CRITICAL SUCCESS FACTORS MODEL (CSF'sM) AFFECTING THE COMPETENCIES OF CIVIL ENGINEER IN CONSTRUCTION PROJECT

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بسم الله الرحمن الرحيم

May Allah protect and bless all my family

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ABSTRACT

Highly skilful and competent civil engineers are required to accelerate and contribute effectively to technology development in spearheading Malaysia's transformation agendas. The competency of these engineers included a combination of technical and thinking skills (intelligences), knowledge and experience, and willingness to conduct specified job tasks and work in compliance with agreed standards, rules and procedures. The aim of this research is to establish the critical success factors models (CSF'sM) affecting competencies of civil engineers in a construction project as well as to help improve managerial performance on the successful completion of construction project. Quantitative research method has been adopted in this study and the main survey using structured questionnaires. The questionnaire consisted of 53 critical success factors and 10 engineering competencies skills. The critical success factors (Independent Variable) is clustered into 5 groups and all the engineering competencies skills (Dependent Variable) is clustered in 1 group. These factors and assigned groups were validated by 33 construction personnel (directors, managers and engineers) during a pilot study. The main survey was conducted with a total of 360 questionnaires were received from civil engineers who work in G7 grade contractor registered with the Construction Industry Development Board (CIDB) and only involved the states of Johor, Selangor and Federal Territory of Kuala Lumpur by respond rate of 60%. The results from the survey were analysed using descriptive analysis and factor analysis. Next, the data analysis is carried out using SmartPLS software. A structural model of critical success factors affecting competencies of civil engineer was developed using Partial Least Squared-Structural Equation Modelling (PLS-SEM) technique. It was found that the model is fit due to the R^2 value = 0.502 and in line with expert's validation results. The model identifies that all 5 groups (Interpersonal Skills, Project Integration Management, Project

Human Resource Management, Project Communication Management and Project Risk Management) are significant with t-value ≥ 1.645. Finally, this finding was validated by 11 construction practitioners who agreed that 'Interpersonal skills' group of factors contributes the highest impact on critical success factors affecting competencies of Civil Engineer in construction project. It is important that Civil Engineer should have knowledge and skills in term of management and technical skill. Therefore, Civil Engineer should improve their personal knowledge management skills in order to help their project team develop and implement project management knowledge and skills for their construction project in future.

ABSTRAK

Jurutera awam yang berkemahiran tinggi dan berkebolehan diperlukan untuk mempercepat dan menyumbang secara berkesan dalam pembangunan teknologi dalam menerajui agenda transformasi Malaysia. Kompetensi jurutera ini merangkumi gabungan kemahiran teknikal dan berfikir (kecerdasan), pengetahuan dan pengalaman, dan kesediaan untuk melakukan tugas pekerjaan tertentu dan bekerja sesuai dengan piawaian, peraturan dan prosedur yang telah dipersetujui. Tujuan penyelidikan ini adalah untuk mewujudkan model faktor kejayaan yang kritikal (CSF'sM) yang mempengaruhi kecekapan jurutera awam dalam projek pembinaan dan juga untuk membantu meningkatkan prestasi pengurusan bagi memastikan kejayaan menyiapkan projek pembinaan. Kaedah penyelidikan kuantitatif telah digunapakai dalam kajian ini dan tinjauan utama menggunakan soal selidik berstruktur. Soal selidik terdiri daripada 53 faktor kejayaan kritikal dan 10 kemahiran kecekapan kejuruteraan. Faktor kejayaan kritikal (*Pembolehubah tidak bersandar*) dikelompokkan menjadi 5 kumpulan dan semua kemahiran kecekapan kejuruteraan (*Pembolehubah bersandar*) dikelompokkan dalam 1 kumpulan. Faktor-faktor dan kumpulan yang ditetapkan ini telah disahkan oleh 33 kakitangan pembinaan (pengarah, pengurus dan jurutera) semasa kajian rintis. Tinjauan utama dilakukan dengan sejumlah 360 soal selidik diterima dari jurutera awam yang bekerja di syarikat kontraktor bergred G7 yang berdaftar dengan Lembaga Pembangunan Industri Pembinaan (CIDB) dan yang hanya melibatkan negeri Johor, Selangor dan Wilayah Persekutuan Kuala Lumpur dengan kadar respon 60%. Hasil tinjauan dianalisis menggunakan analisis deskriptif dan analisis faktor. Seterusnya, analisis data dilakukan dengan menggunakan perisian SmartPLS. Model struktur faktor kejayaan kritikal yang mempengaruhi kecekapan jurutera awam dikembangkan dengan menggunakan teknik *Partial Least Squared-Structural Equation Modeling*

(PLS-SEM). Didapati bahawa model adalah baik kerana nilai R^2 = 0.502 dan selari dengan hasil daripada pengesahan pakar. Model ini mengenal pasti bahawa semua 5 kumpulan (Kemahiran Interpersonal, Pengurusan Integrasi Projek, Pengurusan Sumber Manusia Projek, Pengurusan Komunikasi Projek dan Pengurusan Risiko Projek) adalah signifikan dengan nilai $t \geq 1.645$. Akhir sekali, penemuan ini disahkan oleh 11 pengamal pembinaan yang bersetuju bahawa kumpulan faktor Kemahiran *Interpersonal* memberikan impak tertinggi terhadap faktor kejayaan kritikal yang mempengaruhi kecekapan jurutera awam dalam projek pembinaan. Adalah penting bahawa jurutera awam harus mempunyai pengetahuan dan kemahiran dari segi kemahiran pengurusan dan teknikal. Oleh itu, jurutera awam harus meningkatkan kemahiran pengurusan pengetahuan peribadi untuk membantu pasukan projek membangunkan serta melaksanakan pengetahuan dan kemahiran pengurusan projek untuk projek pembinaan mereka pada masa akan datang.

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LIST OF SYMBOLS AND ABBREVIATIONS

BEM	Board of Engineers Malaysia
CIDB	Construction Industry Development Board
CITP	Construction Industry Transformation Programme
CSF'sM	Critical Success Factors Model Affecting Competencies
CSF	Critical Success Factor
COMP	Engineering Competencies Skills
GDP	Gross Domestic Product
EAC	Engineering Accreditation Councils
EFA	Exploratory Factor Analysis
IMS	Project Integration Management
INS	Interpersonal Skills
NDPC	National Development Planning Committee
PCM	Project Communication Management
PHR	Project Human Resources Management
PBL	Problem-Based Learning
PLS-SEM	Partial Least Square – Structural Equation Modelling
PM	Project Management
PMBOK	Project Management Body of Knowledge
PMI	Project Management Institute
PWD	Public Work Department
RMS	Project Risk Management
SPSS	Statistical Package for Social Science

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

Malaysia is actively working towards achieving high income per capita by 2020. This involves an intensive economic structure transformation. The government has outlined a roadmap for transforming the country to be recognised as a developed nation. The construction sector, as we all know, is a major sector that makes a significant contribution to the economy of a country like Malaysia. For example, by providing the necessary socio-economic infrastructure such as roads, hospitals, schools, and other basic and enhanced facilities, it helps to improve the quality of life of its citizens.

In today's dynamic construction industry, more organisations are confronted with the challenge of hyper competition. This hypercompetitive, rapid changing global market makes project management and civil engineering crucial for competitive advantage and success. Project success has become a main theme and receives remarkable attention from both researchers and practitioners (Andersen *et al.*, 2006; Belassi & Tukel, 1996; Baker *et al.*, 1988; Camilleri, 2016; Ika, 2009; Steinfort *et al.*, 2011).

At first, studies on project success emphasised main lines of investigation: critical success factors (Cleland & King, 1983; Pinto & Slevin, 1987; Pinto & Covin,

1989; Cooke-Davies, 2002; Ika, 2009; McLeod *et al.*, 2012; Serrador & Turner, 2015). To date, researchers had investigated the impact of civil engineer on project success, with special focus on the relevance of their competencies (Izwan *et al*., 2019; Rahim & Siti Rohaida, 2015; Rahim, 2017; Widiasanti *et al.*, 2018; Kraisuth & Panjakajornsak, 2018). Project success is therefore dependent upon the leadership qualities of civil engineer and their ability to bring the best out of their team. Civil engineer has to combine technical knowledge and expertise with behaviours that engender effective multiorganisational teamwork and communication if successful outcomes are to be achieved. These areas of expertise are known collectively as core competencies (Haas *et al.*, 1998)

The concept of competency has been broaden, elusive and diffusive for decades (Ahsan *et al.*, 2013; Stevenson & Starkweather, 2010). However, the most widely accepted definition of competency is the combination of knowledge, skill and attitude (Baumotte *et al.*, 2013; Crawford, 2005; Hanna *et al.*, 2016; IPMA, 2006; Müller & Turner, 2010a, b; Orr *et al.*, 2010; Sherman *et al.*, 2007; Stevenson & Starkweather, 2010). These competencies are fundamental to evaluate construction organisations and projects in order to achieve better performance on the organisational and project levels (Omar & Fayek, 2014; Omar & Fayek, 2016). Competencies in general are difficult to evaluate due to the multidimensional and subjective nature of their assessment. Project competencies, which refer to a collection of knowledge, personal attitudes, skills and relevant experience that lead to project success (IPMA, 2006), have been regarded as one of the most important factors is closely associated with the project success of the organisation (Ekrot *et al.*, 2016).

Many academic surveys resulted in lists of competencies relevant only to project managers (Junior, 2001; Edum-Fotwe & McCaffer, 2000; Dulewicz & Higgs, 2005; Meredith *et al.*, 2017; Stevenson & Starkweather, 2010; Ahsan *et al.*, 2013) but only a few for civil engineers in construction project. In addition, many project management institutions have also developed competency models for their project management, such as the Project Management Competency Development

Framework (PMI, 2008) and the International Project Management Association Competence Baseline (Loufrani-Fedida & Missonier, 2015) as a guideline in project management competencies for project managers and also civil engineers in construction projects.

Fayek & Omar (2016) and Markus *et al*. (2005) found that three fundamental issues related to assess and measure project competencies. First, are the methods implemented actually reliable to assess project competences? In relation to this, there are many project competencies which are measured using self and supervisor ratings, and sometimes from peers. Therefore, project competencies assessments are likely to suffer from reliability issues. Second, are the identified project competencies suitable for assessment? This is important because project competencies require a sufficient level of details that can capture the normative production related processes and individual behaviors. Third, is there any evidence of benefits that result from adopting a competency evaluation approach? The underlying assumptions of all these project competencies initiatives is that they will lead to improved job performances.

Therefore, defining, grouping, and measuring project competencies will result in better understanding and identification of the requirements for successful execution of construction projects.

A synopsis of previous research is first required to provide a basis for developing a definition for project competencies that is suitable for the construction context. Then, a detailed breakdown of project competencies is required to better evaluate them. Finally, project competencies measures need to be developed and explored from new perspectives and aim to advance research on project competencies and critical success factors model. The results are not only conducive to develop model and cultivate project competencies for construction firms, but also benefit individuals who are engaging in project management in their career path.

1.2 Problem Statement

In general, lack of competent civil engineer is one of the factors that cause project failure (Abdul Rahman *et al.*, 2012; Abdul Rahman *et al.*, 2010 ; Berawi *et al.*, 2008) in the construction industries. Besides, it is also found that lack of technical knowledge and skills of the construction workforce in particular civil engineers, is one of the critical factors that cause these problems (Abdullah, Mukmin & Samad, 2011; Abdul Rahman *et al.*, 2010).

Today's world is fundamentally challenging the way civil engineering is practiced. Complexity arises in every aspect of projects, from pre-project planning with varied stakeholders to building with minimum environmental and community disturbance. The planning, scheduling and controlling of work is the management or administrative part of the job for civil engineer (Serpell & Ferrada, 2007). Construction management's knowledge is basic knowledge for one who works as civil engineer in construction industry. The purpose of construction management knowledge is to predict as many of the dangers and problems as possible and to plan, organise and control activities so that projects are completed successfully in spite of all the risk (Eve, 2007). This process should start well before any resource is committed and continue until all work is finished (Bollinger & Smith, 2001).

A good construction management practice will result in a more efficient progress that goes as planned to fulfill the customer's need as in the contract. Deficiencies in management will cause problems at site, such as time and cost overrun, low quality, and poor performance and productivity (Abdullah, Rahman & Awang, 2011; Abdullah, Mukmin & Samad, 2011; National Audit Department Malaysia, 2011; Malaysia Productivity Corporation, 2017; Endut et al., 2009; Flanagan, 2013; Hai *et al.*, 2012; Hamid, 2013; Waris *et al.*, 2012; Rahman, *et al.*, 2012; Tan, 2013), poor workmanship, inadequate safety standards on site, and design negligence (Abdul Rahman *et al.*, 2010).

These problems will affect all parties involved in the construction industries such as contractors, government, clients, and users. Delay and cost overrun will result

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