SUDAN UNIVERSITY OF SCIENCE & TECHNOLOGY

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Designing an integrated performance measurement framework for the Sudanese construction industry

تصميم الاطار المتكامل لقياس الاداء في صناعة التشييد السودانية

A THESIS SUBMITTED TO THE COLLEGE OF GRADUATE STUDIES OF THE SUDAN UNIVERSITY OF SCIENCE AND TECHNOLOGY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY (PhD) IN CIVIL ENGINEERING

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Declaration

I, the signing here-under, declare that I'm the sole author of the Ph.D. thesis entitled Designing an integrated Performance measurement framework for the Sudanese Construction industry which is an original intellectual work. Willingly, I assign the copy-right of this work to the College of Graduate Studies (CGS), Sudan University of Science & Technology (SUST). Accordingly, SUST has all the rights to publish this work for scientific purposes.

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إقرار

أنا الموقع أدناه أقر بأننى المؤلف الوحيد لرسالة الدكتوراه المعنونة تصميم الإطار المتكامل لقياس الأداء في صناعة التشييد السودانية

وهى منتج فكري أصيل . وباختياري أعطى حقوق طبع ونشر هذا العمل لكلية الدراسات العليا جامعه السودان للعلوم والتكنولوجيا ،عليه يحق للجامعه نشر هذا العمل للأغراض العلمية .

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DEDICATION

To my mother that breast me a life

To my wife that gives my life a meaning

ABSTRACT

This study investigates within the context of this research; interdependencies between construction organization's "resources", "project management capabilities", "strategic decisions", "strength of relationships with other parties" and "external factors" with "project performance" and "organization performance" from a resource based perspective which put forward intangible assets of the organization.

To achieve the objectives, a questionnaire survey was administered to 93 Sudanese organizations that are registered in both Sudanese Contractors Association (SCA) and Organizing Council for Engineering Works Contractors (OCEWC), the data was obtained from 325 projects that were held during the last five years within the above organizations and the data were analyzed using Structural Equation Modeling (SEM).

It was hypothesized in this study that a construction organization performance is influenced by the resources within the organization, the long-term and short-term strategies adopted by the organization, the strength of the relationships of the organization with other parties involved in construction projects, external factors and project management capabilities.

A structural equation model was set up to measure the seven latent variables (resources, project management capabilities, strength of relationships with other parties, external factors, project performance

and organization 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 qualitative and the 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 organizations, subjective dimensions of performance have proven to be as effective as the traditional objective dimensions.

ملخص الدراسة

تتناول هذه الدراسة لأغراض هذا البحث العلاقة المتبادلة في مؤسسات التشييد فيما بين موارد المؤسسة, قوة العلاقة بين المؤسسة والمؤسسات الاخري ذات الصلة, العوامل الخارجية, المقدرة علي ادارة المشاريع, القرارات الاستراتيجية, مع مستوي ادارة المشروع ومستوي اداء المؤسسة.

لتحقيق هذه الاهداف تمت ادارة استبيان أتت الاجابة عليه بواسطة 93 مؤسسة سودانية مسجلة في اتحاد المقاولين السوداني ومجلس تنظيم مقاولي الاعمال الهندسية من خلال 325 مشروع تم انجازه في الخمسة سنوات الاخيرة وتم تحليل النتائج باستخدام النمذجة الرياضية.

تم الافتراض في هذه الدراسة أن مستوي اداء مؤسسة التشييد يتاثر بالموارد بالمؤسسة, الاستراتيجيات قصيرة وطويلة الأجل , العوامل الخارجية , ومقدرات ادارة المشروع.

تم عمل نمذجة رياضية للمتغيرات الضمنية السبعة {الموارد , مقدرات ادارة المشروع , قوة العلاقة مع المؤسسات الأخري ذات الصلة , العوامل الخارجية , مستوي اداء المشروع ومستوي اداء المؤسسة} وذلك من خلال المتغيرات الصريحة التابعة لكل متغير ضمني وذلك لرؤية ومعرفة مدي وجود الافتراضات التي تم عملها.

استنادا علي ماتم التوصل اليه في الدراسة يمكننا أن نخلص بأن البحث قدم لطريقة لقياس الاداء من ناحية المعايير الكمية والنوعية علي حد السواء. وجود معامل مسار قوي بين مكونات النموذج الذي تم افتراضه يشير الي انه بعد عقود من الزمان من البحث سيتم التوصل لطريقة لتطوير الاداء في مؤسسات التشييد، كما أن المعايير النوعية أثبتت فعاليتها كما المعايير الكمية.

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LIST OF ABBREVATIONS

ADF	Asymptotically Distribution Free
BSC	Balanced scorecard
CBPP	Construction Best Practice Program
CFA	Confirmatory factor Analysis
CFI	Computer Fit Index
CIM	Computer Integrated Manufacturing
EFQM	European Foundation for Quality management
FMS	Flexible Manufacturing systems
GDP	General Domestic Production
GLM	General Linear Model
GLS	Generalized Least Squares
IBID	Integrated Business Improvement System
IT	Information technology
JIT	Just In Time
KPIs	Key Performance Indicators
KPOs	Key Performance outcomes
ML	Maximum Likelihood
NPV	Net Present value
OCEWC	Organizing Council for Engineering Works Contractors
PMBOK	Project management Body Of Knowledge
PMPF	Performance measurement process framework
PMS	Performance measurement System
RADAR	Result, Approach, deployment, Assessment and Review

R & D	Research & Development
RMSEA	Root Mean square error of approximation
ROE	Return On Equity
ROI	Return on Investment
SCA	Sudanese contractors Association
SEM	Structural Equation modeling
TQM	Total Quality management
UK	United Kingdom

CHAPTER ONE

INTRODUCTION

CHAPTER ONE

INTRODUCTION

1.1 Statement of the research problem

Increasing competition is forcing organizations 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. However, comprehensive performance measurement systems are lacking in construction industry. Moreover, the results achieved from the existing financial based performance measurement systems cannot be used to derive future performance. In the absence of a comprehensive performance measurement system, it is difficult 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.

1.2 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. Gaining competitive advantage became one of the major targets for the organizations recently. Accordingly, organizations made several attempts to gain and sustain competitive advantage in the relevant industry all over the world (Kagioglou et al., 2001).

This often resulted in the adoption of new philosophies such as concurrent engineering, lean production, Just-In-Time (JIT), Total Quality Management (TQM), Benchmarking, Business Process Reengineering (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).

Bititci et al., (1997) believe that performance of an organization should be managed in line with its corporate and functional strategies and objectives. And this is the main stream of performance management system process. The core 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.

Eventually, the feedback is obtained through a performance measurement system. Therefore, this process supports and coordinates the process of systematic management, decision making and taking action throughout the organization (Schalkwyk, 1998).

Performance measurement process determines how successful organizations or individuals have been in 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 an information system 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.

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

Traditionally, the construction industry was focused mainly on project performance (Ward et al., 1991). The performance of projects and contractors were assessed against the client's objectives like cost, time and quality achieved on those projects (Mohsini and Davidson, 1992).

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” rather than “leading” indicators of performance. International research also supports this argument, 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, and ultimately the question of whether the goals were set at an appropriate level 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.

1.3 Objectives of the research

1.3.1 General Objective

The main objective of this study was to design a comprehensive performance measurement system which would have the ability to assess the performance both in project and organization level. This model aims to help organizations to be aware of the performance of their organization and decide on long-term strategies accordingly.

1.3.2 Specific Objectives

The specific objectives of this research are:

- Determination of the measures and indicators of construction projects and construction organizations performance in line with an in depth literature review.
- Development of relationships among performance determinants.
- Analysis of the proposed model and testing the model for validity and reliability.

1.4 Research approach

Most of the conventional approaches are based on key performance indicators, which 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. These KPIs are intended for use as benchmarking indicators for the whole industry (Kagioglou et al., 2001). Organizations 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).

In this study, it was hypothesized that the performance of an organization is influenced by resources, strategic decisions, and strength of the organization's relationships with other parties, the external factors and the project performance. The reasoning in the model and the causality of the interrelationships will be investigated and verified by means of data that will be collected from Sudanese construction organizations based on balanced scorecard.

The analysis of performance measurement frameworks and excellence models that are commonly used revealed that these frameworks have one or more of the following shortcomings:

1. Difficulty in determination of performance criteria.

2. Difficulty in determination of relations between the performance criteria.

3. Lack of a systematic measurement design.

4. Lack of existence of implementation guidelines for the performance measurement systems in recent application and practice.

5. Adaptation of the framework according to the changing external and internal environment in the long term.

1.5 Thesis layout

The thesis is composed of seven chapters. In the first chapter, introductory information has been given covering a background for the research as well as a statement of the problem, and definition of the objectives.

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

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

In the fifth chapter, implementation of the model and results were given, and then a comprehensive statistical analysis of the proposed model was explained in detail in chapter sixth. Finally, the conclusion and recommendations of the study were elaborated in chapter seven.

CHAPTER TWO

PERFORMANCE MEASUREMENT FRAMEWORK FOR CONSTRUCTION INDUSTRY

CHAPTER TWO

PERFORMANCE MEASUREMENT FRAMEWORK FOR CONSTRUCTION INDUSTRY

2. 1 Background

Performance measurement is a significant management tool that organizations use to compete in an ever changing environment. It supports decision-making processes by providing information about how well a set of targets have been met and how precisely predictions have been made (Rantanen et al., 2007).

Sink and Tuttle (1989) asserted that what cannot be measured cannot be managed. Therefore, one of the key tasks of organizations is to design and implement an effective measurement system that assist in providing sufficient and detailed information about their performance for internal and external purposes (Bredrup, 1994).

Organizations use performance measures to evaluate, control and develop their business processes to realize their aims and objectives (Ghalayini and Noble, 1996). Another reason for using performance measures is for benchmarking purposes (Ghalayini and Noble, 1996) where the performance of organizations within one sector can be compared, or even the performance of different departments within one organization are compared, analyzed and evaluated (McCabe, 2001). According to Neely et al. (2002) reasons for using performance measurement can be classified into one of the following categories: checking the organization's position, communicating the organization's position, confirming the organization's priorities or compelling progress. While Sousa et al. (2005) identified the main reason for undertaking this exercise, driving the performance in the direction of achieving organizational objectives. Performance measurement also helps in demonstrating transparency, promoting a productive environment and shaping accountability (De Bruijn, 2002).

2.2 Approaches to performance measurement

The literature shows that the subject of performance measurement has been extensively researched. According to Ghalayini and Noble (1996), performance measurement has been developed through two main phases.

The first phase started in the late 1880s and progressed through into the 1980s. Performance measures used in this phase were financial in nature. The second phase began in the late 1980s. In this phase, businesses used a balanced set of performance measures that includes financial and non-financial measures.

In the first phase, the focus was on financial measures such as Return-On-Investment (ROI), Net-Present-Value (NPV), earnings per share and other management accounting measures. Financial results of organizations were considered of vital significance for measuring their performance (Maskell, 1991). This was because the growth of manufacturing industries, and consequently, the increase of industrial firms in the last two centuries created a need for provision of sufficient monetary information about different business products made by those organizations.

This information was then used in planning and controlling the manufacturing process. Moreover, this information helped in making decisions about potential business opportunities (Maskell, 1991).

The use of monetary based performance measures revealed shortcomings that have been well presented in many research studies. Sanger (1998), for example, referred to the usefulness of financial measures in demonstrating the profitability of a business. However, he claimed that by measuring the results of past activities, organizations are provided with information about what has happened and fail to explain why it happened.

Furthermore, Maskell (1991) classified these shortcomings into five categories; lack of relevance, cost misrepresentation, inflexibility, inability to progress in world class manufacturing and respond to the needs of financial accounting. Within this context, it is understandable why Johnson and Kaplan (1991) advocated that financial measures promote short-termism.

According to Brown (2006), financial measures tend to focus on an organization’s present performance or on the performance in the very near future. Organizations in this case might fail to address long term challenges, such as customer satisfaction, employee satisfaction and product or service quality, which could affect their competitive advantages (Brown, 2006). This fact also made Ghalayini and Noble (1996) describe financial measures as “lagging metrics” because they are outcomes of decisions made in the past and therefore they describe the consequences of historical decisions.

Other authors acknowledged that financial measures are backward looking and cover performance measures of the same nature making them belong to only one dimension in which case they do not provide sufficient information regarding different stakeholders’ needs and wants (Najmi et al., 2005).

Another criticism of financial measures is that these types of measures do not encourage continuous improvement. Their function is mainly pushing managers to attain monetary targets without focusing on the means required to achieve those targets which may improve related business processes continuously (Lee 2002).

In a similar way, Kaplan and Norton (1992) claimed that senior organizational managers recognize that financial accounting measures provide misleading indicators that can adversely affect innovation and business development.

In summary, the first phase of performance measurement development relied on monetary-based performance measures which performed well for the industrial era environment (Kaplan and Norton, 1992). However, these measures are considered outdated in recognizing skills and competencies that organizations need to cope a competitive environment.

This competitive environment in addition to the shortcomings of the traditional measures discussed above marked the beginning of the second phase of performance measurement development (Ghalayini and Noble, 1996).

Organizations needed to respond to the new challenges not only by altering their business strategies to move from low-cost manufacturing to quality, flexibility, short lead time and reliable delivery, but also by applying new technologies and developing new business attitudes to production management such as computer integrated manufacturing (CIM), flexible manufacturing systems (FMS), Just In Time (JIT) and total quality management (TQM) (Ghalayini and Noble, 1996).

Producing competitive products has made non-financial performance measures rise to the same level if not one of more important than financial measures. Non-financial performance measures became significant tools used by operation staff for their everyday management of production and distribution operations (Maskell, 1991). However, financial measures are still significant for external reporting purposes where the need for reliable and integrated cost accounts and financial accounts remains in demand (Maskell, 1991), but the application of new approaches to production management, such as those mentioned above, showed the weaknesses of traditional performance measures and that organizations need to develop new performance measures to regain their ability to operate in a highly competitive market.

Within this context, many authors introduced more “balanced” approaches to performance measurement that respond to the newly emerged thinking (Ghalayini and Noble, 1996). Neely et al. (2002) explained that the term “balanced” means that organizations need to use multi-dimensional measures to attain a balanced view of their business. These measures need to reflect a wide range of performance perspectives including internal and external, financial and non-financial performance in addition to identifying measures that drive the performance and consequently outcome measures.

Bititici et al. (2006) claimed that business improvement techniques, such as six sigma, lean production, and the theory of constraints in addition to many performance measurement studies aimed at business improvement, help businesses improve by applying “formalized, balanced and integrated performance measures”.

In this regard, Hoque and James (2000) claimed that using balanced measures encourages better performance than financial performance measures. They found that there is a positive correlation between using balanced non-financial measures and improved performance.

In a similar way, Davis and Albright (2004), in a study aimed to establish possible correlation between improvements in financial performance and applying balanced performance measures, found that a balanced set of performance measures can improve financial performance. They found that in one organization, greater financial performance of divisions applying balanced measures was observed than in other ones which did not apply balanced measures.

Moreover, Atkinson (2006) investigated using a balanced set of measures in order to develop a wider understanding of those measures' role in implementing organizational strategies. She argued that a "balanced scorecard" can offer the means to implement organizational strategies by emphasizing the relationship between organizational objectives and operational goals and identifying clear performance targets in addition to prioritizing those targets at different hierarchal levels. It is worth noting that using a comprehensive performance framework that covers financial and non-financial measures may not have impacts on business performance.

Neely et al. (2004) conducted a study to investigate the performance impact of a balanced scorecard on organizations. They concluded that the changes in the performance of one organization that apply a balanced scorecard were not considerably different to the changes in the performance of a sister organization that did not in terms of sales growth and gross profit growth.

Research, on the other hand, showed that the effect of balanced measures on organizational performance depends on how they are used within an organization. Braam and Nijssen (2004) claimed that using balanced measures can enhance the performance of an organization if people responsible for the measurement know what is required to apply and use these measures such as involving multidisciplinary teams. The requirements of applying and using performance measures will engage a variety of functional areas within an organization which could assist in creating momentum (Braam and Nijssen, 2004).

Expanding on this issue, Bititici et al. (2006) found that there is a link between the management styles of an organization, its culture and performance measurement. They further explained that this relationship is “bi-directional”, which means that performance measurement can affect the way the organizational culture and management style are formed, and organizational culture and management and leadership style can, in turn, inform measurement of organizational performance.

While business professionals and academic researchers were attempting to tackle the shortcomings of financial performance measurement frameworks by paying more attention to the way that makes monetary measures more relevant, others advocated the need to develop operational measures such as ”cycle time” and “defect rates” claiming that improved financial performance will follow (Kaplan and Norton, 1992).

However, it is not wise to select either financial or operational measures because it has been found that senior managers do not depend on a sole group of measures and omit any others. They know that one set of measures will not offer the chance to know key areas of the business (Kaplan and Norton, 1992). Therefore, both financial and operational performance measures need to be used.

In conclusion, performance measures have developed from being of one dimension, which is the case of the monetary-based performance measures to more balanced and multi-dimensional measures that include financial and non-financial performance measures that promote continuous improvement such as productivity, customer satisfaction, product quality and flexibility (Marchand and Raymond, 2008). In this regard, Grady (1991) said that: "Performance measures need to be balanced. Balance includes internal measures with external benchmarks, cost and non-cost measures, result measures to assess the degree goals are achieved, and process measures to evaluate critical tasks and provide early feedback."

2.3 Performance measurement frameworks

Frameworks include a set of performance measures, guidance and recommendations on the way they are used and the areas they need to focus on in order to help organizations measure their performance.

Neely et al., (2007) explained that organizations have developed and used performance measurement frameworks over the years to define criteria against which their performance will be evaluated. Moreover, operations management literature showed that performance measurement has become integral to business improvement (Moxham, 2009).

Since the mid-1980s the need for balanced multidimensional and improvement-oriented performance measurement frameworks has been established (Bititci et al., 2005). Neely, et al. (2007) stated that in response to “calls from practice” for new and better ways of measuring organizational performance, the academic and consultancy communities have developed a plethora of performance measurement frameworks and methodologies.

Among the most widely cited in the business management discipline are these frameworks:

♦ DuPont Pyramid of Financial Ratios (DuPont, 1910)

♦ Performance Measurement Matrix (Keegan et al., 1989)

♦ Performance Pyramid (Cross and Lynch, 1991)

♦ Results and Determinants Model (Fitzgerald et al., 1991)

♦ Balanced Scorecard (Kaplan and Norton, 1992)

♦ European Foundation for Quality Management (EFQM, 1992)

♦ Input, Processes, Outputs & Outcomes Framework (Brown, 1996).

♦ The Performance Prism (Neely et al., 2000).

2.3.1 DuPont pyramid of financial ratios

The DuPont pyramid of financial ratios is one of the earliest measurement frameworks developed at the beginning of the last century. The framework is based on a hierarchy of financial measures that identify relationships between different financial components of one organization (Berndt, 2013). The ratios were constructed in such a way to form a pyramid or a tree of ratios which are used to calculate the financial benefits generated by that organization (Murphy, 2005).

DuPont performance pyramid revealed measurement deficiencies due to the over emphasis placed on measuring the different aspects of organizational performance in monetary terms (Anderson and McAdam, 2004). In a response to that problem, a framework has been developed and used for benefit quantification purposes.

The new framework was developed by Greeff and Ghoshal (2004) who extended the pyramid at the bottom level to include quantitative performance indicators and their related influencing factors. Those influencing factors can be of qualitative nature which can be used to motivate and assess the outcomes of business initiatives.

ROE = (Net income / Sales) * (Sales / Assets) * (Assets / Equity)

Return on equity = Profit margin*Assets turnover*Equity multiplier

= Profitability * operating efficiency * Financial leverage.

2.3.2 Performance measurement matrix

As explained above, the pyramid of performance measures included performance measures that are monetary based. They were backward looking and lacked the ability to keep organizations up with the pace of changing business environment.

Keegan et al. (1989) argue that organizations usually focus on their internal performance and allocate more time and effort to solve their problems than trying to benchmark their external performance. They concluded that performance measures have to reflect an organization's multidimensional environment.

Therefore, Keegan et al. (1989) introduced a balanced performance measurement matrix (Figure 2.1). They suggested, through this matrix, a number of performance measures categorized on internal, external, cost-based, and non-cost based.

The framework gives organizations the opportunity to enhance their competitive advantages by extending performance measurement to include measures that can express organizational focus on customer satisfaction, growth and production time.

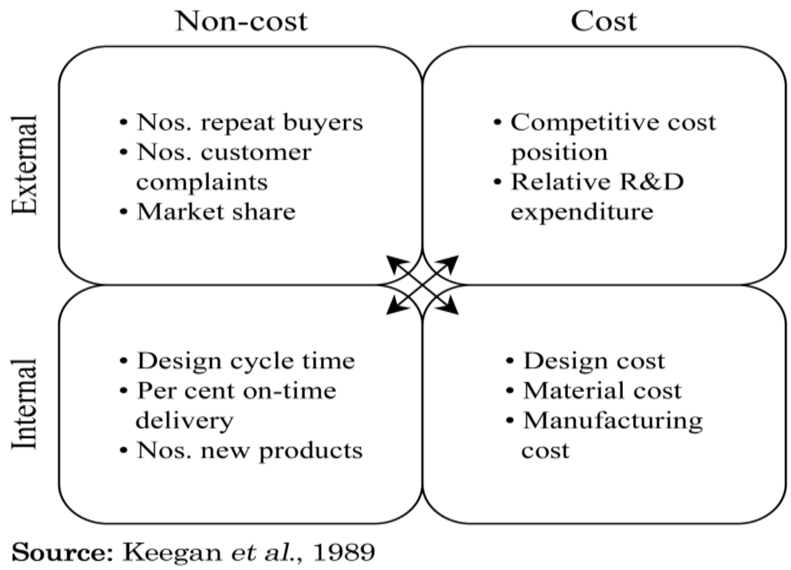

Figure 2.1 Performance measurement matrix (Keegan et al, 1989)

Marchand and Raymond (2008) claimed that this matrix is an operational performance measurement framework that did not takes into consideration the strategic objectives of an organization and did not concentrates on satisfaction, time and cost reductions.

Neely et al., (2002) similarly considered the matrix a simple and flexible model that has the ability to include various measures of performance. However, the matrix does not clearly explain potential relationships among the elements forming different dimensions of business performance (Neely et al., 2000).

In addition, the matrix does not show hierarchal structure of the performance measures which expresses integration across different business functions of an organization, the same way the performance pyramid of financial ratios did.

2.3.3 Performance pyramid

The performance pyramid was developed by Lynch and Cross in 1991 as a response to the growing need for more balanced measurement framework than the traditional performance measures that were expressed mainly in financial terms (Ghalayini and Noble, 1996). Another reason for developing this pyramid of measures was to create a management control tool to assist in defining and maintaining organizational performance. The performance pyramid was illustrated as building blocks that are attached together to form a performance information network (Lynch and Cross, 1995).

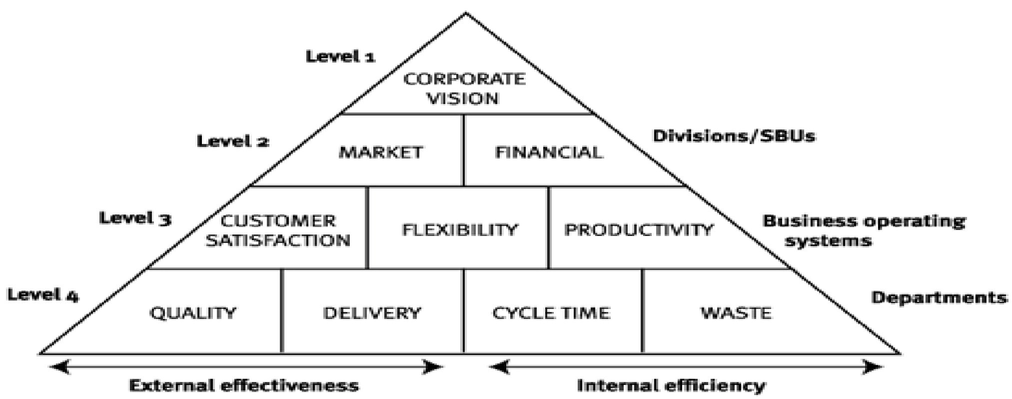

Figure 2.2 The performance pyramid (Lynch & Cross, 1995)

The framework consists of four levels forming a pyramid of objectives and measures (Figure 2.2). Effective linkages between strategy and operations are expressed by disseminating strategic objectives of an organization vertically through the levels from the top down, and then, assigning measures to those objectives from the bottom up (Lynch and Cross, 1995). A vision for the organization is developed and stated at the top level of the pyramid by the organization's senior management. At the next level, objectives for every business unit are established in market and financial terms.

Strategies are consequently devised, explaining the way those objectives should be attained. Additional operating objectives can be identified for key processes supporting the business strategy. These objectives need to be articulated in terms of customer satisfaction, flexibility, and productivity forming the third level of the pyramid. At the foundation level of the framework, objectives are translated into detailed operational criteria such as quality, delivery time and waste (Lynch and Cross, 1995).

Lynch and Cross (1995) pointed out two main characteristics of the pyramid. First, it is a useful method to explain the way objectives are disseminated from senior management of an organization through to the operators. Second, it shows the way the performance measures are populated with data from the bottom level of the pyramid upwards. Based on this, Anderson and McAdam (2004) consider that using this system assists in monitoring organizational performance as performance information is transmitted upwards and downwards between the levels.

The framework can be looked at from two distinctive perspectives; external effectiveness and internal efficiency. The first one can be looked at be external stakeholders who might be interested in measures such as customer satisfaction, quality and delivery time. The other perspective can be looked at internally and cover measures that focus on an organization's production such as cycle time and waste (Neely et al., 2000; Anderson and McAdam, 2004).

Ghalayini, Noble (1996) and Rouse and Putterill (2003) found that the pyramid's four levels concentrate on internal efficiency and external effectiveness of an organization and that the pyramid is a valuable tool for demonstrating organization's performance because it includes measures that link strategic objectives to operational activities. Likewise, Neely et al. (2000) highlighted that expressing the connection between strategic objectives to operational activities is strength of the performance pyramid. In this regard, Ballantine and Cunningham (2001) agreed that the pyramid is an effective means to show and develop the connection between the strategies of an organization and its operations.

In addition, it can be inferred from Rouse and Putterill (2003) that the pyramid has a notion of causality in that internal efficiency of organizational performance can have an impact of the external effectiveness of the generated products and the way a customer and other external stakeholders might perceive them.

It is important to note that one of the weaknesses of the pyramid is that it does not sufficiently reflect employees' perspective and criteria such as employee satisfaction and motivation are missing. This could be why the performance pyramid is difficult to operational (Neely et al., 2000).

2.3.4 Results and determinants model

Acknowledging the fact that appropriate strategies are needed to guide organizations through competitive business environments, Fitzgerald et al. (1991) suggested that managers, when designing business strategies, should pay particular attention to economic atmosphere, client requirements, shareholders expectations, personnel requirements and the use of available resources.

Those areas of attention, based on a synthesis of performance criteria that are developed by different authors in the management field, form a standard for six general performance dimensions (Fitzgerald et al., 1991). Those dimensions are illustrated in Table (2.1).

Table 2.1 Results & determinants framework (Fitzgerald et al., 1991)

Results	**Financial performance**
	Competitiveness
Determinants	**Quality**
	Flexibility
	Resource utilization
	Innovation

Fitzgerald et al. (1991) advised that performance measures are required to assist in implementing and developing those strategies. Therefore, the groups of performance measures have to reflect all the proposed performance dimensions. Besides, Fitzgerald et al. (1991)

pointed out that their six performance dimensions can be divided into two distinctive parts.

The first part expresses the criteria that define the success of the selected strategies. This part includes the competitiveness and financial dimensions, and referred to as the ‘results’ part. The second part explains the factors that assist in achieving success. Therefore, those factors are referred to as ‘determinants’. The ‘determinant’ part includes the rest of performance dimensions that cover flexibility, resource utilization and innovation.

Franco-Santos (2007) identified a particular strength of this results-determinants model. The model shows the notion of causality. This notion is expressed by Rouse and Putterill (2003) who considered that measures of financial performance and competitiveness are related to results whereas measures of quality, resource utilization and innovation are related to causes.

Besides, the model shows that the results gained at one particular time are the main consequences of past business performance, considering specific determinants. Within this context, results are considered as lagging indicators and determinants are considered as leading indicators (Neely et al., 2000).

In addition, Franco-Santos (2007) made the point that this results-determinants model summarizes a concept suggesting that the design and deployment of performance measurement systems necessitates identifying the drivers of performance so that the required performance outcomes can be achieved.

It is important to note that the results determinants model echoes other concepts of causality such as Cross and Lynch performance pyramid (Rouse and Putterill, 2003). Moreover, the Cross and Lynch performance pyramid shows a hierarchal structure that can be beneficial for different organizational level.

2.3.5 The Balanced Scorecard (BSC)

In an attempt to find a suitable measurement framework that avoids placing too much emphasis on financial measures and, at the same time, responds to many researchers and practitioners calling for improving business performance measures, Kaplan and Norton developed a "balanced scorecard” (BSC) that incorporates financial measures in addition to operational measures reflecting customer satisfaction, internal business processes, and an organization’s innovation and development activities (Kaplan and Norton, 1992). The balanced scorecard consists of four perspectives (Figure 2.3):

- *Financial perspective*
- *Internal process perspective*
- *Innovation and learning perspective*
- *Customer perspective*

The financial and customer perspectives were anticipated to respond to the needs of stakeholders and target groups. They were comprised of measures such as sales, profit, market share, and customer satisfaction. The internal processes perspective gives attention to the business operations that are significant for customer satisfaction and efficiency. This perspective may include measures such as cycle time and unit cost data.

Organization's innovation and improvement perspective focus on the ability of an organization to continuously develop and add value to its customers and shareholders (Kaplan and Norton, 1992; Rouse and Putterill, 2003).

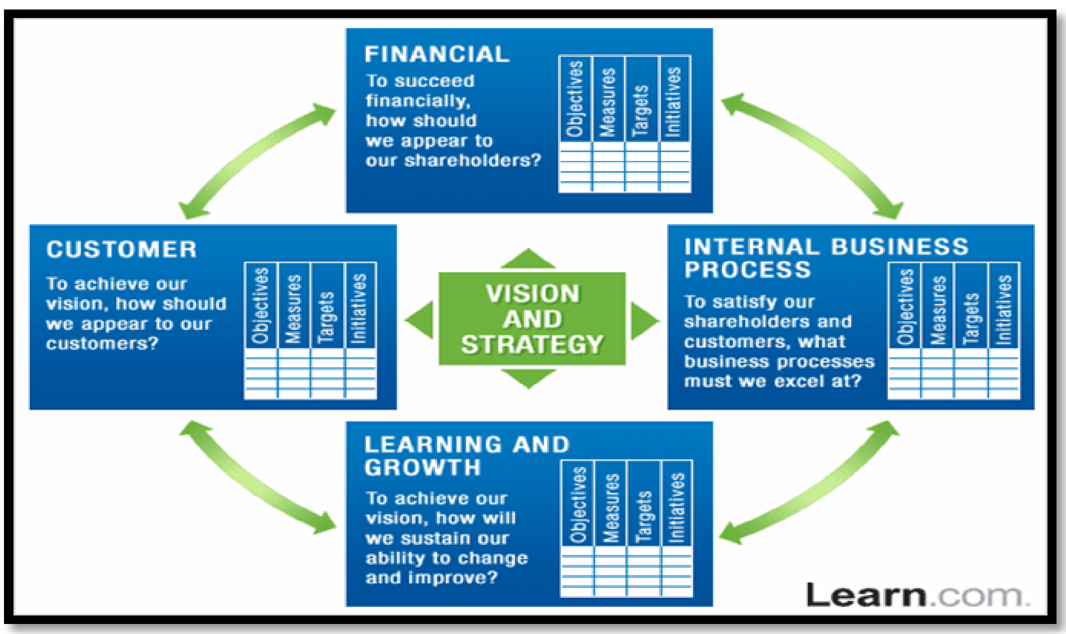

Figure 2.3 The Balanced Scorecard (Kaplan and Norton, 1992)

The BSC is considered one of the most widely recognized and used performance measurement frameworks in business since its inception (Sousa et al., 2005). It is popular because it has a number of advantages.

Neely et al. (2000) pointed out that one of the strengths of BSC is the clear relationships between the four performance perspectives. These four perspectives of the balanced scorecard can not only they provide senior management with a comprehensive view about what they need to know of their organization's performance, but they are interrelated in that operational measures form the drivers to improved financial performance (Bourne et al., 2002).

Within this context, Wongrassamee et al. (2003) and Davis and Albright (2004) claimed that a major strength of the balanced scorecard approach is the emphasis it places on linking performance measures with business unit strategy.

The four perspectives of the BSC link current organization's activities to its future objectives by translating an organizational vision into operational terms, communicating the strategy throughout the organization and linking it to departmental and individual objectives, business planning, and feedback and learning.

Strength was expressed by Neely et al. (2000); the BSC tries to integrate different categories of business performance such as financial performance, production performance and customer satisfaction which is similar to what Keegan's performance matrix was trying to achieve.

Kennerley and Neely (2002) and Neely et al., (2005) identified a significant perspective that is missing from the balanced scorecard which is the competitor perspective. They explained that depending on the BSC set of measures alone would not allow an organization to address "one of the most fundamental questions of all – what are our competitors doing?" However, the balanced scorecard has also been criticized for not clearly determining the relationship and trades-off between its four performance dimensions (Bond, 1999).

In other words, the BSC does not show explicitly the causality notion as seen in the Fitzgerald et al. model and to some extent in Lynch and Cross performance pyramid (Rouse and Putterill, 2003).

Nonetheless, the balanced scorecard lacks the means to measure aspects of human resources, employee satisfaction, supply chain performance, product quality, service quality, environmental and community perspective (Anderson and McAdam 2004).

2.3.6 The European Foundation for Quality Management Excellence Model (EFQM)

Top ranking grades contractors practice the variables and the dimensions of TQM in their organizations to some extent. However, there exist differences in the effectiveness and significance value in each dimension and in each part (Abu Hassan et al. 2011). The European Foundation for Quality Management (EFQM) Excellence

Model was launched in 1992 and has been used by organizations for systematic evaluation and measurement of their business performance (Oakland and Marosszeky, 2006).

The Excellence Model was developed on the basis of Total Quality Management (TQM) principles (Hides et al., 2004). It comprises nine criteria as shown in figure (2.4). The framework has two distinctive parts of performance aspects known as "enablers" and "results". The idea behind this Excellence Model is that “the enablers are the levers that management can pull to deliver future results” (Neely et al., 2000). In other words, the "Enabler" criteria refer to what an organization does and the "Results" criteria refer to what an organization achieves (EFQM, 2013).

In fact the European Foundation for Quality Management identified the link between the two parts of the Excellence Model by stating that "Results" are caused by "Enablers" and is enhanced by feedback from "Results". This idea was taken one step further by Bou-Llusar, et al. (2005) who investigated the causal relationship in the EFQM Excellence Model. They found that enablers and results are strongly associated.

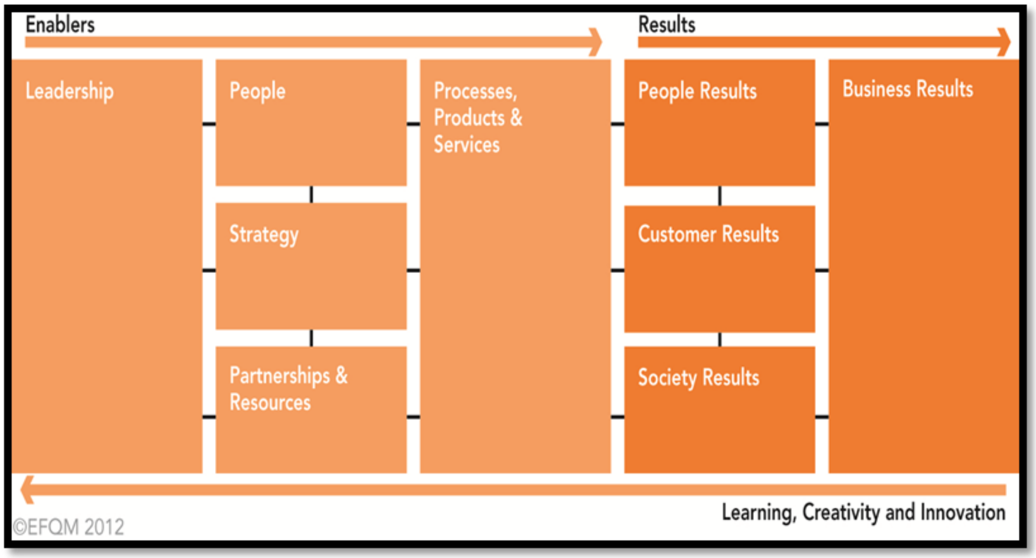

Figure 2.4 EFQM model (EFQM brochure 2013)

The EFQM follows a scoring system that gives equal weight to "enablers" (i.e. 500 points) and "results" (i.e. 500 points). One feature of the EFQM Excellence Model that distinguishes it from other measurement frameworks is that it includes an additional perspective referring to the impact of a business on society (Oakland and Marosszeky, 2006). Although EFQM Excellence Model has gained much popularity, it shows some weakness as being difficult to implement (Wongrassamee et al., 2003; Neely et al., 2000).

This long-term nature of performance improvement that organizations need makes the Excellence Model inappropriate for "quick fixes" (Hides et al., 2004). In addition, the Excellence Model does not recommend certain strategies or plans required for continuous improvement and to manage and control organizational performance successfully (Wongrassamee et al., 2003).

2.3.7 Macro Process Model

Brown (2006) asserted that the performance dimensions need to reflect a balanced view of the business shareholders, stakeholders, customers and personnel. He also emphasized that when designing performance measures, they need to reflect past and future actions. Consequently, he introduced another performance measurement framework and suggested that any measurement framework should include six dimensions. As depicted in figure (2.5) these dimensions are:

- *Financial performance*
- *Product/service quality*
- *Supplier performance*
- *Customer satisfaction*
- *Process and operational performance*
- *Employee satisfaction*

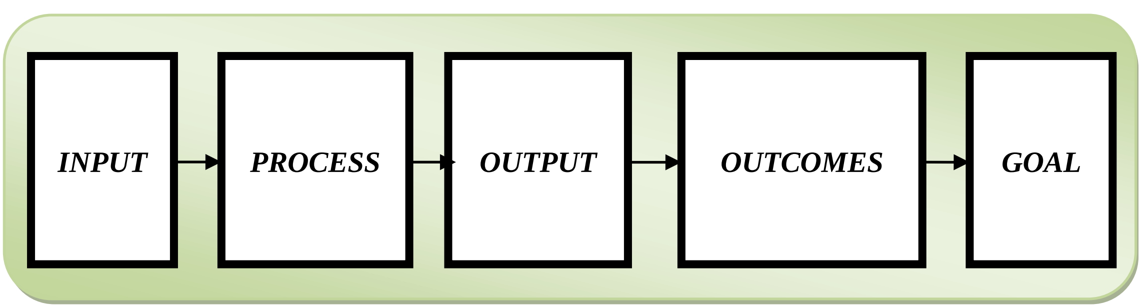

Figure 2.5 Macro process model (Brown 2006)

It can be inferred from Brown’s framework that he tried to counter the criticism of the balanced scorecard for lacking emphasis on employees and not covering the supply chain side of the business. Therefore Brown (2006) presented two dimensions reflecting the shortcomings of the balanced scorecard (BSC). However, the innovation and learning dimension, which is prominent in the BSC, has not been explicitly highlighted in Brown’s framework.

Brown (2006) put particular emphasis on the process and operational performance dimension because he considered “the key to excellence in any organization to be the control of its processes to produce reliable and consistent products and services”.

As a result, Brown (2006) presented the ‘Macro Process Model’ to show the link between five stages in a business process and their performance measures (Figure 2.5). These five stages are inputs, processing system, outputs, outcomes, and goals. Brown suggested that every stage is a performance driver of the next. Within this context, Brown took the concept of connecting performance measures through cause and effect linkages one step further ahead of the BSC (Franco-Santos, 2007). Neely et al. (2000) considered Brown's framework useful because it depicts the distinction between the five stages of a business process and consequently between their measures. While the concept of the model is well structured and functional, Brown's framework is considered a process-based framework as opposed to the hierarchically focused frameworks (Neely et al., 2000).

2.3.8 The Performance Prism

Powell (2004) claimed that performance measurement frameworks such as the Balanced Scorecard, the performance pyramid and the results and determinants model do not sufficiently focus on stakeholders like employees inside an organization, and suppliers and other alliance partners outside the organization.

The Performance Prism was designed by Neely et al. (2001) to reflect wider stakeholders' views so that the increasing demand for satisfying stakeholders needs can be met (Powell, 2004). Similar to the balanced scorecard, the performance prism addresses the needs of stakeholders.

The difference is that while the BSC focuses on two stakeholders (shareholders & customers) the performance prism includes employees, suppliers, intermediaries, regulators and communities as stakeholders (Adams and Neely, 2000).

Sousa et al. (2005) argued that identifying what satisfies stakeholders can guide an organization to improve the business in such a way that will increase stakeholders' satisfaction. The performance prism consists of five interconnected perspectives (Figure 2.6).

1. Stakeholder satisfaction (focus on identification of stakeholders and their requirements);

2. Strategies (focus on developing business strategies required to achieve stakeholders' objectives);

3. Processes (focus on processes needed to achieve business strategies);

4. Capabilities (focus on human and non-human resources needed to complete business processes); and

5. Stakeholder contributions (focus on identifying areas that need continuous attention and input from stakeholders).

Neely et al. (2001) asserted that the traditional assumption that performance measures need to be derived from strategy is not completely correct.

It can be challenged by the concept performance measures should reflect the needs and wants of the stakeholders because organizations develop strategies to create value for stakeholders.

Therefore, by focusing on stakeholders, the performance prism shows that it considers the views of a wider range of players, who are affecting in or affected by the business, such as investors, customers, employees, regulators and suppliers, more than other performance frameworks do (Tangen, 2004).

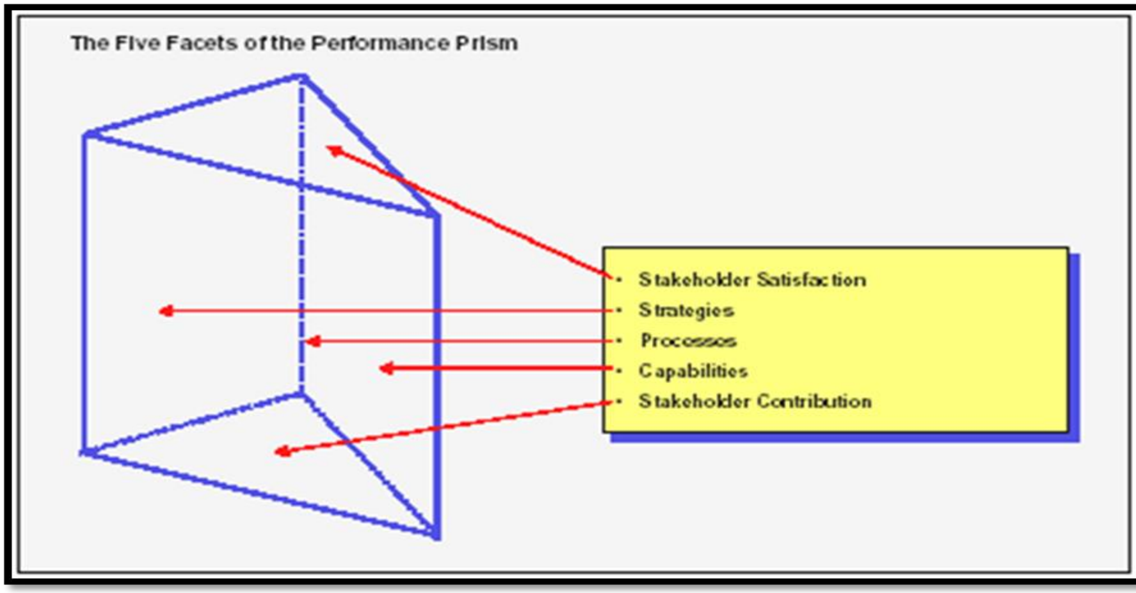

Figure 2.6 The Performance Prism (Neely et al., 2001)

Besides the strong points in the performance prism, which have been mentioned above, it shows a number of limitations. Tangen (2004) pointed out that it does not provide sufficient information about the process by which performance measures are designed to meet the different performance perspectives. This criticism is similar to the one raised by Medori and Steeple (2000) who found that the majority of PMF, including the performance prism, do not show enough directions for choosing and implementing performance measures.

2.4 Performance measurement characteristics

In order to develop a performance measurement framework, it is wise to follow recommended steps highlighted by a number of authors who summarize the characteristics of the performance measures and those of measurement frameworks, and who underline emerging issues and challenges surrounding their development.

Within this context, Folan and Browne (2005) claimed that recommendations concerning performance measurement can be split into two main areas:

♦ Recommendations for the design of a performance measurement framework; and

♦ Recommendations for the performance measures.

They explained that the first area concentrates on the requirements of what constitutes good performance measures, while the second explores the recommendations that have been advocated relating to the design and development of performance measurement frameworks and systems (Folan and Browne, 2005). However, there is an important part that was omitted which is related to recommendations for the process of measuring the performance.

A comprehensive review of performance measurement literature yielded a long list of performance measurement characteristics. The list included many recommendations that were either duplicated or had similar meanings.

A shorter list was produced including three categories of critical recommendations. The three categories focused on the overall structure of measurement frameworks, performance measures and the measurement process (Tables 2.2, 2.3 and 2.4). This developed list of recommendations will be used in later stages of this study as criteria for validation.

Table 2.2 Recommendations for overall structure of measurement frameworks

Comprehensive	Keegan et al. (1989); Fitzgerald et al. (1991); Kaplan and Norton (1992); Brown (2006); Neely et al. (1997); Najmi (2005); Bititci et al. (2005); Cocca and Alberti (2010)
Balanced	Keegan et al. (1989); Maskell (1989), Bititci et al. 2005), Kaplan and Norton (1992); Brown (2006);Neely et al. (1997); Cocca and Alberti (2010)
Adaptable	Maskell (1989); Ghalayini and Noble (1996); Neely et al. (1997);

Table 2.3 Recommendations for performance measurement process

Simple	Ghalayini and Noble (1996); Hudson et al. (2001)
Clear	Globerson (1985), Neely et al. (1997); Najmi et al. (2005)
Feasible	Neely et al. (1997); Cocca and Alberti (2010)
Applicable	Neely et al. (1997); Ghalayini and Noble (1996)

Table 2.4 Recommendations for performance measures

Relevant - Derived from strategy	Globerson (1985); Maskell (1989); Lynch and Cross (1991); Fitzgerald et al. (1991); Kaplan and Norton (1992); Neely et al. (1997); Hudson et al. (2001); Bititci et al. (2005); Cocca and Alberti (2010)
Understandable	Neely et al. (1997); Hudson et al. (2001); Cocca and Alberti (2010)
Effective – useful	Bititci et al. (1997); Neely et al. (1997); Hudson et al. (2001); Cocca and Alberti (2010)
Useful – Relevant	Ghalayini and Noble (1996); Hudson et al. (2001); Cocca and Alberti (2010)
Focused on improvement	Fitzgerald et al. (1991); Ghalayini and Noble (1996); Kaplan and Norton (1992); Neely et al. (1997); Hudson et al. (2001); Bititci et al. (2005)

Although there have been many research studies trying to identify the characteristics of performance measures, researchers still find several challenges when developing appropriate performance measures (Moxham, 2009). One of the difficulties is selecting the right measures. Powell (2004) explained that between the 1980s and 1990s the challenge in a lot of organizations was that they measured the wrong things as the focus was measuring things that were simple to measure. Those measures tended to be of financial and historical nature. She added that, this sort of problem has changed and organizations nowadays face another difficulty which is "excessive measurement"; the desire to quantify everything.

In other words, the new challenge is in identifying what is required to be measured so that the focus will be on what is completely critical. Likewise, Bourne et al. (2002) pointed out that the challenge concerned with developing appropriate measures is considered as a barrier to implementing a performance measurement system.

In fact, they revealed in a study that there are an additional three barriers which can influence the process of measuring the performance of an organization. They referred to difficulties with data access, time and effort required to collect data, and consequences of performance measurement from employees' perspective.

2.5 Project success and its measurement in construction

The main business of the construction industry is to produce buildings and infrastructure using projects as vehicles for this production. Consequently, the performance of construction projects has been carried out using two approaches. The first approach focused on the finished product and the second approach focused on the creation of the product as a process (Kagioglou et al., 2001). The first approach, which considers completing the project on time, within budget and to predetermined specifications as the criteria for project success, has been the predominant approach of measuring the performance of construction projects (Kagioglou et al., 2001). In this approach, the performance of construction projects is judged by using the same criteria used to evaluate the success general projects. These three criteria represented the contractor's perspective of construction project success (Turner, 2009). The opinion of Kagioglou et al., (2001) is that although the three criteria can be considered as an indication of project success or failure, using them exclusively does not show a sufficiently comprehensive view of project performance.

Ward et al. (1991) claimed that using time, cost and quality to measure project success alone has three limitations. The first is the difficulty of measuring the qualitative aspects of criteria such as quality caused by its subjective nature. The second issue is that the three criteria could be interconnected. This shed light on the way that the process of prioritizing these criteria happens. The third limitation is related to the issue of defining the project objectives at a suitable level.

Ward et al. (1991) concluded that defining success by meeting these criteria or exceeding them only reveals a simple meaning of considering a construction project successful. Baker and Fisher (2008) explained that success incorporates, in addition to the technical performance of the project output, satisfaction among different key project participants such as clients, project team and end-users. Moreover, Ward et al. (1991) suggested that other criteria such as the relationship between project key players, goodwill and trust are required.

Such criteria inform the quality of relationship among key project's players which in turn can influence customer satisfaction and affect the success or failure of the project (Bassioni et al., 2004). In addition, Ward et al. (1991) also pointed out that a project should be evaluated by all engaged participants to consider whether their objectives have been met or surpassed.

However, reaching a consensus among project participants regarding project success is difficult because each has a different perspective (Chan et al., 2002). Furthermore, construction projects involve social responsibility aspects because they will have impacts on every element of society (Lim and Mohamed, 1999). Considering this reality, project success should include the perspective of wider stakeholders.

This challenge creates differences in opinions about which stakeholder perspective of project success should be adopted (Lim and Mohamed, 1999). This issue draws the attention to the importance of the project stakeholders' perception of project success and consequently their role in characterizing project success.

The definition of 'stakeholders' is used to embrace whoever has an interest in or is affected by a project. But this definition includes some entities which do not have power to influence the project characterization or its results (Walker, 2007).

Other definitions have further prescription; they consider project stakeholders to comprise only those with the capability and power to inform the project directly (Walker, 2007).

Furthermore, Pinto, (2013) pointed out that in some cases, an organization should pay careful attention to the potential influence that some stakeholders are able to exercise. In some scenarios stakeholders have little power to inform an organization's activities but they may still need to be considered.

However, the most powerful voices often determine what counts as 'good', and therefore what criteria and standards for judgment apply (McNiff et al., 2009).

As discussed in the previously, one of the main characteristics of construction projects is that there are a number of different parties involving in making the project output happen.

Lim and Mohamed (1999) distinguish between two groups of project stakeholders; those who are directly involved in the project like the owner, developer, designer, contractor and subcontractors. For them, project success could be considered as the attainment of a number of pre-determined goals and objectives, which include measures as time, cost, performance, quality and safety.

The other stakeholder group comprises those indirectly involved in the project like the end-users and the general public. These stakeholders might not necessarily have the same goals and objectives for the project.

Lim and Mohamed (1999) considered that project success falls into two categories; the macro and micro perspectives. The macro view concentrates on assessing if the original project concept has been achieved. This assessment can only be performed when the project output starts its operational stage. In addition, this judgment is made by the client and to some extent other stakeholders such as the end-users and local community.

The macro perspective of project success is accordingly formed in the conceptual and operational phases of projects. The micro view, on the other hand, focuses on specific project achievements. These achievements are usually assessed at the end of a construction phase by the parties involved in executing the project.

Hence, the micro perspective of project success is formed in the construction phase and includes success criteria such as time, cost and quality (Lim and Mohamed, 1999).

Kometa et al. (1995) expanded the way project success is evaluated by using a comprehensive framework. Their criteria comprised safety, economy (construction cost), maintenance cost, time and flexibility to users. Kumaraswamy and Thorpe (1996) in the same way proposed a range of criteria for evaluating projects. These included cost, time, quality of workmanship, client and project manager's satisfaction, transfer of technology, friendliness of environment, health and safety.

Chan et al. (2002) summarized project success criteria in three main trends. The first trend is called 'meeting objectives' and includes criteria that reflect the client's needs and objectives. The second trend covers criteria that are of 'global approach' which judge project success 'objectively' and 'subjectively' and include tangible and intangible objectives. The third one is the 'beyond project' trend which represents criteria that expand beyond the project lifecycle and covers measures that are timeframe based that expands few years behind the project completion.

2.6 Performance measurement frameworks in construction

Success criteria are characteristics, features or principles against which project performance is measured and judgments are then made about project success.

A success dimension, on the other hand, is a set of success criteria that have common attributes that can be used to describe specific aspect of the project performance.

The construction industry used measurement frameworks to measure project performance. In this regard, Bassioni et al. (2004) pointed out that the use of performance measurement frameworks (such as the European Foundation for Quality Management (EFQM) excellence model, key performance indicators (KPI) and the Balanced Scorecard in UK construction industry are rising in an attempt to improve performance.

Examples of using such frameworks have been expressed in the construction management literature and are presented below.

2.6.1 Key performance indicators

Nardo et al. (2005) defined an indicator as "a quantitative or a qualitative measure derived from a series of observed facts that can reveal relative positions in a given area".

McCabe (2001) stated that key performance indicators "represent the measures of progress in achievement of the critical success factors".

Turner (2009) said that KPIs are "key control parameters which measure progress towards achievement of success criteria".

Another definition was introduced by Berman (2006) who declared that a key performance indicator is "a measurable variable that is related to a series of process steps whose performance can be managed and delivered against a particular organization or project objective". It can be inferred from the definitions that KPIs can be used to measure both success criteria and critical success factors. In addition, KPIs can represent quantitative or qualitative measures or objective and subjective measures (Chan and Chan, 2004).

Within this context, and as a response to the Latham Report (1998), which promoted the need to improve the efficiency and effectiveness of the industry, and the Egan Report (2002) which emphasized the need to set ambitious targets and effectively measure performance against those targets, the Construction Best Practice Program (CBPP) launched UK construction industry KPIs for performance measurement. These KPIs provide information on the scope of performance being achieved in a variety of construction activities. The KPIs are:

1. Client satisfaction – product
2. Client satisfaction – service
3. Defects
4. Predictability – cost
5. Predictability – time
6. Profitability
7. Productivity
8. Safety
9. Construction cost
10. Construction time

The purpose of introducing the construction KPIs was to provide benchmarking indicators for the entire industry so that any construction organization could measure its performance relative to a national industry norm. This helped the organizations to identify areas for further improvement and development (Kagioglou et al., 2001).

It is worth noting that the CBPP KPIs, on the one hand, have been credited for encouraging construction organizations to measure and benchmark their performance, but, on the other hand, have been criticized because they produce information describing past actions which limits an organization's ability to take pro-active actions.

They can, therefore, be termed as lagging indicators (Beatham et al., 2005). Moreover, Kagioglou et al. (2001) shed light on their comprehensiveness and their focus on the performance of the construction project rather than the organizational performance.

In addition, Kagioglou et al. (2001) found that although the KPIs are aimed at identifying areas for improvement as a result of a benchmarking exercise, they do not provide insight into the tools of improving performance and consequently cannot be effectively used for management decision making. The opinion of Beatham et al. (2004) is that construction companies have used the CBPP KPIs as a marketing tool, instead of using them as a means to manage and improve their businesses. Moreover, a growing number of construction companies preferred adopting the Balanced Scorecard and the EFQM (Robinson et al., 2005).

2.6.2 Conceptual performance measurement process framework (PMPF)

Kagioglou et al. (2001) introduced the conceptual Performance Measurement Process Framework (PMPF) that used the balanced scorecard (BSC) pioneered by Kaplan and Norton (1992) to apply advancements in the manufacturing industry into construction.

The key objective of the framework was to provide a comprehensive performance measurement process framework showing the relationship between measuring and managing performance from a “process” perspective (input, process and output). Their framework incorporated two additional dimensions in addition to the original four dimensions of the BSC’s two perspectives. The two extra dimensions relate to the construction industry and are the project and supplier dimensions.

One of the PMPF’s features is that it signifies links between performance measures and company objectives derived from strategy. In addition, its process-performance measurement relationship matrix shows areas that need further improvements (Bassioni et al., 2004). Kagioglou et al. (2001) found that when measuring the performance of construction projects using the BSC as a template measurement framework, three of the four BSC perspectives can apply:

1. *Financial perspective;*
2. *Internal processes perspective;*
3. *Customer perspective.*

Kagioglou et al. (2001) argued that the fourth perspective, which deals with organizational learning and continuous improvement, can be challenging due to the fact that participants in construction projects have temporary relationships. This may form an obstacle to the identification and agreement of appropriate methods for measuring and managing performance.

Kagioglou et al. (2001) indicated that the Performance Management Process Framework (PMPF) is conceptual in form & lacks validation which means that it cannot be used effectively by construction organizations on its current status because the framework needs empirical evidence to derive its final form (Kagioglou et al., 2001).

2.6.3 An Integrated Business Improvement System

The design of the Integrated Business Improvement System (IBIS) utilized the EFQM Excellence Model. Consequently, the IBIS includes nine criteria similar to the EFQM Excellence Model. Moreover, business objectives are required to be established for all the criteria of the model before the measurement process starts. This guarantees a comprehensive assessment of business performance. In addition, the RADAR logic of the EFQM model is used to initiate continuous improvement.

The IBIS system was also designed in such a way that each high-level business objective will be assigned with one or more critical success factors (CSFs) and then a measure will be allocated to each of these CSFs. Hence, using the designed measures would indicate whether the CSFs have been fulfilled or not and therefore whether the related business objective has been achieved or failed (Beatham et al., 2005).

The structure of the IBIS includes three types of performance measures; key performance indicators (KPIs), key performance outcomes (KPOs) and perception measures (Beatham et al., 2005). In order to understand the distinction between these three types of measures, it is necessary to explore the meaning of two performance related terms: lagging measures and leading measures. The opinion of Beatham et al., (2004) is that lagging measures can be described by referring to their characteristics:

- They are used to assess completed performance results

- They do not offer the opportunity to change performance or alter the result of associated performance

- They are used only as a historical review.

On the other hand, Beatham et al., (2004) defined leading measures by saying that: “They are measures of performance whose results are used either to predict future performance of the activity being measured, or present the opportunity to change practice accordingly, or to enable future decisions to be made on future associated activities based on the outcome of previous activities.”

The opinion of Andersen et al. (2006) is that ‘lagging indicators’ are measures that record documented results. He further explained that they are used after a business process is finished at a stage when the product/service it is aimed to achieve is complete. In a similar way, Hale (2003) suggested that the use of lagging indicators is linked to generating business results. Therefore, Hale asserted that achievements should be considered as lagging indicators; they are the outcomes of a finished process that involved human and non-human resources. In addition, they show if an organization (or a project) is successful in achieving the outcomes they intended to deliver.

Beatham et al., (2004) considered that KPIs “are measures that are indicative of performance of associated processes.” Therefore, they are used as leading indicators, and because they can signal an early warning, they offer the possibility of modifying a process and to make suitable decisions. Consequently, this type of measure can be considered a leading measure (Beatham et al., 2004). Similarly, Beatham et al., (2004) suggested that KPOs “are results of a completed action or process. They therefore do not offer the opportunity to change.”

Consequently, this type of measure can be considered a lagging measure. Perception measures are the type of measure that can be used frequently at different phases of a project to provide individual judgment about some performance aspects such as “satisfaction” measures. Therefore, they can be considered as leading or lagging indicators Beatham et al., (2004).

2.6.4 A business performance measurement framework

Performance measurement in construction was perceived to address two functions. The first focuses on assessing general business health of organizations. The second focuses on assessing organizations' strategic performance (Bassioni et al., 2005).

The former perceived function of performance measurement involves obtaining a general and comprehensive examination of the way construction organizations perform in various aspects of the business. The performance of this function can be appropriately assessed by adopting EFQM Excellence Model which provides a wide and general view of performance.

The other perceived function of performance measurement pays attention to a fewer number of business areas that are linked to an organization's strategic objectives. This function is best assessed by using the balanced scorecard (BSC) (Bassioni et al., 2005). Bassioni et al. (2005) suggested that organizations should have a measurement system that performs both functions.

A comprehensive conceptual framework for measuring business performance in the construction industry was, therefore, developed based on the principles of existing frameworks such as the Balanced Scorecard (Kaplan and Norton, 1992), and the EFQM Models. Such models were used since they are widely known and well established in practice in addition to academia, therefore, providing initial validity of the developed framework (Bassioni et al., 2005). The development process began by incorporating the Balanced Scorecard four perspectives and the EFQM criteria, into a comprehensive collection of performance dimensions (Bassioni et al., 2005). The aim was to extract the embedded logic from the original frameworks to form a causal map instead of a set of performance dimensions.

The resulting framework consisted of two parts; the first relates to performance driving factors and the second relates to performance results factors. The performance driving factors comprised leadership; customer and other stakeholder focus; strategic management; information and analysis; people management; partnerships and suppliers management; resources management; intellectual capital management; risk management; work culture; and process management.

The performance results factors comprised: people, supplier results and partnership; project results, customer and society results; and organizational business results (Bassioni et al., 2005). Bassioni et al.'s research showed that the relationships between the performance dimensions in their framework found complicated, and not necessarily causal. Moreover, their study also showed that the suggested framework is more suitable for measuring general business health, since it has a comprehensive nature and include a broad range of performance factors, rather than assessing the strategic performance, which needs taking particular attention to areas of strategic importance (Bassioni et al., 2005).

In conclusion, Bassioni et al. (2005) explained that the detailed implementation of the conceptual framework needed more investigation. They also concluded that scoring techniques need to be developed. Moreover, the framework didn't demonstrate the relationships between different components of performance factors which, consequently, require further examination (Bassioni et al., 2005).

2.6.5 The project excellence model

The concept of the EFQM Excellence Model which shows causality between performance drivers and performance results has been adopted by Westerveld (2003) who developed a Project Excellence Model linking success criteria and critical success factors for projects. The developed framework comprises of six result aspects reflecting project success criteria and six organizational aspects reflecting critical success factors. Westerveld (2003) suggested that the successful completion of projects requires attention to be paid, by the temporarily formed project organization, to result areas (project success criteria) and to organizational aspects (critical success factors).

This model illustrates that the good project results upon completion depend on a set of factors controlled by the project organization. In addition, the Project Excellence Model recognizes the distinction between project management success and project success presented by DeWitt (1988), by taking into consideration the broader success dimensions.

2.7 Structural equation modeling (SEM)

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.

Structural 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, 2011; Mueller, 2011; Garver and Mentzer, 1999).

2.7.1 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.

- 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.

- 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.

2.7.2 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 latent. 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.

2.7.3 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".

2.7.4 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 hypothesizes 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 *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 Eigen value 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. A common rule of thumb is that the indicators should have a Cronbach's alpha of 0.7 to judge the set reliable (Nunnally, 2010). 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.

2.7.5 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).

2.7.6 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) with its 90% confidence interval, (3) the comparative fit index (CFI), and (4) the non-normed fit index (NNFI).

- ***Model chi square ($\chi2$)***

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 $\boldsymbol{\chi 2}$ for a just identified model generally equals zero and has no degrees of freedom. If $\boldsymbol{\chi 2} = 0$, the model perfectly fits the data. As the value of $\boldsymbol{\chi 2}$ increases, the fit of an over identified 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 non-central 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 covariance 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 non normed 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.

2.8 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 equation modeling technique are;

- □ Specification of the model,
- □ Estimation and identification of the model, and
- □ 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.

2.9 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 programs 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 6.2 was selected to perform the statistical analysis of performance data.

2.10 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 regressions 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 auto correlated 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. (2010), 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.

CHAPTER THREE

MATERIALS AND METHODS

CHAPTER THREE

MATERIALS & METHODS

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 organization.

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 was designed and administered to survey the Sudanese construction industry professionals.

3.1 Construction organization performance framework

A comprehensive review of existing literature was previously carried out in order to identify the performance measures at both organization and project levels. Besides, validity of the determined performance measures and the model was justified. Hence, the model was designed based on the information deducted from the theoretical background.

3.2 Design of the questionnaire

This design was chosen to meet the objectives of the study, namely to determine the knowledge and views of construction organization top managements with regard to performance measurement.

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.

3.3 The study population and sample

The study population consisted of all construction organizations that are registered in both Sudanese Contractor Association (SCA) and Organizing Council for Engineering Works Contractors (OCEWC). A convenient sample of 114 construction organizations was identified in a random selection process and the respondents were 93 organizations which represent 81.6% of the total sample.

3.4 Data collection procedure

The questionnaire was administered in Sudanese construction organizations established in Sudan, describing the objective of the study, inquiring about these organizations' willingness to participate in the study and requesting a face-to-face interview with an executive at each organization.

Ten pilot questionnaire sheets were completed to test the applicability and consistency of the questionnaire components. Ninety three questionnaire sheets were completed, and were administered by face-to-face interviews. Questionnaires were personally distributed by the researcher to the selected respondents, and the data was collected over a period of six month.

3.5 Reliability and validity

To achieve content validity, questionnaires included a variety of questions on the knowledge of construction organizations.

Questions were based on information gathered during the literature review to ensure that they were representative of what construction organization leaders should know about their organizations.

Content validity was further ensured by consistency in administering the questionnaire. All questionnaires were distributed to subjects by the researcher personally.

The questions were formulated in simple language for clarity and ease of understanding. Clear instructions were given to the subjects.

All the respondent subjects completed the questionnaire in the presence of the researcher. This was done to prevent subjects from giving questionnaire to other people to fill on their behalf.

3.6 Ethical considerations

The conducting of research requires not only expertise and diligence, but also honesty and integrity. This is done to recognize and protect the rights of human subjects.

To render the study ethical, the rights to self-determination, anonymity, confidentiality and informed consent were observed. Verbal permission was obtained from the persons in charge of the all construction organizations in which that completed the questionnaires.

Subjects were informed about the purpose of the study, the procedures that would be used to collect the data, and assured that there were no potential risks or costs involved.

In this study anonymity was ensured by not disclosing the construction organization's name on the questionnaire and research reports and detaching the verbal consent from the questionnaire.

Confidentiality was maintained by keeping the collected data confidential and not revealing the subjects’ identities when reporting or publishing the study.

Subjects were treated as autonomous agents by informing them about the study and allowing them to voluntarily choose to participate or not.

Lastly, information was provided about the researcher in the event of further questions or complaints.

After the data was collected it was organized and analyzed with a computer program called (EQS 6.2).

3.7 Hypothesis regarding the relations between the factors

Given the model and the performance measures with the indicators, there are a number of 13 hypotheses in the proposed performance measurement model on the way to measure the performance of a construction organization and the individual project.

H1: A model consisting of six constructs were designed in order to understand their effects on organization performance.

H2: “Resources” construct of the model has a direct effect on “project performance” and “organization performance”.

H3: “Strategic decisions” has a direct effect on “organization performance”.

H4: “Strategic decisions” has an indirect effect on “project performance”.

H5: “Strength of relationships with other parties” has a direct effect on “resources”.

H6: “Strength of relationships with other parties” has an indirect effect on “project performance”.

H7: “Strength of relationships with other parties” has an indirect effect on “organization performance”.

H9: “External factors” has a direct effect on “strength of relationships with other parties”.

H9: “External factors” has an indirect effect on “project performance”.

H10: “External factors” has an indirect effect on “organization performance”.

H11: “External factors” has an indirect effect on “strategic decisions”.

H12: “External factors” has a direct effect on “resources”.

H13: “Project performance” has a direct effect on “organization performance”.

The validity of these hypotheses will be analyzed and discussed in the coming chapters.

CHAPTER FOUR

PROPOSED PERFORMANCE MEASUREMENT MODEL

CHAPTER FOUR

PROPOSED PERFORMANCE MEASUREMENT MODEL

There is a general agreement among researchers and industry professionals that one of the major obstacles to promote improvement in construction organizations 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 organization.

In the light of this approach, a multi-faceted performance measurement model with a bunch of appropriate performance measures and indicators was constructed.

4.1 Proposed performance measurement framework

A comprehensive review of existing literature was carried out in order to identify the performance measures at both organization and individual project levels.

Besides, validity of the determined performance measures and the model was justified consulting to some industry professionals and theoretical background.

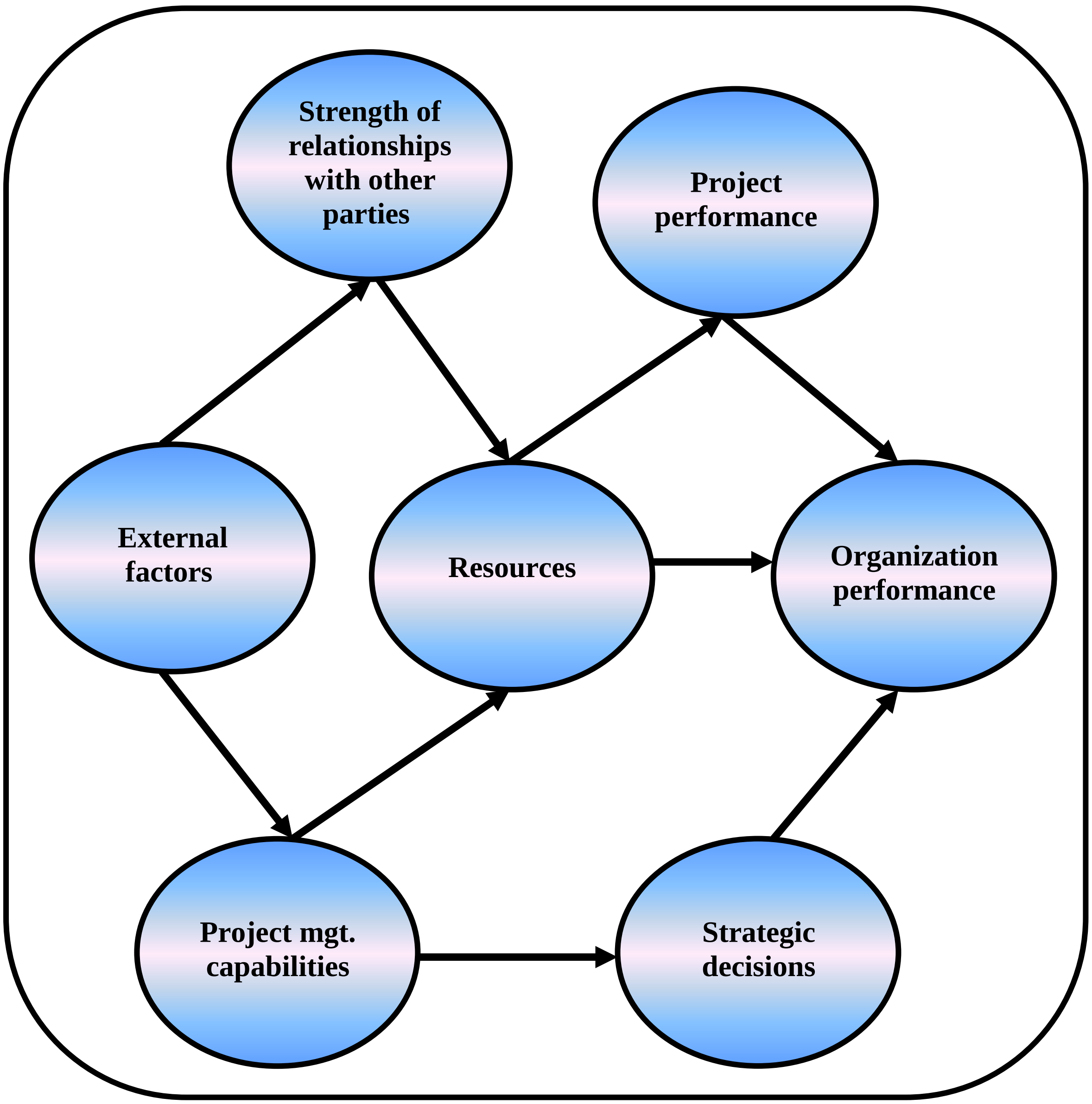

Figure 4.1 A proposed performance measurement model (literature)

Table 4.1 Performance measures and indicators

EXTERNAL FACTORS	RESOURCES
International relations	Financial resources
Macro-economic conditions	Technical competency
Political conditions	Leadership
Socio-cultural conditions	Experience
Legal conditions	Organization image
Supply power	Infrastructure
Demand	Human resources
Technology	**STRATEGIC DECISIONS**
Market competition	Differentiation strategies
PROJECT MANAGEMENT CAPABILITIES	Project selection strategies
Human resources management	Market selection strategies
Cost management	Partners selection strategies
Quality management	Organization management strategies
Schedule management	Customer relations strategies
Risk management	
Supply chain management	**PROJECT PERFORMANCE**
Health and safety management	Project profitability
Knowledge management	Internal customer satisfaction
Research & development capabilities	External customer satisfaction
ORGANIZATION PERFORMANCE	**STRENGTH OF RELATIONSHIPS**
Financial perspective	Relations with government
Internal business perspective	Relations with labor organizations
Learning and growth perspective	Relations with competitors
Customer perspective	Relations with community organizations

4.2 Performance measures

An organization is a complex structure, consisting of different interrelated components that influence its performance (Tang and Ogunlana, 2003). These components include the resources of the construction organization, organization project management capabilities, strength of its relationships with other parties, and the strategic decisions of the organization.

4.2.1 Resources

An organization's resources may be defined as its tangible and intangible assets. They include the organization's financial resources, technical competencies, leadership characteristics, experience, image in the industry, infrastructure, and human resources.

- **Financial resources** indicate an organization's strength in the market in terms of its capacity to carry out projects. Adequate financial resources ensure the organization can get into risky situations that have a prospect of high returns. As an organization'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 an organization is measured by examining the ratio of its liabilities 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 retain age. 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 an organization 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 (Raz et al, 2002).

According to Warszawski (1996), an organization's technical competency can be assessed by analyzing the organization's preferred construction methods, the experience of its technical staff, the productivity and speed of its construction activities and the quality of the organization'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).

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 and equipping of leaders with different skills (Darcy and Kleiner, 1991).

Leadership is also an enabling activity of EFQM in which organizations are assumed to require leadership factor for any of their decisions or actions (Beatham et al., 2004).

- **Experience** is highly related to an organization'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 organizations 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 organization** 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 addresses the expectation and demand of the clients and users, like in all other market oriented industries. Moreover, image of an organization may enable higher profitability by attracting better clients & investors and increasing the value of the product (Fombrun, 1986).

4.2.2 Project management capabilities

• **Research and development capability** is a response to increased industry requirements that occurred as a result of globalization and competition between the organizations.

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 organizations are forced to develop and adopt new technologies in order to survive.

•**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-2013).

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-2013). 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-standardized in nature of construction projects that makes it difficult to manage quality.

The processes of a quality management system are plan quality management, perform quality assurance, and control quality (PMBOK-2013). Even minor defects may require re-construction and may impair the facility's operations 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.

- **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). The capability of an organization 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 (Sawacha et al., 1999).

4.2.3 Strength of the relationships with other parties

The performance of construction organizations 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 organizations, and financial institutions.

The strength of these relationships is related to the mutual satisfaction of the parties. The primary relationships that are of more importance than others include relationships with construction owners, labor unions, and regulatory agencies because of the reasons discussed in the following sections.

- **Relationships with labor organizations** concern employment policies and practices and relates to the management of the human resources of the organization. For example, if an organization 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 organizations accordingly.

In general terms, bureaucratic obstacles set by regulatory agencies to maintain standards in organizations' day-to-day operations, and organizations' 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).

4.2.4 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 (Neely et al., 1997). The strategies selected for this study 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 organization to deal effectively with the threat of new entrants to the market (Porter, 2009).

Many new construction organizations enter the industry every year because starting a new organization does not require a large investment; consequently the construction industry becomes more competitive and forces existing organizations 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 organization does not possess.

- **Organizational management strategies** involve decisions pertaining to the organization's reporting structure, planning, controlling and coordinating systems, as well as the management of the informal relations among the different parties within the organization (Barney, 1991).

4.2.5 External factors

Traditionally, external factors refer to variables that are beyond the control of an organization. There is no doubt that market conditions constitute exogenous factors that are solely influenced by outside parties. The effect of market conditions on organization success was discussed by many researchers (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 organizations established in the relevant countries. The organizations 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 organizations 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, 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 is different in each country. Understanding the legislation of a country should be obligatory for a manager since the majority of the delays in a project are caused by the disputes.

● **Supply power** refers to the impact of suppliers of materials and equipment that are needed in the execution of projects. The quality, cost of materials, 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.

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

4.3 Performance indicators

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

4.3.1 Project performance

A variety of different projects constitute the structure of the construction industry. In spite 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 (Kagioglou et al. 2001). The construction industry is a very dynamic industry in which accommodates 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 than the other criteria were selected in order to cover factors affecting project performance.

Project profitability is essential for an organization's survival and growth in the business cycle (Akintoye and Skitmore, 1991) and financial success of an organization 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.
An organization’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 (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 organizations 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 (internal)/user (external) 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.

According to (Chan et al., 2002) construction organizations 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 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 bring profit to the organization in the short term (Kaplan and Norton, 1996b). Besides, in the dynamic environment of the construction industry organizations 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 organizations can be adopted either as a narrow or broad market and product/service approach. First approach provides the organization 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 organization'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 external factors in an individual market (Kale and Arditi, 2003)

4.3.2 Organization 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 an organization. It combines four perspectives to assess the performance of an organization.

- **The financial perspective** indicates the success of the organization measured in terms of indicators such as profitability, turnover, etc. The financial performance measures indicate whether the organization'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 an organization are: increase in revenues and profitability, market 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 (Liebowitz and Suen, 2000). However it is argued that overemphasis on financial leads to an “unbalanced” situation with regard to other perspectives.

Schneiderman (1999) states that organizations that really benefit from a scorecard process would inevitably move the focus of their attention to the non-financial scorecard metrics. It is understandable that overemphasis on achieving and maintaining short-term financial results can cause organizations to overinvest in short-term fixes and to under invest 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 an organization and its growth potential. Organizational learning capacity and the achievements of the organization in such areas as organization 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 whetted 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 of any knowledge-worker organization.

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

1. Objectives pertaining to employees developing core competencies (re-skilling employees, training, personnel development etc.), employees' satisfaction, retention and productivity, creating the appropriate climate for action (strategic awareness, alignment, teamwork for synergies, empowerment, rewarding, interaction with knowledge workers).

2. Objectives pertaining to systems and procedures: developing the organization'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, 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 and perform with more creativity (Prusak and Cohen, 2001).

In the case of innovation, Kim and Mauborgne (1997) found that in high-growth organizations 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 (McCabe, 2001).

- **The internal business perspective** is an indicator of the success and efficiency of the operational and managerial activities in the organization. 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 new 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 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, 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 & development and IT expenses per employee (Kagioglou et al., 2001).

•**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 meeting customer requirements and performance measurement. Earlier researchers concluded that customer orientation is positively associated with performance of the organization (Appiah-Adu and Singh, 1998).

According to Kaplan and Norton (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 (McCabe, 2001)

CHAPTER FIVE

IMPLEMENTATION OF THE MODEL AND RESULTS

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In this section of the study, an in depth data tabulated from the questionnaire that was distributed to the respondent construction organizations about the proposed performance measurement model.

5.1 General information

1. Number of years in construction market?

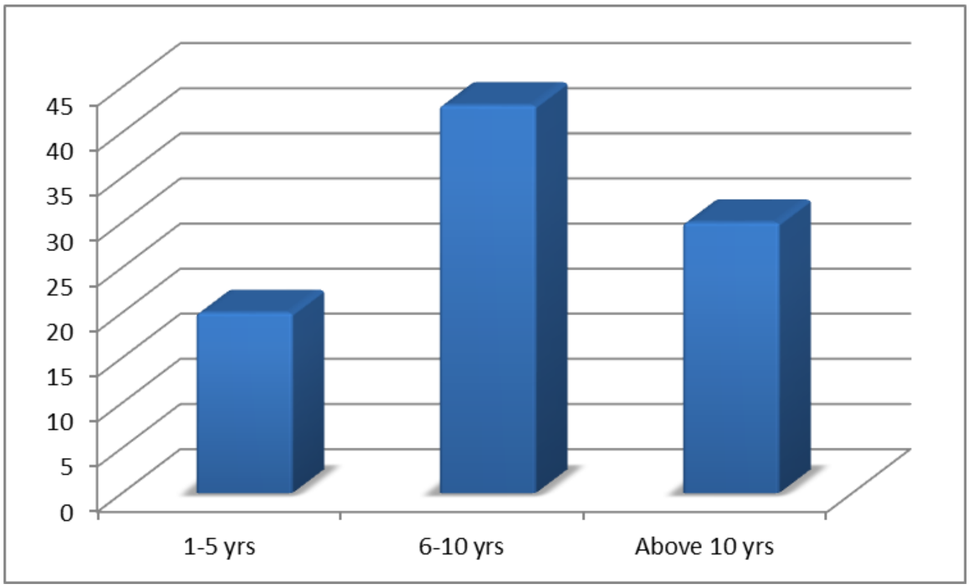


Figure (5.1) Organization experience (years)

2. Organization experience

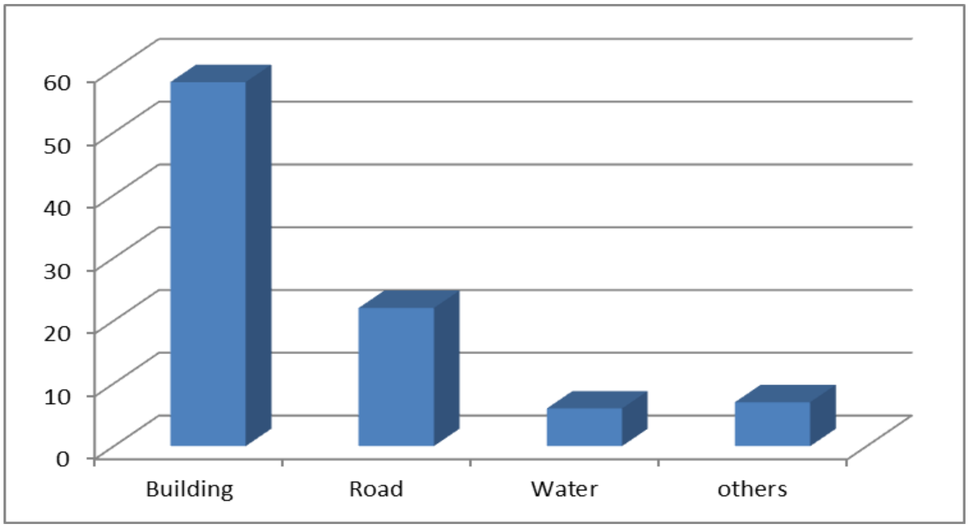


Figure (5.2) Organization Experience (field)

3. Is the organization work outside Sudan?

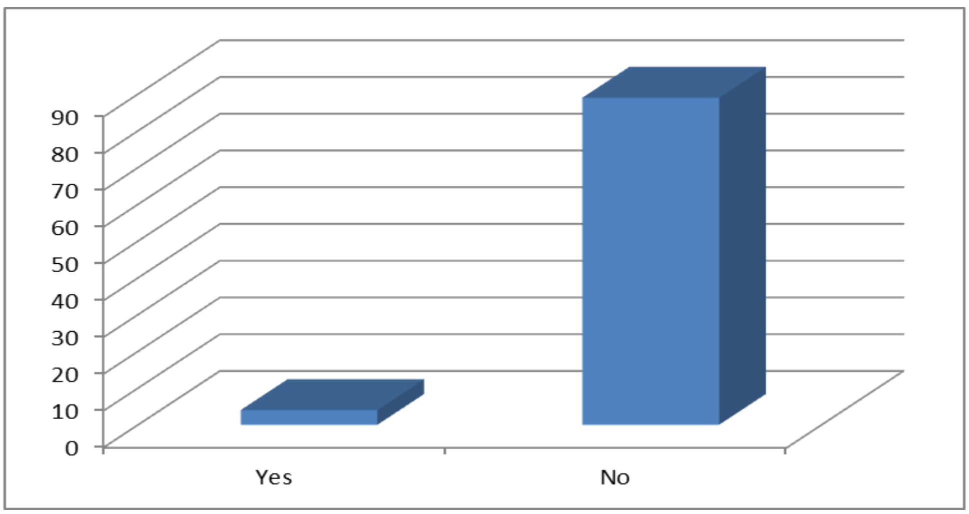


Figure (5.3) Organization place of work

4. Organization capital in million SDG

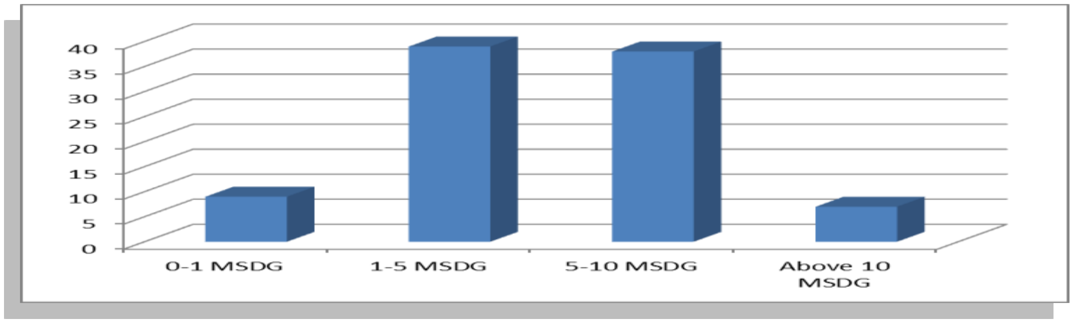
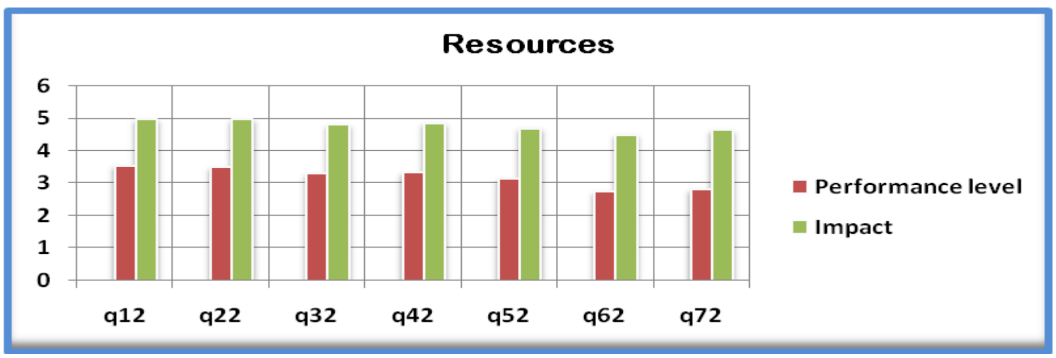


Figure (5.4) Organization capital

5.2 Resources

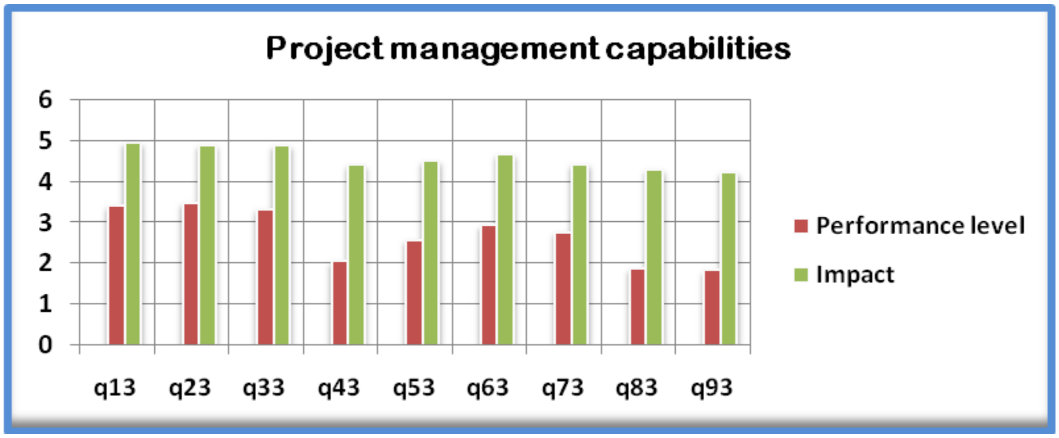


#	***Code***	***Descriptions***	***Performance level***	***Impact***
			Mean value	
1	*q12*	*Financial resources*	*3.5484*	*4.9785*
2	*q22*	*Technical competency*	*3.4946*	*4.9785*
3	*q32*	*Leadership*	*3.3011*	*4.8065*
4	*q42*	*Experience*	*3.3441*	*4.8602*
5	*q52*	*Organization image*	*3.1398*	*4.6989*
6	*q62*	*Infrastructure*	*2.7419*	*4.5054*
7	*q72*	*Human resources*	*2.8065*	*4.6452*

Figure 5.5 Resources

As shown in Figure (5.5) above, "financial resources" and "technical competency" parameters were found to be the most important among others even exceeding a major factor such as the "experience". However, the output of a construction project cannot be adequate without the existence of a technically competent team.

5.3 Project management capabilities

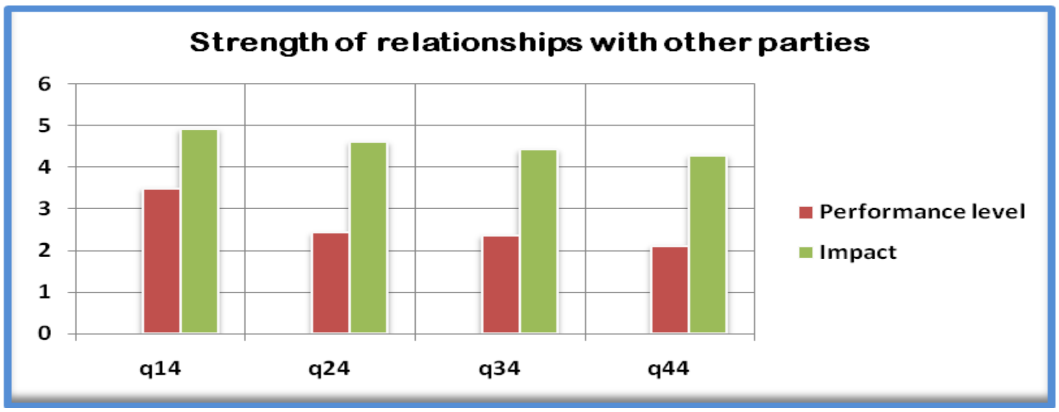


#	*Code*	*Descriptions*	*Performance level*	*Impact*
			Mean value	
1	*q13*	*Human resources management*	3.3871	4.9247
2	*q23*	*Cost management*	3.4624	4.8710
3	*q33*	*Quality management*	3.3118	4.8602
4	*q43*	*Schedule management*	2.0430	4.3871
5	*q53*	*Risk management*	2.5591	4.4839
6	*q63*	*Supply chain management*	2.9140	4.6452
7	*q73*	*Health & safety management*	2.7527	4.4086
8	*q83*	*Knowledge management*	1.8602	4.2688
9	*q93*	*R & D management*	1.8172	4.2043

Figure 5.6 Project management capabilities

The "Human resources management, cost and quality" were highlighted as the most important parameters among the competencies in project management (refer to Figure 5.6) above. They were also rated as the highest considering the respondent organizations. "Knowledge management" and "R&D management" competencies their values were the lowest ratings.

5.4 Strength of relationships with other parties



#	Code	Descriptions	Performance level	Impact
			Mean value	
1	q14	*Relations with government*	*3.4946*	*4.9140*
2	q24	*Relations with labor orgns.*	*2.4301*	*4.6129*
3	q34	*Relations with competitors*	*2.3656*	*4.4301*
4	q44	*Relations with community orgns.*	*2.1183*	*4.2903*

Figure 5.7 Strength of relationships with other parties

As shown in Figure (5.7), "Relations with government" was found to be the most important parameter not surprisingly as the government is the major customer in the construction projects in the

Sudan. 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. “Relations with community organizations” parameter gained the lowest ratings.

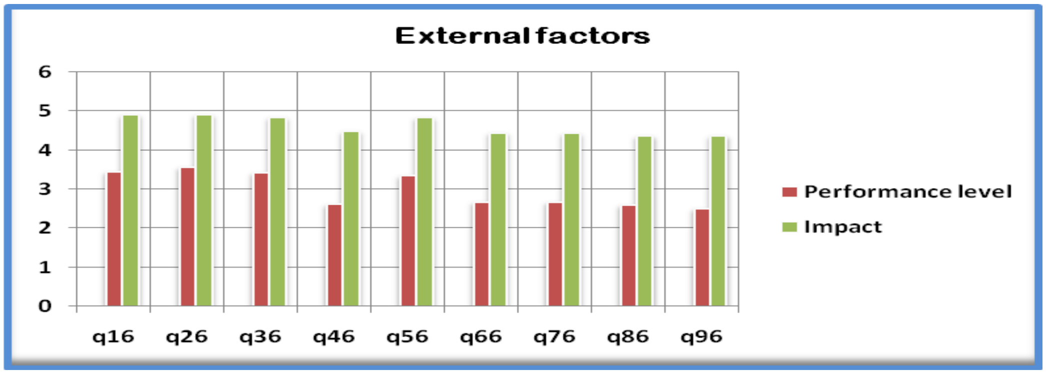
5.5 Strategic decisions

#	*Code*	*Descriptions*	*Performance level*	*Impact*
			Mean value	
1	*q15*	*Differentiation strategy*	*3.1935*	*4.8172*
2	*q25*	*Project selection strategies*	*2.6667*	*4.3441*
3	*q35*	*Market selection strategies*	*2.5914*	*4.2796*
4	*q45*	*Partner selection strategies*	*2.6129*	*4.3011*
5	*q55*	*Organization management strategies*	*2.6774*	*4.3118*
6	*q65*	*Customer relations strategy*	*2.9462*	*4.6129*

Figure 5.8 Strategic decisions

From the Figure (5.8), it can be inferred that, all variables have got nearly the same importance levels and ratings with an exception in "differentiation, customer relation, organization management, partner strategies, and market selection strategies". "Differentiation strategies" was rated as the highest of all variables while "Market selection strategies" was rated as the lowest.

5.6 External factors

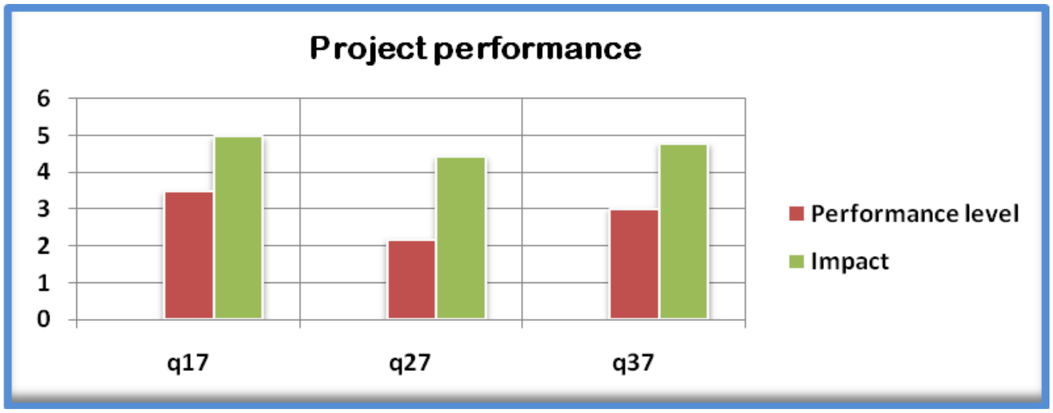


#	*Code*	*Descriptions*	*Performance level*	*Impact*
			Mean value	
1	*q16*	*International relations*	*3.4516*	*4.9032*
2	*q26*	*Macroeconomics factors*	*3.5699*	*4.9140*
3	*q36*	*Political factors*	*3.4301*	*4.8387*
4	*q46*	*Socio cultural factors*	*2.6129*	*4.4839*
5	*q56*	*Legal factors*	*3.3441*	*4.8370*
6	*q66*	*Suppliers power*	*2.6774*	*4.4516*
7	*q76*	*Demand*	*2.6774*	*4.4301*
8	*q86*	*Technology*	*2.6022*	*4.3656*
9	*q96*	*Market competitions*	*2.5054*	*4.3656*

Figure 5.9 External factors

"International relations", "macroeconomics factors", "political factors" and "legal factors" are the highest rated among others while "market competitions" was rated as the lowest.

5.7 Project performance

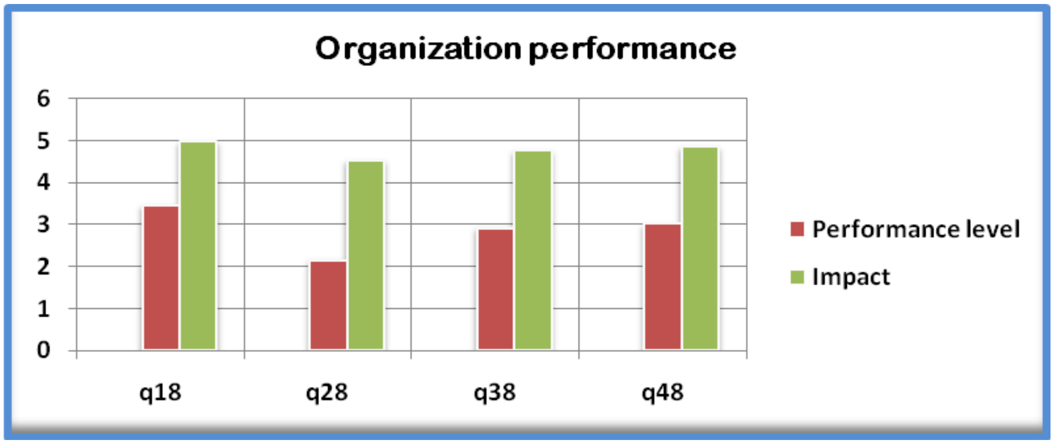


#	Code	Descriptions	Performance level	Impact
			Mean value	
1	q17	*Project profitability*	3.4946	4.9785
2	q27	*Internal customer satisfaction*	2.1828	4.4301
3	q37	*External customer satisfaction*	3.0215	4.7957

Figure 5.10 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 (5.10), a relative supremacy of "project profitability" was observed followed by the "external" and "internal" customer satisfaction.

5.8 Organization performance



#	Code	Descriptions	Performance level	Impact
			Mean value	
1	q18	Financial perspective	3.4731	4.9892
2	q28	Learning & growth perspective	2.1613	4.5376
3	q38	Internal business perspective	2.9247	4.7634
4	q48	Customer perspective	3.0215	4.8602

Figure 5.11 Organization performance

The importance level and ratings of the indicators of “organization performance” denote the expected final status of the respondent organizations. In this sense, status of an organization was examined by four dimensions of the very well known “balanced scorecard”. As seen in Figure (5.11), a realistic result was obtained and, “financial perspective” was found to be most important, followed by “customer”, “internal business” and “learning and growth” perspectives.

CHAPTER SIX

DISCUSSIONS, ANALYSIS AND INTERPRETATION OF RESULTS

CHAPTER SIX

DISCUSSIONS, ANALYSIS AND INTERPRETATION OF RESULTS

In this section of the study, an in depth analysis of the acquired data will be explained. In order structure the causal relationship between the 42 variables which were selected as being the key measures and indicators of performance.

6.1 Validity of the performance measures and indicators

The data obtained from the 93 construction organizations and 325 projects were analyzed by using Structural Equation Modeling (SEM) software package called EQS 6.2. In this part of the thesis, after testing the validity of the measurement model, the analysis results of the structural model will be presented.

6.1.1 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.

6.1.2. 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 6.2 analysis results, as seen in Table (6.1), Cronbach's alpha values were 0.943 for "resources", 0.787 for "project management capabilities", 0.923 for "external factors", 0.927 for "strategic decisions ", 0.852 for "strength of relationships with other parties", 0.716 for "projects performance" and 0.846 for "organization performance".

These reliability values are satisfactory since the Cronbach's alpha coefficients are all above 0.70, the minimum value recommended by Nunnally (2010).

Table 6.1 Cronbach's alpha of latent variables

LATENT VARIABLE	CRONBACH'S ALPHA VALUES
Resources	*0.943*
Project management capabilities	*0.787*
External factors	*0.923*
Strategic decisions	*0.927*
Strength of relation with others	*0.852*
Project performance	*0.716*
Organization performance	*0.846*

6.1.3 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 parameters were assessed and all factor loadings were found to be significant at $\alpha = 0.05$ as in Table (6.2).

Table 6.2 Latent variable "Resources" factor loading

RESOURCES	FACTOR LOADINGS
Financial resources	*0.753*
Technical competencies	*0.886*
Leadership	*0.837*
Experience	*0.886*
Organization image	*0.840*
Infrastructure	*0.817*
Human resources	*0.820*

Table 6.3 Latent variable "Project management capabilities" factor loadings

PROJECT MANAGEMENT CAPABILITIES	FACTOR LOADINGS
Human resources management	0.625
Cost management	0.934
Quality management	0.852
Schedule management	0.682
Risk management	0.789
Supply chain management	0.694
Health & safety management	0.199
Knowledge management	0.885
Research & development capabilities	0.855

Table 6.4 Latent variable "External factors" factor loadings

EXTERNAL FACTORS	FACTOR LOADINGS
International relations	0.765
Macroeconomics factors	0.948
Political factors	0.762
Socio economical factors	0.652
Legal factors	0.534
Supplier power	0.789
External demand	0.874
Technology	0.828
Market competition	0.812

Table 6.5 Latent variable "Strength of relationships with other parties" factor loadings

STRENGTH OF RELATIONSHIP	FACTOR LOADINGS
Relations with government	*0.909*
Relations with labor organizations	*0.664*
Relations with competitors	*0.444*
Relations with community organizations	*0.609*

Table 6.6 Latent variable "Strategic decisions" factor loadings

STRATEGIC DECISIONS	FACTOR LOADINGS
Differentiation strategies	*0.588*
Projects selection strategies	*0.874*
Market selection strategies	*0.944*
Partners selection strategies	*0.940*
Organization management strategies	*0.838*
Customer relations strategies	*0.415*

Table 6.7 Latent variable "Projects performance" factor loadings

PROJECT PERFORMANCE	FACTOR LOADINGS
Project profitability	*0.628*
Internal customer satisfaction	*0.454*
External customer satisfaction	*0.822*

Table 6.8 Latent variable "Organization performance" factor loadings

ORGANIZATION PERFORMANCE	FACTOR LOADINGS
Financial perspective	*0.485*
Learning & growth perspective	*0.499*
Internal business perspective	*0.769*
Customer perspective	*0.686*

6.1.4 Discriminant validity testing of performance measures

The discriminant validity is the extent to which the items representing a latent variable discriminate that construct from other items representing other latent variables.

Low correlations between variables indicate the presence of discriminant validity. The correlation metrics calculated for all constructs shows that all intercorrelations are below 0.90, suggesting that there is no multicollinearity (Hair et al. 2010), but indicating that the constructs have discriminant validity & these correlations provide evidence that they are complementary.

6.2 Structural model (Hypothesis testing application)

Steps of Structural Equation Modeling:

□ Specification of the model,

□ Estimation and identification of the model,

□ Evaluation of the model fit.

6.2.1 Specification of the proposed model

This model is specified by the following direct path equations:

□ $\mathbf{O} = \mu_1 * \mathbf{P} + \mu_2 * \mathbf{R} + \mu_3 * \mathbf{S} + \alpha_1$. ....(1).

□ $\mathbf{P} = \mu_4 * \mathbf{R} + \alpha_2$ ....(2).

□ $\mathbf{S} = \mu_5 * \mathbf{PMC} + \alpha_3$...(3).

□ $\mathbf{R} = \mu_6 * \mathbf{SR} + \mu_7 * \mathbf{PMC} + \alpha_4$..(4).

□ $\mathbf{SR} = \mu_8 * \mathbf{E} + \alpha_5$...(5).

□ $\mathbf{PMC} = \mu_9 * \mathbf{E} + \alpha_6$..(6).

Where; **O** is organization performance, **P** is project performance, **R** is resources, **S** is strategic decisions, **PMC** is project management capabilities, **SR** is strength of relationship with other parties, **E** is external factors, **μ** is a path coefficient and **α** is an error term.

6.2.2 Estimation and identification of the proposed model

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 robust model fit indices such as NNFI, CFI, RMSEA and the ratio of $\chi 2$ per degree of freedom are provided in the analysis report.

6.2.3 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. 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.

Table 6.9 Model fit indices for latent variable "Resources"

Fit indices	Allowable range	Overall
NNI	0 (no fit)-1 (perfect fit)	*0.861*
CFI	0 (no fit)-1 (perfect fit)	*0.903*
RMSEA	< 0.1	*0.083*
$\chi 2$/ dof	< 3	*1.770*

Table 6.10 Model fit indices for latent variable "Strength of relationships with other parties"

Fit indices	Allowable range	Overall
NNI	0 (no fit)-1 (perfect fit)	*0.945*
CFI	0 (no fit)-1 (perfect fit)	*0.948*
RMSEA	< 0.1	*0.082*
$\chi 2$/ dof	< 3	*1.790*

Table 6.11 Model fit indices for latent variable "Project management capabilities"

Fit indices	Allowable range	Overall
NNI	0 (no fit)-1 (perfect fit)	*0.922*
CFI	0 (no fit)-1 (perfect fit)	*0.936*
RMSEA	< 0.1	*0.080*
$\chi 2$/ dof	< 3	*1.460*

Table 6.12 Model fit indices for latent variable "Strategic decisions"

Fit indices	Allowable range	Overall
NNI	0 (no fit)-1 (perfect fit)	*0.882*
CFI	0 (no fit)-1 (perfect fit)	*0.910*
RMSEA	< 0.1	*0.099*
$\chi 2$/ dof	< 3	*1.680*

Table 6.13 Model fit indices for latent variable "External factors"

Fit indices	Allowable range	Overall
NNI	0 (no fit)-1 (perfect fit)	*0.791*
CFI	0 (no fit)-1 (perfect fit)	*0.796*
RMSEA	< 0.1	*0.098*
$\chi 2$/ dof	< 3	*1.810*

Table 6.14 Model fit indices for latent variable "Project performance"

Fit indices	Allowable range	Overall
NNI	0 (no fit)-1 (perfect fit)	*0.962*
CFI	0 (no fit)-1 (perfect fit)	*0.962*
RMSEA	< 0.1	*0.082*
χ2/ dof	< 3	*1.270*

Table 6.15 Model fit indices for latent variable "Organization performance")

Fit indices	Allowable range	Overall
NNI	0 (no fit)-1 (perfect fit)	*0.967*
CFI	0 (no fit)-1 (perfect fit)	*0.969*
RMSEA	< 0.1	*0.021*
χ2/ dof	< 3	*1.060*

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.

Reliability values of the constructs were also calculated and presented in the previous parts of the analysis results.

Having obtained reliable constructs and constituent variables with significant factor loadings and goodness of fit indices within the allowable ranges for each construct, and the structural model will assess below in Figure (6.1).

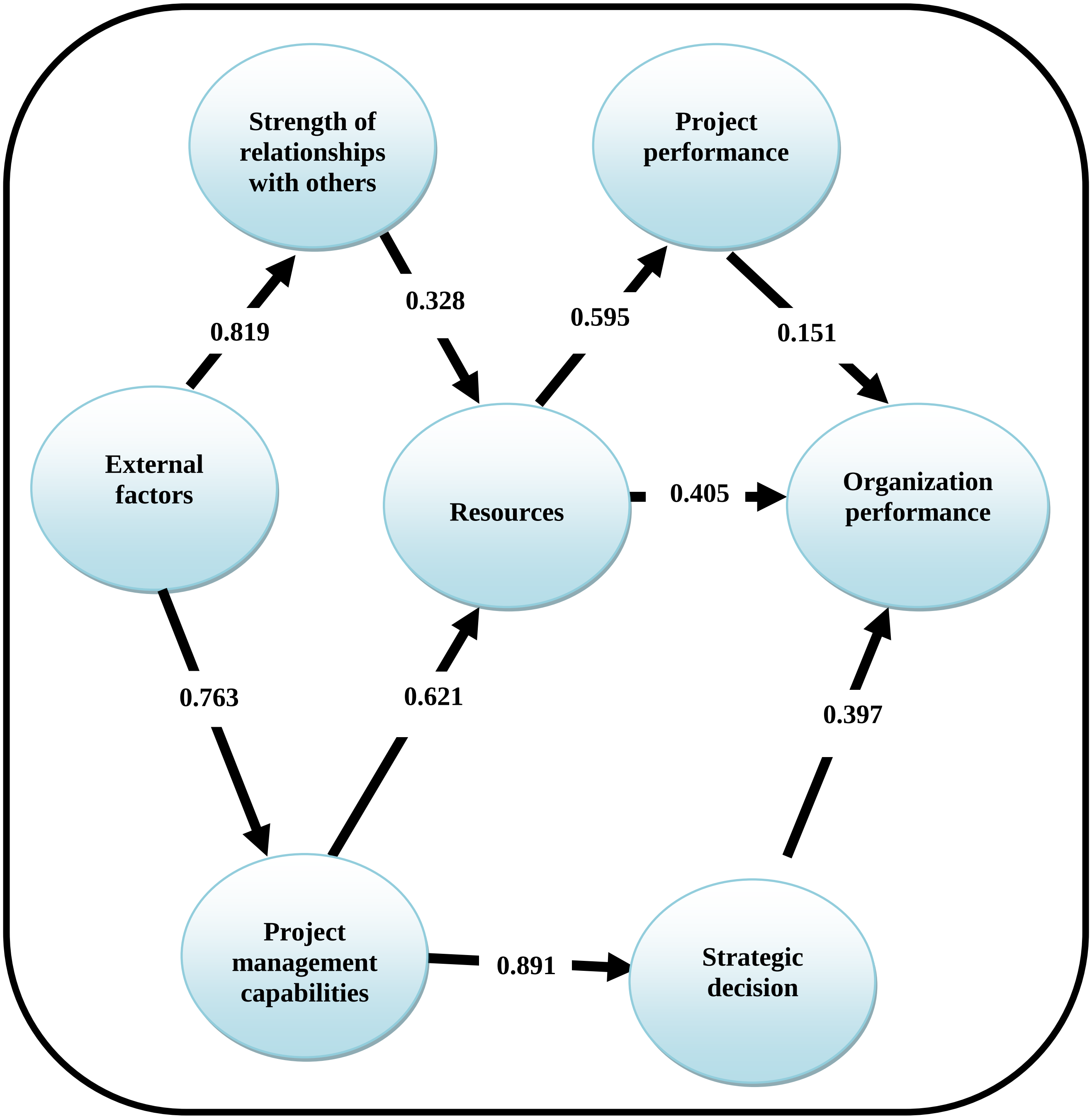


Figure 6.1 The initial (proposed) model

Table 6.16 Model fit indices for "The initial model"

Fit indices	Allowable range	Overall
NNI	0 (no fit)-1 (perfect fit)	*0.727*
CFI	0 (no fit)-1 (perfect fit)	*0.742*
RMSEA	< 0.1	*0.082*
$\chi 2$/ dof	< 3	*1.500*

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.

Reliability values of the constructs were also calculated and presented in the previous parts of the analysis results. Having obtained reliable constructs and constituent 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 (6.1). The overall model fit indices listed in Table (6.16) interpreted a relatively good fit of the data since all findings were within the allowable ranges.

In Figure (6.1), 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 "organization 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 often, 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.

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 preferred model should not be rejected in favor of statistically equivalent ones.

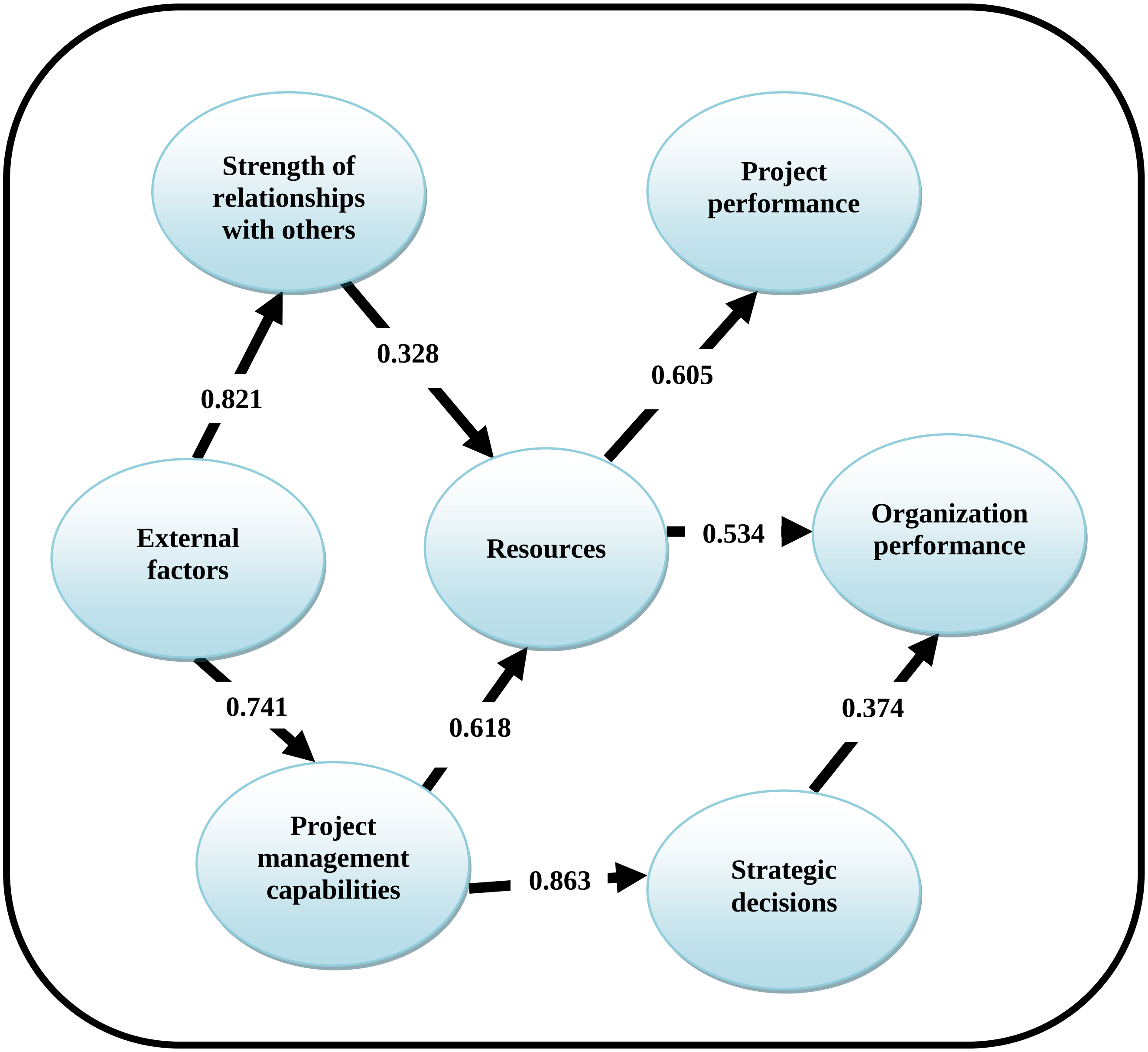


Figure 6.2 The respecified model

Table 6.17 Model fit indices for "The respecified model"

Fit indices	Allowable range	Overall
NNI	0 (no fit)-1 (perfect fit)	*0.787*
CFI	0 (no fit)-1 (perfect fit)	*0.783*
RMSEA	< 0.1	*0.082*
$\chi 2$/ dof	< 3	*1.500*

In the respecified model, insignificant path coefficient between "project performance" and "organization performance" constructs was eliminated (Figure 6.2). However, as mentioned before, the relation between the "project performance" and "organization performance" is inevitable. Thus, it was decided to consider this strong relationship in an additional structural model which is going to be presented later.

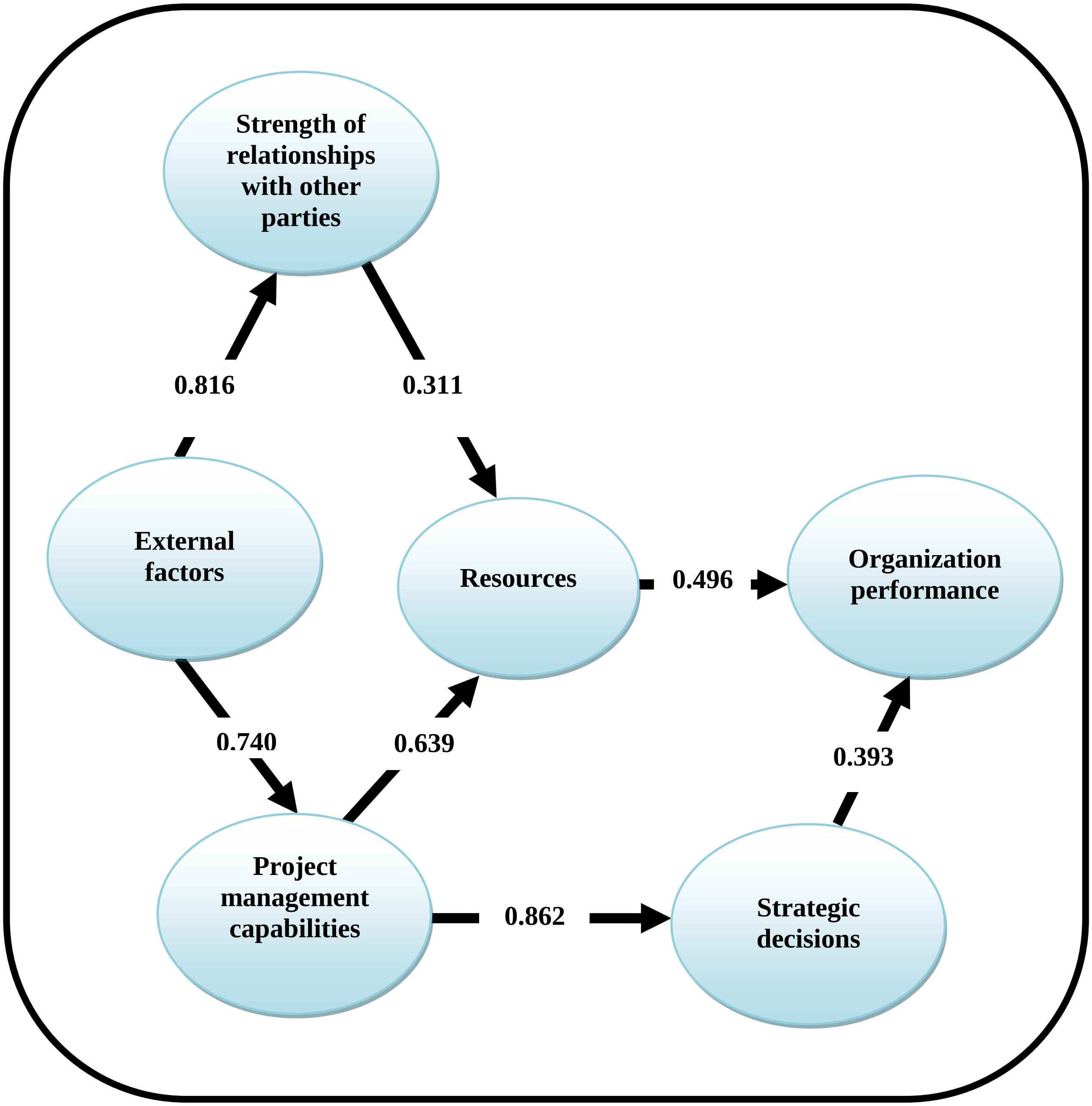


Figure 6.3 The final model

Table 6.18 Model fit indices for "The final model"

Fit indices	Allowable range	Overall
NNI	0 (no fit)-1 (perfect fit)	*0.868*
CFI	0 (no fit)-1 (perfect fit)	*0.860*
RMSEA	< 0.1	*0.067*
$\chi 2$/ dof	< 3	*1.480*

Table 6.19 Comparison of the models fit indices

Fit indices	Initial model	Respecified model	Final model
NNI	*0.727*	*0.787*	*0.862*
CFI	*0.742*	*0.783*	*0.860*
RMSEA	*0.082*	*0.082*	*0.067*
$\chi 2$/ dof	*1.500*	*1.500*	*1.480*

6.3 Effect of "project performance" on "organization performance"

The effects of project performance on organization performance were investigated through their constituent variables. Projects performance was indicated by three factors (project profitability, internal customer satisfaction and external customer satisfaction) in the model which summarize the critical success factors of a project.

The indicators of organization performance were taken from the perspectives of the Balanced Scorecard of Kaplan and Norton, namely, "Financial", "Learning and growth", "Internal business" and "Customer" perspectives.

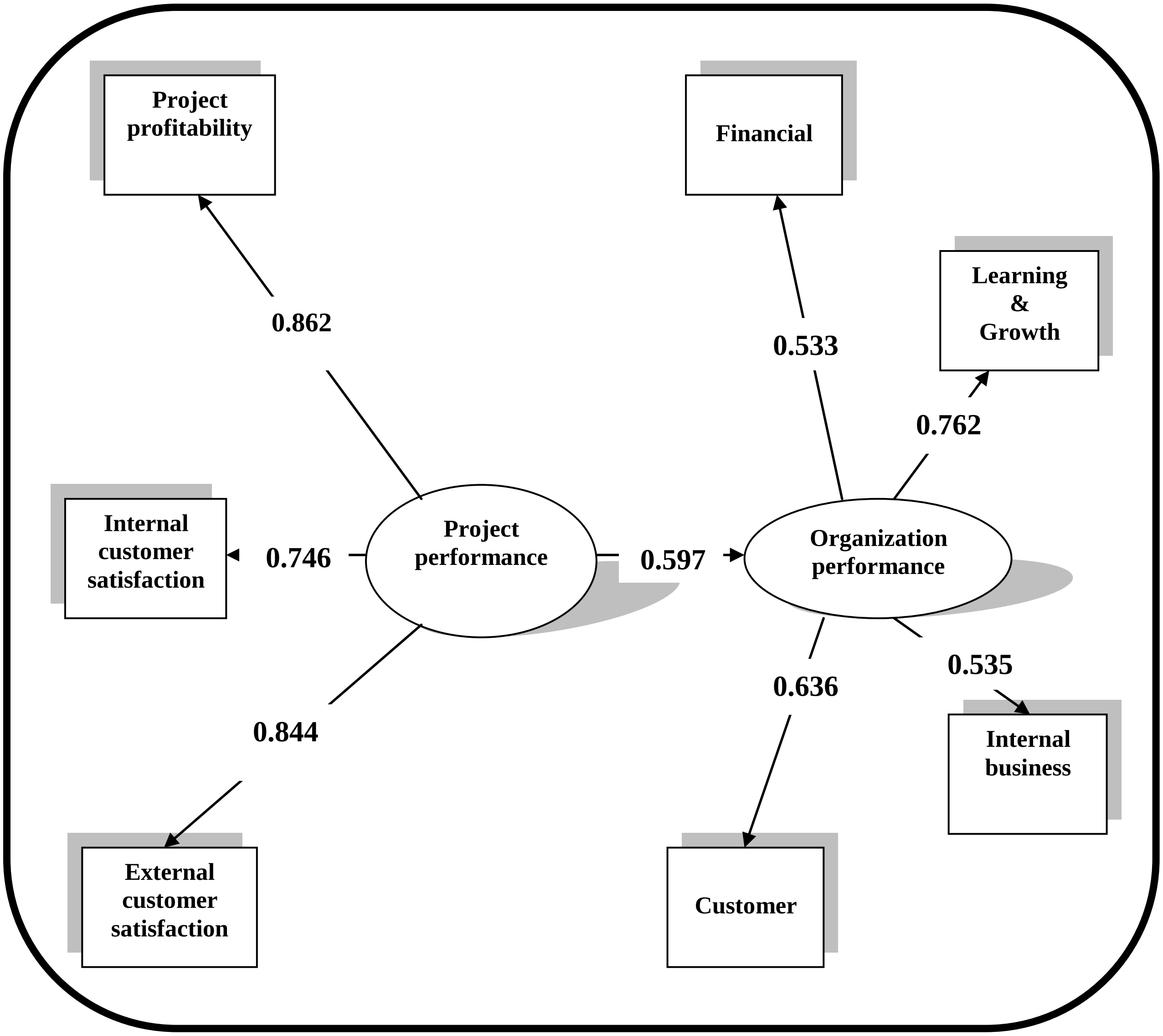


Figure 6.4 The effect of "project performance" on "organization performance"

The structural model was analyzed and the model fit indices were found to be very close to perfect values of recommended ranges as can be seen in Table (6.20) which can be considered as an evidence of the strength of relationship between two constructs.

Table 6.20 Model fit indices for "projects performance to organization performance"

Fit indices	Allowable range	Overall
NNI	0 (no fit)-1 (perfect fit)	*0.961*
CFI	0 (no fit)-1 (perfect fit)	*0.965*
RMSEA	< 0.1	*0.077*
$\chi 2$/ dof	< 3	*1.340*

Within the structural model, for every unit "projects performance" goes up, "organization performance" also goes up 0.597. Moreover, the effects of measures of projects performance on organization performance indicators can also be analyzed such as, for example;

*Project profitability * 0.862 * 0.597 = 0.533 * Financial perspective,*

*Project profitability * 0.966 = Financial perspective.*

The rest of the equations which have the ability to evaluate the effects of "projects performance" on "organization performance" indicators are shown below:

*0.966*Project profitability*	*= Financial perspective*
*0.836*Internal customer satisfaction*	*= Financial perspective*
*0.990*External customer satisfaction*	*= Financial perspective*
*0.675*Project profitability*	*= Learning & growth perspective*
*0.585*Internal customer satisfaction*	*= Learning & growth perspective*
*0.693*External customer satisfaction*	*= Learning & growth perspective*
*0.962*Project profitability*	*= Internal business perspective*
*0.932*Internal customer satisfaction*	*= Learning & growth perspective*

*0.987*External customer satisfaction*	*= Learning & growth perspective*
*0.809*Project profitability*	*= Customer perspective*
*0.700*Internal customer satisfaction*	*= Customer perspective*
*0.830*External customer satisfaction*	*= Customer perspective*

6.4 Overall view of the analysis results

Data collected from 93 construction organizations and 325 projects held by those 93 organizations participated into the survey were analyzed in order to determine the key performance measures and the indicators for the construction industry both from the project and the organization perspectives.

The main objective was to design 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 program package called EQS 6.2 was used for the statistical analysis. According to the analysis results, all Cronbach's alpha values were well beyond 0.7 which was the threshold suggested by Nunnally (2010) (Table 6.1). All factor loadings for the indicators of latent variables were found to be significant at α=0.05. Moreover, goodness of fit indices for each construct was in the recommended ranges of Kline (2011).

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 improve it with new hypothetical relations. Accordingly, the initial model (Figure 6.1) 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 having the ability to measure performance from different perspectives. In the first model, effects of determined measures of performance were shown on both projects performance and organization performance which makes it a single tool to measure project performance and organization performance in a single measurement model (Figure 6.1). In the second model, neglecting the effects of performance measures on projects performance, their effects on organization performance was only considered (Figure 6.2). In the last and the final partial model, the effects of projects performance on organization performance were investigated (Figure 6.3).

This very well-known relationship was evaluated from the measures of projects performance to the indicators of organization performance which were taken as the perspectives of balanced scorecard. The effects of each variable on each perspective of organization performance were demonstrated in mathematical equations. Goodness of fit indices for all three models was found to be quite satisfactory as mentioned in Tables (6.16, 6.17 & 6.18).

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 organizations and the projects performance as well.

6.5 "Organization strengths/weaknesses" versus project management capabilities

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 (6.21) and Figures (6.5, 6.6 & 6.7). The hypothesis set in the study that "organization strength/weaknesses" which is defined by "organization resources", "strategic decisions" and "strength of relationships with other parties" is a key factor in the development of "project management capabilities" 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, the majority of whom pointed out the importance of "project management capabilities" among other criteria.

Based on the above findings, it can be stated that "organization strengths/weaknesses" plays an important role on the success of projects since it has a direct and significant influence on "project management capabilities". The positive influence of companywide characteristics on project management capabilities is also supported by other studies. According to the strategic management literature, companywide characteristics are defined as the strengths of an organization and the strengths of an organization have the potential to be translated into an opportunity for the organization as well.

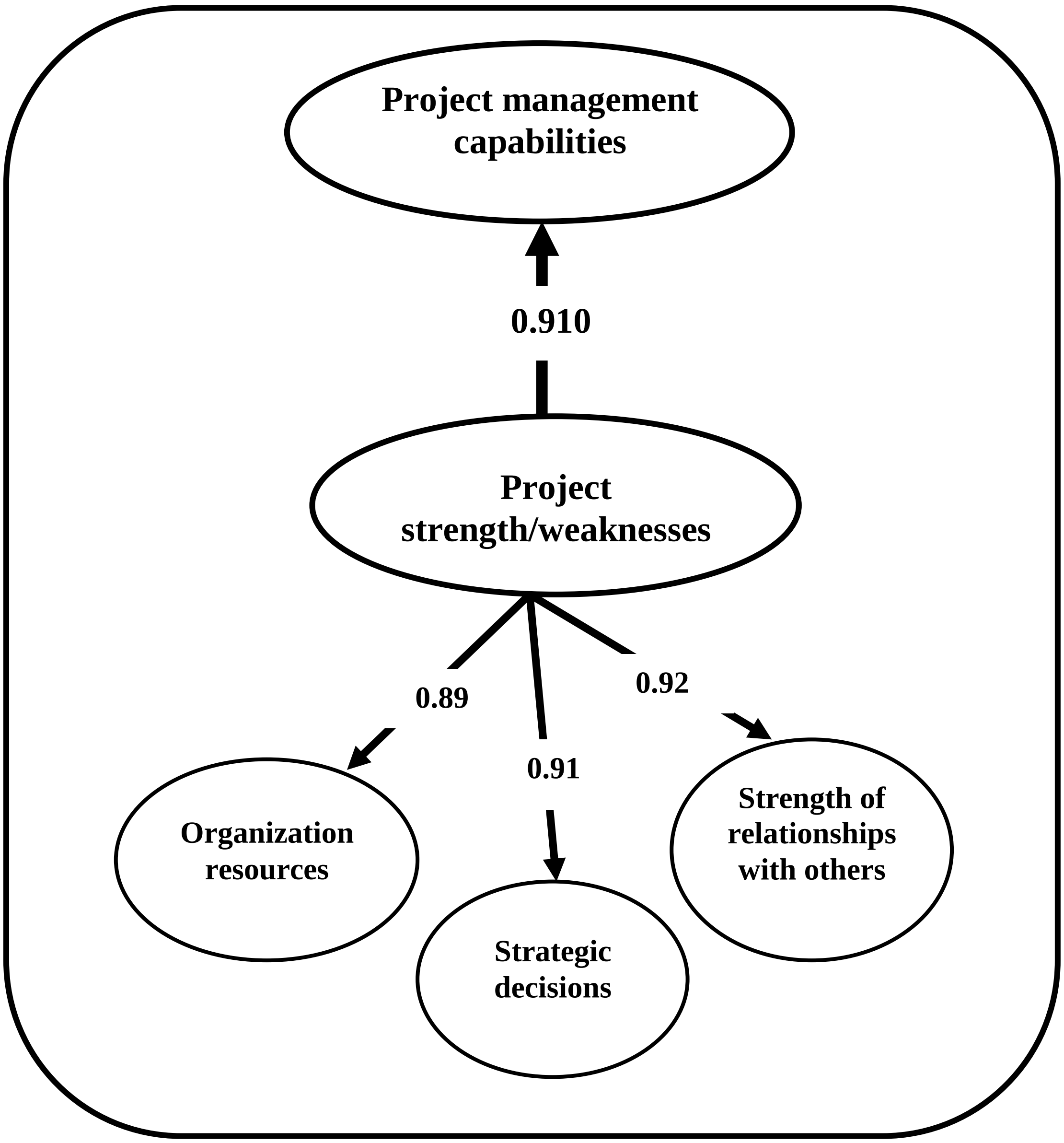


Figure 6.5 Relations of "organization strengths/weaknesses"

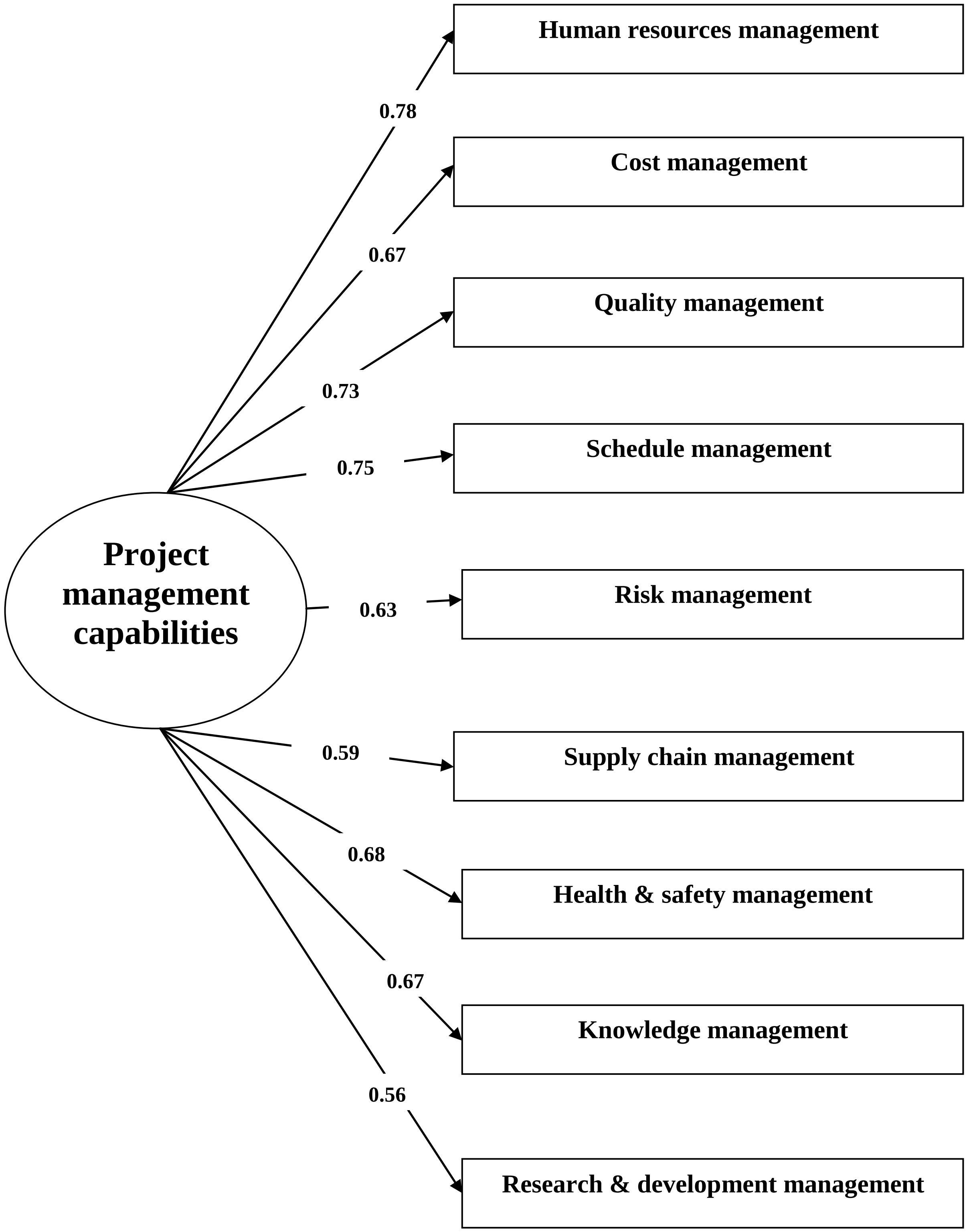


Figure 6.6 Project management capabilities relations

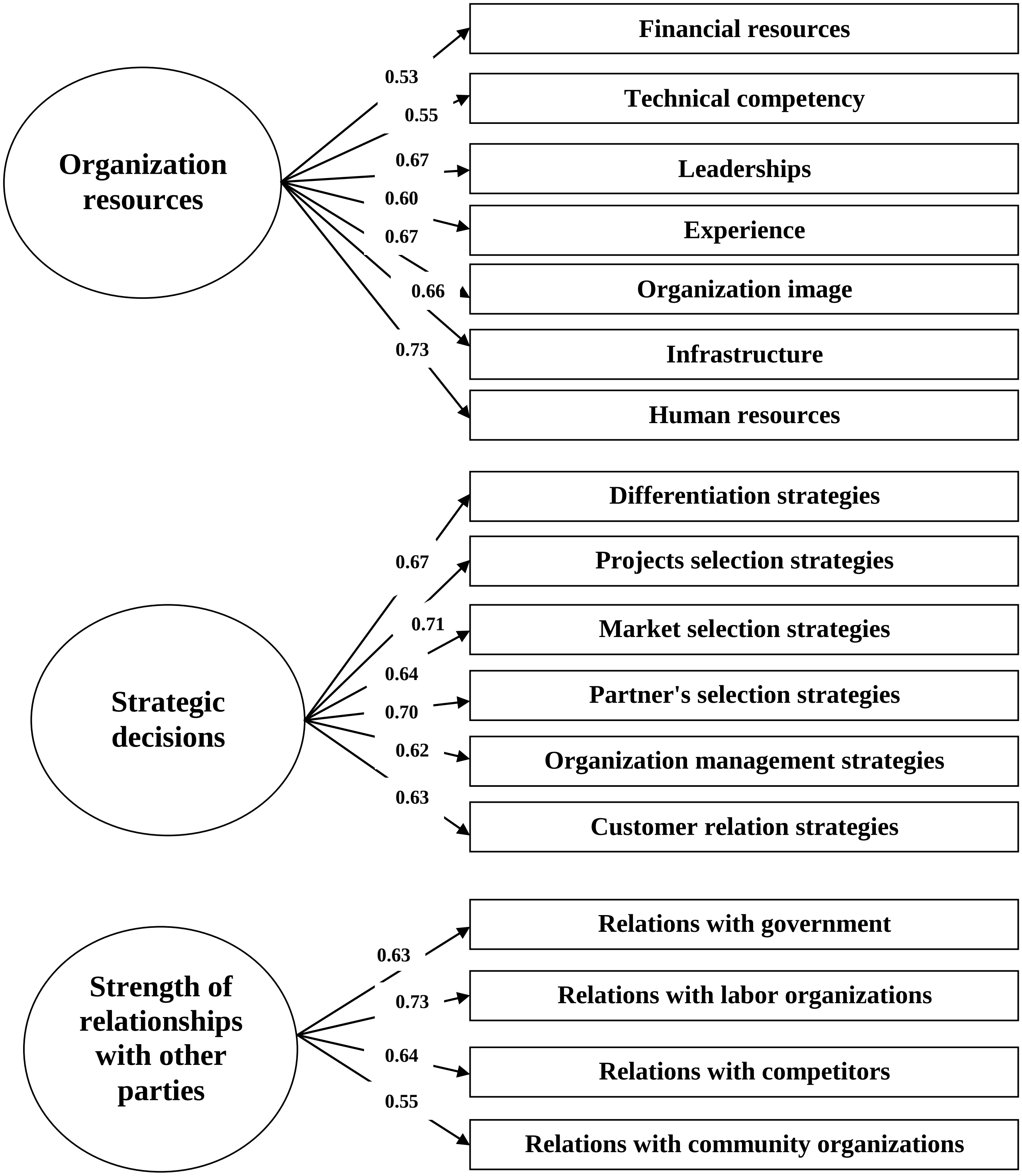


Figure 6.7 "Organization resources", "strategic decisions" and "strength of relationships with other parties" relations

Table 6.21 Model fit indices

Fit indices	Allowable range	Overall
NNI	0 (no fit)-1 (perfect fit)	*0.845*
CFI	0 (no fit)-1 (perfect fit)	*0.837*
RMSEA	< 0.1	*0.082*
$\chi 2$/ dof	< 3	*1.470*

6.5.1 "Organization resources" versus "project management capabilities"

"Organization resources" which is one of the determinants of "organization Strengths / weaknesses" with a factor loading of 0.92 depends on the size of the organization and the competitive environment in which the organization operates.

In order to have a positive impact on project success, organization resources should be valuable, rare, inimitable, and should lack of substitutes (King and Zeithaml, 2001).

Based on their higher factor loadings in Figures (6.5, 6.6, 6.7), it can be stated that "leadership", "organization image", "human resources" and "infrastructure" are important resources.

While leadership is of importance in the execution of all project management activities, "organization image", receptiveness to "innovation", "research and development capability" and "human resources" can be considered as sources of competitive advantage. Leadership in developing and using innovative management techniques is expected to affect project management capabilities in "quality", "cost", and "schedule" management.

6.5.2 “Strategic decisions” versus "project management capabilities"

“Strategic decisions”, with a factor loading of 0.90 is a major indicator of “organization strengths/weaknesses”, and in turn impacts project management capabilities significantly.

Emphasizing the importance of strategic decisions, Child (1972) states that organizations 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 six constituent variables, all closely related to competition. All have the power to manipulate the course of action in a project.

Market/project/ partner selection strategies conducted along with differentiation and organizational management strategies can constitute important organization strengths or weaknesses, which in turn can impact project management capabilities.

Market, project, partner selection is likely to impact project management capabilities such as knowledge management, risk management and cost management. All the above strategies implemented through comprehensive customer relation strategies in order to survive the organization.

6.5.3 “Strength of relationships with other parties” versus "project management capabilities"

“Strength of relationships with other parties” was also found to be loading significantly on “project management capabilities”. The positive influence of strong relationships with other parties was also discussed and confirmed in the literature. The strength of the relationships between the contractor and the client facilitates the operations and helps to achieve better performance.

Considering the sophisticated nature of the industry and the cultural values of the society, the relationship of a construction organization were assessed not only with the client, but also with government agencies and labor unions. On this account, the communication and negotiation skills of organization executives have to be stressed. The strength of an organization’s relationships with other parties is expected to impact project management capabilities such as quality, schedule and human resources management.

6.5.4 Conclusion of "organization strengths / weaknesses" versus "project management capabilities"

According to the model presented in Figures (6.5, 6.6 & 6.7), organization strengths/weaknesses are defined by the latent variables “organization resources”, “strategic decisions” and “strength of relationships with other parties”. It was hypothesized that “organization strengths/weaknesses”, so defined, impacts “project management capabilities”. In order to test this hypothesis, a questionnaire survey was administered to 93 Sudanese construction organizations.

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 Nunnally (2010) which indicated that the internal reliability of the individual constructs was quite high.The goodness of fit indices presented in Table (6.21) 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 and has a very strong path coefficient (0.91) shown in Figure (6.5). Beyond the success criteria commonly mentioned in previous research on project management, the considerable influence of organization 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 organization should adjust their resources, 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, organizations 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 should be developed with prospective community organizations, labor unions, and government.

6.6 Organization performance

In this study, “financial performance”, “learning and growth”, “internal business” and “customer satisfaction” were used as the general indicators of organization performance in place of “cost, time and quality”. The reason for selecting BSC was its established status in the literature. By combining “financial performance”, “learning and growth”, “internal business” and “customer satisfaction”, “organization 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 “organization performance” were found to be 0.485 for “financial perspective”, 0.499 for “learning and growth perspective”, 0.769 for “internal business perspective” and 0.686 for “customer perspective”.

It can be argued from this finding that, “internal business perspective” with the highest factor loading value under this construct has the potential to be affected by performance measures and indicate the performance level of the organization much more than the other factors. “Customer perspective”, “learning and growth 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 an organization 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 organizations 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 organizations to make continuous improvements in their service, processes and products.

An organization's ability to innovate, learn and grow is directly related to its own value. Only through these abilities, can a construction organization penetrate into new markets, operate more complex projects and increase profit in short terms; grow and thereby increase shareholder value in the long term.

6.7 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 “internal customer satisfaction” and “external customer satisfaction” alongside “project profitability”.

The factor loadings of these variables were found to be as 0.628 for “project profitability, 0.454 for “internal customer satisfaction” and 0.822 for “external customer satisfaction”. Considering the significant higher loading of “external customer satisfaction” it can be inference that long term and strategic decisions should displace short term acquisitions.

As mentioned in literature, long-term strategies do not have to bring profit to the organization in the short-term. This finding is complementary with “organization performance” in which “internal business perspective” was deemed to rate more than the other variables. Therefore, the increasing importance of qualitative performance measures which provide organizations 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 0.628 is no surprising given the high importance level of project profitability observed from the descriptive statistics of the data. "Internal customer satisfaction" rated relatively low compared to other variables of this factor even though it can still be considered as high with a factor loading of 0.454. Many organizations today have an organization mission that focuses on customer who corresponds to "internal customer" in construction industry. Customer's concerns mainly rely as mentioned in literature on four categories which are time, quality, performance, and service. Accordingly, the success of a project depends on the satisfaction of the expectation of the customer in these terms.

CHAPTER SEVEN

CONCLUSION & RECOMMENDATIONS

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

7.1 CONCLUSIONS

Globalization brought more capacity and resources to construction organizations, expanded the market areas, variety of projects and partners and thereby increased a major driver of improvement called competitiveness. However, as a result of globalization, unexpected economical fluctuations both in national and global level including unforeseen difficulties and risks brought also threats to construction organizations as well as the opportunities.

Consequently, performance management of organizations and projects as a strategic decision making tool became an important subject of interest during the last decades. It is observed 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.

Through the literature it is observed that positive effects from performance measurement such as improved customer satisfaction and organization image, increased productivity and business improvement. Considering these, it can be said that performance measurement is important for organizations 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 organizations, it observed that sometimes the cost of introducing and implementing performance measurement exceeded the potential benefits of it. Then it is concluded 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 performance measurement systems has limited the freedom of managers due to its rigidity.

Hence, considering the needs of the industry and the potential benefits, a performance measurement model including five latent variables, namely "resources", "strength of relationships with other parties", "project management capabilities", "strategic decisions" and "external factors" were determined to evaluate the "organization performance” and the “project performance”. All latent variables had their constituent variables with a total number of 42 variables.

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

Data collected from the organizations were analyzed 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 was 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 testing.

The final model which has a potential to be used in construction organizations 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 organizations. Analysis results also verified the validity of the constructs.

 “Resources” construct of the model has a direct effect on “project performance” and “organization 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, “research and development capability” was found to be more prominent than the other variables which justified the fact that adaptation of an organization 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 “research & development capability”. In this regard “research and development” plays a key role to raise the profile of the construction industry.

Further, successful implementations of “research and development” activities create the opportunity for the construction organizations to be competitive in the international market. Despite the importance of “research and development” 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 of an organization 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 organization 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.

 It was also stated before that organizations can achieve higher performance by adopting different competitive positioning alternatives based on strategic decisions. Higher factor loadings of the construct interpret that competitive positioning of an organization is mostly effected by “project” and “partner” selection strategies respectively.

An organization should evaluate its proficiency in “resources” as well as “project management capabilities” 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 organizations.

As a result, partnering of organizations 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 party, 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 should be established by the organization 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 also the indirect impact on “project performance” and “organization performance” as well.

Positive influence of strong relationships was discussed and confirmed also in the literature. 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”.

 Even though most researchers associate resources directly with organization performance, it was found that, “project management capabilities” enhance organization capabilities such as “finances” through “profitable-projects”, “leadership” and “organization image” through successful project performance and “technical competency” and organization “experience” through the exercise of project management expertise.

Moreover, the results of the analysis indicated that, “Project management capabilities” 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 “supply chain management” across projects.

 “Macro-economic” and “political conditions” of a country influence a governments’ policy on its investments for government funded construction projects. On the other hand, considering the Sudanese construction organizations, 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 an organization indirectly, effecting the strength of relationships with the government of the host country thereby lowering the bureaucracy and eliminating causes related to “legal conditions”.

- Construction is an industry which assembles separate organization in a temporary multidisciplinary organization, to produce utilities like buildings, roads, bridges, etc. In this regard, construction organizations are project based organizations and it is not far-fetched to argue that “project performance” has a direct effect on “organization performance”. Therefore, it was decided to evaluate the effects of “project performance” measures such as project profitability and client/user satisfaction to the organization, on “organization 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 subjective measures among objective 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.

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 organizations.

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, organizational learning, and customer satisfaction thereby long term contributions of the individual projects to enhance the performance perspectives which have the ability to provide sustainability to the organizations.

The proposed performance measurement tool extrapolates the "resources" and "project management capabilities" that the organization 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 organization.

7.2 Recommendations

1. It appears that the use of performance measurement systems have both negative and positive effects on the organization but in the meantime 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 judgments of the industry professionals.

2. 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 organizations 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.

7.3 Limitations and constraints

The limitations related to the research mainly based on the data collection process. Data were collected from construction organizations established in Sudan and registered in both Sudanese Contractor Association (SCA) and Organizing Council for Engineering Works Contractors (OCEWC). Although most of the respondent organizations work nationally, measures were determined according to their availability in Sudanese construction industry since respondents were Sudanese organizations.

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.

The main constraint that the research faced was the culture of Sudanese organizations of dealing with questionnaires of no importance to answer it with an in depth care. Besides that an appropriate data analysis software is not available in Sudan.

7.4 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 organizations 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 it's suggested that:

1. The investigation of performance measures may be maintained constantly and updated to catch new developments. Moreover re-judging the relations between the factors performance model may be redesigned according to up to date information.

2. Questionnaire survey was administered to organizations established in Sudan therefore perceptions of only Sudanese organizations were acquired. The conclusions of the research may be tested in different countries than Sudan and a more global view of the performance requirements of construction organizations in practice may be determined. Adoption of a global mode may be lack of local requirements specific to each country; nevertheless a globally homogenized and mobile model may be designed responding to the requirements of different countries' market environment.

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APPENDICES

APPENDIX A

QUESTIONNAIRE FOR CONSTRUCTION INDUSTRY ORGANIZATION PROFESSIONALS

While responding, please aware that;

□ Check the most appropriate ✖ for multiple choice questions.

□ Questions will be answered in a **1** to **5** Likert Scale.

□ The meaning of the numbers in the Likert Scale considered as:

1: Very low, 2: Low, 3: Average, 4: High & 5: Very high.

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

1. GENERAL INFORMATIONs

GENERAL INFORMATIONS	Answer			
Number of years in construction market?	**1-5**	**5-10**	**More than 10 yrs.**	
Organization experience	**Building**	**Roads**	**Water**	**Others**
Is the organization work outside Sudan?	**Yeas**	**No**		
Organization capital in million SDG	**0-1**	**1-5**	**5-6**	**More than 10**

2. RESOURCES

RESOURCES	Impact					Performance level				
	1	2	3	4	5	1	2	3	4	5
Financial resources										
Technical competency										
Leadership										
Experience										
Organization image										
Infrastructure										
Human resources										

3. PROJECT MANAGEMENT CAPABILITIES

PROJECT MANAGEMENT CAPABILITIES	Impact					Performance level				
	1	2	3	4	5	1	2	3	4	5
Human resources management										
Cost management										
Quality management										
Schedule management										
Risk management										
Supply chain management										
Health & safety management										
Knowledge management										
R & D management										

4. STRENGTH OF RELATIONSHIPS WITH OTHER PARTIES

STRENGTH OF RELATIONSHIPS WITH OTHER PARTIES	Impact					Performance level				
	1	2	3	4	5	1	2	3	4	5
Relation with government										
Relations with labor organizations										
Relations with competitors										
Relations with community organizations										

5. STRATEGIC DECISIONS

STRATEGIC DECISIONS	Impact					Performance level				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
Differentiation strategy										
Project selection strategies										
Market selection strategies										
Partner selection strategies										
Organization management strategies										
Customer relations strategies										

6. EXTERNAL FACTORS

EXTERNAL FACTORS	Impact					Performance level				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
International relations										
Macroeconomics factors										
Political factors										
Socio cultural factors										
Legal factors										
Suppliers power										
demand										
Technology										
Market competitions										

7. PROJECT PERFORMANCE

PROJECT PERFORMANCE	Impact					Performance level				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
Project profitability										
Internal customer satisfaction										
External customer satisfaction										

8. ORGANIZATION PERFORMANCE

ORGANIZATION 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										

THANK YOU

APPENDIX B

بسم الله الرحمن الرحيم

استبانة لقياس الإداء المؤسسي لشركات التشييد بالسودان

♦ **للاجابة علي أسئلة الاستبيان نرجو الاتي :**

® **ضع علامة (×) للإجابة المناسبة في المربع الخاص بذلك.**

® **الأسئلة لها إجابات من 1 الي 5 وتعني الأتي:**

(منخفض جدا (1), منخفض (2), متوسط (3), عالي (4), عالي جدا (5)).

القسم الأول: معلومات عامة

معلومات عامة	الاجابة			
1. عدد سنوات الشركة في سوق التشييد	1 - 5	5 - 10	أكثر من 10 سنوات	
2. مجالات عمل وخبرة المؤسسة	مباني	طرق	مياه	أخري
3. هل تعمل الشركة في دول أخري غير السودان ؟	نعم		لا	
4. رأس مال الشركة التقريبي بالمليون جنيه سوداني	0 - 1	1 - 5	5 - 10	أكثر من 10

القسم الثاني: الموارد

الموارد	الاثر بصورة عامة					مستوى الآداء في الشركة				
	1	2	3	4	5	1	2	3	4	5
1. الموارد المالية										
2. المقدرات الفنية										
3. القيادة										
4. الخبرة										
5. صورة الشركة (الشهرة التجارية)										
6. البنية التحتية (مباني, ...)										
7. القوي البشرية (العاملون)										

القسم الثالث: الامكانات لادارة المشروعات

الامكانات لادارة المشروعات	الاثر بصورة عامة					مستوى الآداء في الشركة				
	1	2	3	4	5	1	2	3	4	5
1. ادارة الموارد البشرية										
2. ادارة التكلفة										
3. ادارة الجودة										
4. ادارة الزمن والوقت										
5. ادارة المخاطر										
6. ادارة دائرة الامداد										
7. ادارة الصحة والسلامة المهنية										
8. ادارة المعرفة										
9. ادارة البحث والتطوير										

القسم الرابع: قوة العلاقة فيما بين الشركة والمؤسسات الاخري

قوة العلاقة فيمابين الشركة والمؤسسات الأخري	الاثر بصورة عامة					مستوى الآداء في الشركة				
	1	2	3	4	5	1	2	3	4	5
1. العلاقات مع مؤسسات الحكومة										
2. العلاقة مع منظمات العاملين										
3. العلاقة مع المنافسين										
4. العلاقة مع المجتمع ومؤسساته										

القسم الخامس: القرارات الاستراتيجية

القرارات الاستراتيجية	الاثر بصورة عامة					مستوى الآداء في الشركة				
	1	2	3	4	5	1	2	3	4	5
1. استراتيجات التميز عن الاخرين										
2. استراتيجيات اختيار المشاريع										
3. إستراتيجيات اختيار السوق										
4. استراتيجيات اختيار الشركاء										
5. استراتيجيات ادارة الشركة										
6. استراتيجيات العلاقة مع الزبائن										

القسم السادس: العوامل الخارجية

العوامل الخارجية	الاثر بصورة عامة					مستوى الآداء في الشركة				
	1	2	3	4	5	1	2	3	4	5
1. العلاقات الدولية										
2. عوامل الاقتصاد الكلي										
3. العوامل السياسية										
4. العوامل الاجتماعية والثقافية										
5. العوامل القانونية										
6. قوة الموردين										
7. الطلب الخارجي علي الخدمة										
8.التكنولوجيا المستخدمة										
9. المنافسة في السوق										

القسم السابع: مستوي آداءالمشروعات

آداء المشروعات	الاثر بصورة عامة					مستوى الآداء في الشركة				
	1	2	3	4	5	1	2	3	4	5
1. ربحية المشروع										
2. رضاء العاملين										
3. رضاء العميل أو الزبون										

القسم الثامن: مستوي آداء الشركة

اداء الشركة	الاثر بصورة عامة					مستوى الآداء في الشركة				
	1	2	3	4	5	1	2	3	4	5
1.المحور المالي										
2. محور التعلم والنمو										
3. محور الاداء الداخلي										
4. محور الزبون										

نشكركم علي حسن تعاونكم

والله الموفق

APPENDIX C

Initial model analysis output

```
EQS, A STRUCTURAL EQUATION PROGRAM, MULTIVARIATE SOFTWARE, INC.
COPYRIGHT BY P.M. BENTLER, VERSION 6.2 (C) 1985 - 2014 (B107).

PROGRAM CONTROL INFORMATION
/TITLE
Model built by EQS 6 for Windows (Initial model)
/SPECIFICATIONS
DATA='c: \users\ccc\desktop\data - copy_1.ess;
VARIABLES=42; CASES=93;
METHOD=ML; ANALYSIS=COVARIANCE; MATRIX=RAW;
/LABELS
V1=V1; V2=V2; V3=V3; V4=V4; V5=V5;
V6=V6; V7=V7; V8=V8; V9=V9; V10=V10;
V11=V11; V12=V12; V13=V13; V14=V14; V15=V15;
V16=V16; V17=V17; V18=V18; V19=V19; V20=V20;
V21=V21; V22=V22; V23=V23; V24=V24; V25=V25;
V26=V26; V27=V27; V28=V28; V29=V29; V30=V30;
V31=V31; V32=V32; V33=V33; V34=V34; V35=V35;
V36=V36; V37=V37; V38=V38; V39=V39; V40=V40;
V41=V41; V42=V42;
/EQUATIONS
V1  =   *F1 + E1;
V2  =   *F1 + E2;
V3  =   *F1 + E3;
```

```
V4  =   *F1 + E4;
V5  =   *F1 + E5;
V6  =   *F1 + E6;
V7  =   *F1 + E7;
V8  =   *F2 + E8;
V9  =   *F2 + E9;
V10 =   *F2 + E10;
V11 =   *F2 + E11;
V12 =   *F2 + E12;
V13 =   *F2 + E13;
V14 =   *F2 + E14;
V15 =   *F2 + E15;
V16 =   *F2 + E16;
V17 =   *F3 + E17;
V18 =   *F3 + E18;
V19 =   *F3 + E19;
V20 =   *F3 + E20;
V21 =   *F4 + E21;
V22 =   *F4 + E22;
V23 =   *F4 + E23;
V24 =   *F4 + E24;
V25 =   *F4 + E25;
V26 =   *F4 + E26;
V27 =   *F5 + E27;
V28 =   *F5 + E28;
V29 =   *F5 + E29;
V30 =   *F5 + E30;
```

```
V31 =   *F5 + E31;
V32 =   *F5 + E32;
V33 =   *F5 + E33;
V34 =   *F5 + E34;
V35 =   *F5 + E35;
V36 =   *F6 + E36;
V37 =   *F6 + E37;
V38 =   *F6 + E38;
V39 =   *F7 + E39;
V40 =   *F7 + E40;
V41 =   *F7 + E41;
V42 =   *F7 + E42;
F1  =   *F2 + *F3 + D1;
F2  =   *F5 + D2;
F3  =   *F5 + D3;
F4  =   *F2 + D4;
F6  =   *F1 + D6;
F7  =   *F1 + *F4 + *F6 + D7;
/VARIANCES
  F5 = *;
  E1 = *;
  E2 = *;
  E3 = *;
  E4 = *;
  E5 = *;
  E6 = *;
  E7 = *;
```

```
E8 = *;
E9 = *;
E10 = *;
E11 = *;
E12 = *;
E13 = *;
E14 = *;
E15 = *;
E16 = *;
E17 = *;
E18 = *;
E19 = *;
E20 = *;
E21 = *;
E22 = *;
E23 = *;
E24 = *;
E25 = *;
E26 = *;
E27 = *;
E28 = *;
E29 = *;
E30 = *;
E31 = *;
E32 = *;
E33 = *;
E34 = *;
```

```
E35 = *;
E36 = *;
E37 = *;
E38 = *;
E39 = *;
E40 = *;
E41 = *;
E42 = *;
D1 = *;
D2 = *;
D3 = *;
D4 = *;
D6 = *;
D7 = *;
/COVARIANCES
/PRINT
FIT=ALL;
TABLE=EQUATION;
/END

   120 RECORDS OF INPUT MODEL FILE WERE READ

 DATA IS READ FROM c:\users\ccc\desktop\data - copy_1.ess

 THERE ARE 42 VARIABLES AND    93 CASES
 IT IS A RAW DATA ESS FILE
```

TITLE: Model built by EQS 6 for Windows (Initial model)

SAMPLE STATISTICS BASED ON COMPLETE CASES

UNIVARIATE STATISTICS

VARIABLE	V1	V2	V3	V4	V5
MEAN	3.5484	3.4946	3.3011	3.3441	3.1398
SKEWNESS (G1)	-0.8918	-0.5909	-0.3937	-0.6956	-0.1167
KURTOSIS (G2)	0.0295	-0.2438	-0.0138	0.2011	-0.4065
STANDARD DEV.	0.6514	0.6856	0.7487	0.8007	0.7884

VARIABLE	V6	V7	V8	V9	V10
MEAN	2.7419	2.8065	3.3871	3.4624	3.3118
SKEWNESS (G1)	0.0287	0.2561	-0.1491	-0.4769	-0.3975
KURTOSIS (G2)	-0.1665	-0.8385	-0.3370	-0.3319	0.0977
STANDARD DEV.	0.8196	0.6798	0.6599	0.6846	0.7369

VARIABLE	V11	V12	V13	V14	V15
MEAN	2.0430	2.5591	2.9140	2.3226	1.8602
SKEWNESS (G1)	0.3187	-0.1320	-0.2735	0.3830	0.5182
KURTOSIS (G2)	-0.4732	-0.5479	-0.4002	-0.0151	-0.4616
STANDARD DEV.	0.7928	0.8401	0.7754	0.7396	0.7884

VARIABLE	V16	V17	V18	V19	V20
MEAN	1.8172	3.4946	2.4301	2.3656	2.1183
SKEWNESS (G1)	0.6124	-0.6861	0.0203	0.2665	0.3665
KURTOSIS (G2)	-0.1675	-0.2572	-0.6976	-0.5209	-0.5751
STANDARD DEV.	0.7654	0.6531	0.8772	0.8570	0.8704

VARIABLE	V21	V22	V23	V24	V25
MEAN	3.1935	2.6667	2.5914	2.6129	2.6774
SKEWNESS (G1)	-0.3095	-0.3076	-0.5432	-0.5354	-0.4285
KURTOSIS (G2)	-1.0497	0.0425	0.0611	0.1339	0.2259
STANDARD DEV.	0.7262	0.6810	0.6795	0.6599	0.6283

VARIABLE	V26	V27	V28	V29	V30
MEAN	2.9462	3.4516	3.5699	3.4301	2.6129
SKEWNESS (G1)	-0.2136	-0.9593	-0.9706	-1.0548	0.0075
KURTOSIS (G2)	-0.5162	0.1954	0.1192	0.2252	-0.6835
STANDARD DEV.	0.7571	0.7592	0.7132	0.8262	0.8601

VARIABLE	V31	V32	V33	V34	V35
MEAN	3.3441	2.6774	2.6774	2.6022	2.5054
SKEWNESS (G1)	-0.6288	-0.1240	-0.0118	0.0524	0.2980
KURTOSIS (G2)	0.0485	-0.5661	-0.6619	-0.5038	-0.6261
STANDARD DEV.	0.7297	0.8362	0.8362	0.7959	0.8550

VARIABLE	V36	V37	V38	V39	V40
MEAN	2.6989	1.9032	2.2473	3.4731	2.1613
SKEWNESS (G1)	-0.3517	0.0218	0.8823	-0.5598	0.2791
KURTOSIS (G2)	-0.7583	-0.1760	0.7496	-0.6481	-0.4846
STANDARD DEV.	0.5062	0.5910	0.5034	0.5822	0.8248

VARIABLE	V41	V42
MEAN	2.9247	3.0215
SKEWNESS (G1)	-0.1804	-0.1893
KURTOSIS (G2)	-0.5319	-0.7783
STANDARD DEV.	0.7552	0.7515

MULTIVARIATE KURTOSIS

MARDIA'S COEFFICIENT (G2,P) = 20.2514
NORMALIZED ESTIMATE = 1.6062

ELLIPTICAL THEORY KURTOSIS ESTIMATES

MARDIA-BASED KAPPA
= 0.0110 MEAN SCALED UNIVARIATE KURTOSIS = -0.0977

MARDIA-BASED KAPPA IS USED IN COMPUTATION. KAPPA= 0.0110

CASE NUMBERS WITH LARGEST CONTRIBUTION TO NORMALIZED
MULTIVARIATE KURTOSIS:

CASE NUMBER	1	38	42	58	77
ESTIMATE	234.0503	145.9069	125.9143	127.2327	159.7522

TITLE: Model built by EQS 6 for Windows (Initial model)

COVARIANCE MATRIX TO BE ANALYZED: 42 VARIABLES
BASED ON 93 CASES.

	V1	V2	V3	V4	V5	V6
V1	0.424					
V2	0.367	0.470				
V3	0.366	0.436	0.561			
V4	0.374	0.448	0.504	0.641		
V5	0.346	0.387	0.447	0.527	0.622	
V6	0.317	0.346	0.405	0.470	0.493	0.672
V7	0.205	0.227	0.287	0.317	0.386	0.450
V8	0.275	0.263	0.295	0.289	0.315	0.340
V9	0.287	0.323	0.348	0.372	0.380	0.371
V10	0.273	0.311	0.340	0.348	0.369	0.353
V11	0.204	0.207	0.280	0.268	0.298	0.316
V12	0.244	0.264	0.362	0.338	0.399	0.407
V13	0.232	0.228	0.287	0.280	0.349	0.315
V14	0.212	0.208	0.250	0.279	0.291	0.367
V15	0.175	0.179	0.249	0.244	0.281	0.355
V16	0.134	0.146	0.240	0.227	0.276	0.333
V17	0.248	0.253	0.317	0.339	0.311	0.314
V18	0.240	0.241	0.293	0.296	0.254	0.395
V19	0.232	0.274	0.356	0.340	0.361	0.411
V20	0.261	0.321	0.355	0.372	0.396	0.400
V21	0.241	0.262	0.332	0.357	0.364	0.355
V22	0.185	0.232	0.275	0.290	0.297	0.337
V23	0.194	0.248	0.287	0.316	0.308	0.339
V24	0.193	0.237	0.270	0.298	0.305	0.323
V25	0.168	0.237	0.272	0.275	0.274	0.318
V26	0.193	0.233	0.310	0.312	0.290	0.345
V27	0.282	0.318	0.330	0.365	0.349	0.368
V28	0.206	0.237	0.250	0.302	0.300	0.290
V29	0.251	0.263	0.282	0.318	0.320	0.330
V30	0.236	0.248	0.270	0.243	0.294	0.334
V31	0.179	0.187	0.265	0.250	0.267	0.285
V32	0.190	0.227	0.305	0.243	0.317	0.372
V33	0.222	0.281	0.348	0.297	0.383	0.394
V34	0.188	0.210	0.273	0.258	0.328	0.342
V35	0.144	0.236	0.259	0.259	0.353	0.306
V36	0.134	0.151	0.168	0.159	0.140	0.128
V37	0.065	0.092	0.127	0.131	0.122	0.181
V38	0.091	0.148	0.186	0.186	0.204	0.217
V39	0.249	0.274	0.302	0.314	0.303	0.286
V40	0.193	0.213	0.288	0.237	0.238	0.379
V41	0.227	0.244	0.284	0.276	0.304	0.350
V42	0.205	0.228	0.309	0.275	0.301	0.321

	V7	V8	V9	V10	V11	V12
V7	0.462					
V8	0.206	0.435				
V9	0.264	0.308	0.469			
V10	0.278	0.280	0.430	0.543		
V11	0.248	0.244	0.252	0.334	0.629	
V12	0.294	0.336	0.315	0.345	0.421	0.706
V13	0.288	0.262	0.323	0.353	0.297	0.473
V14	0.259	0.254	0.251	0.300	0.388	0.426
V15	0.266	0.218	0.218	0.261	0.430	0.383
V16	0.279	0.202	0.216	0.242	0.399	0.397
V17	0.216	0.241	0.258	0.257	0.228	0.264
V18	0.236	0.299	0.245	0.212	0.340	0.322
V19	0.311	0.303	0.307	0.320	0.408	0.424
V20	0.317	0.302	0.390	0.408	0.386	0.444
V21	0.277	0.272	0.279	0.319	0.296	0.347
V22	0.250	0.207	0.254	0.301	0.275	0.308
V23	0.235	0.225	0.245	0.303	0.290	0.307
V24	0.229	0.228	0.214	0.263	0.267	0.284
V25	0.230	0.213	0.216	0.254	0.242	0.269
V26	0.250	0.260	0.264	0.278	0.231	0.389
V27	0.197	0.302	0.311	0.336	0.274	0.266
V28	0.177	0.212	0.245	0.309	0.236	0.200
V29	0.204	0.256	0.288	0.354	0.329	0.268
V30	0.239	0.293	0.268	0.285	0.332	0.306
V31	0.209	0.235	0.209	0.261	0.213	0.240
V32	0.274	0.289	0.303	0.352	0.351	0.389
V33	0.328	0.289	0.346	0.395	0.362	0.400
V34	0.281	0.232	0.273	0.354	0.398	0.355
V35	0.284	0.226	0.264	0.352	0.380	0.312
V36	0.061	0.107	0.119	0.149	0.133	0.094
V37	0.144	0.179	0.176	0.183	0.211	0.239
V38	0.179	0.153	0.124	0.150	0.163	0.252
V39	0.201	0.206	0.225	0.242	0.208	0.243
V40	0.282	0.285	0.240	0.232	0.319	0.365
V41	0.268	0.258	0.263	0.295	0.210	0.314
V42	0.265	0.263	0.218	0.254	0.249	0.336

	V13	V14	V15	V16	V17	V18
V13	0.601					
V14	0.322	0.547				
V15	0.270	0.437	0.622			
V16	0.299	0.397	0.529	0.586		
V17	0.206	0.219	0.222	0.157	0.427	
V18	0.222	0.371	0.311	0.275	0.328	0.770
V19	0.347	0.370	0.356	0.350	0.306	0.548
V20	0.402	0.353	0.354	0.348	0.267	0.383
V21	0.299	0.317	0.299	0.286	0.305	0.275
V22	0.297	0.272	0.225	0.232	0.254	0.308
V23	0.247	0.296	0.257	0.229	0.291	0.319
V24	0.216	0.257	0.239	0.233	0.259	0.310
V25	0.222	0.203	0.204	0.201	0.216	0.249
V26	0.321	0.235	0.221	0.218	0.233	0.273
V27	0.235	0.277	0.259	0.214	0.307	0.249
V28	0.202	0.216	0.200	0.192	0.215	0.165
V29	0.233	0.251	0.246	0.243	0.209	0.183
V30	0.227	0.268	0.326	0.309	0.259	0.407
V31	0.204	0.203	0.157	0.161	0.230	0.209
V32	0.298	0.312	0.313	0.299	0.248	0.379
V33	0.331	0.333	0.335	0.353	0.259	0.336
V34	0.281	0.347	0.346	0.318	0.264	0.336
V35	0.261	0.281	0.300	0.289	0.204	0.226
V36	0.104	0.120	0.121	0.075	0.140	0.120
V37	0.220	0.162	0.149	0.178	0.103	0.173
V38	0.185	0.126	0.133	0.144	0.137	0.164
V39	0.193	0.204	0.197	0.164	0.231	0.218
V40	0.264	0.295	0.284	0.312	0.202	0.386
V41	0.298	0.253	0.239	0.236	0.233	0.283
V42	0.306	0.200	0.188	0.200	0.207	0.262

	V19	V20	V21	V22	V23	V24
V19	0.734					
V20	0.543	0.758				
V21	0.352	0.292	0.527			
V22	0.362	0.322	0.348	0.464		
V23	0.368	0.342	0.341	0.406	0.462	
V24	0.360	0.329	0.293	0.348	0.405	0.435
V25	0.293	0.299	0.270	0.337	0.356	0.363
V26	0.422	0.419	0.293	0.286	0.282	0.272
V27	0.257	0.294	0.357	0.293	0.306	0.275
V28	0.224	0.280	0.269	0.246	0.257	0.245
V29	0.265	0.329	0.307	0.243	0.232	0.212
V30	0.382	0.340	0.347	0.337	0.308	0.305
V31	0.210	0.187	0.281	0.225	0.229	0.189
V32	0.456	0.386	0.324	0.348	0.334	0.341
V33	0.445	0.419	0.367	0.359	0.356	0.352
V34	0.397	0.406	0.339	0.333	0.336	0.344
V35	0.411	0.483	0.325	0.301	0.328	0.339
V36	0.090	0.112	0.113	0.072	0.104	0.100
V37	0.188	0.251	0.128	0.163	0.123	0.125
V38	0.235	0.231	0.158	0.170	0.156	0.151
V39	0.260	0.302	0.244	0.225	0.239	0.239
V40	0.386	0.361	0.218	0.250	0.241	0.237
V41	0.365	0.422	0.276	0.301	0.284	0.275
V42	0.383	0.356	0.246	0.257	0.248	0.258

	V25	V26	V27	V28	V29	V30
V25	0.395					
V26	0.254	0.573				
V27	0.267	0.253	0.576			
V28	0.229	0.216	0.446	0.509		
V29	0.184	0.263	0.445	0.480	0.683	
V30	0.298	0.229	0.340	0.277	0.375	0.740
V31	0.177	0.203	0.278	0.280	0.350	0.330
V32	0.308	0.352	0.299	0.262	0.314	0.493
V33	0.330	0.319	0.299	0.273	0.325	0.482
V34	0.305	0.283	0.290	0.262	0.293	0.442
V35	0.306	0.321	0.237	0.252	0.291	0.393
V36	0.087	0.081	0.127	0.119	0.109	0.154
V37	0.131	0.223	0.142	0.088	0.129	0.147
V38	0.157	0.274	0.126	0.118	0.142	0.151
V39	0.219	0.232	0.251	0.238	0.251	0.261
V40	0.216	0.291	0.209	0.190	0.278	0.367
V41	0.258	0.365	0.284	0.304	0.315	0.351
V42	0.235	0.447	0.218	0.216	0.262	0.269

	V31	V32	V33	V34	V35	V36
V31	0.532					
V32	0.319	0.699				
V33	0.362	0.580	0.699			
V34	0.291	0.490	0.522	0.633		
V35	0.270	0.480	0.545	0.551	0.731	
V36	0.105	0.130	0.130	0.140	0.132	0.256
V37	0.088	0.197	0.186	0.200	0.191	0.025
V38	0.121	0.200	0.200	0.165	0.200	0.054
V39	0.183	0.252	0.296	0.245	0.247	0.144
V40	0.183	0.357	0.324	0.347	0.320	0.103
V41	0.211	0.367	0.356	0.339	0.332	0.108
V42	0.221	0.355	0.333	0.313	0.337	0.104

	V37	V38	V39	V40	V41	V42
V37	0.349					
V38	0.133	0.253				
V39	0.068	0.132	0.339			
V40	0.255	0.210	0.205	0.680		
V41	0.177	0.204	0.275	0.371	0.570	
V42	0.241	0.288	0.240	0.377	0.404	0.565

BENTLER-WEEKS STRUCTURAL REPRESENTATION:

NUMBER OF DEPENDENT VARIABLES = 48
DEPENDENT V'S: 1   2   3   4   5   6   7   8   9 10
DEPENDENT V'S: 11 12 13 14 15 16 17 18 19 20

DEPENDENT V'S: 21 22 23 24 25 26 27 28 29 30
DEPENDENT V'S: 31 32 33 34 35 36 37 38 39 40
DEPENDENT V'S: 41 42
DEPENDENT F'S: 1   2   3   4   6   7

NUMBER OF INDEPENDENT VARIABLES = 49
INDEPENDENT F'S: 5
INDEPENDENT E'S: 1 2 3 4 5 6 7 8 9 10
INDEPENDENT E'S:11 12 13 14 15 16 17 18 19 20
INDEPENDENT E'S:21 22 23 24 25 26 27 28 29 30
INDEPENDENT E'S:31 32 33 34 35 36 37 38 39 40
INDEPENDENT E'S 41 42
INDEPENDENT D'S: 1 2 3 4 6 7

NUMBER OF FREE PARAMETERS = 100
NUMBER OF FIXED NONZERO PARAMETERS = 48

```
3RD STAGE OF COMPUTATION REQUIRED    338721 WORDS OF MEMORY.
PROGRAM ALLOCATED   2000000 WORDS

DETERMINANT OF INPUT MATRIX IS   0.25326D-33

PARAMETER         CONDITION CODE
 V32, F5           LINEARLY DEPENDENT ON OTHER PARAMETERS
  V6, F1           LINEARLY DEPENDENT ON OTHER PARAMETERS
 V16, F2           LINEARLY DEPENDENT ON OTHER PARAMETERS
 V18, F3           LINEARLY DEPENDENT ON OTHER PARAMETERS
 V22, F4           LINEARLY DEPENDENT ON OTHER PARAMETERS
 V36, F6           LINEARLY DEPENDENT ON OTHER PARAMETERS
 V39, F7           LINEARLY DEPENDENT ON OTHER PARAMETERS
```

TITLE: Model built by EQS 6 for Windows (Initial model)

MAXIMUM LIKELIHOOD SOLUTION (NORMAL DISTRIBUTION THEORY)

STANDARDIZED RESIDUAL MATRIX:

LARGEST STANDARDIZED RESIDUALS:

NO.	PARAMETER	ESTIMATE	NO.	PARAMETER	ESTIMATE
1	V38, V26	0.508	11	V41, V26	0.344
2	V42, V26	0.469	12	V27, V21	0.332
3	V29, V28	0.423	13	V41, V20	0.314
4	V28, V27	0.420	14	V39, V28	0.311
5	V21, V17	0.381	15	V23, V17	0.307
6	V26, V20	0.376	16	V39, V20	0.304
7	V39, V17	0.359	17	V29, V27	0.302
8	V16, V15	0.357	18	V39, V27	0.296
9	V26, V19	0.352	19	V36, V17	0.291
10	V37, V26	0.349	20	V37, V20	0.279

```
05-MAY-14      PAGE:   5 EQS     Licensee:

 TITLE:   Model built by EQS 6 for Windows (Initial model)

 MAXIMUM LIKELIHOOD SOLUTION (NORMAL DISTRIBUTION THEORY)

 DISTRIBUTION OF STANDARDIZED RESIDUALS

    ----------------------------------------
    !                                      !
 320-                                      -
    !                    *                 !
    !                    *                 !
    !                    *                 !
    !                    *                 !          RANGE
FREQ PERCENT
 240-                    *                 -
    !                 *  *  *              !    1   -0.5  -  --
   0   0.00%
    !                 *  *  *              !    2   -0.4  -  -0.5
   0   0.00%
    !                 *  *  *              !    3   -0.3  -  -0.4
   0   0.00%
    !                 *  *  *              !    4   -0.2  -  -0.3
   1   0.11%
 160-                 *  *  *              -    5   -0.1  -  -0.2
  47   5.20%
    !                 *  *  *              !    6    0.0  -  -0.1
 231  25.58%
    !                 *  *  *              !    7    0.1  -   0.0
 310  34.33%
    !                 *  *  *              !    8    0.2  -   0.1
 231  25.58%
    !                 *  *  *              !    9    0.3  -   0.2
  66   7.31%
  80-                 *  *  *              -    A    0.4  -   0.3
  13   1.44%
    !                 *  *  *  *           !    B    0.5  -   0.4
   3   0.33%
    !              *  *  *  *  *           !    C     ++  -   0.5
   1   0.11%
    !              *  *  *  *  *           !    ------------------
-------------
    !              *  *  *  *  *  *        !          TOTAL
 903 100.00%
    ----------------------------------------
       1  2  3  4  5  6  7  8  9  A  B  C    EACH "*" REPRESENTS
16 RESIDUALS
```

05-MAY-14 PAGE: 6 EQS Licensee:

TITLE: Model built by EQS 6 for Windows (Initial model)

MAXIMUM LIKELIHOOD SOLUTION (NORMAL DISTRIBUTION THEORY)

GOODNESS OF FIT SUMMARY FOR METHOD = ML

INDEPENDENCE MODEL CHI-SQUARE = 3612.491 ON 861 DEGREES OF FREEDOM

INDEPENDENCE AIC = 3000.491 INDEPENDENCE CAIC = -41.077
MODEL AIC = 268.904 MODEL CAIC = -2567.773

CHI-SQUARE = 1204.504 BASED ON 803 DEGREES OF FREEDOM
PROBABILITY VALUE FOR THE CHI-SQUARE STATISTIC IS 0.00000

THE NORMAL THEORY RLS CHI-SQUARE FOR THIS ML SOLUTION IS 1233.566.

FIT INDICES

BENTLER-BONETT NORMED FIT INDEX	=	0.603
BENTLER-BONETT NON-NORMED FIT INDEX	=	0.727
COMPARATIVE FIT INDEX (CFI)	=	0.742
BOLLEN'S (IFI) FIT INDEX	=	0.757
MCDONALD'S (MFI) FIT INDEX	=	0.003
JORESKOG-SORBOM'S GFI FIT INDEX	=	0.504
JORESKOG-SORBOM'S AGFI FIT INDEX	=	0.442
ROOT MEAN-SQUARE RESIDUAL (RMR)	=	0.066
STANDARDIZED RMR	=	0.123
ROOT MEAN-SQUARE ERROR OF APPROXIMATION (RMSEA)	=	0.082

90% CONFIDENCE INTERVAL OF RMSEA (0.075 , 0.089)

RELIABILITY COEFFICIENTS

CRONBACH'S ALPHA	=	0.976
RELIABILITY COEFFICIENT RHO	=	0.979

STANDARDIZED FACTOR LOADINGS FOR THE FACTOR THAT GENERATES MAXIMAL RELIABILITY FOR THE UNIT-WEIGHT COMPOSITE BASED ON THE MODEL (RHO):

V1	V2	V3	V4	V5	V6	V7
0.7547	0.8856	0.8370	0.8863	0.8403	0.8169	0.8197
V8	V9	V10	V11	V12	V13	V14
0.6254	0.9335	0.8519	0.6824	0.7889	0.6944	0.1991
V15	V16	V17	V18	V19	V20	V21
0.8849	0.8552	0.9094	0.6644	0.4441	0.6085	0.5879
V22	V23	V24	V25	V26	V27	V28
0.8739	0.9444	0.9398	0.8381	0.4148	0.7945	0.9480
V29	V30	V31	V32	V33	V34	V35
0.7620	0.6515	0.5335	0.7885	0.8744	0.8279	0.8117
V36	V37	V38	V39	V40	V41	V42
0.6282	0.4540	0.8217	0.4848	0.4989	0.7687	0.6861

TITLE: Model built by EQS 6 for Windows (Initial model)

MAXIMUM LIKELIHOOD SOLUTION (NORMAL DISTRIBUTION THEORY)

STANDARDIZED SOLUTION:
R-SQUARED

```
V1    =V1 = .794*F1 + .608 E1     .631
V2    =V2 = .862*F1 + .507 E2     .743
V3    =V3 = .896*F1 + .443 E3     .803
V4    =V4 = .903*F1 + .429 E4     .816
V5    =V5 = .883*F1 + .469 E5     .780
V6    =V6 = .808*F1 + .589 E6     .653
V7    =V7 = .705*F1 + .709 E7     .497
V8    =V8 = .716*F2 + .699 E8     .512
V9    =V9 = .769*F2 + .640 E9     .591
V10   =V10= .797*F2 + .604 E10    .635
V11   =V11= .754*F2 + .657 E11    .568
V12   =V12= .797*F2 + .604 E12    .635
V13   =V13= .722*F2 + .692 E13    .521
V14   =V14= .787*F2 + .617 E14    .620
V15   =V15= .723*F2 + .691 E15    .522
V16   =V16= .718*F2 + .696 E16    .515
V17   =V17= .667*F3 + .745 E17    .445
V18   =V18= .756*F3 + .655 E18    .571
V19   =V19= .900*F3 + .436 E19    .810
V20   =V20= .786*F3 + .619 E20    .617
V21   =V21= .724*F4 + .690 E21    .524
V22   =V22= .893*F4 + .451 E22    .797
V23   =V23= .961*F4 + .276 E23    .924
V24   =V24= .927*F4 + .375 E24    .860
V25   =V25= .886*F4 + .464 E25    .784
V26   =V26= .608*F4 + .794 E26    .369
V27   =V27= .647*F5 + .762 E27    .419
V28   =V28= .624*F5 + .781 E28    .389
V29   =V29= .629*F5 + .777 E29    .396
V30   =V30= .754*F5 + .657 E30    .568
V31   =V31= .641*F5 + .768 E31    .411
V32   =V32= .851*F5 + .526 E32    .723
V33   =V33= .892*F5 + .453 E33    .795
V34   =V34= .856*F5 + .516 E34    .734
V35   =V35= .788*F5 + .616 E35    .620
V36   =V36= .392*F6 + .920 E36    .154
V37   =V37= .527*F6 + .850 E37    .278
V38   =V38= .747*F6 + .664 E38    .559
```

STANDARDIZED SOLUTION:
R-SQUARED

TITLE: Model built by EQS 6 for Windows (Initial model)

MAXIMUM LIKELIHOOD SOLUTION (NORMAL DISTRIBUTION THEORY)

```
 V39   =V39 = .704*F7 + .710 E39                            .495
 V40   =V40 = .684*F7 + .730 E40                            .467
 V41   =V41 = .796*F7 + .606 E41                            .633
 V42   =V42 = .855*F7 + .518 E42                            .731


  F1   =F1 = .621*F2 + .328*F3 + .588 D1                    .654
  F2   =F2 = .763*F5 + .502 D2                              .648
  F3   =F3 = .819*F5 + .589 D3                              .653
  F4   =F4 = .891*F2 + .626 D4                              .708
  F6   =F6 = .595*F1 + .655 D6                              .570
  F7   =F7 = .405*F1 + .397*F4 + .151*F6+.000 D7           1.000
```

```
-------------------------------------------------------------------
                          E N D    O F    M E T H O D
-------------------------------------------------------------------
 Today is 2014/05/05
 Execution begins at 09:07:49
 Execution ends   at 09:07:49
 Elapsed time =       0.00 seconds
```

APPENDIX D

Respecified model analysis output

```
EQS, A STRUCTURAL EQUATION PROGRAM, MULTIVARIATE SOFTWARE, INC.
  COPYRIGHT BY P.M. BENTLER, VERSION 6.2 (C) 1985 - 2014 (B107).

    PROGRAM CONTROL INFORMATION

 /TITLE

 Model built by EQS 6 for Windows (Respecified model)

 /SPECIFICATIONS

 DATA='c: \users\ccc\desktop\data - copy_1.ess;

 VARIABLES=42; CASES=93;

 METHOD=ML; ANALYSIS=COVARIANCE; MATRIX=RAW;

 /LABELS

 V1=V1; V2=V2; V3=V3; V4=V4; V5=V5;

 V6=V6; V7=V7; V8=V8; V9=V9; V10=V10;

 V11=V11; V12=V12; V13=V13; V14=V14; V15=V15;

 V16=V16; V17=V17; V18=V18; V19=V19; V20=V20;

 V21=V21; V22=V22; V23=V23; V24=V24; V25=V25;

 V26=V26; V27=V27; V28=V28; V29=V29; V30=V30;

 V31=V31; V32=V32; V33=V33; V34=V34; V35=V35;

 V36=V36; V37=V37; V38=V38; V39=V39; V40=V40;

 V41=V41; V42=V42;

 /EQUATIONS

 V1 =   *F1 + E1;

 V2 =   *F1 + E2;

 V3 =   *F1 + E3;

 V4 =   *F1 + E4;
```

```
V5 =   *F1 + E5;
V6 =   *F1 + E6;
V7 =   *F1 + E7;
V8 =   *F2 + E8;
V9 =   *F2 + E9;
V10 =   *F2 + E10;
V11 =   *F2 + E11;
V12 =   *F2 + E12;
V13 =   *F2 + E13;
V14 =   *F2 + E14;
V15 =   *F2 + E15;
V16 =   *F2 + E16;
V17 =   *F3 + E17;
V18 =   *F3 + E18;
V19 =   *F3 + E19;
V20 =   *F3 + E20;
V21 =   *F4 + E21;
V22 =   *F4 + E22;
V23 =   *F4 + E23;
V24 =   *F4 + E24;
V25 =   *F4 + E25;
V26 =   *F4 + E26;
V27 =   *F5 + E27;
V28 =   *F5 + E28;
V29 =   *F5 + E29;
V30 =   *F5 + E30;
V31 =   *F5 + E31;
```

```
V32 =   *F5 + E32;

V33 =   *F5 + E33;

V34 =   *F5 + E34;

V35 =   *F5 + E35;
```

```
05-MAY-14      PAGE:   2 EQS     Licensee:
 TITLE:   Model built by EQS 6 for Windows (Respecified model)

   53 V36=   *F6 + E36;
   54 V37=   *F6 + E37;
   55 V38=   *F6 + E38;
   56 V39=   *F7 + E39;
   57 V40=   *F7 + E40;
   58 V41=   *F7 + E41;
   59 V42=   *F7 + E42;
   60 F1 =   *F2 + *F3 + D1;
   61 F2 =   *F5 + D2;
   62 F3 =   *F5 + D3;
   63 F4 =   *F2 + D4;
   64 F6 =   *F1 + D6;
   65 F7 =   *F1 + *F4 + D7;
   66 /VARIANCES
   67   F5 = *;
   68   E1 = *;
   69   E2 = *;
   70   E3 = *;
   71   E4 = *;
   72   E5 = *;
   73   E6 = *;
   74   E7 = *;
   75   E8 = *;
   76   E9 = *;
```

```
E10 = *;
E11 = *;
E12 = *;
E13 = *;
E14 = *;
E15 = *;
E16 = *;
E17 = *;
E18 = *;
E19 = *;
E20 = *;
E21 = *;
E22 = *;
E23 = *;
E24 = *;
E25 = *;
E26 = *;
E27 = *;
E28 = *;
E29 = *;
E30 = *;
E31 = *;
E32 = *;
E33 = *;
E34 = *;
E35 = *;
E36 = *;
```

```
E37 = *;
E38 = *;
E39 = *;
E40 = *;
E41 = *;
E42 = *;
```

```
05-MAY-14      PAGE:   3 EQS     Licensee:

 TITLE:   Model built by EQS 6 for Windows (Respecified model)

      D1 = *;
      D2 = *;
      D3 = *;
      D4 = *;
      D6 = *;
      D7 = *;
    /COVARIANCES
    /PRINT
    FIT=ALL;
    TABLE=EQUATION;
    /END


     120 RECORDS OF INPUT MODEL FILE WERE READ

   DATA IS READ FROM c:\users\ccc\desktop\data - copy_1.ess



   THERE ARE 42 VARIABLES AND    93 CASES
   IT IS A RAW DATA ESS FILE
```

TITLE: Model built by EQS 6 for Windows (Respecified model)

MAXIMUM LIKELIHOOD SOLUTION (NORMAL DISTRIBUTION THEORY)

DISTRIBUTION OF STANDARDIZED RESIDUALS

```
    ----------------------------------------
    !                                      !
 340-                    *                 -
    !                    *                 !
    !                    *                 !
    !                    *                 !
    !                    *                 !           RANGE
FREQ PERCENT
 255-                    *                 -
    !                 *  *                 !    1   -0.5  -  --
   0   0.00%
    !                 *  *                 !    2   -0.4  -  -0.5
   0   0.00%
    !                 *  *  *              !    3   -0.3  -  -0.4
   0   0.00%
    !                 *  *  *              !    4   -0.2  -  -0.3
   1   0.11%
 170-                 *  *  *              -    5   -0.1  -  -0.2
  48   5.32%
    !                 *  *  *              !    6    0.0  -  -0.1
 236  26.14%
    !                 *  *  *              !    7    0.1  -   0.0
 339  37.54%
    !                 *  *  *              !    8    0.2  -   0.1
 210  23.26%
    !                 *  *  *              !    9    0.3  -   0.2
  53   5.87%
  85-                 *  *  *              -    A    0.4  -   0.3
  11   1.22%
    !                 *  *  *              !    B    0.5  -   0.4
   5   0.55%
    !              *  *  *  *  *           !    C     ++  -   0.5
   0   0.00%
    !              *  *  *  *  *           !    ------------------
-------------
    !              *  *  *  *  *  *        !           TOTAL
 903 100.00%
    ----------------------------------------
       1  2  3  4  5  6  7  8  9  A  B  C    EACH "*" REPRESENTS
17 RESIDUALS
```

TITLE: Model built by EQS 6 for Windows (Respecified model)

```
MAXIMUM LIKELIHOOD SOLUTION (NORMAL DISTRIBUTION THEORY)

GOODNESS OF FIT SUMMARY FOR METHOD = ML

INDEPENDENCE MODEL CHI-SQUARE        =    4312.491 ON   861
DEGREES OF FREEDOM

INDEPENDENCE AIC =    3000.491   INDEPENDENCE CAIC =     -41.077
       MODEL AIC =     296.406          MODEL CAIC =   -2543.804

CHI-SQUARE =      1904.406 BASED ON      804 DEGREES OF FREEDOM
PROBABILITY VALUE FOR THE CHI-SQUARE STATISTIC IS      0.00000

THE NORMAL THEORY RLS CHI-SQUARE FOR THIS ML SOLUTION IS 1932.076.

FIT INDICES
-----------
BENTLER-BONETT      NORMED FIT INDEX =     0.597
BENTLER-BONETT NON-NORMED FIT INDEX =     0.787
COMPARATIVE FIT INDEX (CFI)          =     0.783
BOLLEN'S           (IFI) FIT INDEX   =     0.719
MCDONALD'S         (MFI) FIT INDEX   =     0.003
JORESKOG-SORBOM'S  GFI  FIT INDEX   =     0.494
JORESKOG-SORBOM'S AGFI  FIT INDEX   =     0.431
ROOT MEAN-SQUARE RESIDUAL (RMR)      =     0.062
STANDARDIZED RMR                     =     0.116
ROOT MEAN-SQUARE ERROR OF APPROXIMATION (RMSEA)    =     0.082
90% CONFIDENCE INTERVAL OF RMSEA  (0.075 , 0.089)

RELIABILITY COEFFICIENTS
------------------------
CRONBACH'S ALPHA                                   =     0.976
RELIABILITY COEFFICIENT RHO                        =     0.980
```

```
  TITLE:   Model built by EQS 6 for Windows (Respecified model)


  MAXIMUM LIKELIHOOD SOLUTION (NORMAL DISTRIBUTION THEORY)


  STANDARDIZED SOLUTION:
   R-SQUARED

   V1     =V1 = .791*F1 + .612 E1                                .625
   V2     =V2 = .858*F1 + .513 E2                                .737
   V3     =V3 = .895*F1 + .447 E3                                .800
   V4     =V4 = .898*F1 + .440 E4                                .806
   V5     =V5 = .881*F1 + .473 E5                                .777
   V6     =V6 = .811*F1 + .584 E6                                .658
   V7     =V7 = .709*F1 + .705 E7                                .503
   V8     =V8 = .716*F2 + .698 E8                                .513
   V9     =V9 = .769*F2 + .640 E9                                .591
   V10    =V10= .797*F2 + .604 E10                               .635
   V11    =V11= .753*F2 + .658 E11                               .568
   V12    =V12= .797*F2 + .604 E12                               .635
   V13    =V13= .723*F2 + .691 E13                               .522
   V14    =V14= .787*F2 + .617 E14                               .619
   V15    =V15= .722*F2 + .692 E15                               .521
   V16    =V16= .717*F2 + .697 E16                               .514
   V17    =V17= .668*F3 + .745 E17                               .446
   V18    =V18= .755*F3 + .655 E18                               .571
   V19    =V19= .899*F3 + .437 E19                               .809
   V20    =V20= .786*F3 + .618 E20                               .618
   V21    =V21= .724*F4 + .690 E21                               .525
   V22    =V22= .893*F4 + .449 E22                               .798
   V23    =V23= .959*F4 + .282 E23                               .920
   V24    =V24= .927*F4 + .376 E24                               .859
   V25    =V25= .887*F4 + .462 E25                               .786
   V26    =V26= .613*F4 + .790 E26                               .376
   V27    =V27= .647*F5 + .762 E27                               .419
   V28    =V28= .624*F5 + .782 E28                               .389
   V29    =V29= .629*F5 + .777 E29                               .396
   V30    =V30= .754*F5 + .657 E30                               .568
   V31    =V31= .641*F5 + .768 E31                               .411
   V32    =V32= .851*F5 + .526 E32                               .724
   V33    =V33= .892*F5 + .452 E33                               .795
   V34    =V34= .856*F5 + .516 E34                               .734
   V35    =V35= .788*F5 + .616 E35                               .621
   V36    =V36= .443*F6 + .896 E36                               .197
   V37    =V37= .452*F6 + .892 E37                               .205
   V38    =V38= .667*F6 + .745 E38                               .445


  STANDARDIZED SOLUTION:
   R-SQUARED
```

TITLE: Model built by EQS 6 for Windows (Respecified model)

MAXIMUM LIKELIHOOD SOLUTION (NORMAL DISTRIBUTION THEORY)

```
 V39   =V39= .775*F7 + .632 E39                                       .600
 V40   =V40= .664*F7 + .748 E40                                       .441
 V41   =V41= .823*F7 + .569 E41                                       .677
 V42   =V42= .785*F7 + .620 E42                                       .616
  F1   =F1 = .618*F2 + .328*F3 + .577 D1                              .667
  F2   =F2 = .741*F5 + .501 D2                                        .749
  F3   =F3 = .821*F5 + .588 D3                                        .654
  F4   =F4 = .862*F2 + .623 D4                                        .612
  F6   =F6 = .605*F1 + .506 D6                                        .744
  F7   =F7 = .534*F1 + .374*F4 + .545 D7                              .703
```

```
-------------------------------------------------------------------
                          E N D    O F    M E T H O D
-------------------------------------------------------------------
 Today is 2014/05/05
 Execution begins at 19:52:25
 Execution ends   at 19:52:25
 Elapsed time =       0.00 seconds
```

APPENDIX E

Final model analysis output

```
EQS, A STRUCTURAL EQUATION PROGRAM, MULTIVARIATE SOFTWARE, INC.
  COPYRIGHT BY P.M. BENTLER, VERSION 6.2 (C) 1985 - 2014 (B107).

    PROGRAM CONTROL INFORMATION

    /TITLE
    Model built by EQS 6 for Windows (Final model)
    /SPECIFICATIONS
    DATA='c:\users\ccc\desktop\data - copy_1.ess';
    VARIABLES=42; CASES=93;
    METHOD=ML; ANALYSIS=COVARIANCE; MATRIX=RAW;
    /LABELS
    V1=V1; V2=V2; V3=V3; V4=V4; V5=V5;
    V6=V6; V7=V7; V8=V8; V9=V9; V10=V10;
    V11=V11; V12=V12; V13=V13; V14=V14; V15=V15;
    V16=V16; V17=V17; V18=V18; V19=V19; V20=V20;
    V21=V21; V22=V22; V23=V23; V24=V24; V25=V25;
    V26=V26; V27=V27; V28=V28; V29=V29; V30=V30;
    V31=V31; V32=V32; V33=V33; V34=V34; V35=V35;
    V36=V36; V37=V37; V38=V38; V39=V39; V40=V40;
    V41=V41; V42=V42;
    /EQUATIONS
    V1 =   *F1 + E1;
    V2 =   *F1 + E2;
    V3 =   *F1 + E3;
    V4 =   *F1 + E4;
```

```
V5 =   *F1 + E5;
V6 =   *F1 + E6;
V7 =   *F1 + E7;
V8 =   *F2 + E8;
V9 =   *F2 + E9;
V10 =   *F2 + E10;
V11 =   *F2 + E11;
V12 =   *F2 + E12;
V13 =   *F2 + E13;
V14 =   *F2 + E14;
V15 =   *F2 + E15;
V16 =   *F2 + E16;
V17 =   *F3 + E17;
V18 =   *F3 + E18;
V19 =   *F3 + E19;
V20 =   *F3 + E20;
V21 =   *F4 + E21;
V22 =   *F4 + E22;
V23 =   *F4 + E23;
V24 =   *F4 + E24;
V25 =   *F4 + E25;
V26 =   *F4 + E26;
V27 =   *F5 + E27;
V28 =   *F5 + E28;
V29 =   *F5 + E29;
V30 =   *F5 + E30;
V31 =   *F5 + E31;
```

```
V32 =   *F5 + E32;

V33 =   *F5 + E33;

V34 =   *F5 + E34;

V35 =   *F5 + E35;
```

```
V39 =   *F7 + E39;
V40 =   *F7 + E40;
V41 =   *F7 + E41;
V42 =   *F7 + E42;
F1 =   *F2 + *F3 + D1;
F2 =   *F5 + D2;
F3 =   *F5 + D3;
F4 =   *F2 + D4;
F7 =   *F1 + *F4 + D7;
/VARIANCES
  V36 = *;
  V37 = *;
  V38 = *;
  F5 = *;
  F6 = *;
  E1 = *;
  E2 = *;
  E3 = *;
  E4 = *;
  E5 = *;
  E6 = *;
  E7 = *;
  E8 = *;
  E9 = *;
```

```
E10 = *;
E11 = *;
E12 = *;
E13 = *;
E14 = *;
E15 = *;
E16 = *;
E17 = *;
E18 = *;
E19 = *;
E20 = *;
E21 = *;
E22 = *;
E23 = *;
E24 = *;
E25 = *;
E26 = *;
E27 = *;
E28 = *;
E29 = *;
E30 = *;
E31 = *;
E32 = *;
E33 = *;
E34 = *;
E35 = *;
E39 = *;
```

```
E40 = *;
E41 = *;
E42 = *;
D1 = *;
D2 = *;
D3 = *;
```

```
05-MAY-14      PAGE:   3 EQS     Licensee:

 TITLE:   Model built by EQS 6 for Windows (Final model)

  110   D4 = *;

  111   D7 = *;

  112 /COVARIANCES

  113 /PRINT

  114 FIT=ALL;

  115 TABLE=EQUATION;

  116 /END


     116 RECORDS OF INPUT MODEL FILE WERE READ

   DATA IS READ FROM c:\users\ccc\desktop\data - copy_1.ess



   THERE ARE 42 VARIABLES AND    93 CASES
   IT IS A RAW DATA ESS FILE
```

```
05-MAY-14      PAGE:   4 EQS     Licensee:

 TITLE:   Model built by EQS 6 for Windows (Final model)


 MAXIMUM LIKELIHOOD SOLUTION (NORMAL DISTRIBUTION THEORY)


 DISTRIBUTION OF STANDARDIZED RESIDUALS


    ----------------------------------------
    !                                      !
 280-                    *                 -
    !                    *                 !
    !                    *                 !
    !                    *                 !
    !                 *  *                 !           RANGE
FREQ PERCENT
 210-                 *  *                 -
    !                 *  *                 !    1   -0.5  -  --
   0   0.00%
    !                 *  *  *              !    2   -0.4  -  -0.5
   0   0.00%
    !                 *  *  *              !    3   -0.3  -  -0.4
   0   0.00%
    !                 *  *  *              !    4   -0.2  -  -0.3
   1   0.11%
 140-                 *  *  *              -    5   -0.1  -  -0.2
  41   4.54%
    !                 *  *  *              !    6    0.0  -  -0.1
 225  24.92%
    !                 *  *  *              !    7    0.1  -   0.0
 286  31.67%
    !                 *  *  *              !    8    0.2  -   0.1
 179  19.82%
    !                 *  *  *              !    9    0.3  -   0.2
  71   7.86%
  70-                 *  *  *  *           -    A    0.4  -   0.3
  50   5.54%
    !                 *  *  *  *  *        !    B    0.5  -   0.4
  38   4.21%
    !              *  *  *  *  *  *  *     !    C     ++  -   0.5
  12   1.33%
    !              *  *  *  *  *  *  *     !    ------------------
-------------
    !              *  *  *  *  *  *  *  *  !           TOTAL
 903 100.00%
    ----------------------------------------
       1  2  3  4  5  6  7  8  9  A  B  C    EACH "*" REPRESENTS
14 RESIDUALS
```

```
 05-MAY-14      PAGE:   5 EQS     Licensee:

  TITLE:   Model built by EQS 6 for Windows (Final model)


  MAXIMUM LIKELIHOOD SOLUTION (NORMAL DISTRIBUTION THEORY)

  GOODNESS OF FIT SUMMARY FOR METHOD = ML

  INDEPENDENCE MODEL CHI-SQUARE =    3822.491 ON   861 DEGREES OF
FREEDOM

  INDEPENDENCE AIC =    3000.491   INDEPENDENCE CAIC =     -41.077
         MODEL AIC =     355.215          MODEL CAIC =   -2499.126

  CHI-SQUARE =     1195.215 BASED ON     808 DEGREES OF FREEDOM
  PROBABILITY VALUE FOR THE CHI-SQUARE STATISTIC IS      0.00000

  THE NORMAL THEORY RLS CHI-SQUARE FOR THIS ML SOLUTION IS 1225.304.

  FIT INDICES
  -----------
  BENTLER-BONETT     NORMED FIT INDEX =     0.683
  BENTLER-BONETT NON-NORMED FIT INDEX =     0.868
  COMPARATIVE FIT INDEX (CFI)         =     0.860
  BOLLEN'S          (IFI) FIT INDEX   =     0.703
  MCDONALD'S        (MFI) FIT INDEX   =     0.002
  JORESKOG-SORBOM'S GFI FIT INDEX     =     0.493
  JORESKOG-SORBOM'S AGFI FIT INDEX    =     0.433
  ROOT MEAN-SQUARE RESIDUAL (RMR)     =     0.082
  STANDARDIZED RMR                    =     0.176
  ROOT MEAN-SQUARE ERROR OF APPROXIMATION (RMSEA)    =     0.067
  90% CONFIDENCE INTERVAL OF RMSEA (0.060, 0.074)

  RELIABILITY COEFFICIENTS
  ------------------------
  CRONBACH'S ALPHA                                   =     0.976
  RELIABILITY COEFFICIENT RHO                        =     0.980
```

TITLE: Model built by EQS 6 for Windows (Final model)

MAXIMUM LIKELIHOOD SOLUTION (NORMAL DISTRIBUTION THEORY)

STANDARDIZED SOLUTION:
R-SQUARED

```
V1    =V1 = .802*F1 + .597 E1     .643
V2    =V2 = .867*F1 + .499 E2     .751
V3    =V3 = .898*F1 + .439 E3     .807
V4    =V4 = .905*F1 + .425 E4     .819
V5    =V5 = .881*F1 + .473 E5     .776
V6    =V6 = .803*F1 + .596 E6     .645
V7    =V7 = .698*F1 + .716 E7     .488
V8    =V8 = .715*F2 + .699 E8     .511
V9    =V9 = .768*F2 + .641 E9     .589
V10   =V10= .796*F2 + .605 E10    .634
V11   =V11= .754*F2 + .656 E11    .569
V12   =V12= .797*F2 + .604 E12    .635
V13   =V13= .722*F2 + .692 E13    .521
V14   =V14= .788*F2 + .616 E14    .621
V15   =V15= .723*F2 + .690 E15    .523
V16   =V16= .718*F2 + .696 E16    .516
V17   =V17= .667*F3 + .745 E17    .445
V18   =V18= .755*F3 + .655 E18    .571
V19   =V19= .899*F3 + .437 E19    .809
V20   =V20= .786*F3 + .619 E20    .617
V21   =V21= .725*F4 + .689 E21    .525
V22   =V22= .893*F4 + .449 E22    .798
V23   =V23= .959*F4 + .284 E23    .920
V24   =V24= .927*F4 + .376 E24    .858
V25   =V25= .887*F4 + .462 E25    .786
V26   =V26= .614*F4 + .789 E26    .377
V27   =V27= .648*F5 + .762 E27    .420
V28   =V28= .625*F5 + .781 E28    .390
V29   =V29= .630*F5 + .777 E29    .397
V30   =V30= .754*F5 + .657 E30    .568
V31   =V31= .641*F5 + .768 E31    .411
V32   =V32= .850*F5 + .526 E32    .723
V33   =V33= .891*F5 + .453 E33    .795
V34   =V34= .856*F5 + .517 E34    .733
V35   =V35= .787*F5 + .617 E35    .620
V39   =V39= .773*F7 + .634 E39    .598
V40   =V40= .664*F7 + .748 E40    .441
V41   =V41= .826*F7 + .563 E41    .683
```

STANDARDIZED SOLUTION:
R-SQUARED

```
05-MAY-14      PAGE:  7 EQS     Licensee:

 TITLE:   Model built by EQS 6 for Windows (Final model)


 MAXIMUM LIKELIHOOD SOLUTION (NORMAL DISTRIBUTION THEORY)

  V42   =V42= .784*F7 + .621 E42                                 .614
   F1   =F1 = .639*F2 + .311*F3 + .600 D1                        .640
   F2   =F2 = .740*F5 + .500 D2                                  .750
   F3   =F3 = .816*F5 + .588 D3                                  .654
   F4   =F4 = .862*F2 + .622 D4                                  .613
   F7   =F7 = .496*F1 + .393*F4 + .562 D7                        .685




-------------------------------------------------------------------
                          E N D   O F   M E T H O D
-------------------------------------------------------------------
 Today is 2014/05/05
 Execution begins at 19:59:52
 Execution ends   at 19:59:58
 Elapsed time =       6.00 seconds
```