationship of the contractor with the client” is another certain fact which can be deduced from the findings.

  Moreover “competitiveness” in the environment has a great effect on companies to raise their performance through enhancing their relationships with the client, government and with labor unions as well. “Socio-cultural conditions of a country” as being the factor with the highest loading under “external factors” construct, enhances “long term contributions of the project to the company” and “learning and growth perspectives” through “strategic decisions” such as “market and project selection” considering the cultural

proximity of the host country and increasing the efficiency of project management competencies.

- Construction is an industry which assembles separate companies in a temporary multidisciplinary organization, to produce utilities like buildings, roads, bridges, etc. In this regard, construction companies are project based organizations and it is not far-fetched to argue that "project performance" has a direct effect on "company performance". Therefore, it was decided to evaluate the effects of "project performance" measures such as project profitability, client/user satisfaction and long term contributions of the project to the company, on "company performance" perspectives such financial, learning and growth, internal business and customer in a separate model. Highly satisfactory and reliable findings of the analysis verified this approach. The results provided a synopsis of performance concept for construction industry and extrapolated the major aim of the thesis set at the very beginning of the research as the investigation of a contemporary performance measurement model designed to highlight the significance of qualitative measures among quantitative ones.

  The prominent highlights of the model were the effects of client/user satisfaction on the performance regarding the customer perspective and project profitability corresponding to financial perspective. The emphasis in internal business perspective is the identification and measuring of the processes that organizations must excel at to meet organizational and client/user expectations which lead to achieving their profitability and satisfaction goals.

  "Long term contributions of the project to the company" was distinguished above other factors such as "profitability" by having the highest factor loading under project performance construct likewise "learning and growth

perspective" exceeded "financial perspective" under "company performance". The growth is the improvement of the company's size through a long term period. Drucker (1994) describes growth as a successful outcome, which provides the market demands, uses economic and effective resources, creates profit for expansion, and manages future risks. In this regard, long term constributions of a project can only be acquired by effectively using the intangible factors depicted in the proposed model such as under "resources and capabilities", "external factors", "strength of relationships with other parties", "project management competencies" and "strategic decisions" constructs.

The major findings of the research indicated that, construction industry is conceived to the new challenges of business environment in the pursuit of success and there is a considerable change in the perceptions of the construction companies. Traditional criteria of success such as finance and profitability which are short term yielded to long term strategic factors of success such as research and development activities, innovation capabilities, organizational learning, customer satisfaction thereby long term contributions of the individual projects to enhance the performance perspectives which have the ability to provide sustainability to the companies. The performance measurement model designed by the optimization of the industry professionals' experiences with an extensive literature review was verified by the analysis of the data. Hence, a comprehensive and valid performance measurement tool was provided for construction companies to assess not only their current performance in means of retrospective terms but also to assess their future performance by prudential success factors which lead them to set strategies in the long term.

The proposed performance measurement tool extrapolates the "resources and capabilities" and "project management competencies" that the company will need to innovate and enhance its "learning and growth"; determine significant threats and

opportunities of the business environment in the “external factors” and “strength of relationships with other parties” and build the right “strategic decisions” that add value which will eventually lead to higher “customer satisfaction” and financial shareholder value for the company.

Suggestions for further research

The suggestions for future research can be split into two groups: those concerning the use of the data acquired from the companies in producing new knowledge of performance measures and indicators and those concerning the use of the measurement system.

The proposed model was designed corresponding to the requirements of the current business environment. However, the requirements of a competitive business environment such as construction industry change so fast. Thus, in the future, the investigation of performance measures may be maintained constantly and updated to catch new developments. Moreover rejudging the relations between the factors performance model may be redesigned according to up to date information.

Questionnaire survey was admisitered to companies established in Turkey therefore perceptions of only Turkish companies were acquired. The conclusions of the research may be tested in different countries than Turkey and a more global view of the performance requirements of construction companies in practice may be determined. Adoption of a global mode may be lack of local requirements specific to each country, nevertheless a globally homogenised and mobile model may be designed responding to the requirements of different countries’ market environment.

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APPENDIX A

A SAMPLE OF THE QUESTIONNAIRE

CONTENT

1. PERFORMANCE MEASUREMENT SYSTEM FOR CONSTRUCTION COMPANIES

Within the context of a PhD thesis held in Construction Management and Engineering Division of Civil Engineering Department in Middle East Technical University, a system to measure the performance of construction companies is going to be developed. The major objective of the study is to create a performance database for Turkish construction companies by verifying the validity of the preassumed measures and the indicators.

The proposed performance measurement system is composed of 7 parameters along with their 44 sub-parameters. It is assumed that, those parameters which have the tendency to influence performance are, “resources and capabilities”, “the strength of

relationship with other parties", "project management competencies", "strategic decisions", "external factors", "project performance" and "company performance".

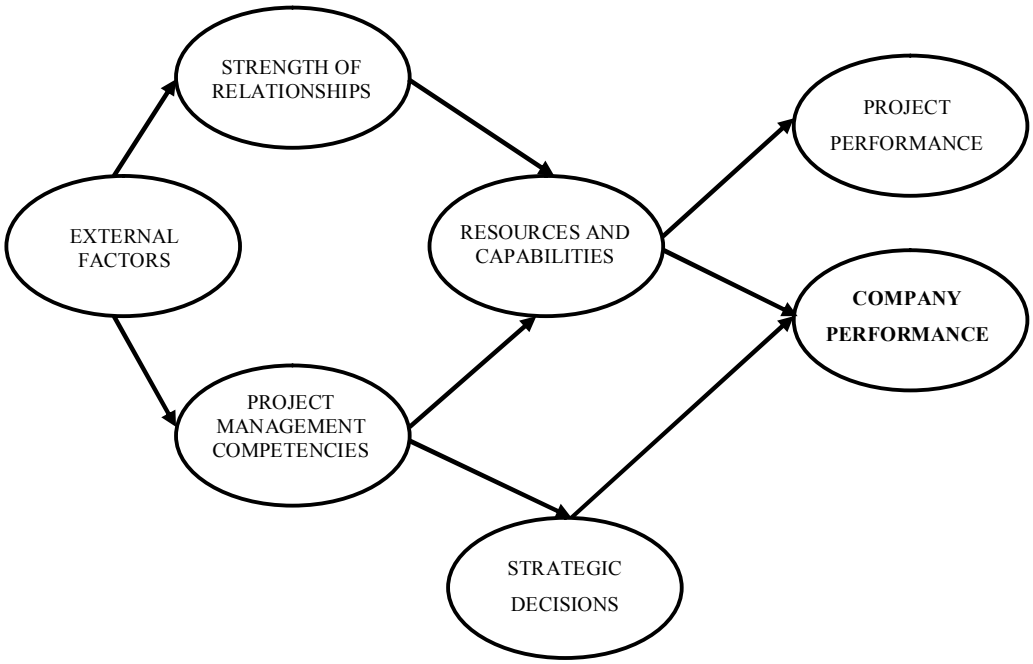

Figure A.1 Performance measurement framework

2. GENERAL INFORMATION ABOUT THE QUESTIONNAIRE

While responding, please aware that;

- Check the related most appropriate box ☒ for multiple choice questions.
- Questions will be answered in a 1 to 5 Likert Scale. The meaning of the numbers in the Likert Scale should be considered as:
  - 1: Very low
  - 2: Low

- 3: Average
- 4: High
- 5: Very high.

All information given by the companies will be kept confidential and used for academic issues only. Thereof, within the context of the questionnaire, names of the companies were not asked.

3. GENERAL INFORMATION ABOUT THE COMPANIES

1. Please state the number of years that your company has been in the construction sector..... year.
2. Please state the areas of expertise of your company (you may have more than one choice).

Buildings (Housing, touristic facilities, trade centers, social and cultural facilities, hospitals, military facilities, universities, government buildings etc.)	☐
Transport (Highway, tunnel, bridge, railway, seaport, airport, etc.)	☐
Infrasturcture (City infrastructure, water and waste water facilities, pipelines, etc.)	☐
Hydraulic structures (Dams, irrigation systems.)	☐
Industrial buildings (Industrial plants, power stations, petrochemical plants, refinery, telecommunication, energy transportation lines etc.)	☐
Other (please state).....	

3. Please state your company's domestic turnover over the last 5 years by the end of 2006.....US Dollars.
4. Please state your company's international turnover over the last 5 years by the end of 2006..... US Dollars.
5. Please state your company's market areas.

Construction	☐
Construction + Construction related (ready made concrete, iron-steel, mould-scaffolding etc.)	☐
Construction+ Construction related + Construction unrelated sectors (finance, tourism etc.)	☐

6. Please state the number of different countries your company has operated over the last 5 years (Turkey excluded).....countries.

4. RESOURCES AND CAPABILITIES

QUESTION

Impact: What is the level of impact of sub-parameters under "Resources and capabilites" on the success of a construction company?

Performance level: What is the extent the parameters are realized by your company?

(Please consider your closest rivals while stating.)

RESOURCES AND CAPABILITIES	Impact					Performance Level				
	1	2	3	4	5	1	2	3	4	5
Financial resources	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Technical competency	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Leadership	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Experience	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Company image	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Research and development capability	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Innovation capability	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Assess your company's performance considering its "resources and capabilites".	Total performance level				
	1	2	3	4	5
	☐	☐	☐	☐	☐

5. STRENGTH OF RELATIONSHIPS WITH OTHER PARTIES

QUESTION

Impact: What is the level of impact of sub-parameters under "Strength of relationships with other parties" on the success of a construction company?

Performance level: What is the extent the parameters are realized by your company?

(Please consider your closest rivals while stating.)

STENGTH OF RELATIONSHIPS	**Etkisi**					**Performans Düzeyi**				
	1	2	3	4	5	1	2	3	4	5
Relations with client	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Relations with government	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Relations with labor unions	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Assess your company's performance considering its "strenth of relationships with other parties".	**Total performance level**				
	1	2	3	4	5
	☐	☐	☐	☐	☐

6. PROJECT MANAGEMENT COMPETENCIES

QUESTION

Impact: What is the level of impact of sub-parameters under "Project management competencies" on the success of a construction company?

Performance level: What is the extent the parameters are realized by your company?

(Please consider your closest rivals while stating.)

PROJECT MANAGEMENT COMPETENCIES	Impact					Performance level				
	1	2	3	4	5	1	2	3	4	5
Schedule management competency	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Cost management competency	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Quality management competency and certification	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Human resources management competency	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Project risk management competency	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Project procurement management competency	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Claims management	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Project knowledge management competency	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Health and safety management competency	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Assess your company's performance considering its "project management competencies".	Total performance level				
	1	2	3	4	5
	☐	☐	☐	☐	☐

7. STRATEGIC DECISIONS

QUESTION

Impact: What is the level of impact of sub-parameters under "Strategic decisions" on the success of a construction company?

Performance level: What is the extent the parameters are realized by your company?

(Please consider your closest rivals while stating.)

STRATEGIC DECISIONS	**Etkisi**					**Performans Düzeyi**				
	1	2	3	4	5	1	2	3	4	5
Differenatiaiton strategy	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Market selection strategies	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Project selection strategies	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Client selection strategies	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Partner selection strategies	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Project management strategies	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Investment decisions	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Organizational management strategies	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Assess your company's performance considering its "strategic decisions".	**Total performance level**				
	1	2	3	4	5
	☐	☐	☐	☐	☐

8. EXTERNAL FACTORS

QUESTION

Impact: What is the level of impact of sub-parameters under "External factors" on the success of a construction company?

Direction of impact: If your company effected positively, please put (+) sign, if effected negatively (-) sign, if not effected at all, then sign as (0).

Performance level: What is the extent the parameters are realized by your company?

(Please consider your closest rivals while stating.)

EXTERNAL FACTORS	Impact					Direction			Performance level				
	1	2	3	4	5	+	-	0	1	2	3	4	5
International relations	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Macro-economic conditions	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Political conditions	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Socio-cultural conditions	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Legal conditions	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Intense rivalry between companies	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
New entrants to the market	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Supply power	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Client power	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Demand	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Assess your company's performnce considering its behaviour to "external factors".	Total performance level				
	1	2	3	4	5
	☐	☐	☐	☐	☐

9. PROJECT PERFORMANCE

QUESTION

Project size: Please choose a number of projects, through the projects that your company held during the last 5 years, then state their size in terms of their financial impacts on the company.

PROJECT	SCALE				
	small	small-medium	medium	medium-large	large
A	☐	☐	☐	☐	☐
B	☐	☐	☐	☐	☐
C	☐	☐	☐	☐	☐
D	☐	☐	☐	☐	☐
E	☐	☐	☐	☐	☐
F	☐	☐	☐	☐	☐
G	☐	☐	☐	☐	☐
H	☐	☐	☐	☐	☐
I	☐	☐	☐	☐	☐
J	☐	☐	☐	☐	☐

QUESTION

Impact: What is the level of impact of sub-parameters under "Project performance" on the success of a construction company?

PROJECT PERFORMANCE	Impact				
	1	2	3	4	5
Project profitability	☐	☐	☐	☐	☐
Client / user satisfaction	☐	☐	☐	☐	☐
Long-term contributions of the project to the company	☐	☐	☐	☐	☐

QUESTION

Performance level: Considering the project of your company (over the last 5 years) that you have chosen in the previous question, what is the extent the parameters are realized by your company?

PROJECT	Performance level														
	Project profitability					Client / user satisfaction					Long-term contributions of the project to the company				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
A	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
B	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
C	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
D	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
E	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
F	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
G	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
H	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
I	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
J	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Considering the projects that your company held over the last 5 years, asesss the project performnece in general.	**Total performance level**				
	1	2	3	4	5
	☐	☐	☐	☐	☐

10. COMPANY PERFORMANCE

The Balanced Scorecard Technique: The BSC is a management system (not only a measurement system) that enables organizations to clarify their vision and strategy and translate them into action. It provides feedback around both the internal business processes and external outcomes in order to continuously improve strategic performance and results. When fully deployed, the BSC transforms strategic planning from an academic exercise into the nerve center of an enterprise.

The BSC provides managers assess their company's perfromance from four different perspectives which are, finacial perspective, learning and growth perspective, internal business perspective and customer perspective.

QUESTION

Impact: What is the level of impact of the balanced scorecard perspectives on the performance measurement of a construction company?

Performance level

1.Financial perspective: How do we look to our shareholders?

2.Learning and growth perspective: Can we continue to improve and create value?

3.Internal business perspective: What must we excel at?

4.Customer perspective: How do customers see us?

COMPANY PERFORMANCE	Impact					Performance Level				
	1	2	3	4	5	1	2	3	4	5
Financial perspective	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Learning and growth perspective	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Internal business perspective	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Customer perspective	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Assess your COMPANY PERFORMANCE in general.	Total performance level				
	1	2	3	4	5
	☐	☐	☐	☐	☐

APPENDIX B

DESCRIPTIVE STATISTICS

Table B.1 Descriptive statistics of general information on respondent companies

Descriptive Statistics	Age (years)	Domestic turnover ($)	International turnover ($)	Total turnover ($)	Number of countries operated
Mean	30.5342	284224989.2	287206983	562304369.4	7.2466
Sum	2229	20748424210	20966109759	41048218969	529
Sum of square	36172.1644	9.51727E+18	2.06809E+19	4.2917E+19	21007.5616
St.dev.	22.4141	363571618.8	535942477.2	772055432.5	17.0813
Median	30	160000000	50000000	235000000	4
One quartile	16	55000000	20000000	81833136	2
Three quartile	40	300000000	250000000	740000000	7
Minimum	1	4000000	5000000	0	0
Maximum	172	1700000000	3000000000	3225000000	107
Range	171	1696000000	2995000000	3225000000	107
Skewness	3.4319	1.9983	2.8811	2.0356	5.3933
Kurtosis	19.823	3.5195	9.1798	3.566	28.4921

Table B.2 Descriptive statistics of "Resources and Capabilities" construct regarding "importance".

Descriptive Statistics	V1	V2	V3	V4	V5	V6	V7
Mean	4.21	4.82	4.14	4.71	4.12	3.53	3.55
Sum	307.00	352.00	302.00	344.00	301.00	258.00	259.00
Sum of square	53.92	18.68	66.63	22.96	65.89	78.16	86.08
St.dev.	0.87	0.51	0.96	0.56	0.96	1.04	1.09
Median	4.00	5.00	4.00	5.00	4.00	4.00	4.00
One quartile	4.00	5.00	3.00	5.00	4.00	3.00	3.00
Three quartile	5.00	5.00	5.00	5.00	5.00	4.00	4.00
Minimum	2.00	3.00	2.00	3.00	1.00	2.00	1.00
Maximum	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Range	3.00	2.00	3.00	2.00	4.00	3.00	4.00
Skewness	-0.80	-2.81	-0.75	-1.82	-0.92	-0.02	-0.38
Kurtosis	-0.25	6.71	-0.59	2.28	0.32	-1.16	-0.52

Table B.3 Descriptive statistics of “Resources and Capabilities” construct regarding “rating”.

Descriptive Statistics	V1	V2	V3	V4	V5	V6	V7
Mean	3.92	4.12	3.71	4.11	3.88	3.37	3.38
Sum	286.00	301.00	271.00	300.00	283.00	246.00	247.00
Sum of square	51.51	49.89	64.96	55.12	75.89	69.01	69.26
St.dev.	0.85	0.83	0.95	0.88	1.03	0.98	0.98
Median	4.00	4.00	4.00	4.00	4.00	3.00	3.00
One quartile	3.00	4.00	3.00	4.00	3.00	3.00	3.00
Three quartile	5.00	5.00	4.00	5.00	5.00	4.00	4.00
Minimum	2.00	2.00	1.00	1.00	1.00	2.00	1.00
Maximum	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Range	3.00	3.00	4.00	4.00	4.00	3.00	4.00
Skewness	-0.26	-0.52	-0.38	-0.84	-0.68	0.19	-0.38
Kurtosis	-0.74	-0.62	-0.31	0.69	-0.01	-0.94	-0.13

Table B.4 Descriptive statistics of "Strength of relationships with other parties" construct regarding its "importance" and "rating".

Descriptive Statistics	V8		V9		V10	
	importance	**rating**	**importance**	**rating**	**importance**	**rating**
Mean	4.25	3.84	3.74	3.29	3.93	3.27
Sum	310.00	280.00	273.00	240.00	287.00	239.00
Sum of square	53.56	58.03	82.05	80.96	84.66	74.52
St.dev.	0.86	0.90	1.07	1.06	1.08	1.02
Median	4.00	4.00	4.00	3.00	4.00	3.00
One quartile	4.00	3.00	3.00	3.00	3.00	3.00
Three quartile	5.00	4.00	5.00	4.00	5.00	4.00
Minimum	2.00	2.00	1.00	1.00	1.00	1.00
Maximum	5.00	5.00	5.00	5.00	5.00	5.00
Range	3.00	3.00	4.00	4.00	4.00	4.00
Skewness	-0.89	-0.37	-0.43	-0.31	-0.52	0.07
Kurtosis	-0.09	-0.62	-0.77	-0.54	-0.82	-0.26

Table B.6 Descriptive statistics of "Project management competencies" construct regarding its "importance".

Descriptive Statistics	V11	V12	V13	V14	V15	V16	V17	V18	V19
Mean	4.42	4.33	4.64	3.92	4.05	4.11	4.05	4.22	4.18
Sum	323.00	316.00	339.00	286.00	296.00	300.00	296.00	308.00	305.00
Sum of square	53.84	58.11	34.74	69.51	75.78	61.12	75.78	64.49	72.68
St.dev.	0.86	0.90	0.69	0.98	1.03	0.92	1.03	0.95	1.00
Median	5.00	5.00	5.00	4.00	4.00	4.00	4.00	5.00	5.00
One quartile	4.00	4.00	5.00	3.00	3.00	3.00	3.00	4.00	3.00
Three quartile	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Minimum	2.00	2.00	2.00	2.00	1.00	2.00	2.00	1.00	2.00
Maximum	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Range	3.00	3.00	3.00	3.00	4.00	3.00	3.00	4.00	3.00
Skewness	-1.32	-1.04	-1.90	-0.37	-0.65	-0.54	-0.65	-1.04	-0.86
Kurtosis	0.68	-0.10	2.77	-1.02	-0.54	-0.91	-0.84	0.52	-0.55

Table B.7 Descriptive statistics of "Project management competencies" construct regarding its "rating".

Descriptive Statistics	V11	V12	V13	V14	V15	V16	V17	V18	V19
Mean	3.79	3.81	3.81	3.47	3.41	3.60	3.58	3.86	3.74
Sum	277.00	278.00	278.00	253.00	249.00	263.00	261.00	282.00	273.00
Sum of square	53.92	61.32	67.32	62.16	51.67	55.48	71.84	58.63	76.05
St.dev.	0.87	0.92	0.97	0.93	0.85	0.88	1.00	0.90	1.03
Median	4.00	4.00	4.00	3.00	3.00	4.00	4.00	4.00	4.00
One quartile	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Three quartile	4.00	4.00	5.00	4.00	4.00	4.00	4.00	5.00	5.00
Minimum	2.00	1.00	2.00	2.00	1.00	2.00	2.00	1.00	2.00
Maximum	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Range	3.00	4.00	3.00	3.00	4.00	3.00	3.00	4.00	3.00
Skewness	-0.11	-0.47	-0.35	0.10	-0.06	0.12	-0.08	-0.41	-0.31
Kurtosis	-0.82	-0.08	-0.85	-0.83	0.67	-0.78	-1.04	-0.08	-1.03

Table B.7 Descriptive statistics of "Strategic decisions" construct regarding its "importance".

Descriptive Statistics	V20	V21	V22	V23	V24	V25	V26	V27
Mean	4.25	4.18	4.44	3.93	4.36	4.34	4.04	3.92
Sum	310.00	305.00	324.00	287.00	318.00	317.00	295.00	286.00
Sum of square	55.56	50.68	47.97	64.66	70.74	52.44	72.88	91.51
St.dev.	0.88	0.84	0.82	0.95	0.99	0.85	1.01	1.13
Median	5.00	4.00	5.00	4.00	5.00	5.00	4.00	4.00
One quartile	4.00	4.00	4.00	3.00	4.00	4.00	3.00	3.00
Three quartile	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Minimum	2.00	2.00	2.00	1.00	2.00	2.00	1.00	1.00
Maximum	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Range	3.00	3.00	3.00	4.00	3.00	3.00	4.00	4.00
Skewness	-0.75	-0.77	-1.27	-0.55	-1.36	-0.99	-0.82	-0.60
Kurtosis	-0.66	-0.09	0.63	-0.17	0.56	-0.16	-0.06	-0.63

Table B.8 Descriptive statistics of "Strategic decisions" construct regarding its "rating".

Descriptive Statistics	V20	V21	V22	V23	V24	V25	V26	V27
Mean	3.70	3.73	3.86	3.73	3.67	3.78	3.68	3.45
Sum	270.00	272.00	282.00	272.00	268.00	276.00	269.00	252.00
Sum of square	49.37	52.52	46.63	56.52	82.11	48.49	59.75	72.08
St.dev.	0.83	0.85	0.80	0.89	1.07	0.82	0.91	1.00
Median	4.00	4.00	4.00	4.00	4.00	4.00	4.00	3.00
One quartile	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Three quartile	4.00	4.00	4.00	4.00	5.00	4.00	4.00	4.00
Minimum	2.00	2.00	2.00	1.00	1.00	2.00	1.00	1.00
Maximum	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Range	3.00	3.00	3.00	4.00	4.00	3.00	4.00	4.00
Skewness	-0.13	-0.25	-0.23	-0.40	-0.28	-0.19	-0.45	-0.08
Kurtosis	-0.54	-0.53	-0.52	0.07	-0.88	-0.53	-0.05	-0.39

Table B.9 Descriptive statistics of “External factors” construct regarding its “importance”.

Descriptive Statistics	V28	V29	V30	V31	V32	V33	V34	V35	V36	V37
Mean	3.78	4.00	3.60	2.93	3.74	4.03	3.37	3.75	3.99	4.26
Sum	276.00	292.00	263.00	214.00	273.00	294.00	246.00	274.00	291.00	311.00
Sum of square	82.49	64.00	89.48	76.66	82.05	51.95	93.01	59.56	46.99	36.05
St.dev.	1.07	0.94	1.11	1.03	1.07	0.85	1.14	0.91	0.81	0.71
Median	4.00	4.00	4.00	3.00	4.00	4.00	3.00	4.00	4.00	4.00
One quartile	3.00	3.00	3.00	2.00	3.00	4.00	3.00	3.00	4.00	4.00
Three quartile	5.00	5.00	4.00	3.00	5.00	5.00	4.00	4.00	5.00	5.00
Minimum	1.00	2.00	0.00	1.00	1.00	1.00	1.00	2.00	2.00	3.00
Maximum	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Range	4.00	3.00	5.00	4.00	4.00	4.00	4.00	3.00	3.00	2.00
Skewness	-0.72	-0.50	-0.81	0.06	-0.71	-0.87	-0.13	-0.39	-0.45	-0.41
Kurtosis	0.03	-0.79	0.68	-0.12	0.00	1.11	-0.89	-0.58	-0.29	-0.93

Table B.10 Descriptive statistics of "External factors" construct regarding its "rating".

Descriptive Statistics	V28	V29	V30	V31	V32	V33	V34	V35	V36	V37
Mean	3.68	3.92	3.55	2.84	3.66	3.96	3.27	3.64	3.92	4.19
Sum	269.00	286.00	259.00	207.00	267.00	289.00	239.00	266.00	286.00	306.00
Sum of square	75.75	63.51	82.08	64.03	76.44	52.88	84.52	54.74	43.51	35.32
St.dev.	1.03	0.94	1.07	0.94	1.03	0.86	1.08	0.87	0.78	0.70
Median	4.00	4.00	4.00	3.00	4.00	4.00	3.00	4.00	4.00	4.00
One quartile	3.00	3.00	3.00	2.00	3.00	4.00	2.00	3.00	3.00	4.00
Three quartile	4.00	5.00	4.00	3.00	4.00	5.00	4.00	4.00	4.00	5.00
Minimum	1.00	2.00	0.00	1.00	1.00	1.00	1.00	2.00	2.00	3.00
Maximum	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Range	4.00	3.00	5.00	4.00	4.00	4.00	4.00	3.00	3.00	2.00
Skewness	-0.66	-0.44	-0.88	-0.07	-0.66	-0.86	-0.10	-0.38	-0.39	-0.28
Kurtosis	0.16	-0.74	1.01	0.08	0.09	1.02	-0.78	-0.49	-0.15	-0.93

Table B.11 Descriptive statistics of "Project performance" construct regarding its "importance" and "rating".

Descriptive Statistics	V38		V39		V40	
	importrance	rating	importance	rating	importance	rating
Mean	3.90	2.71	4.92	3.22	4.42	3.03
Sum	284.51	198.00	359.20	235.00	322.78	221.00
Sum of square	130.39	68.96	16.54	70.49	89.93	73.95
St.dev.	1.35	0.98	0.48	0.99	1.12	1.01
Median	5.00	3.00	5.00	3.00	5.00	3.00
One quartile	2.60	2.00	5.00	2.00	5.00	2.00
Three quartile	5.00	3.00	5.00	4.00	5.00	4.00
Minimum	1.20	1.00	1.80	1.00	1.35	1.00
Maximum	5.00	5.00	5.00	5.00	5.00	5.00
Range	3.80	4.00	3.20	4.00	3.65	4.00
Skewness	-0.60	0.60	-5.89	0.07	-1.63	0.19
Kurtosis	-1.26	-0.20	33.08	-0.87	1.03	-0.60

Table B.12 Descriptive statistics of "Company performance" construct regarding its "importance".

Descriptive Statistics	V41	V42	V43	V44
Mean	4.73	4.67	4.32	4.71
Sum	345.00	341.00	315.00	344.00
Sum of square	28.52	38.11	59.75	28.96
Standard deviation	0.63	0.73	0.91	0.63
Median	5.00	5.00	5.00	5.00
One quartile	5.00	5.00	4.00	5.00
Three quartile	5.00	5.00	5.00	5.00
Minimum	3.00	2.00	2.00	2.00
Maximum	5.00	5.00	5.00	5.00
Range	2.00	3.00	3.00	3.00
Skewness	-2.08	-2.25	-0.99	-2.32
Kurtosis	2.76	4.19	-0.25	4.96

Table B.13 Descriptive statistics of "Company performance" construct regarding its "rating".

Descriptive Statistics	V41	V42	V43	V44
Mean	3.78	3.74	3.51	3.81
Sum	276.00	273.00	256.00	278.00
Sum of square	44.49	46.05	46.25	47.32
Standard deviation	0.79	0.80	0.80	0.81
Median	4.00	4.00	4.00	4.00
One quartile	3.00	3.00	3.00	3.00
Three quartile	4.00	4.00	4.00	4.00
Minimum	2.00	2.00	2.00	2.00
Maximum	5.00	5.00	5.00	5.00
Range	3.00	3.00	3.00	3.00
Skewness	-0.11	0.01	-0.02	-0.11
Kurtosis	-0.51	-0.65	-0.45	-0.65

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PUBLICATIONS

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