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MOST EFFICIENT CRITICAL SUCCESS FACTOR FOR CONSTRUCTION

James Ohol[1], Abhishek Oza[2], Aniruddha Kolhapure[3], Roshni Singh[4], Prof. Ashish P. Waghmare[5]

[1,2,3,4]Uder Graduation Student, Department of Civil Engineering DYPSOET Pune, Maharashtra
[5]Professors, Department of Civil Engineering DYPSOET Pune, Maharashtra, India

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Abstract - The concept of success of construction projects and literature review of critical success factors is discussed in this paper. Critical success factors have been recognized in different settings however there is no broad agreement. The vast majority of these reviews are excessively non specific and offer a conversation starter of relevance on a particular industry, for example, construction industry. Along these lines, the motivation behind this paper is to distinguish critical success factors through a critical writing with unique consideration on project execution phase of construction projects. The review looks to give a superior comprehension, understanding and investigation of the critical success factors that are basic to the achievement of any compelling construction project and the path forward. The research findings will be expected to assist the organization in evaluating the performance of project management. This paper concentrates the diverse elements influencing success of construction projects in view of literature survey

Key words: Critical Success Factors, Construction Projects, Project Management, Project Success, Project Success Criteria, Contractors

1. INTRODUCTION

1.1 BACKGROUND TO THE RESEARCH

An examination of the relevant recent literature indicates that construction projects are frequently completed with large cost overruns, extended schedules and quality concerns. Delay is defined as the time overruns either beyond the completion date specified in the contract, or beyond the date that the parties agreed upon for delivery of the project. A delay in a construction project may cause losses, or negatively affect some or all of the project parties. The effects of delay may include time overrun, cost overrun, disputes, arbitration, litigation, and total abandonment. Some studies directly examine delays and attempt to identify their causes as well as ways to avoid them.

During the last four decades a number of studies have investigated factors which aid successful completion of projects, particularly those which affect project success more than others. "Critical success factors thus are, for any business, the limited number of areas in which results, if they are satisfactory, will ensure competitive performance".

The concept of success in a construction project can, according to some researchers be evaluated only when the evaluation dimensions are adequately defined. Generally, in any project the evaluation dimensions correspond to the traditional constraints of time, cost, and quality parameters. Ashley defined project success as "results better than expected or normally observed in terms of cost, schedule, quality, safety, and participant satisfaction". The first study to identify lists of critical success factors was undertaken who identified which factors were most influential in successfully completing construction projects.

Research into critical success factors has been undertaken since 1967, and demonstrates the development of information on critical success factors based on empirical and theoretical studies. This report builds on these past studies by investigating the success and delay factors they identify. This work examines success and delay factors in an integrated fashion to determine which critical success factors are most influential in avoiding particular critical delay factors. This will provide organizations involved in construction projects with the foundation on which such strategies - on how to avoid delays - can be developed in the future

1.2 SCOPE OF THE WORK

A great number of decisions need to be taken during the project management process and as usual, the decisions at the earlier phases of the design have a bigger impact on the project management practice as compared at later stages or during building operation or construction. If project managers are not aware of the criteria that would influence their goals set from the inception phase then the project will not be successful. Hence, this study will identify the CSFs that affect the level of project performance through a project management practice and rank those CSFs that will enable the project management companies to evaluate the project outcome. CSFs will become a gauge by which project managers can evaluate their companies. CSFs allowed the company to implement standard organizational management skills to improve the company and project performance.

1.3 OBJECTIVES OF STUDY

The objectives of the study are as follows:

- To identify external critical success factors for construction projects.
- To identify internal critical success factors for construction projects.

- To evaluate the identified critical success factors in order of their importance.
- To evaluate the effects of the identified critical success factors on the successful construction projects.

CHAPTER 2

LITERATURE REVIEW

This chapter confers the review of literature regarding the critical success factors for effective construction management of the past researches and studies. The most noteworthy of them which are relevant to the thesis are being reviewed.

2.1 International Journal of Business and Social Science Vol. 7, No. 3; March 2016, Critical Success Factors: En Route for Success of Construction Projects, By Susil Kumara Silva et al.

The study of critical success factors is a means of improving effectiveness and efficiency of projects. Critical success factors have been identified in various contexts but there is no general agreement. Most of these studies are too generic and pose a question of applicability on a specific industry such as construction. Therefore, the purpose of this paper is to identify critical success factors through a critical literature review with special attention on project execution stage of construction projects and to identify research gaps to be filled in the future. 40 external factors and 34internal factors were identified. 10 external factors and 19internal factors are repeated in 3 or more papers. More researches are needed on the relationship between critical human resource management factors and project success. Findings are instrumental for industry professionals, academics and policy makers. Further, it will add to the project management body of knowledge. This paper aimed at presenting literature relevant to project critical success factors with special reference to construction industry. The argument is that the factors in Table 1 are external to the contractor as well as the contractor has minimal/no control or influence over it. Most of the identified factors through the said studies cover different disciplines or knowledge areas such as human resources management, financial management, logistics and operational etc. However, less attention has been drawn on specific areas such as human resource related factors (HR knowledge area).

Following are the major findings from above paper:

- Factors are external to the contractor but these factors have a great impact on achieving particular project success and on industry development. 40 external factors were identified.
- External factors basically could be viewed as issues related to government policies, client & consultant's characteristics and industry issues/challenges. Industry-wide issues should be addressed at the industry level forums/institutions.
- 34 internal factors were identified and the findings consisting of important human resources management challenges as well. 19 factors were identified as very important.

2.2 Construction Economics and Building, 16(1), 18 - 32 Copyright: Construction Economics and Building 2016. Critical success factors for implementing risk management systems in developing countries, By, M. Reza Hosseini, Nicholas Chileshe et al.

A review of published studies on risk management in developing countries reveals that critical success factors for implementing risk management has remained an under-researched area of investigation. This paper is aimed at investigating the perceptions of construction professionals concerning the critical success factors (CSFs) for implementation of risk management systems (IRMS). Survey data was collected from 87 construction professionals from the Iranian construction industry as a developing country. The results indicate that four factors are regarded as highly critical: 'support from managers', 'inclusion of risk management in construction education and training courses for construction practitioners', 'attempting to deliver projects systematically', and 'awareness and knowledge of the process for implementing risk management'. Assessing the associations among CSFs also highlighted the crucial role of enhancing the effectiveness of knowledge management practices in construction organisations. Study also revealed that parties involved in projects do not agree on the level of importance of CSFs for implementing risk management in developing countries. This study contributes to practice and research in several ways. For practice, it increases understanding of how closely knowledge management is associated with the implementation of risk management systems in developing countries. For research, the findings would encourage construction practitioners to support effective knowledge management as a precursor to higher levels of risk management implementation on construction projects.

Following are the major findings from above paper:

- The results showed that support from high-ranked managers is a crucial precursor for higher level of risk management implementation across the industry.
- This study, because it identifies the risks in developing countries utilising different methods, makes a number of important contributions to the risk management body of knowledge.
- The study also highlights the underlying associations between the effective knowledge

management in construction organisations in developing countries and risk management implementation, providing a new perspective for addressing the problems associated with implementation of risk management in developing counties.

- The analyses also showed that the clients, contractors and consultants did not agree with regard to the overall ranking of the CSFs.

2.3 Proceedings of 12th International Conference on Business Management, 7th and 8th December 2015, Critical Success Factors for Construction Projects: A Literature Review, by, Warnakulasuriya B N F & Arachchige B J H

Project success factors have been very popular and lists of critical success factors have been identified but there is no general agreement. Studies on critical success factors are too generic and pose a question of applicability on a specific industry such as construction. Construction industry, by its nature, is a complex; project oriented, high risk, and competitive business. It is one of the major contributors to the national economy and has a multiple impact on a county. Construction project failures are increasingly reported around the globe and achieving success of construction projects is becoming extremely difficult in today's turbulent environment. According to heresy evidence, construction project failures are abundant in Sri Lanka as well. Determining key success factors in different project context is a challenge and it is extremely important for the industry professionals and academics. Therefore, this paper attempts to identify critical success factors through a literature review with special attention on project execution stage of construction projects.34 success factors were identified from recent papers and 19 factors are repeated in 3 or more papers. More research is needed on the relationship between critical human resource management factors and project success. Findings are instrumental for professionals and academics and will add to the construction project management body of knowledge.

Following are the major findings from above paper:

- 34 success factors were identified and the findings consisted of important human resources management related challenges.
- More empirical researches are needed on the relationship of human resources management related critical success factors with project success and organizational success in construction project management context.
- Success factors identified by various researchers were grouped and presented as success factors on which contractor has no or has the least control/influence and success factors on which contractor has full or a considerable level of control/influence.

2.4 International Journal of Research in Management, Science & Technology (E-ISSN: 2321-3264) Vol. 3, No. 1, April 2015, Critical Success Factors for Public Sector Construction Project Delivery: A Case of Owerri, Imo State, By Benedict Amade, Emmanuel Chinenye Ubani et al.

This study analyzes the results of a survey that aimed at assessing the critical success factors for public sector construction projects in Owerri, Imo State of Nigeria. The effects of the identified critical success factors on public sector construction project delivery were also examined. Data on the study variables were collected via structured questionnaires from fifty six (56) professionals within construction firms located in Owerri, Imo State using the Krejcie and Morgan Method of sampling. Respondents for the study were approached personally to elicit information from using questionnaires and interviews. Various statistical tools such as reliability test using Kaiser-Meyer-Olkin (KMO) measure of sampling accuracy and Barlett test of sphericity were used in determining the accuracy of the method, while factor analysis and linear multiple regression were applied in data analysis and inference using SPSS software. The exploratory factor analysis highlights a specific set of six (6) critical success factors after subjecting sixteen (16) of the initial variables to factor analysis.
The six (6) critical success factors include; efficient and effective procurement process/method, effective communication management, adequate planning, leadership skills of the project manager, weather conditions, and effective coordination of project activities. The results of the findings after subjecting the six (6) identified critical success factors to regression revealed that adequate planning had a significant impact on the success of public sector construction projects, while the remaining five (5) factors did not explain any significant variance in the success of public sector construction project delivery. The findings from this study contributes to the public sector construction project critical success factors literature by conceptualizing more on leadership skills of the project manager, effective management of communication and most importantly the provision of adequate planning in terms of schedule, and cost as a multidimensional construct for public sector construction projects success.

Following are the major findings from above paper:

- An exploration of the identified factors was achieved through an interrelationship between variables using the factor analytical approach and linear multiple regression analysis technique.
- A cursory look at the factors identified in the initial analysis indicates that the critical factors for a successful public sector construction projects are

efficient and effective procurement process/method, effective communication management, adequate planning, leadership skills of the project manager, weather conditions, and effective coordination of project activities.

- The results of the findings after subjecting identified critical success factors of public sector construction project delivery revealed that adequate planning had a significant impact on the success of public sector construction projects.

2.5 Jordan Journal of Civil Engineering, Volume 8, No. 4, 2014, Identification of Critical Success Factors (CSFs) for Public Private Partnership (PPP) Construction Projects in Syria, By, Alis Kahwajian , Shukri Baba et al.

The collaboration between the public and the private sectors is an important issue that has attracted the attention of most governments around the world. Public Private Partnership (PPP) is one important approach among many that meets this goal. Syria, in the present time, needs this type of contract to reduce the huge pressure on the treasury by attracting the required funds for developing, extending and operating many vital infrastructure projects. In fact, the best results obtained from PPP contracts depend on determining the Critical Success Factors (CSFs), which are influenced by the local strategies and related to the nature of each of these factors and its importance, without neglecting the nature of the project under consideration. This research aims at identifying the critical success factors that influence PPP projects in Syria based on previous similar studies supported by a structured questionnaire survey. It also attempts to uncover the current PPP practice and highlight the main obstacles that hinder its implementation in the Syrian construction industry. The identified CSFs are ranked according to their importance, for public and private sectors independently and collectively. This research ultimately aims at developing a new practical framework to help decision makers both in public and private sectors in selecting the optimum PPP contract for the construction industry in Syria taking the most important CSFs into account.

Following are the major findings from above paper:

- This study has identified twenty two critical success factors that influence public and private partnership projects in the Syrian construction industry.
- This questionnaire also sought to discover any additional factors that characterize the Syrian construction industry. As a result, three additional factors have been identified; Readiness level of the concerned sector/ Nature of the service, Cost of (fuel, electricity, water etc.) and Availability of work requirements.
- The main problems facing PPP projects in Syria are: lack of legislations, weakness in the administrative and legal competencies of the public sector, immaturity of the partnership experience in the private sector and lack of experienced private and public consulting organizations in Syria specializing in financial, technical and legal aspects of PPP projects.
- It is clear based on the findings of the conducted questionnaire that there is an urgent need in Syria to develop a legal, cultural and regulatory PPP environment.

2.6 International Journal of Engineering and Technical Research (IJETR) ISSN: 2321-0869, Volume-2, Issue-2, February 2014, Critical Success Factors for Contractors, by, Hamimah Adnan, Norazian Mohd Yusuwan et al

To achieve the objectives, 68 related factors for successful construction of projects were classified into project characteristics, contractual arrangements, project participants and interactive process. A questionnaire survey was administered to 120 contractors and it was found that site limitation and location, project size, adequacy of funding, technical approval authorities, pioneering status, constructability, economic risks, political risks and impact on the public were critical towards the success of the projects. Additionally, the contractual arrangements, formal dispute resolution process, adequacy of plans and specifications, realistic obligations and clear objectives, motivation and incentives, risk identification and allocation were considered critical. Different sets of critical success factors were identified for the different objectives (time, quality and cost). By focusing on the CSFs identified in this research, project teams have a better chance of achieving excellent project performance and will be able to furnish clients and other project stakeholders with useful information to successfully implement projects.

Following are the major findings from above paper:

- From the project characteristics on time, cost and quality these factors were site limitation and location, project size, adequacy of funding, technical approval authorities, pioneering status, constructability, economic risks, political risks and impact on public.
- Based on contractual arrangement on time, cost and quality, it was found that formal dispute resolution process, adequacy of plans and specifications, realistic obligations and clear objectives, motivation and incentives, risk identification and allocation were influencing critical factors.
- Based on interactive process on time, cost and quality, it was found that planning, monitoring, communication and project organisation were crucial.

- Finally, based on the overall project based on time, cost and quality, it was found that interactive process, project characteristics, contractual arrangement and project participants were of importance.

2.7 AMER International Conference on Quality of Life, 4-5 January 2014, Determining Critical Success Factors of Project Management Practice: A conceptual framework, by, Zarina Alias et al.

Critical success factors (CSFs) are inputs to project management practice which can lead directly or indirectly to project success. It encompasses many elements, which have to be synchronized to ensure the project delivery on time. The purpose of this study is to identify the extent of the relationship between CSFs and project performance. The research findings will be expected to assist the organization in evaluating the performance of project management. Finally, the conceptual framework was developed by identifying five (5) variables for project success namely Project Management Action, Project Procedures, Human Factors, External Issues and Project Related Factors. The tool used to achieve the relationship between the critical success factor and project performance in this study is by developing a conceptual framework. Critical success factor is a variable that can have a significant impact that delivers measurable improvements to the project success. Organisations/companies look to forecasting tool to help them speed their progress toward performance improvement, and to guide them around pitfalls that might otherwise slow or even halt their initiatives of project performance. Therefore, in order to improve the project performance, it is essential to determine the critical success factors in the current project management practices. In order to achieve this, the variables for project success are essentially important to be identified and established towards achieving the objective of this study.

Following are the major findings from above paper:

- Results from this study are expected to help project management practitioners to achieve specific construction performance level.
- Then it will define the critical factors that lead to project success and provide a forecasting tool to enable parties to rapidly assess the possibility of a successful project from their viewpoint.
- This study also elaborates a conceptual framework for determining critical success factors in project management practices based on five (5) variables for project success, which should be taken into consideration during the project management phases from inception until project completion in order to enhance project success.
- Finally, it is hoped that this study will beneficial to all parties involved in construction industries and would stand as a good basis for future research.

2.8 Management Science Letters 4 (2014) 1325–1334, Identifying program critical success factors in construction industry, by, Sarmad Kiania, Vahidreza Yousefia et al

In project management literature, the concept of program is a group of related projects managed in a coordinated way to obtain benefits not available from managing them individually. This paper attempts to identify program critical success factors focusing on Iran's construction industry so that the level of relative importance of various factors could be determined for key stakeholders. Furthermore, since a program includes a set of projects, another objective of this study is to find out whether the projects of program are accomplished, successfully or not. Therefore, to run this study, first literature of topic based on research keywords is reviewed. Then a conceptual model including all the aspects of program success factors is presented. Next, critical success factors are quantitatively analyzed by performing an empirical investigation on active organizations and firms of Iran's construction industry. The study employs questionnaire and performs interview surveys with construction program professionals and experts. Finally, the critical success factors of program are sorted according to their ranks. The results show that program-related factors maintain the highest effects on program success followed by organization-related and project-related issues.

Following are the major findings from above paper:

- The study has asserted that program success may include organization-related factors, program related factors, project-related factors and factors associated with external environment.
- Analysis of this study shows that program-related factors have most CSF in Iran construction programs.
- Critical success factors for projects are not necessarily the same as critical success factors for program but they may play a considerable role in program success.
- If all the projects of one program are successfully performed (measured by product and project quality, timelines, budget compliance, and degree of customer satisfaction), it will not be guaranteed to have successful program, because there are more aspects and factors which will affect it.

2.9 Asian Social Science; Vol. 9, No. 9; 2013, ISSN 1911-2017 E-ISSN 1911-2025 Published by Canadian Center of Science and Education 211,Developing Critical Success Factors (CSFs) for Effective Construction Management in Malaysia Industry, By, Ayob. Norizam & M. A. Malek

Construction management (CM) can be considered as the central concern in conducting of construction projects. In order to deliver high-quality product to both purchaser and buyer, there is a need to assess the efficiency of the company behind the product. Despite numerous journal papers explaining critical success factors (CSFs) for construction projects, very few focus on determining the CSFs for construction management. The primary objective of this paper is to identify the principal CSFs for construction management through literature review and survey. From the review, seven main factors can be determined from all of the sub-factors discovered. Those factors were assembled into a questionnaire and distributed among construction industry practitioners, including property developers, consultants and contractors. An analysis of factors was then used to ascertain the dependent and independent variables necessary for developing an assessment system for evaluating construction management in construction industry firms. The exploratory research in this paper focuses on the link between CSFs and an effectiveness in construction management for construction industry practitioners in Malaysia.

Following are the major findings from above paper:

- Through the survey, researcher identified some missing parameters that might be consolidated from perspective of construction industry practitioners.
- Practitioners suggested that some enhancement on the survey that included assessment on practitioners financial status, construction managers specific task and responsibilities and relationship between quality control and safety measures to be add on for measuring construction management effectiveness.
- It is evidence that construction industry in Malaysia recognized and implemented effective construction management in their firms but only they have not realized the contribution towards the successful on construction project.

2.10 11th International Conference on Modern Building Materials, Structures and Techniques, MBMST 2013, Development of a Conceptual Critical Success Factors Model for Construction Projects: a Case of Lithuania, By, Neringa Gudienėa, Audrius Banaitisa et al.

This paper aims to develop a conceptual critical success factors model for construction projects in Lithuania. The concept of success of construction projects and literature review of critical success factors is discussed in the first part. Conceptual model adapted to Lithuania is developed and its elements are described in the second part. Grouped decision-making matrix for the multiple criteria analysis of critical success factors of construction projects is presented at the end of paper. The critical success factors model for Lithuania construction projects is given. The model consists of seven groups of critical success factors: external factors, institutional factors, projects related factors, project management/team members related factors, project manager related factors, client related factors, contractor related factors. The variables within each group are interrelated. A variable in one group can influence a variable in the others. The elements of the proposed model are discussed.

Following are the major findings from above paper:

- A conceptual model that includes the grouped critical success factors affecting project success was developed.
- It was described seven major groups of factors, namely external factors, institutional factors, projects related factors, project management/team members related factors, project manager related factors, client related factors and contractor related factors influencing the project success in Lithuania.
- For future research, factor analysis method could be used to investigate the underlying relationship among the identified CSFs to find out the clusters that can better represent all the CSFs and a multiple criteria analysis of alternatives in order to select the most successful project.

2.11 IJCRB.Webs.Com Interdisciplinary Journal Of Contemporary Research In Business Copy Right © 2012 Institute Of Interdisciplinary Business Research \ December 2012 Vol 4, No 8, Determining The Critical Success Factors In Construction Projects: AHP Approach, By, Afshin Pakseresht , Dr. Gholamreza Asgari

The purpose of this study is identifying and ranking the critical success factors in construction projects of Pars Garma Company. In order to identify these factors, this study was planned and performed in two stages. At the first stage to identify the critical success factors a questionnaire was made and distributed among 58 people of staff managers, project managers and technical experts of Pars Garma Company. Then data obtained from the distributed questionnaires was analyzed using Z-test and SPSS 16 software. At the second stage by omitting low-effect factors, a questionnaire was designed based on AHP method to collect the opinions of experts and distributed among 15 persons of the organizational experts. The returned

questionnaires of this stage were analyzed by Expert Choice software. The research findings indicate that the critical success factors in construction projects have different priorities and weights. Also, considering the importance, the critical success factors are respectively: Technical and economic assessment of the project required resources, experience and executive records of project manager, project strategic planning and executive experiences of contractor team about the project subject.

Following are the major findings from above paper:

- By more concentration on these factors, their effectiveness could be maximized.
- These factors assist the managers in utilizing the resources and facilities and consequently reforming their use pattern.
- They accelerate organization's success achievement by faster removing the existing barriers, especially in competitive conditions.
- They prevent probable perceptual errors and imaginations of the managers based on the importance of some factors to other factors and realize the factors prioritization and impede the realization of various errors.
- They help the organization to implement the strategic plans successfully.

2.12 IRACST- International Journal of Research in Management & Technology (IJRMT), ISSN: 2249-9563 Vol. 2, No. 5, October 2012, Critical Success Factors of Knowledge in Projects: Evidence from Construction Industry of Malaysia, By, Ehsan Borousan et al.

Knowledge management can be defined as the act of arranging, establishing, and sharing the movement of knowledge within the organizations. The use of past information and knowledge in new projects reduce the need of referring to past projects, minimize the time and cost of solving problems and raise the quality of finding solutions to the problems during the construction phase of a project. Knowledge that are earned from past projects can be used and shared between different engineers and experts who participated in the project so that improve the construction process and minimize the time and cost of finding the solutions for the problems. This paper establishes the critical success factors (CSFs) for executing knowledge management in construction projects particularly from the Malaysian point of view. The opinions of different groups including general contractors and subcontractors regarding the critical success factors for knowledge management in construction phase were examined through the data that was collected from the questionnaires and interviews distributed between project participants concerning their knowledge management experiences in the company. Factor analysis and multiple regressions were used to investigate the relationship between the perception of success knowledge management and a group of success factors which was hypothesized in the study. The findings of the study reveal that in order to implement knowledge management successfully, certain requirements must be met. A willingness to share knowledge, the establishment of a reward strategy, a clear definition of rules, a friendly and satisfied knowledge exchanging system, and well-function knowledge management organization were identified as the major underlying factors for the success of knowledge management. The establishment of success factors developed effective strategies for increasing knowledge management in construction as well as improving the project's performance.

Following are the major findings from above paper:

- The key goal of this study is approved to be relevant and significant to the larger number of success implementation of knowledge management in construction projects.
- Ten critical success factors of the study were obtained from the combination of empirical studies with the viewpoint of 40 engineers regarding the knowledge management divisions in construction projects.
- These factors made a valid foundation and an underlying support for the evaluation of knowledge management's performance in construction projects.
- Based on the result of the analysis, five of the success factors were chosen as the critical ones. "Willingness for knowledge sharing," "Define a strategy for rewarding," "Friendly system for knowledge sharing," "Having a mechanism to approve activities," and "Top Management Support & Leadership" are proved to be necessary in order to generate successful results to knowledge management in construction.
- According to the analysis of the questionnaire's responses, nearly all engineers approve and think that knowledge management in construction projects is an essential process in advancing construction management.

2.13 Proceedings of the 2012 International Conference on Industrial Engineering and Operations Management Istanbul, Turkey, July 3 – 6, 2012, Critical Success Factors of Implementing Total Quality Management in Libyan Organisations, By Nawal Gherbal et al.

Total Quality Management (TQM) is one of the approaches that contributes towards ensuring that projects are being delivered to the stakeholder requirements. The main purpose of this paper is to identify critical success factors (CSFs) that affect the implementation of TQM in

Libyan Construction Industry (LCI). This research adopted both quantitative and qualitative research methods. The findings of this research is based upon 200 questionnaires distributed to quality and general managers working with forty-five construction contracting companies operating in the public and private sectors in Tripoli. The structured survey yielded 130 responses and the data collated was analysed using factor analysis. The results identify five reliable and valid TQM dimensions, namely organisation management, communication to improve quality, training and development, employee involvement and recognition, and culture. The data were collected through the developed survey questionnaires. Before the wider distribution of the questionnaire, the questionnaires were pilot – tested, where the pre test was conducted to test the workability. Nannulay (1978), suggested that the pretest must be carried on similar groups After several intensive questionnaire reviews and amendments with academics. The scree plot exposed a clear break after the five components. Scree test, was used to determine that five components be retained for further investigation.

Following are the major findings from above paper:

- Both validity analysis and reliability of the survey have been conducted and it has been concluded that the survey is fairly reliable and valid.
- The research findings from all the analysis identify five reliable and valid TQM constructs; five are implementation constructs and one outcome construct. The five constructs which are organisation commitment, communication to improve quality, Training and Development, employee's involvement and recognition and work environment and organisational culture.
- The correlation analysis showed that there is interrelation between the five factors which is significant correlation between all factors.
- The finding from the questionnaires survey and interview reveals that the successful for implementation of TQM in LCI can be affected by those factors, where the results indicated that the communication to improve quality and training and development the most critical factors of successful the implementation of TQM in LCI.
- From the interviews the researcher found that there was a clear lack of implementation of the critical success factors CSFs of TQM demonstrated through features such as, lack of knowledge of QM and lack of management commitment.

2.14 Proceedings – EPOC 2012 Conference, Engineering Project Organizations Conference, Rheden, the Netherlands, A Holistic Success Model for the Construction Industry, by, Olawafunsho Farinde and David Sillars

The contribution of this paper is to present the development of a new Construction Company Success Model that was subsequently used for a further study into key performance indicators in the Nigerian construction industry. The new model reflects not only the immediate definition of success of project management, but also reflects the definition of success for the enterprise of which the project management is a part. To develop the new model, a model that is prevalent in the software programming industry was found and adapted to the language of construction project development. The model proposes that both Project Management and Project-Product performance are key fundamental elements in modelling success. This holistic view wraps together a perspective that is longer than the temporal nature of a project management organization. As part of the larger study, the two fundamental factors within the model were tested through a survey of Nigerian construction professionals, and the importance of the Project Management and Project-Product factors were confirmed. This paper presents the model as a new perspective for evaluating the organizational and project management practices that lead to success.

Following are the major findings from above paper:

- This paper presents a construction company success model, which is developed by integrating project management success and project-product success.
- The new model developed can be used as a framework to help construction project managers and construction companies identify the differences between project management success (construction organization success) and project-product success, (owner's success) and what needs to be done to meet these criteria during the project-planning phase.
- Having a clear definition of project success will not only aid organizations in generating incomes and making profits, it will also help them identify how to gain more of a market by helping clients meet their needs alongside their own.

CHAPTER 3

THEORETICAL CONTENTS

3.1 INTRODUCTION TO CONSTRUCTION INDUSTRY IN INDIA

The construction industry is the second largest industry in India after agriculture. It accounts for about 11% of India as GDP. It makes significant contribution to the national economy and provides employment to large number of people.

There are mainly three segments in the construction industry like real estate construction which includes residential and commercial construction; infrastructure building which includes roads, railways, power etc.; and industrial construction that consists of oil and gas refineries, pipelines, textiles etc. According to a study by ASSOCHAM, the burgeoning Indian construction industry, currently worth $70 billion, will rise to US$120 billion by 2010.

Construction is an essential part of any country's infrastructure and industrial development. Construction industry, with its backward and forward linkages with various other industries like cement, steel bricks etc. catalyses employment generation in the country. Construction is the second largest economic activity next to agriculture. Broadly construction can be classified into 3 segments as Infrastructure, Industrial and Real Estate.

Infrastructure segments involve construction projects in different sectors like roads, railways, ports, irrigation, power etc. Industrial construction is contributed by expansion projects from various manufacturing sectors. Real estate construction can be sub-divided into residential, commercial, malls/multiplexes etc. The construction activity involved in different segments differs from segment to segment. Construction of houses and roads involves about 75% and 60% of civil construction respectively. Building of airports and ports has construction activity in the range of 40-50%. For industrial projects, construction component ranges between 15-20%. Within a particular sector also construction component varies from project to project.

Construction sector contributed about 11.5% to the country's GDP in FY 08. Over past few years, growth of the construction has followed the trend of economic growth rate of the country. The multiplier factor between growth rates of construction and GDP has been about 1.5X-1.6X. Over past 3 years, construction as a percentage of GDP has increased from 8.0% in FY 06 to 8.5% in FY 08. Construction activity being labour intensive has generated employment for about 33 million people in the country.

The construction industry in India is highly fragmented. There are number of unorganised players in the industry which work on the subcontracting basis. To execute more critical projects, nowadays bids are increasing placed in consortium. But the profitability of the construction projects varies across different segments. Complex technology savvy projects can fetch higher profit margins for construction companies as compared to low technology projects like road construction. Various projects in Construction industry are working capital intensive. Working capital requirement for any company depends on the order mix of the companies.

The construction industry operates on the basis of contractual agreements. Over the years different types of contracts have been developed. It mainly depends on the magnitude and nature of work, special design needs, and annual requirements of funds and complexities of job. Construction projects can be materialised through number of smaller contracts which mainly depends upon size of the project and diversified nature of activities to be carried out in the project. As a result, Subcontracting is a common phenomenon in the construction industry

The Construction industry of India is an important indicator of the development as it creates investment opportunities across various related sectors. The construction industry has contributed an estimated Rs. 6708 billion to the national GDP in 2011-12 (a share of around 9%).The industry is fragmented, with a handful of major companies involved in the construction activities across all segments; medium-sized companies specializing in niche activities; and small and medium contractors who work on the subcontractor basis and carry out the work in the field. In 2011, there were slightly over 500 construction equipment manufacturing companies in all of India. The sector is labour-intensive and, including indirect jobs, provides employment to more than 35 million people.

3.1.1 Construction Industry In Developing Countries

In developing countries, the construction industry is a key barometer of economic performance. The construction industry contributes a significant percentage of the gross domestic product (GDP) of these countries and provides employment to a substantial proportion of the working population.

The construction industry plays a major role in the economy. Possible measures of the role of the industry in the economy include:

- The size of the industry is substantial in terms of percentage contribution of construction to GDP. It provides an appreciable share as its output typically constitutes 7 – 10 % of GDP;
- Percentage proportion of construction to Gross Domestic Fixed Capital Formation. The industry is critical to infrastructure development and provides a sizable contribution to fixed capital formation

relative to other industries;

- Its value-adding capacity;
- The share of investment devoted to entirely new construction is likely to be higher in developing countries than in developed; and
- Construction is relatively labour-intensive in that it uses a larger number of workers per unit output than most other industries, and as such is important as an employer. The industry employs 5 – 15 % of the labour force in most developing countries.

3.1.2 Difficulties Faced By Construction Industries In Developing Countries

Construction industries in all countries face many difficulties and challenges. However, the problems facing the construction industry in developing countries are significantly more fundamental, more serious and more complex. In developing countries, these difficulties and challenges sit alongside the general situation of socio-economic stress, chronic resource shortages and a general inability to deal with key issues. Whilst in all countries, the construction industry faces conditions of uncertainty and risk, the sources of such risk are severe in developing countries and include:

- **Instability**

Construction is one of the first industries to feel the effects of an economic recession. This phenomenon, coupled with financial and other business risks, makes the development of this sector difficult. The construction industry in both developed and developing countries is volatile; however, instability and volatility are more severe in developing countries where resources are scarcer. Discontinuities and fluctuations which characterize construction demand are also volatile in developing countries. For this reason, local contractors are not able to maintain and develop permanent supervisory staff and skilled labour, nor can they establish an appropriate supply of basic equipment. Although clients (usually the government) may require the use of local contractors to do the work, there may be very few qualified local contractors available.

- **Scarce resources**

Many developing countries are richly endowed with natural resources, but most are also characterized by shortage of resources such as money, trained people, technical 'know how', and appropriate technology.

- **Relatively unskilled labour forces**

Construction activity in developing countries draws mostly on unskilled labour. A reliable supply of labour will be affected largely by the seasonal demand for agricultural labour. Some developing countries promote labour-intensive construction to provide social and economic advantages for the population, even though this procedure might hinder the quality and completion of the construction projects. Although labour is abundant in developing countries there tends to be a shortage of skilled labour.

- **Low levels of productivity, overruns and excessive wastages**

Research into construction projects in some developing countries indicates that by the time a project is complete, the actual cost exceeds the original contract price by 30% while change orders result in an 8.3% cost overrun Both housing and public buildings experience delays in completion and face constant modifications as work progresses. This has proven to be a serious and very expensive problem in Jordan's construction industry, for example. The successful execution of construction projects, keeping them within estimated cost and the prearranged schedules, primarily depends on the existence of an efficient construction sector capable of sustained growth and development in order to cope with the requirements of social and economic development and to utilize the latest technology in planning and execution. Adequate planning at the early stages of a project is critical for minimizing delays and cost overruns.

- **Poor infrastructure**

In general, poor infrastructure reduces productivity. Even the existence of an established bureaucracy does not necessarily mean the country has adequate and efficient infrastructure such as roads, water, utilities, transportation systems etc. According to the World Bank, up to 15% of production is lost between the farm gate and the consumer because of poor roads and storage facilities. This has the effect of reducing incomes to farmers and raising costs for urban consumers, thus mitigating against prospects for industrialization.

- **Fraudulent practices, and the inability to adopt best practice**

The cost of materials, fraudulent practices and kickbacks, and fluctuations of material prices are among the most important factors leading to high construction costs in developing countries. Contractors, therefore, may need to increase their budget to allow for 'hidden taxes/costs' in developing countries. Further, the system of competitive bidding does little to alleviate these constraints. In theory, the system of accepting the least cost bid should encourage efficiency; however, contractors, particularly small ones, have very little room for manoeuvre in pricing a tender. The design is fixed, the cost of the material to be used is fixed and rates for hired equipment are fairly standard. A contractor therefore makes a profit by limiting overhead costs, raising labour productivity, and/or rationalizing site organization. Small contractors also have the difficulty of obtaining credit,

as there is no continuity of work and no assurance of jobs. They cannot afford or obtain credit for the purchase of plant and equipment. As a result they are often trapped in a sequence of inefficient technology, leading to low productivity. In contrast the large contracting firms, which are often foreign owned, are well versed in the procedures governing the industry, and also have little difficulty in providing the necessary bonds and guarantees.

- **Financing characteristics typical in developing countries**

In developing countries, large projects are usually funded through loans from international agencies or developed countries' governments, and investments from private firms based in other countries. The most important sources of multilateral finance for construction projects are the World Bank and the International Monetary Fund (IMF). These institutions lend funds at interest rates below those charged by other private leaders and sometimes at no interest. Other international lending agencies include the United Nations, represented by organizations such as the World Health Organization (WHO), International Labour Organization (ILO), United Nations Industrial Development Organization (UNIDO) and United Nations Centre for Human Settlement (UNCHS). These agencies fund health centres, education infrastructure and affordable housing settlements.

- **Government influence**

Many of the construction projects in developing countries are so large and costly that they can only be accomplished by direct government involvement. The governments of developing countries generally set the rules for the development of contractual relationships, thereby influencing the public construction sector. The private sector also feels this influence through policies and legislation regarding licenses and permits, sanitary and building codes, minimum wage rates, corporate taxes, rules on importation of materials, and terms and availability of financing for construction According to the World Bank while the construction industry in developed countries is affected by political institutions, it is not as strongly affected as in developing countries. Contractors may, therefore, need to exercise caution, accept greater levels of risk, and purchase additional insurance to cover possible losses. Government responsibility to ensure that improvements are made to the construction industry is best done by encouraging local contractors to increase their capabilities, and enlarging the capacity of local material industries.

2.11.1 Project Parties

Table 3.1 summarises the construction project parties' roles. The primary construction project parties are:

1. Owner: Owners play the most important role in the construction project life cycle by defining project requirements, functions and services. Also, owners are responsible for providing financial support to a project.
2. Contractor: Firms or individuals generally contract with owners in order to execute certain projects according to specific conditions. The contractors are usually private contractors who undertake to construct the project under certain terms and conditions, and to the design and specifications provided by the project teams.
3. Designer (Architect/Engineer): The third party in construction projects is the designer, who interprets the owner's needs and creates a tangible blueprint of a project. For some projects, the designer also assumes the role of supervising activities during the construction phase. The project team usually includes the various departments within the ministry of development as well as a private consultant who is appointed to implement government projects.
4. Government Regulatory Agencies involved in the project: These agencies include, among others, electrical services, public works department (building, water , sewerage, structure, etc), fire brigade, Economic Planning unit, health, Town and Country planning, the Land Department and Survey Department.

Table 3.1 Construction Project Parties Roles

CONTRACT PARTY	ROLES
Owner	Determines whether it is necessary to build the facility Provides financial support to develop the project Determines the scope of work Most important player in the process
Contractor	Creates the facility based on the A/E's drawings and specifications Manages different resources during the project's development phase
Architect/Engineer (A/E)	Responsible for project design Fortifies the final project Determines which materials will be used and how they will fit together Develops the project's drawing and specifications

3.1.4 Common Problems: Construction Industry

The delays experienced during the stages of construction can be identified in three overlapping areas: problems of shortages or inadequacies in industry infrastructure; problems caused by clients and consultants/engineers; and problems caused by a contractor's incompetence/inadequacies. The researcher reviewed the projects which encountered delays, and based on follow-up discussion with stakeholders (Owners, Engineers, Consultants and Contractors) the following were cited as common problems in the building construction process:

3.1.4.1 Owners

The most frequently cited cause of delay for construction projects is change orders from the owners. There are two types of delay: compensable and non compensable delay. For marketing reasons, change orders tend to occur more often in private projects because private owners are in the habit of changing plans to meet customer demand and in line with the changing economic climate. Contractors accused owners of being slow in decision making, and requests from owners are usually made at short notice, thereby impacting on a contractor's plan. Some change orders can be large, requiring extensive redesign. These results, in many instances, in contractors wasting resources while waiting for owners to decide on specialty contractors and designers, decorative materials and suppliers, and provision of adequate information on the changes required.

CHAPTER 4

METHODOLOGY

4.1 INTRODUCTION

The project is mainly based on questionnaire survey. Hence a round of questionnaire survey was taken. Statistical Package for Social Scientist i.e. SPSS software is used to analysis the responses received and the details or the procedure adopted is given further.

4.2 RESEARCH APPROACH

The research approach includes information about Factor Analysis and also the component of factor analysis. Factor analysis is the process which is carried out in the SPSS software.

4.3.1 Factor Analysis

Factor analysis is a statistical method used to describe variability among observed, correlated variables in terms of a potentially lower number of unobserved variables called factors. For example, it is possible that variations in six observed variables mainly reflect the variations in two unobserved (underlying) variables. Factor analysis searches for such joint variations in response to unobserved latent variables. The observed variables are modelled as linear combinations of the potential factors, plus "error" terms. The information gained about the interdependencies between observed variables can be used later to reduce the set of variables in a dataset. Factor analysis originated in psychometrics and is used in behavioural sciences, social sciences, marketing, product management, operations research, and other fields that deal with data sets where there are large numbers of observed variables that are thought to reflect a smaller number of underlying/latent variables.

Factor analysis is related to principal component analysis (PCA), but the two are not identical. There has been significant controversy in the field over differences between the two techniques (see section on exploratory factor analysis versus principal components analysis) below. Clearly though, PCA is a more basic version of exploratory factor analysis (EFA) that was developed in the early days prior to the advent of high-speed computers. From the point of view of exploratory analysis, the eigen values of PCA are inflated component loadings, i.e., contaminated with error variance.

Example

Suppose a psychologist has the hypothesis that there are two kinds of intelligence, "verbal intelligence" and "mathematical intelligence", neither of which is directly observed. Evidence for the hypothesis is sought in the examination scores from each of 10 different academic fields of 1000 students. If each student is chosen randomly from a large population, then each student's 10 scores are random variables. The psychologist's hypothesis may say that for each of the 10 academic fields, the score averaged over the group of all students who share some common pair of values for verbal and mathematical "intelligences" is some constant times their level of verbal intelligence plus another constant times their level of mathematical intelligence, i.e., it is a combination of those two "factors". The numbers for a particular subject, by which the two kinds of intelligence are multiplied to obtain the expected score, are posited by the hypothesis to be the same for all intelligence level pairs, and are called **"factor loading"** for this subject. For example, the hypothesis may hold that the average student's aptitude in the field of astronomy is

{10 × the student's verbal intelligence} + {6 × the student's mathematical intelligence}.

The numbers 10 and 6 are the factor loadings associated with astronomy. Other academic subjects may have different factor loadings.

Two students having identical degrees of verbal intelligence and identical degrees of mathematical

intelligence may have different aptitudes in astronomy because individual aptitudes differ from average aptitudes. That difference is called the "error" — a statistical term that means the amount by which an individual differs from what is average for his or her levels of intelligence (see errors and residuals in statistics).

The observable data that go into factor analysis would be 10 scores of each of the 1000 students, a total of 10,000 numbers. The factor loadings and levels of the two kinds of intelligence of each student must be inferred from the data.

4.3.2 Type of Factor Analysis

Exploratory factor analysis (EFA) is used to identify complex interrelationships among items and group items that are part of unified concepts. The researcher makes no *a priori* assumptions about relationships among factors.

Confirmatory factor analysis (CFA) is a more complex approach that tests the hypothesis that the items are associated with specific factors. CFA uses structural equation modelling to test a measurement model whereby loading on the factors allows for evaluation of relationships between observed variables and unobserved variables. Structural equation modelling approaches can accommodate measurement error, and are less restrictive than least-squares estimation. Hypothesized models are tested against actual data, and the analysis would demonstrate loadings of observed variables on the latent variables (factors), as well as the correlation between the latent variables.

4.3.3 Types of Factoring

Principal component analysis (PCA) is a widely used method for factor extraction, which is the first phase of EFA. Factor weights are computed to extract the maximum possible variance, with successive factoring continuing until there is no further meaningful variance left. The factor model must then be rotated for analysis.

Canonical factor analysis, also called Rao's canonical factoring, is a different method of computing the same model as PCA, which uses the principal axis method. Canonical factor analysis seeks factors which have the highest canonical correlation with the observed variables. Canonical factor analysis is unaffected by arbitrary rescaling of the data.

Common factor analysis, also called principal factor analysis (PFA) or principal axis factoring (PAF), seeks the least number of factors which can account for the common variance (correlation) of a set of variables.

Image factoring is based on the correlation matrix of predicted variables rather than actual variables, where each variable is predicted from the others using multiple regression.

Alpha factoring is based on maximizing the reliability of factors, assuming variables are randomly sampled from a universe of variables. All other methods assume cases to be sampled and variables fixed.

Factor regression model is a combinatorial model of factor model and regression model; or alternatively, it can be viewed as the hybrid factor model, whose factors are partially known.

4.3.4 Terminology

Factor loadings**:**

Commonality is the square of standardized outer loading of an item. Analogous to Pearson's r, 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 (column) and divide by the number of variables. (Note the number of variables equals the sum of their variances as the variance of a standardized variable is 1.) This is the same as dividing the factor's eigenvalue by the number of variables.

Interpreting factor loadings**:**

By one rule of thumb in confirmatory factor analysis, loadings should be .7 or higher to confirm that independent variables identified a priori are represented by a particular factor, on the rationale that the .7 level corresponds to about half of the variance in the indicator being explained by the factor. However, the .7 standard is a high one and real-life data may well not meet this criterion, which is why some researchers, particularly for exploratory purposes, will use a lower level such as .4 for the central factor and .25 for other factors. In any event, factor loadings must be interpreted in the light of theory, not by arbitrary cut off levels.

In oblique rotation, one gets both a pattern matrix and a structure matrix. The structure matrix is simply the factor loading matrix as in orthogonal rotation, representing the variance in a measured variable explained by a factor on both a unique and common contributions basis. The pattern matrix, in contrast, contains coefficients which just represent unique contributions. The more factors, the lower the pattern coefficients as a rule since there will be more common contributions to variance explained. For oblique rotation, the researcher looks at both the structure and pattern coefficients when attributing a label to a factor. Principles of oblique rotation can be derived from both cross entropy and its dual entropy.

Communality:

The sum of the squared factor loadings for all factors for a given variable (row) is the variance in that variable accounted for by all the factors, and this is called the communality. The communality measures the percent of variance in a given variable explained by all the factors jointly and may be interpreted as the reliability of the indicator.
Spurious solutions: If the communality exceeds 1.0, there is a spurious solution, which may reflect too small a sample or the researcher has too many or too few factors.
Uniqueness of a variable: That is, uniqueness is the variability of a variable minus its communality.

Eigenvalues:/Characteristic roots:

The eigenvalue for a given factor measures the variance in all the variables which is accounted for by that factor. The ratio of eigenvalues is the ratio of explanatory importance of the factors with respect to the variables. If a factor has a low eigenvalue, then it is contributing little to the explanation of variances in the variables and may be ignored as redundant with more important factors. Eigenvalues measure the amount of variation in the total sample accounted for by each factor.

Extraction sums of squared loadings:

Initial eigenvalues and eigenvalues after extraction (listed by SPSS as "Extraction Sums of Squared Loadings") are the same for PCA extraction, but for other extraction methods, eigenvalues after extraction will be lower than their initial counterparts. SPSS also prints "Rotation Sums of Squared Loadings" and even for PCA, these eigenvalues will differ from initial and extraction eigenvalues, though their total will be the same.

Factor scores (also called component scores in PCA):

These are the scores of each case (row) on each factor (column). To compute the factor, score for a given case for a given factor, one takes the case's standardized score on each variable, multiplies by the corresponding loadings of the variable for the given factor, and sums these products. Computing factor scores allows one to look for factor outliers. Also, factor scores may be used as variables in subsequent modelling. (Explained from PCA not from Factor Analysis perspective).

CONCLUSIONS

- Based on the responses to a questionnaire survey conducted among construction professionals engaged in real estate as well as in infrastructure projects, a set of most significant success factors have been identified for construction project performance criteria.
- This study helps to identify the rankings of the top critical success factors such as Availability of financial resources before project execution, Clarity of roles & responsibilities, Project manager commitment & involvement, Delay in project approval etc. for the construction projects according to construction practitioners' point of view.
- The most important success factor among all success factor turn out to be "Availability of financial resources before project execution" in the analysis.
- By comparing the results of both Pune and Aurangabad city we can conclude that the internal critical success factors such as Availability of financial resources before project execution, Project manager commitment & involvement and Top management support were common CSFs between both cities' analysis. Whereas external critical success factors such as Site condition and Delay in project approval were common.
- Identification of critical success factors by this study also leads one to realise that it is not sufficient to only maximise the results of the critical success factors but it is also necessary to minimise the negative impact of failure factors.
- It is suggested that the critical factors identified in the analysis above should be followed during the execution of the project.

1.1 FUTURE SCOPE OF WORK

The work carried in this project related to responses received from technical persons who work in real estate as well as in infrastructure projects. It's being seeing that each and every person has different perspective towards success of construction project. Further again the responses are from different consultants as well as contractors, hence again the views are different.

Success is followed by failure so, failure factors are not considered in this project, and they do have importance along with success factors as factors which can cause the failure of construction project also can be find out.

This study has further scope such as survey can be done on different categories such as real estate projects, or only considering infrastructure project etc. Again in real estate project the study can be further classified in to small real project or mass housing project and how factors can affect differently for different conditions.

This project includes the ranking according to responses received from consultant as well as from contractor, but work can be carried on success factors according to contractor point of view in real estate project or in infrastructure project and the same with consultant point view. And after comparing that results will be more sophisticated.

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