CRITICAL SUCCESS FACTORS FOR THE CONSTRUCTION INDUSTRY[1]

Zakari Tsiga[2], **Michael Emes**, **Alan Smith**

University College London, Mullard Space Science Laboratory, UK.

Abstract

This study aims to identify the critical success factors for projects in the construction industry. A list of factors were identified from the existing literature and grouped into categories. The authors added project risk management and requirements management to the list of categories to test the hypothesis that these should also be considered as critical success factors in the construction industry. The study identified 58 success factors classified into 11 groups, which were tested using an elicitation technique. Forty-nine responses were collected from project managers, who had an average or 15 years of project management experience and had participated in more than 15 projects. Once the data was collected, the authors adopted the use of the relative importance index to rank the categories. From the results, the top five most important are (1) Project Organization, (2) Project Manager Competence, (3) Project Risk Management, (4) Project Team Competence and (5) Requirements Management. This lead to the conclusion that both project risk management and requirements management should be considered as critical success factors. Further analysis of the data highlights the importance of scope management and soft skills in Requirements Management and Project Risk Management respectively.

Keywords: Construction Projects; Critical Success Factors; Project Risk Management; Project Success; Requirements Management.

JEL codes: *D20, L10, M19*

Introduction

The Construction industry is one of the main sectors of the economy; it consists of the entire process from project visualization to demolition of buildings and infrastructure. As a service industry it is interlinked with various industries. The importance of the construction industry can be seen throughout history and in the development of economies. According to the World Market Intelligence (2010) the construction industry employs more people than any other single industry in the world. The report by Global Construction Perspectives and Oxford Economics (2013) suggest that the sector is globally expected to rise by $6.3 trillion or over 70 % to $15 trillion by 2025 compared to $8.7 trillion in 2012. The construction

[1] *Second Editions are previously published papers that have continued relevance in today's project management world, or which were originally published in conference proceedings or in a language other than English. Original publication acknowledged; authors retain copyright. This paper was originally presented at the 5th Scientific Conference on Project Management in the Baltic States, University of Latvia, April 2016. It is republished here with the permission of the author and conference organizers*

[2] Corresponding author: Zakari Tsiga, E-mail address: zakari.tsiga.13@ucl.ac.uk.

© 2016 University of Latvia
© 2016 Professional Association of Project Managers

industry incorporates all civil engineering projects such as building projects as well as the maintenance and repair of existing constructed projects.

As the industry is constantly growing, newer and bigger projects are always undertaken (Chan & Chan, 2004). These new undertakings generally come with more complexities as boundaries are being pushed. An example of such large project currently being undertaking is the Saadiyat Island project in Abu Dhabi, UAE with an estimated budget cost of $26 billion (Ponzini, 2011).

Project success is the end deliverable of every undertaken project. Project success has been a subject of debate (Alexandrova & Ivanova, 2012). In the construction sector various efforts have been taken in other to determine these project success criteria because different stakeholders have different views and perception of a project this in itself can lead to various views on project success.

1. Background

1.1 Project Success

In the past, research on project success focused on the achievement of the iron triangle objectives (time, cost and quality) until recently researchers have identified the need to widen the criteria for measuring project success (Atkinson, 1999; Wateridge, 1998). Researchers such as de Wit (1988) emphasize that a project is considered successful if its stakeholders are generally successful and the projects technical performance specification has been achieved. Muller (2007) states that projects differ in a variety of ways such as size, uniqueness and complexity this has lead researchers such as Westerveld (2003) to state that the criteria for measuring project success should vary from project to project and hence it would be difficult to have a unique set of criteria for all projects in all industries.

1.2 Critical Success Factors

The identification and careful consideration of critical success factors can have a positive outcome on a project. New participants in the construction industry and also established companies can use these factors to easily help themselves in better project delivery for future projects (Bullen & Rockart, 1981).

Rockart (1982) define critical success factors as “those key areas of activity in which favorable results are absolutely necessary for a manager to reach his/her goals”. Researcher such as Futrell et al (2001) agree with the above stated definition as they believe critical success factors are those factors in a project that can lead to a positive achievement of stakeholder expectations and requirements. Boynton & Zmud (1984) goes to the extent of stating that the achievement of CSFs in projects ensures positive outcome.

Critical success factors have been used in a wide variety of projects in different sectors such as information technology (Almajed & Mayhew, 2014), Petroleum (Tsiga et al., 2016), Space (Tsiga et al., 2016) as well as for generic projects (Muller & Jugdev, 2012; Pinto & Prescott, 1988). A review of the literature by Tsiga et al. (2016) identified the critical success factors and their corresponding categories as shown in **Table 1**.

© 2016 University of Latvia
© 2016 Professional Association of Project Managers

Table 1

Critical success factors and categories

Category	Critical Success Factors	Sources
External Challenge	Economic environment, social environment, political environment, physical environment and regulatory/legal environment.	(Gudiene et al., 2014); (Omran et al., 2012); (Tan & Ghazali, 2011)
Client knowledge and experience	Nature of finance, experience, organization size, emphasis on cots quality and time, ability to brief, decision making, roles and contribution, expectations and commitment, involvement and influence.	(Gudiene et al., 2014); (The Standish Group, 2013); (Omran et al., 2012)
Top management support	Support given to project head, support to critical activities, understanding of project difficulty and stakeholder influence.	(Ram & Corkindale, 2014); (Varajao et al., 2014); (Almajed & Mayhew, 2014).
Institutional factors	Standards and permits.	(Gudiene et al., 2014);
Project characteristics	Project type, size, nature, complexity, design, resources allocation time and level of technology.	(Yong & Mustaffa, 2013); (Omran et al., 2012).
Project manager competence	Experience, coordinating and motivating skills, leading skills, communication and feedback, management skills, conflict resolution skills and organizing skills.	(Toor & Ogunlana, 2009); (Malach-Pines et al., 2009); (Barclay & Osei-Bryson, 2009).
Project organization	Planning and control effort, team structure and integration, safety and quality program, schedule and work definition, budgeting and control of subcontractors.	(Gudiene et al., 2014); (Varajao et al., 2014); (Berssaneti & Carvalho, 2015).
Contractual aspects	Contract type, tendering (procedures or steps for the selection of that service) and procurement (company selection to provide services) process.	(Yong & Mustaffa, 2013); (Omran et al., 2012); (Tan & Ghazali, 2011); (Chan et al., 2004).
Project team competence	Team experience, technical skills, planning and organizing skills, commitment and involvement, teams adaptability to changing requirements, working relationships, educational level, training availability and decision making effectiveness.	(Gudiene et al., 2014); (Varajao et al., 2014); (Almajed & Mayhew, 2014); (Ram & Corkindale, 2014).
Project Risk Management	The factors under project risk management are sub divided into two which are firstly hard aspects with initiation, identification, assessment, response planning, response implementation and secondly, soft aspects of risk, which are risk communication and attitude, monitoring and review	(Almajed & Mayhew, 2014), (Rabechini Junior & Monteiro de Carvalho, 2013), (Didraga, 2013),
Requirements Management	Elicitation technique, identification, analysis and negotiation, modelling, validation and scope management	(Mirza et al., 2013) (Didraga, 2013)

Source: (Tsiga et al., 2016)

2. Methods

There has already been some research performed on projects in the construction industry. The first step taken in this research was to examine the already established CSFs from literature and previous work. Projects such as the London Olympic Park (Davies & Mackenzie, 2013) and the Sydney Opera House (Colbert, 2003) were carefully analysed before a standard set of factors was obtained. The factors gotten where then categorised into 11.

Another strategy implemented in this research was to develop the questionnaire using the key categories and factors identified and test them by asking professionals working in the industry to provide us with their views. The implementation of the technique allowed the authors to be able to analyse and quantify the data gotten from the respondents.

The data was analysed using the Statistical Package for Social Science (SPSS) software to perform test such as the hypothesis test would be discussed in section 4.

2.1 Questionnaire Design

The survey consisted of 37 questions, which were then grouped into 5 different sections. The first section contained background information of the respondents such as experience and qualification. The next section had 11 questions that the respondents ranked based on a 10-point scale. The third and fourth sections asked respondents to rank factors of project risk management and requirements management also using the 10 point scale and the final section consisted of only two questions aimed at asking respondents details of they wanted to be contacted for further research and discussions.

After the questionnaire was designed before being distributed, a small pilot test was conducted with potential participants to get feedback on possible improvements. The recommendations gotten from the test was implemented to the design before final distribution.

2.2 Study Sample

The study was distributed online via email and business oriented social networking sites LinkedIn, as such the participants are geographically located in different parts of the world with diverse project experience in the construction industry. The total number of completed and valid responses are obtained from the survey was 49.

Most respondents are currently project managers with master's degrees, have an average of more than 15 years' project experience and also more than 15 years' project management experience.

They have participated in more than 15 projects with an average value of order of magnitude 100 million $/€/£, delivering service projects and other categories of projects; they are mostly geographically located in the United Kingdom, United States of America, Nigeria, Australia and Canada.

3. Data Analysis and Findings

3.1 Relative Importance index

Relative importance index has been implemented in this study with the aim of it providing a better understanding of individual predictors and their individual role amongst a given set (Tonidandel & LeBreton, 2011). This method has been implemented in various project management literature such as (Gudiene et al., 2013; Iyer & Jha, 2006). The formula for the calculation is shown below:

$$RII = \frac{\Sigma M}{N*P} = (0 \leq RII \leq 1) \quad (1)$$

M is the weight given to a factor by a respondent, in the range of 1 to 10. N is the highest score available (10 in this case) and P is the total number of respondents that have answered the question. The results of the relative importance index for the CSFs are shown in Table 2.

Table 2

Results of Relative Importance Index Calculation

Category	**RII**	**Rank**
Project Organization	0.892	1
Project Manager Competence	0.890	2
Project Risk Management	0.850	3
Project Team Competence	0.843	4
Requirements Management	0.827	5
Top Management Support	0.824	6
Contractual Aspects	0.806	7
Institutional factors	0.790	8
External Challenge	0.749	9
Client Knowledge and Experience	0.730	10
Project Characteristics	0.716	11

Source: Authors' construction

Table 3

Results of Relative Importance Index Calculation on aspects of Project Risk Management

Project Risk Management	**RII**	**Rank**
Communication and culture	0.864	1
Initiation	0.853	2
Planning of Responses	0.834	3

© 2016 University of Latvia
© 2016 Professional Association of Project Managers

Identification	0.823	4
Monitoring and Review	0.823	4
Implementation of responses	0.809	6
Assessment	0.760	7

Source: Authors' construction

Table 4

Results of Relative Importance Index Calculation on aspects of Requirements Management

Requirements Management	RII	Rank
Scope Management	0.883	1
Identification	0.867	2
Analysis and Negotiation	0.826	3
Validation	0.817	4
Modelling	0.770	5

Source: Authors' construction

3.2 Reliability of Scale

Reliability of scale is used to "calculate the stability of a scale from the internal consistency of an item by measuring the construct" (Santos, 1999). Nunnally & Bernstein (1994) suggest that in order to ensure high reliability and internal consistency the value of the Cronbach's alpha for the construct should be grater that 0.7. Table 5 depicts the results of the test on our study 47.

Table 5

Reliability of Scale Test Results

Constructs	No of Items	Cronbach's Alpha
Critical Success Factors	11	0.864
Project Risk Management	7	0.812
Requirements Management	5	0.745

Source: Authors' construction

3.3 Factor Analysis

Bartletts Sphericity is one of the methods used for factor analysis, here the constructs in the study are considered viable and acceptable only if their individual factor loading is above 0.5 (Tabachnick & Fidell, 2007). In the case of this study all the questions had a factor loading of above 0.5. This is considered to be good.

© 2016 University of Latvia
© 2016 Professional Association of Project Managers

3.4 Hypothesis Test

In order to accept a hypothesis and reject the null hypothesis, certain conditions have to be considered. The t-value should be > 2.0 and the p-value should be <0.05. **Table 6** depicts the results of the test, which means both hypotheses have been accepted as they meet the both criteria's.

Table 6

Hypothesis Test Result

Hypotheses	t-value	p-value (Sig)	Outcome
H1: Project Risk Management	4.569	0.002	**Accepted**
H2: Requirements Management	2.051	0.008	**Accepted**

Source: Authors' construction

4. Discussion

The first aim of this research is to determine if project risk management and requirements management have an influence on project success in the construction industry. Once the data was collected, a hypothesis test was carried out on the data, the results of the test as depicted in **Table 6** supports the relationship of project risk management to project success and requirements management to project success which has led to the rejection of the null hypothesis.

As both hypotheses have been accepted, it is important to also rank the factors against the already established categories. To achieve this, the use of the relative importance index was implemented for the ranking. From the results in **Table 2,** one can denote that the most important factor is Project Organization. As Project Risk management and Requirement management have not been previously included in the past literature it is a bit surprising to see that Project Risk Management is regarded as the 3rd most important factor and Requirements Management came in as 5th in the ranking. More research should be carried out as to ascertain why so? Are they important for all projects in all sectors or only for the construction sector? And why they haven't been included as CSFs in previous research?

In the category of Project risk management, from the results shown in **Table 3,** communication and culture is deemed to be the most important aspect of the category, which showcases the importance of the soft side of risk management. Scope management is also deemed to be the most important factor in requirements management as show cased in the results in **Table 4**, this is known to have a cob web effect on the other factors in requirements management.

The result of this study highlights areas to utilize scarce resources with the aim of improving the chances of delivering better projects in the construction industry.

Conclusion

CSFs that can influence the outcome of projects have been an area of great discussion and debate in project management; some studies have determined that CSFs are sector specific and some factors play greater roles in some sectors. This study has identified 11 categories that have been with 58 factors that have an impact on projects in the construction industry.

The 11 categories have been ranked based on their relative importance index calculated from the data gotten. This research highlights the importance of requirements management and project risk management in construction projects as both had a positive relationship with project success and ranked higher than some already established categories.

The results of this research highlights the importance of more research should be carried out in this area for better delivery of projects.

Acknowledgement

The authors of this paper would like to give a warm thanks to all those that participated and helped during this study. Special thanks go to Mrs Jane Galbraith of the UCLs Statistical Science department for her contribution towards the survey design and data analysis. A noteworthy appreciation goes to the Petroleum Technology Development Fund (PTDF) and the Nigerian Universities Commission (NUC) for the financial support provided during the research.

References

Alexandrova, M. & Ivanova, L., 2012. Critical success factors of project management: empirical ecidence from projects supported by EU programmers. In *Systematic Economic Crisis: Current issues and persperctive*. Skopje, 2012. The Internation ASECU Conference.

Almajed, A. & Mayhew, P., 2014. An empirical investigation of IT project success in developing countries. *IEEE*, pp.984--990.

Atkinson, R., 1999. Project management: cost, time and quality, teo best guesses and a phenomenom, its time ot accept other success criteria. *International Jorunal of Project Management* , pp.337-42.

Barclay, C. & Osei-Bryson, K.-M., 2009. Toward a more practical approach to evaluating programs: The Multi-Objective Realization approach. *Project Management Journal*, pp.74-93.

Berssaneti, F.T. & Carvalho, M.M., 2015. Identification of variables that impact project success in Brazilian companies. *International Journal of Project Management*, pp.638--649.

Boynton, A.C. & Zmud, R.W., 1984. An assessment of critical success factors. *Sloan Management Review (pre-1986)*, pp.17-27.

Bullen, C. & Rockart, J., 1981. A primer on critical success factors. *Sloan School of Management*.

Chan, A. & Chan, A.P., 2004. Key Performance indicators for measuring construction success.. *Benchmarking: an international journal* , pp.203-21.

Chan, A.P., Scott, D. & Chan, A.P., 2004. Factors affecting the success of a construction project. *Journal of construction engineering and management*.

Colbert, F., 2003. Company Profile: The Sydney Opera House: An Australian Icon. *International Journal of Arts Management*, 5(2), pp.69-77.

Davies, A. & Mackenzie, I., 2013. Project complexity and systems integration: Constructing the London 2012 Olympics and Paralympics Games. *International Journal of Project Management*, 32, pp.773-90.

de Wit, A., 1988. Measurement of Project Success. *International Journal of Project Management*, pp.164-70.

Didraga, O., 2013. The Role and the Effects of Risk Management in IT Projects Success. *Informatica Economica*, pp.86-98.

Futrell, R.T., Shafer, L.I. & Shafer, D.F., 2001. *Quality software project management*. Prentice Hall PTR.

Global Construction Perspective and Oxford Economics, 2013. *Global Construction 2025: A global forcast for the construction industry to 2025.*. London : Global Construction Perspective and Oxford Economics.

Gudiene, N., Banaitis, A. & Banaitienne, N., 2013. Evaluation of critical success factors for construction projects - an empirical study in Lithuania. *International journal of strategic property management* , pp.21-31.

Gudiene, N., Banaitis, A., Podvezko, V. & Banaitiene, N., 2014. Identification and evaluation of the critical success factors for construction projects in Lithuania: AHP approach. *Journal of Civil Engineering and Management*, pp.350-59.

Iyer, K. & Jha, K., 2006. Factors affecting cost performance: evidence from Indian construction projects. *International journal of project management* , pp.283-357.

Malach-Pines, A., Dvir, D. & Sadeh, A., 2009. Project manager-project (PM-P) fit and project success. *International Journal of Operations & Production Management*, pp.268-91.

Mirza, M.N., Pourzolfaghar, Z. & Shahnazari, M., 2013. Significance of Scope in Project Success. *Procedia Technology*, pp.722-29.

Muller, R.A., 2007. The influence of project managers on project success criteria and project success by type of project. *European Management Journal*, pp.298-309.

Muller, R. & Jugdev, K., 2012. Critical success factors in projects. *International Journal of Managing Projects in Business*.

Nunnally, J. & Bernstein, 1994. Psychometric theory.

Omran, A., Abdulbagei, M. & Gebril, A., 2012. An Evaluation of Critical Success Factors for Construction Project in Libya. *International Journal of Economic Behavior*, pp.17-25.

Pinto, J.K. & Prescott, J.E., 1988. Variations in critical success factors over the stages in the project life cycle. *Journal of Management*, pp.5-18.

Ponzini, D., 2011. Large scale development projects and the star architecture in the absence of democratic politics: The case of Abu Dhabi, UAE. *CITIES: The international journal of urban policy andplanning.* , 28(3), pp.251-59.

Rabechini Junior, R. & Monteiro de Carvalho, M., 2013. Understanding the Impact of Project Risk Management on Project Performance: an Empirical Study. *Journal of technology management and innovation*, p.6.

Ram, J. & Corkindale, D., 2014. How ``critical'' are the critical success factors (CSFs)? Examining the role of CSFs for ERP. *Business Process Management Journal*, pp.151-74.

Rockart, J.F., 1982. The changing role of the information systems executive: a critical success factors perspective. *Massachusetts Institute of Technology Boston*, p.2.

Santos, J.R.A., 1999. Cronbach's Alpha: A tool for assessing the relability of scales. *Journal of extension* , pp.1-5.

Tabachnick, B. & Fidell, L., 2007. *Using multivariate statistics*. Boston : Pearson.

Tan, D.J. & Ghazali, M., 2011. Critical success factors for malaysian contractors in international construction projects using analytical hierarchy process. In *International Conference on Engineering, Project, and Production Management EPPM*., 2011.

The Standish Group, 2013. Chaos Manifesto. *Standish Group*.

Tonidandel, S. & LeBreton, J.M., 2011. Relative importance analysis: A useful supplement to regression analysis. *Journal of Business and Psychology*, pp.1-9.

Toor, S.-u.-R. & Ogunlana, S.O., 2009. Construction professionals' perception of critical success factors for large-scale construction projects. *Construction Innovation*, pp.149-67.

Tsiga, Z., Emes, M. & Smith, A., 2016. Critical success factors for projects in the petroleaum industry.. In *The Second International Conference on Organizational Strategy, Business Models and Risk Management.*. Manchester, UK. , 2016. SDIWC.

Tsiga, Z., Emes, M. & Smith, A., 2016. Critical success factors for projects in the space sector. *Journal of Modern Project Mangement*, pp.57-63.

Varajao, J., Dominguez, C., Ribeiro, P. & Paiva, A., 2014. Critical success aspects in project management: similarities and differences between the construction and software industry. *Tehnivcki vjesnik*, pp.583-89.

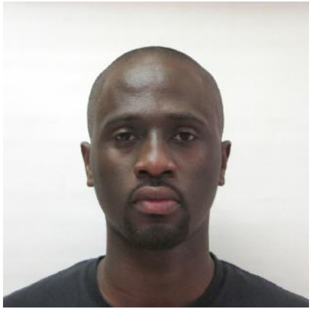
Wateridge, J., 1998. Hos IS/IT projects be measured for success? *International Journal of Project Management*, pp.59-63.

Westerveld, E., 2003. The Project Excellence Model: Linking success criter and critical success factors.. *International Journal of Project Management* , pp.411-18.

World Market Intelligence, 2010. *The Future of Global Construction to 2014.* Market Intelligence Report.

Yong, Y.C. & Mustaffa, N.E., 2013. Critical success factors for Malaysian construction projects: an empirical assessment. *Construction Management and Economics*, pp.959--978.

About the authors



Zakari Danlami Tsiga

London, UK

Zakari Danlami Tsiga, MSc is a PhD student working at the University College London (UCL). Prior to beginning the PhD program, Zakari undertook a masters' program at the same university, this gave him the opportunity to work on the delivery of various projects for different clients such as Microsoft and the London Clearing House. From his work he developed an interest in Technology management and the importance of successful project delivery.

Zakari Tsiga can be contacted at zakari.tsiga.13@ucl.ac.uk.

Michael Emes, MEng, PhD, MIET, MAPM, MINCOSE

London, UK

Michael Emes is Deputy Director of UCL Centre for Systems Engineering and Head of the Technology Management Group at UCL's Mullard Space Science Laboratory (MSSL). He completed his first degree in Engineering, Economics and Management at St John's College, Oxford, and a PhD at MSSL in developing cooling technologies for spacecraft. He worked as a strategy consultant for Mercer Management Consulting (now Oliver Wyman) on projects in retail, energy and transport, including a project advising the Department for Transport on how to address the problems of the rail sector in the last days of Railtrack plc. Michael now conducts teaching and research at UCL in the areas of systems engineering and technology management in domains including transport, health, defence and aerospace. He is a member of APM, INCOSE and the IET. He is Programme Manager and a lead trainer for the European Space Agency's Project Manager Training Course and is Programme Director for UCL's MSc in the Management of Complex Projects.

Prof. Alan Smith, PhD

London, United Kingdom

Alan Smith was awarded a PhD at Leicester University in 1978 based on his X-ray study of supernova remnants. His work involved the payload development and flight of a Skylark sounding rocket from Woomera, South Australia. Between 1984 and 1990 he worked for the European Space Agency at its technology centre in the Netherlands as both an astrophysicist and as an instrument developer. His early career involved a combination of technology development (space flight hardware on European, and Russian satellites), project management and astrophysics. In 1990 he joined University College London's Mullard Space Science Laboratory, initially as Head of Detector Physics eventually becoming Director and Head of Department (2005). In 1998 he was made a Professor of Detector Physics. While at UCL he has been Director of UCL's Centre for Advanced Instrumentation Systems (1995-2005), a Co-Director of the Smart Optics Faraday Partnership (2002-2005) and is presently founding Director of the Centre for Systems Engineering (1998-present). Alan was appointed Vice-Dean for Enterprise for the faculty of Mathematical and Physical Sciences in 2007, helped set up UCL's Centre for Space Medicine in 2011 and is a member of UCL's Institute for Risk and Disaster Reduction board. He is a Fellow of the Royal Astronomical Society and of the Association of Project Management.

© 2016 University of Latvia
© 2016 Professional Association of Project Managers