Expert perspective on success factors of civil engineers in improving project competencies in construction

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Abstract. Success factors (CSFs) are inputs to construction management preparation which can lead immediately or indirectly to undertaking success. It encompasses many elements, which have to be synchronized to make certain the project is delivered on time. Competencies are important in all fields of human endeavor. Features of the building technique and construction undertaking render this ability essential. Therefore the selection of a civil engineer for a building project is an imperative mission decision. The selection procedure entails special criteria and be in accordance with agency’s policies and challenge specifications. Traditionally, five (5) potential experts are interviewed and the most certified will be chosen in compliance with organization priorities and task conditions. This paper aims to disclose a conceptual, critical success factor affecting competencies of civil engineer for development undertaking in Malaysia. Hopefully the end result can be used as a practice to measure the degree of competency of civil engineer.

1. Introduction

Search for factors in project success is no longer new in management studies. Since 1960, various researches have been conducted to discover the factors that are without a doubt important to be considered for achieving the success on initiatives [1]; [2]. In their review, [3] noticed that the success and failure factors have been first introduced with the aid of [4] in context of project management. However, the terminology of crucial success elements (CSFs) for undertaking administration used to be first used by way of [5] noted in [6]. Until to date, several research associated to CSFs have been conducted in a number of sectors such as information technology (IT), industrial systems, construction, method engineering, commercial enterprise development, and operations management.

Researchers have regularly emphasized on the need for identifying a set of frequent success factors that can be used through by construction experts and project managers to measure the success of their projects. The current authors, however, are no longer convinced with this notion, especially for building venture management in construction project. Even among several research studies, there seems to be little or no agreement on the listing of success elements due to special interior aspects and special boundary stipulations of every construction project [7]. As claimed via [8], each and every project has a specific set of success factors which may no longer be transferable to any other project.

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Even though some characteristics are common in tasks – for example constrained budget, schedule, great standards and a series of complex and interrelated activities [9], most vary from task to project. Composition of mission team; constraints of resources; availability of neighborhood technical and managerial expertise; competence of contractors, subcontractors, and supplier’s physical attributes of project; its ground and environmental conditions; and finally geographic area are some of the factors that are more often than not specific for each and every construction project.

Success of the construction project importantly depends on how the challenges has been planned, managed and geared up by a good project team without guide and commitment from the top management itself. The success elements are greater useful in decision-making support; more player-based lookup studies should be conducted. Several elements determine the development of the Malaysia development industry. These encompass the availability of labor, financial resources, constructing materials, and machinery. In the development industry, the manpower performs a pivotal function particularly. The huge numbers of construction personnel from managers, executives, civil engineers, personnel from different levels, and general workers. The standard consequence of the mission in one way or some other are affected from the performance of every individual involved in the project. Engineers, specifically civil engineers, are quintessential in construction projects. Before a task is realized, they have to find out about and assess its feasibility; as soon as the project was approved, civil engineers need to plan, design and manage every stages of the construction. To make sure that the project goals are achieved, before construction work at the site commences, civil engineers need to coordinate with their clients, consultants, main contractors, subcontractors, and suppliers appropriately. Henceforward, civil engineers need to have adequate on-site experiences. Frequently, they are also entrusted with excessive levels of managerial level and administrative responsibilities. At that time, organizations proudly owning such as directors, general managers and project managers the project ought to display the overall performance of their engineers to ensure that their projects are effectively executed

2. Definition of Competencies

Competencies are advisable concepts that try to describe why certain people accomplish better than other [10];[11];[12];[13];[14];[15]. Competency is an individual’s fundamental characteristic that is causally related to impact the performance in a job or situation and job tasks. A person needs competencies, which are abilities to use knowledge and to make it happen. That reveals what a person is capable of doing and why he or she acts in a certain way. According to [16] stated the competencies have been grouped in the International Competence Baseline into three categories: behavioural, technical and contextual competencies. Table 1 revealed the definitions of competencies from 2008 until present:

| Competencies definition                                                                 | Sources                                      |
|----------------------------------------------------------------------------------------|----------------------------------------------|
| “The ability to do something well” or “an important skill that is needed to do a job”. | Cambridge Advance Learner’s Dictionary [17] |
| Competencies are a combination set of an individual’s knowledge, personal characteristics and abilities used to execute a particular activity or task. | Caupin et al. [18]; Muller & Turner [19]     |
| Competency is a combination of technical (hard skills and knowledge) and behavioral/non-technical (soft skills and abilities). | Hassan et al. [20]                         |
Competencies as “a cluster of related knowledge, traits, attitudes and skills that affect a major part of one’s job; that correlate with performance on the job; that can be measured against well-accepted standards; and that can be improved via training and development”. Sanchez [21]

Competencies are as an ability or capability; it consists of a set of alternate behaviors organized around an underlying construct. Liikamaa [15]

3. Success Criteria for Construction Projects

According to Chan & Chan [22], Alzahrani & Emsley [23] mentioned success are defines as the grade to which project objectives and expectation are encountered. In addition, Alias et al. [24] stated Project success means that certain expectation for given member were met, either, owner or client, consultant, main contractor etc.

For example, Frodel [25] has drawn a list of success criteria in construction through reviewing 16 articles. His empirical study has originated success measures, as success on a project means different things to different people [22];[26];[27]. Time, cost and quality are the main criteria to success on a project for construction project, while, safety and environment are also addition criteria that contribute to success on a project nowadays. Nearly every related article mentions these three criteria namely time, cost and quality and point out the importance of them in a construction project and in the views of project participants, such as [28], [3] and [29]. Atkinson [30] identified these three criteria as the ‘Iron Triangle’. Besides, Table 2 summaries and discusses the potential factors selected from previous literature.

| Factors                        | Sources                                      | Discussion                                                                                                                                 |
|--------------------------------|----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| The company’s technical        | Alzahrani & Emsley [23]                      | Successful project based on having the right planning, goals, capacity at the right time, knowing and targeting the related customers, cost effective supply and then constant innovation. |
| Planning Efforts              | Doloi et al. [31]; Jha & Iyer [32]           | Successful project implies the use of advanced planning methods that allow to determine the feasible sequences of activities and to finish a project within the time and budget allocated. |
| Effective project management   | Gudiene et al. [33]; Chan & Chan [22]        | Implementation of Project management techniques such as planning and control of time, cost and quality have been widely recognized to project success. Besides, success of one project are depend on having such as realistic and definite goal, client satisfaction, competition and etc. |
| site management                | Doloi et al. [31]                            | Effective site management requires competent such as civil engineer, Project manager to allocate work in line with the workers skill, ability and knowledge they have. Then, evaluate workers when they do jobs efficiently. |
| Motivation in the team         | Tabish & Jha [34]; Kog & Loh [35]            | All personnel such as civil engineer, project manager and workers in the worksite must be motivated to achieve their target and planning, carry out their job responsibilities safely. Hopefully, the possibilities of achievement and recognition will give an opportunity for rewards, additional responsibilities and personal development |
4. Preliminary Data Form Experts
Since the critical success factors (CSFs) were identified in the literature review, it should be further confirmed by professionals of construction before developing the questionnaire instrument. The preliminary question about this research was presented to five (5) industrial experts during interviews (Table 3). The selection of the expert panels is based on the following criteria:

a. Experts to have at least 10 years or more working experience in construction industry in Malaysia.

b. Expert to have knowledge of the critical success factors affecting competencies.

The interviews were conducted using ‘WhatsApp’ application and telephone call and lasted for 0.5 to 60 minutes, depending on the interviewees’ available time slots and how many comment they gave.

Table 3. Expert Profiles

| Position | Experience (years) |
|----------|-------------------|
| Consultant | Professional engineer (Director of Company) | 28 |
| Consultant | Professional engineer (Managing Director) | 18 |
| Consultant | Professional engineer (Principal) | 25 |
| Contractor | Professional engineer (Chief Executive Officer) | 15 |
| Consultant | Professional engineer (Associate Director) | 17 |

All interviewees agreed with that topic and also provided valuable comments on the professionalism of civil engineer (Table 4). Civil engineer must be a professional and have enough experience, skill, knowledge and ability to handle the tasks. Competencies are very important for civil engineer because it bound with professional ethic from the Board of Engineer (BEM), Malaysia. Moreover, it related with the successful or failure of one project. For example, competence civil engineer must understand the modern tools especially, computer programs such as BIM, structural analysis programs, scheduling programs and etc, identify and solve the design discrepancies, recognise the safety and authority requirements in design and other issues in the construction project. Registration of Engineer Act 1967 is the act that governs the engineer in Malaysia. Another important comment is the outcome from this study should give the paradigm to education development and the role of the ministry in collaboration with the industry. The first version of the questionnaire was developed after these interviews.

Table 4. Competencies and experience of civil engineer

| Descriptions | Yes | No |
|--------------|-----|----|
| Competencies of civil engineer affecting the successful of construction project. It’s reasonable or not? | 100% | 0% |
| Experiences for civil engineer is important because it’s affect the successful of construction project. | 100% | 0% |

Table 5 show a summary of the civil engineers evaluation. There are seventh (7) criterions are as follows; (1) Ability to function in multidisciplinary teams, cooperate to get the job done, (2) Ability to identify, formulate and solve engineering problem, (3) Understanding of professional and ethical responsibility, (4) Ability to write clear, effective technical document, (5) Recognising the impact of technology on society and environment, (6) Maintaining technical competence, career growth through continuing education, in-house training, professional job requirements and (7) Ability to prepare and deliver oral presentations. Overall each criteria was more than 80% except criteria no 7. The
questionnaire was adapted from Enshassi & Hassouna [36], which assess meant by employers of newly graduated civil engineers.

Table 5. Summary of the civil engineers evaluation

| No | Criteria                                                                 | Strongly Disagree | Disagree | Moderate | Strong Agree | Strongly Agree |
|----|--------------------------------------------------------------------------|-------------------|----------|----------|--------------|----------------|
| 1  | Ability to function in multidisciplinary teams, cooperate to get the job done | 0%                | 0%       | 0%       | 20%          | 80%            |
| 2  | Ability to identify, formulate and solve engineering problem             | 0%                | 0%       | 0%       | 0%           | 100%           |
| 3  | Understanding of professional and ethical responsibility                | 0%                | 0%       | 0%       | 20%          | 80%            |
| 4  | Ability to write clear, effective technical document                      | 0%                | 0%       | 0%       | 20%          | 80%            |
| 5  | Recognising the impact of technology on society and environment          | 0%                | 0%       | 0%       | 20%          | 80%            |
| 6  | Maintaining technical competence, career growth through continuing education, in-house training, and professional job requirements. | 0%                | 0%       | 0%       | 0%           | 100%           |
| 7  | Ability to prepare and deliver oral presentations                         | 0%                | 0%       | 0%       | 40%          | 60%            |

5. Conclusions
From the analysis, presently competent civil engineers are crucial in the construction industry. However, the listed competency criteria listed above must be strictly followed in order to ensure that the civil engineer attains the required standards. The success or failure of the individual projects depends on the competency of the civil engineer.

Apart from that, the competency criteria can be used as a hiring guideline and also guidelines that aspiring civil engineers look upon. The author hopes that the competency elements will provide a new knowledge to be used for the management practice.

6. References
[1] Cooke-Davies T 2002 The real success factors on project Int. J. of Project Management 20 pp 185-90
[2] Chan A P C, Ho D C K and Tam C M 2001 Design and build project success factors: multivariate analysis J. of Construction Eng. and Management, ASCE 127 pp 93-100.
[3] Belassi W and Tukel O L 1996 A news framework for determining critical success/failure factors in projects Int. J. of Project Management 14 pp 141-51
[4] Rubin I M and Seeling W 1967 Experience as a factor in the selection and performance of project managers IEEE Transactions on Eng. and Management 14 pp 131-5
[5] Rockat J F 1982 The changing role of the information system executive: a critical success factor perspective MIT Sloan Management Review 23 pp 3-13
[6] Savindo V, Grobler F, Parfitt K, Guvenis M and Coyle M 1992 Critical success factors for construction projects J. of Construction Eng. and Management, ASCE, 118 pp 94-111
[7] Nguyen L D, Ogunlana S O and Lan D T 2004 A study on project success factors on large construction projects in Vietnam Eng. Construction and Architectural Management 11 pp 404-13
[8] Liu A M M 1999 A research model of project complexity and goal commitment effects on project outcome Eng., Construction and Architectural Management 6 No. 2, pp. 105-11
[9] Belout A and Gauvreau C 2004 Factors influencing the project success: the impact of human resource
[10] Kets De Vries M 2001 The leadership mystiques: A user’s manual for the human enterprise (Great Britain: Biddles Ltd, Guildford & King’s Lynn)
[11] Boyatzis R 1982 The competent manager. A model for effective performance. (New York: John Wiley & Sons Inc.)
[12] Boyatzis R 2008 Competencies in the 21th century J. of Management Development 27
[13] Hopkins M M 2008 Social and emotional competencies predicting success for male and female executives J. of Management Development 27 pp 13–35
[14] McClelland D C 1998 Identifying competencies with behavioral – event interviews Psychological Science 9 pp 185-211
[15] Liikamaa K 2015 Developing a project manager’s competencies: A collective view of the most important competencies 6th Int. Conf. on Applied Human Factors and Ergonomics (AHFE 2015) and the Affiliated Conf., AHFE 2015 Procedia Manufacturing 3 pp 681 – 87
[16] Project Management Institute 2000 Project Management Body of Knowledge (Pennsylvania: PMBOK)
[17] Cambridge Advanced Learner's Dictionary 2008 3rd Ed. (Cambridge University Press)
[18] Caupin G, Knoepfel H, Koch G, Pannenbacker K, Peez-Polo F and Seabury C 2006 ICB-IPMA Competence Baseline – Version 3 (Netherlands: International Project Management Association)
[19] Muller R & Turner R 2010 Leadership competency profiles of successful project managers Int. J. of Project Management 28 pp 437-48 http://dx.doi.org/10.1016/j.ijproman.2009.09.003.
[20] Hassan F, Samad Z, Hassan S,Che Mat M & Isnin Z 2010 Training the Construction Workforce: A Case Study of Malaysia. Conference Proceeding W089-Special Track 18th CIB World Building Congress, (pp.230-241).
[21] Sanchez J C 2011 University training for entrepreneurial competencies: Its impact on intention of venture creation. Springer Science+Business Media, pp. 239–254 DOI 10.1007/s11365-010-0156-x.
[22] Chan A P C & Chan A P L 2004 Key performance indicators for measuring construction success. Benchmarking: An International Journal, 11(2), 203-221. http://dx.doi.org/10.1108/14635770410532624.
[23] Alzahran J & Emsley M 2013 The impact of contractors’ attributes on construction project success: A post construction. International Journal of Project Management 31. pp 313–322.
[24] Alias Z, Zawawi E M A, Yusof K & Abra A 2014 Determining Critical Success Factors of Project Management Practice: A conceptual framework. Procedia-Social and Behavioral Sciences, 153, 61–69 (http://doi.org/10.1016/j.sbspro.2014.10.041)
[25] Frodel M 2008 Swedish construction clients’ views on project success and measuring performance J. of Eng., Design and Technology 6 pp 21–32
[26] Freeman M and Beale P 1992 Measuring project success Project Management J. 23 pp 8–17
[27] Liu A M M & Walker A 1998 Evaluation of project outcomes. Construction Management and Economics 16, 209–219.
[28] Walker D H T 1996 The Contribution of the Construction Management Team to Good Construction Time performance – an Australian Experience. Journal of Construction Procurement, 2(2), pp4-18.
[29] Hatuzh Z and Skitmore M 1997 Evaluating Contractor Prequalification Data: selection criteria and project success factors Construction Management and Economics 15 pp129-147
[30] Atkinson R 1999 Project management: cost, time and quality, two best guesses and a phenomenon, it’s time to accept other success criteria Int. J. of Project Management 17 337-42

[31] Doloi H, Sawhney A, Iyer K C and Rentala S 2012 Analyzing factors affecting delays in Indian construction projects Int. J. of Project Management 30 pp 479-489 (http://dx.doi.org/10.1016/j.ijproman.2011.10.004)

[32] Jha K N & Iyer K C 2007 Commitment, coordination, competence and the iron triangle Int. J. of Project Management 25 pp 527–40 (http://dx.doi.org/10.1016/j.ijproman.2006.11.009)

[33] Gudiene N, Banaitis A, Podvezko V & Banaitiene N 2014 Identification and evaluation of the critical success factors for construction projects in Lithuania: AHP approach J. of Civil Eng. and Management 20 pp 350–59 (http://dx.doi.org/10.3846/13923730.2014.914082)

[34] Tabish S Z and Jha K N 2012 Success traits for a construction project, ASCE J. of Construction Eng. and Management 138 pp 1131–38 (http://dx.doi.org/10.1061/(ASCE)CO.1943-7862.0000538)

[35] Kog Y C and Loh P K 2012 Critical success factors for different components of construction projects, ASCE J. of Construction Eng. And Management 138 pp 520–28 (http://dx.doi.org/10.1061/(ASCE)CO.1943-7862.0000464)

[36] Enshassi A and Hassouna A 2005 Assessment by employers of newly graduated civil engineers from the Islamic University of Gaza European Journal of Engineering Education 30 pp 309-20