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Key Competencies for Post-Contract Transaction Minimization in Design-Build Projects

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Abdulazeez Umar Raji
Department of Estate Management, Bayero University, Kano
Email: auraji.esm@buk.edu.ng

Abstract

The construction industry has been struggling with the issue of inconsistent performance with respect to cost of projects, completion time and the delivery of a quality product. These challenges have been addressed by researchers with some success, however in contrast to other industries the construction industry is still seen to be lagging. It is evident that dissatisfaction of clients with the finished product and construction process has prompted many researchers to address the issue of client's requirements. The much-neglected aspect of Post-Contract Transaction Costs (PTCs) that affect project performance, viewed as a sub-system that needs to be minimized for projects to have a clear benefits realization potential. This paper seeks to establish the specific design-build (DB) contractor team competencies for post-contract transaction costs minimization. 357 G7 contractors were selected through systematic sampling technique from 4,625 registered G7 contractors in Malaysia. The data was analysed using Principal Factor Analysis (PFA) in SPSS to establish the specific DB contractor team competency. The findings indicate that functional, and knowledge competency of DB contractors' team are significant towards minimizing PTCs It is also evident that DB project requirement, objectives, and contractor team ability to handle changes as well as communication skills is the most significant competencies for DB contractor team towards minimizing PTCs. These findings establish that functional and social competencies of DB contractor team play a significant role in DB projects in order to leverage on its full potential.

Key words: *Competencies; Design-Build (DB); Post-Contract Transaction Costs*

Introduction

The construction industry has been struggling with the issue of inconsistent performance with respect to cost of projects, completion time and the delivery of a quality product. These challenges have been addressed by researchers with some success, however in contrast to other industries the construction industry is still seen to be lagging. One strategy that has evolved amongst construction practitioners and researchers is the adoption and adaptation of ideas and techniques developed within other industries. The major ones being the Manufacturing and the Information and Communication Technology fields (Wiinberg 2010; Sapountzis 2013; Ohene-Addae 2013).

The concept of Best Value, Value Maximization and Benefits Realization are a few notable concepts adapted from other industries, but yet to be realized as having a significant impact. This section provides an introduction to the main subject of Benefits Realization in the process of procurement of building projects, to start with. The research problem related to low achievement of client satisfaction on construction projects is identified. Within this context of client satisfaction, based on comprehensive literature review, it is clear that mainstream research on construction project performance has neglected the aspect of skills and competencies of key project participants towards minimizing Transaction Costs (TCs) - a clear gap within the research literature. Viewed from the perspective of client satisfaction (which is represented in this thesis within the context of benefits maximization), the traditional procurement strategies, with respect to this measure for project success, that is achieved through the conventional *requirements capture* process (the precursor to benefits maximization) is presented.

In Malaysia, not all the D&B projects were successfully delivered as designed and planned. The DB concept has been labeled to be 'designed to fail' by the then Malaysian Second Finance Minister as reported by the New Sunday Times, February 4, 2007. This is due to the fact that, some of the DB mega projects have failed to effectively deliver benefits as to client's requirements (Jasri, 2011). It is noted by Gambo and Gomez (2015); Abdul Rahman *et. al.* (2006); Seng & Yusof (2006); Isa *et. al.* (2011); and Hashim *et. al.* (2006) that clients' expectations in the DB delivery system are not adequately met and the system is not being practiced in the manner that is meant to leverage on its potential benefits in the Malaysian construction industry. According to Abdul Rahman *et. al.* (2006) and Gambo & Gomez (2015) identified lack of management expertise as a contributor to DB project failure. Another key problem identified is Transaction costs (Rajeh, 2014; Li *et. al.,* 2015; Raji, 2017). These post-contract TCs could be high arising from disputes and litigation, as conflict and disputes are deemed to occur in the construction industries of many countries (including Australia, USA, UK, Hong Kong, New Zealand and Nigeria) and inflict a high cost to the industry both in terms of direct and indirect costs. It is found that the post-contract TCs for DB range from 3.4% to 14.7% with an average of 9.5% of the overall project value (Rajeh, 2014; Li *et. al.,* 2015). In Malaysia, the situation is not different with an average of 7% ranging from 3.5% to 13.5% of the project value based on the pilot study conducted as part of this research.

A critical review of the current DB approach is presented based on the understanding that the Design-Build (DB) project delivery system was developed primarily as an attempt to overcome the shortcomings of the traditional procurement strategies, in relation to client satisfaction. The proposed research aim of a context-specific DB contractors' team-competency approach is argued for (and tested) as a driver in order to Maximize Benefits with respect to satisfying clients' needs for DB projects. In this research, the DB project environment is viewed as currently being able to provide the most conducive platform for achieving benefits maximization. However, it is evident from previous research that it is failing to achieve the highly acclaimed advantages in comparison to traditional procurement. An outline research methodology is presented along with the roadmap towards achieving the research aim of establishing a contractors' team-competency action framework for benefits maximization in D&B projects. The structure of the thesis is represented in progressive phases based on the research flow, highlighting the actions to be taken to develop, evaluate and conclude the research findings that can contribute to higher efficiency for maximizing benefits. Thus, driving benefits realization by leveraging on team performance, enabled by team commitment that emphasizes on competency development for performative action through Knowledge-In-Action.

Competency and performance

In the past few decades, competencies were often used for the basis of performance appraisal (Cardy & Selvarajan, 2006). The competencies as a measurement tool identify behavioral factors relevant to performance in a job and viewed as how the job is carried out. Many organizations use competency models as a part of their employee development program to appraise behavioral performance indicators together with objectives (Özçelik & Ferman, 2006). Consequently, many scholars (McClelland, 1973, Levenson *et. al.,* 2009; Ryan *et. al.,* 2009; Yaşar, Ünal, & Zaim, 2013) have claimed that assessment of employees' competencies provide an effective method for predicting job performance.

There is a variety of research that clarifies the relationship between competencies and employees' job (task) performance (McClelland, 1973; Liu *et. al.,* 2005; Dainty, 2004; Levenson, 2006; Ryan *et. al.,* 2009). The findings of Ahadzie *et. al.* (2009) demonstrates the suitability and potential usefulness of their competency-based model that reflects elements of both performance behaviors and outcomes in predicting the performance. Similarly, there are other research (Ryan *et. al.,* 2009) highlighting the validity and utility of competencies in predicting employees' work performance. Qiao and Wang (2009) suggest that team-building, communication; coordination, execution and continual learning are critical competencies for the success of middle managers in China.

Although, the relationship between individual competencies and organizational performance has been addressed by previous studies, there are less empirical evidences established (Levenson *et. al.,* 2009; Ryan *et. al.,* 2009; Gammie & Joyce, 2009). On the other side, despite the increasing

tendency in using competency models, there is still some confusion and skepticism about the relation between competencies and performance. These are mainly because of the difficulties in assessment of competencies (Currie & Darby, 1995) and the complex and lengthy process required for identifying the appropriate competency performance relationship (Vakola *et. al.,* 2007). In addition to that, organizational performance has many dimensions, yet it is not easy to connect individual competencies to organizational performance (Liu *et. al.,* 2005; Vakola *et. al.,* 2007). In this research, DB contractor teams-competence will be assessed to establish a causal relationship with minimizing post-contract TCs for achieving optimal benefits realization and thus in a more specific sense addressing a particular aspect of project performance in the construction industry aimed at benefits or value maximization.

Furthermore, in this research, competency is operationalized from the previous studies of IPMA (2006); Hua (2010); Silvius & Schipper (2012, 2014). The study reflects on DB contractor`s team-competency towards optimal benefits realization in the DB delivery system. Hence, the three competency variables namely: knowledge, functional and social competency with eighteen items were developed to assess DB contractor team-competency towards benefits realization. Finally, this study considers DB contractor team competence as second order formative construct.

Table 1. Measurement of D&B team-competences construct

Construct	Definition	Measures	Sources
Knowledge/ Cognitive Competence	Is the possession of appropriate work-related knowledge and the ability to put them to effective use. The linkage of cognitive competence with knowledge emphasizes the importance of the latter part of the definition, i.e. the ability to apply knowledge in a variety of ways.	• Project orientation • Program orientation • Business • System, products and technology • Health, security, safety & environment • Personnel management • Finance • Legal	Silvius & Schipper *et. al.* (2014); Silvius & Schipper *et. al.* (2012); Mahmood *et. al.* (2006); Said *et. al.* (2009); Lubbe & Barnard *et. al.* (2013); (Lubbe, 2010), Hua (2010); Delamare Le Deist & Winterton (2005); Cheetham & Chivers (1996); Manley & Garbett (2000); Paris *et. al.* (2000); Klarner *et. al.* (2013)
Functional/ Technical competence	The ability to perform a range of work-based tasks effectively to produce specific outcomes. Personal or Behavioral Competence: is the ability to adopt appropriate, observable behaviors in work-related situations.	• DB project requirement & objectives • DB risk & opportunity • Quality • Resources • D&B procurement & contract • Changes • Communication skills	
	The possession of appropriate personal and	• Engagement • Self-control	

Social/ **Behavioral Competence**	professional values and the ability to make sound judgments based upon these in work-related situations. It also involves team-generic competence which can be defined as the team's behavioral and social skills that determine how the members relate to one another and to others outside the team, such as external clients	• Results orientation • Consultation • Conflicts & crisis • Ethics • Leadership	

Competency and Post Contract Transaction Costs

A competency is defined by Marrelli (1998) as measurable human capacities that are required for effective work performance demands. According to Boyatzis (1982), action or specific behaviour is seen as the manifestation of a competency in the context of a specific task or environment. In addition, individual competency is defined by Parry (in Cooper, 2000) as a cluster of associated knowledge, skills and attitudes, which enhances performance on the job. The United States Office of Human Resources (2005) define competency as a measurable pattern of knowledge, skill, abilities, behaviours, and other characteristics that an individual need to perform work roles or occupational functions successfully.

The linkage between competency and job performance is addressed by Boyatzis in "Model of Effective Job Performance" in 1982. This model specifies that effective action and performance will occur when all three of the critical components, i.e. organizational environment, job demands, and an individual's competencies, are consistent or fit. In 2008, Boyatzis further transformed the previous model to "Theory of Action and Job Performance". In the model, Boyatzis (2008) highlights that individual's competencies are key elements towards maximum performance.

According to Carey *et. al.* (2006), the existence of technical competence is conducive to speedy decisions, smooth operations, less rework, and easy communication, all of which contributes to lower transaction costs in construction projects. One of the key characteristics of transactions that make projects more costly is complexity and uncertainty (Williamson, 2010a). They are always paired with bounded rationality and opportunistic behaviour of contractors. Bounded rationality refers to the limited competence of human actors in solving complex problems and process information (Simon, 1991). These limits of rationality are reached under conditions of uncertainty about possible outcomes and complexity in the number of possible outcomes of a situation. It is seen

to be the main cause of many contracts to be incomplete and subject to opportunists that lead to hazardous results (Williamson, 1985).

According to Dosi and Teece (1998), competences are the pillars of competitiveness of the firm and involve a coordinated set of capabilities, complementary assets, skills of individuals and organizational routines (Bataglia, Silva, & Klement, 2011; Nogueira & Bataglia, 2012). In an effort to integrate the approaches of transaction costs and competences, Jacobides and Winter (2005) in a theoretical study elaborate a conceptual model for co-evolution of transaction costs and competences along a productive chain. Their initial assumption is that the distribution of competencies between the actors determines the vertical scope that they adopt in the value chain. In addition, they posit that if distribution of skills is uneven, transaction costs are expected to be high. On the other hand, if the competences are uniform across agents, the specialization of agents would only occur if transaction costs are low.

In this research, DB contractors' team-competency reflects three integrated dimensions: knowledge/cognitive, functional and social competencies. However, from a DB delivery system perspective, displaying superior competencies is seen as key towards minimizing post-contract TCs in order to achieve high project performance. Throughout the literature, competency was operationalized in several distinct ways. However, it is concluded here that from reviewing literature that there seems to be a significant positive relationship with project performance in general and transaction costs in particular (Jacobides & Winter, 2005; Lee & Liu, 2006; Thai-ngam & Vathanophas, 2007; Boyatzis, 2008; Bataglia *et. al.,* 2011; Nogueira & Bataglia, 2012).

METHODOLOGY

The population of study consisted of 4,625 G7 contractors (highest grade of registered contractors, eligible to bid for value of work above RM10million (USD2.41m) registered with CIDB Malaysia based on the CIDB website directory as of December 2015 (CIDB, 2015). Based on Saunders *et. al.* (2015) sampling table, 357 G7 contractors were selected through systematic sampling technique with 3% margins of error and 95% confidence level. A total of 248 questionnaires were returned with 17 considered as invalid. The collected data was tested for missing data and Monotone Response Pattern. The data from the 231 questionnaires were analysed using Principal Components Analysis in SPSS version 21.

FINDINGS

The Principal Components Analysis (PCA) in SPSS was used to extract the 15 specific DB contractor team competencies. Prior to performing PCA, the suitability of the data for factor analysis was assessed. Inspection of the correlation matrix revealed the presence of many coefficients of 0.4 and above. As shown in the KMO and Bartlett's Test table below, the Kaiser-Meyer-Olkin value is 0.877, exceeding the recommended value of 0.6 (Tabachnick & Fidell, 2018; Aldrich, 2019) and

Bartlett's Test of Sphericity reaches statistical significance (Sig. value 0.05 or smaller), supporting the factorability of the correlation matrix (Hair *et. al.*, 2018).

Table 2: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.877
Bartlett's Test of Sphericity	Approx. Chi-Square	2705.575
	df	120
	Sig.	.000

Furthermore, based on the analysis, Varimax method of orthogonal approach was adopted for the factor rotation. Orthogonal approach indicates that all components are assumed to be uncorrelated (Bordens & Abbott, 2018; Aldrich, 2019). Varimax rotation method is the most commonly used method which attempts to minimise the number of variables that have high loadings on each other (Pallant, 2016). Based on this analysis, rotation converged in 6 iterations. PCA revealed the presence of 3 components with eigenvalues exceeding 1, explaining 67.5% of total variance. The percentage of variance for each retained component and its eigenvalue are included in Table 2. Retaining components with eigenvalues of 1 or greater is the most commonly used rule. According to Hinton, McMurray, and Brownlow (2014), "an eigenvalue of 1 indicates that the factor can explain as much variability in the data as a single original variable." There is no threshold for the minimum percentage of total variance explained however, Hair *et. al.* (2018) mentioned that 60% is satisfactory. The rotated component matrix table was generated in SPSS and decision with respect to the number of components to be extracted was made. All principles loaded on all 3 components (Refer to Table 3) even though, there were cases of cross loading, in which some were retained (if the difference is <0.2) and those above (if the difference is >0.2) were removed.

Table 3: Result of factor analysis

Components	Eigen value	% of Variance	Name of components[a]	Competency[b]	Factor loading
1	2.988	59.765	Knowledge Competency	KC01	0.767
				KC02	0.782
				KC04	0.754
				KC07	0.736
				KC08	0.814

2	3.228	64.564	Functional Competency	FC01	0.922
				FC02	0.851
				FC06	0.862
				FC07	0.746
3	3.606	60.093	Social Competency	SC01	0.721
				SC02	0.765
				SC04	0.830
				SC05	0.797
				SC06	0.768
				SC07	0.763

[a] Components were named based on extraction and characteristics of the group
[b] The meaning of KC, FC, SC is presented in the list below.

A 3-component competency was established based on Varimax rotation of principal component analysis (see Table 3). These 3 factor groupings with eigenvalues greater than 1.000 explain 64% of the variance. Each of the competencies belonged to only one of the groupings, with the value of factor loading exceeding 0.50 (Aksorn and Hadikusumo 2008).

Component 1: *Knowledge Competency*

This component, which accounted for 59.76% (see Table 3) of the total variances between competencies, was less percentage variance than the other 2 components. It indicated that DB contractor team in Malaysia consider knowledge competency significant in DB project delivery process. To enhance the understanding of DB contractor team, their specific competencies and potential influence need to be established. Therefore, this component, which relates to competencies, is described as *project orientation*; *program orientation; system, product and technology*; *finance* and *legal* as represented by KC01-KC05.

The findings of this research is consistent with and confirms the previous literature on competency such as Silvius & Schipper *et. al.* (2014); Silvius & Schipper *et. al.* (2012); Lubbe & Barnard *et. al.* (2013); Delamare Le Deist & Winterton (2005); Cheetham & Chivers (1996); Manley & Garbett (2000); Paris *et. al.* (2000); Klarner *et. al.* (2013)

Component 2: *Functional Competency*

This component, which accounted for 64.56% (see, Table 3) of the total variances between competencies, was considered relatively more significant as shown in percentage variance than the other 2 components. It indicated that DB contractor team in Malaysia consider functional competency significant in DB project delivery process. Key competencies such as *DB project requirement and objectives* in which the team clearly understand the goals, client requirement and conditions of the project, as well *quality*, *changes* – where the team have the ability to handle requests for change efficiently and effectively taking into account the scope of the project and the impact of the changing clients requirements. In addition, *communication* skills deployed efficiently and effectively are also established as significant to functional competency of DB contractor team. The result is consistent with the previous literature such as Silvius & Schipper *et. al.* (2014); Silvius & Schipper *et. al.* (2012); Lubbe & Barnard *et. al.* (2013); Delamare Le Deist & Winterton (2005); Cheetham & Chivers (1996); Manley & Garbett (2000); Paris *et. al.* (2000); Klarner *et. al.* (2013)

Component 3: *Social Competency*

The third component, account for 60.09% (see, Table 3) of the total variances between competencies, was seen as significant based on the analysis, as percentage variance than only one 1 components. It indicated that DB contractor team in Malaysia consider social competency significant in DB project delivery process. Key competencies such as *leadership* stimulate and motivate team members and interested parties to act in the interest of the project and show efficient and effective behaviour whilst, *Engagement*; the contractor team are personally committed and reflect the personal buy-in from all individuals associated with the project. Similarly, *results orientation*; to remain focus on the project goals and the interests of the client is paramount. *Consultation;* contractor team analyse issues and situations, seek advice and new insights on different alternatives; the contractor team recognizes potential *conflicts and crisis* at an early stage and help proffer solutions that will solve the issue in the best interest of the project. In addition, the team clearly understand *ethics* and moral values and act accordingly. Refer to Table 4 below for the measurement items. The findings of is in line with the previous study of Silvius & Schipper *et. al.* (2014); Silvius & Schipper *et. al.* (2012); Lubbe & Barnard *et. al.* (2013); Delamare Le Deist & Winterton (2005); Cheetham & Chivers (1996); Manley & Garbett (2000); Paris *et. al.* (2000); Klarner *et. al.* (2013).

Table 4: Measurement items – DB contractor team-competency

a)

#	**DB Knowledge competency**
KC01	*Project orientation*: As part of the contractor team we understand the rationale for the project and we are aware of the organizational context of the project
KC02	*Program orientation*: As part of the contractor team we are capable of aligning program goals to business strategy and develop new proposals for new projects supporting this strategy
KC04	*System, products & technology*: As part of the contractor team we understand and manage the causes and effects of actions in the project effectively
KC07	*Finance*: As part of the contractor team we have adequate knowledge of and insight in the financial and administrative processes of the project and integrate these aspects in our actions
KC08	*Legal*: As part of the contractor team we are aware of legal, compliance and liability aspects of the project

b)

	DB Functional competency
FC01	*DB project requirement & objectives*: As part of the contractor team we recognize and clearly understand the goals, client requirements and conditions of the project
FC02	*Quality*: As part of the contractor team we understand the quality aspects at project execution and manage the realization of these aspects
FC06	*Changes*: As part of the contractor team we are able to handle requests for change efficiently and effectively taking into account the scope of the project and the impact of the changing client's requirements
FC07	*Communication*: As part of the contractor team we are skilled in communication and deploy our skills efficiently and effectively

c)

	DB Social competency
SC01	*Leadership*: As part of the contractor team we stimulate and motivate team members and interested parties to act in the interest of the project and show efficient and effective behaviour
SC02	*Engagement*: As part of the contractor team we are personally committed and reflect the personal buy-in from all individuals associated with the project
SC04	*Results orientation*: As part of the contractor team we do not lose focus on the project goals and the interests of the client
SC05	*Consultation*: As part of the contractor team we analyse issues and situations, seek advice and new insights on different alternatives
SC06	*Conflict & crisis*: As part of the contractor team we recognize potential conflicts of interest or crisis at an early stage and help proffer solutions that will solve the issue
SC07	*Ethics*: As part of the contractor team we clearly understand ethics and moral values and act accordingly

CONCLUSION

It is evident that DB organizational structures have a tendency to transform into hybrid forms due to lack of core and specific competencies thereby reforming to benefits from markets and avoid hierarchies so as to minimize costs. However, this can be compromise on process efficiencies and cause additional TCs. From socio-technical point of view with emphasis on human action to minimize PTCs, competencies were identified from extant literature as components of human action. Viewed from a Lean perspective, transaction costs could be seen as one form of waste as recognized by economists. In this research TCs are considered to be substantial extra work and rework, and antagonistic relationships with owners, which end up in dispute and conflict, disagreements, change order and claims which occur in the post-contract phase of D&B projects.

The findings indicate that functional competencies of DB contractors' team are key towards minimizing PTCs. It is also evident that DB project requirement and objectives, and contractor team ability to handle changes as well as communication skills is the most significant competencies for DB contractor team towards minimizing PTCs, wherein the identified specific competencies are viewed as indicators of project performance.

This research offers new understanding for contractor team of the DB delivery system in the construction industry to put emphasis on team-competency to deliver the objectives of DB delivery system as planned. It will also enable key DB contractors to steer their organizations towards a more effective DB delivery system. Hence, it is proposed that in order to minimize PTCs, functional and social competencies of DB contractor team need to be given greater emphasis in order for DB projects to leverage on its full potential with respect to permitting a greater interplay of structure and agency.

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