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IDENTIFYING CONSTRUCTION ORGANIZATIONAL COMPETENCY MEASURES AND PERFORMANCE INDICATOR METRICS

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Abstract: Understanding how to successfully identify and manage organizational competencies is critical for construction organizations, given the direct and significant influence they have on an organization's performance. Organizational competencies are combinations of knowledge, skills, abilities, and other underlying characteristics that contribute to increased organizational effectiveness, competitiveness, profitability, and performance. Research on organizational competencies has been receiving significant attention in recent years, and it is becoming increasingly more vital for construction organizations to explore new approaches to assess and enhance their competencies. Furthermore, it is important for construction organizations to adopt effective strategies and performance measurement methods if they are to improve their effectiveness and competitiveness. The variables that characterise construction organizational competencies are both quantitative and qualitative in nature, and thus require measurement methods and modeling techniques that can handle both variable types. Additionally, relating organizational competencies to performance is essential in order to identify target areas leading to improved performance. In order to address these challenges, this paper reviewed literature related to organizational competencies, competency frameworks, and competency models, including both models that have been developed specifically for use within the construction domain as well as those developed for use in other disciplines. Next, an overview of performance measurement methods are provided, and based on an analysis of the literature, organizational competency measures and key performance indicator metrics are developed. Finally, this study proposed a data collection approach and a model, which will assist researchers and industry practitioners in evaluating the competencies of construction organizations.

1 BACKGROUND AND PROBLEM STATEMENT

Most industries are dynamic in nature, and the construction industry is no exception. However, due to the increasing uncertainties in technology, budgets, and development processes, the environment is becoming more complex (Chan and Chan 2004). The construction industry has also long been criticized for its underperformance. For instance, Radujković et al. (2010) argue that the construction industry still suffers from inefficiency and ineffectiveness, and that it lags far behind all other industries. Momaya and Selby (1998) compared the competitiveness of Canadian construction industry with that of Japan and the U.S. The study showed that the Japanese construction industry is more competitive than both U.S. and Canada,

while the Canadian construction industry is less competitive than its U.S. counterpart. The Construction Owners Association of Alberta (COAA) (2009, 2014) conducted a major project performance assessment in two phases and revealed that while Alberta projects showed improved performance in the second phase of the assessment, these projects experienced overall poorer cost and schedule performance as compared to U.S. projects.

The literature indicates widespread misconception of the concept of organizational competency. Cullen Coates & Associates (CCA) (2008) and Edgar and Lockwood (2008) argue that organizational competency is perceived narrowly as individual skills and capabilities. For example, a wide range of studies emphasize only select aspects of competency: individual/personal competencies (Hogan 2009), managerial competencies (Herlein 2009), leadership competencies (Shyne-Turner 2010), and cost estimation competencies (Hollmann and Elliot, 2006). Likewise, some studies were conducted at the project level, rather than the organizational level (IMPA 2006, Omar 2015, Omar and Fayek 2016). These findings demonstrate a need for researchers to capture a comprehensive analysis of all corporate aspects of organizational competencies in a way that is aligned with the strategic goals of corporations operating in a highly competitive global market. However, Fayek (2012) stresses that the challenges in effectively capturing these corporate aspects of organizational competencies (input and output variables) can be attributed to uncertainty in the construction industry.

In this paper, a comprehensive list of organizational competency measures and performance metrics is presented. In addition, a competency framework and model are introduced that will enable researchers to identify the link between competency and performance, which will in turn provide construction organizations with an improved means of predicting organizational performance. This paper is organized into five sections: section 1 presents essential background information for the study; section 2 offers a review of previous studies on organizational competencies and performance, section 3 includes a thorough discussion of the proposed model and framework; section 4 discussed measurement methods, and section 5 covers conclusions and reflections on future research to be conducted towards developing detailed competency measures and performance metrics for construction organizations.

2 ORGANIZATIONAL COMPETENCY AND PERFORMANCE

2.1 Organizational Competency

The concept of “competency” was first proposed in McClelland’s (1973) paper entitled “Testing for competency rather than for intelligence”, which argues that traditional intelligence tests do not predict future life success (Boyatiz 1982, Spenser and Spenser 1993, Vazirani 2010, Chouhan and Srivastava 2014). However, McClelland failed to provide a concrete definition of competencies, and instead, used examples, such as traditional cognitive skills (reading, writing and calculating) and personal variables, to illustrate the concept. Recent studies argue that organizational competencies have been mistakenly construed as performance measures (CCA 2008, Omar and Fayek 2016), thus, the following section provides a careful analysis of the literature in order to clarify these misconceptions surrounding competency.

2.1.1 Competency Basics and Definition

Shyne-Turner (2010) notes that many researchers cite Boyatzis’s 1982 study as a critical milestone in research pertaining to competency. This study first coined the definition of competency as “an underlying characteristic of a person, which results in effective and/ or superior performance in a job”. In general, competencies are defined as “combinations of motives, traits, self-concepts, attitudes or values, content knowledge or cognitive behavioural skills; any individual characteristic that can be reliably measured or counted and that can be shown to differentiate superior from average performers” (Spencer and Spencer 1993, Vazirani 2010, Chouhan and Srivastava 2014), though there is no clear consensus on the definition of organizational competencies (Fayek 2012). For example, recent works by Edgar and Lockwood (2008), Subramanian et al. (2009), and CCA (2008) all propose relatively different definitions of organizational competencies. However, these definitions clearly indicate that the analysis must capture the performance of the organization as a whole, not just the individual employees. Therefore, this paper proposes the following working definition of organizational competency:

"*Organizational competency is an integrated combination of resources, particular set of skills, necessary information, technologies, and the right corporate culture that enable an organization to achieve its corporate goals, competitive advantage, and superior performance.*"

2.1.2 Components and Types of Competency

The elements that make up competency are as follows: knowledge, skills, motives, traits/personal characteristics, and the concept of self (Spencer and Spencer 2003, Vazirani 2010, Chouhan and Srivastava 2014). The Iceberg model proposed by Spencer and Spencer (1993) summarizes these elements as visible (e.g., knowledge and skill) and hidden (e.g., motive, trait and self-concept). Both visible and hidden elements are considered to be behavioural competencies (Omar 2015). In contrast, motives and traits, which capture what workers will do on the job without close supervision, can be identified as initiators (Chouhan and Srivastava 2014). Thus, the components of competency can predict certain behaviors that will ultimately emerge as key for improved performance (Spencer and Spencer 1993, Chouhan and Srivastava 2014). IPMA (2006) classifies competency into three major categories: technical (project management tasks), behavioural (individual characters), and contextual (knowledge and capabilities). Similarly, Omar and Fayek (2014, 2016) and Omar (2015) categorize competencies into two groups: functional (how an organization operates and functions) and behavioural (attributed to individuals). In addition, Shyne-Turner (2010) devises four types of competencies: core competencies, organizational competencies, job/role competencies, and personal or individual competencies.

2.1.3 Organizational Competency Frameworks, Models, and Measures

In this section, organizational competency frameworks and models proposed by past studies are reviewed. The iceberg model (Spencer and Spencer 1993), the eye of competence model (IPMA 2006), the fuzzy hybrid intelligent model (Omar and Fayek 2016, Omar 2015), and the engineering competence model (USDOL 2015) are among some of the competency models discussed below. In regards to competency frameworks, McDermott's (2003) work is examined, which divides competency into two dimensions: functional and integrative. In addition, Edgar and Lockwood (2008) developed four major perspectives to understand organizational competencies: (1) understanding of specific phenomena and their related disciplines, (2) technology, (3) functional skills, and (4) an integration of technology and skills.

According to Fayek (2012), the variables that define construction organizational competencies are both quantitative and qualitative in nature, requiring modeling techniques that can capture both. Additionally, relating organizational competencies to performance is essential in order to identify target areas to improve performance. Past researchers have paid significant attention to methods for evaluating organizational competencies, based on the importance of these methods in improving organizational effectiveness, competitiveness, and profitability. However, most of this research has been focused on competencies in domains other than construction (Fayek 2012, Omar and Fayek 2014, 2016).

2.2 Organizational Performance

The importance of having processes in place to support the evaluation and improvement of organizational performance is evident throughout the global market. Owing to the simultaneous implementation of projects and the control of many input resources within the construction industry, it is becoming necessary for practitioners to carry out performance measurement at the organizational level (Horta 2010). Bassioni et al. (2005) reports that in the construction industry, the research focus has shifted from project level to organizational level. Studies conducted by Kagioglou et al. (2001) and Bassioni et al. (2005) suggest that these changes can be attributed to criticism placed on the construction industry for its underperformance. With these suggestions in mind, this paper will seek to contribute to advancements in the methods for performance measurement at the organizational level.

2.2.1 Organizational Performance Measurement

Measurement of organizational performance is essential (Deng and Smyth 2013, Jin et al. 2013); Jin et al. (2013) maintain that the measurement of performance is critical for senior managers that are responsible

for strategic decision making and operations in general. However, Deng and Smyth (2013) argue that the construct of organizational performance is poorly understood and operationalized in existing construction management research. According to Deng and Smyth (2014), the reason for this discord can be attributed, at least in part, to the lack of research, as well as to the project-based nature of past research since projects are not a standard unit of output (i.e., projects may differ in size, type, complexity, etc.). In support of Deng and Smyth's (2014) argument, Kagioglou et al. (2001) and Bassioni et al. (2005) suggest that research in performance at the organizational level is small as compared to the body of research conducted at the project level. The main objective of performance evaluation is to assist managers and other members of the organization in developing objectives for the direction, traction, and speed of their organization's operations. Accordingly, the literature shows that performance measurement frameworks have been implemented in the construction industry since the mid-1990s (Deng and Smyth 2013, Jin et al. 2013). The highly competitive environment and profound challenges in the construction industry are putting pressure on organizations to implement systematic methods for measuring performance in a way that will allow them to continuously improve their performance and competitive advantage (Horta and Camanho 2014).

2.2.2 Performance Metrics

The use of key performance indicators (KPIs) dominates the practice of performance measurement in construction (Deng and Smyth 2014). Horta et al. (2010) argues that each individual KPI examines only a portion of organizational activity, which may be seen as a limitation. Horta et al. (2010) suggests that a comprehensive performance evaluation must be based on the analysis of several indicators. However, it may also be difficult to gain an overall view of performance, as the number of indicators that can be computed for each company may be unmanageably large (Horta et al. 2010). Many conceptual frameworks exist for measuring organizational performance in construction, such as those developed by Kagioglou et al. (2001), Bassioni et al. (2005), Horta et al. (2010, 2014), and Jin et al. (2013). These frameworks reflect the advanced practices of organizational performance measurement in the construction industry (Deng and Smyth 2014). The literature reveals that there are three specific types of measures that can be used in the construction industry: KPIs; key performance outcomes (KPOs); and perception measures (PerMs) (Beatham et al. 2004, Radujković et al. 2010). KPIs are indicative of assigned processes and can predict future trends, which aids in identifying problems at the early stages of a project. KPIs are considered to be leading indicators in that they provide opportunities for change. In contrast, KPOs are results of completed actions or processes; KPOs are lagging measures and do not enable change. Managers in construction sometimes utilize KPOs as KPIs, such as such as profit, return on equity, and time, though they may not be aware of it (Beatham et al. 2004; Radujković et al. 2010). Perception measures (PerMs) can be either lagging or leading, depending on the time in which they were measured. PerMs are often measured through surveys and interviews and are dependent on the managers' focus (Radujković et al. 2010).

3 PROPOSED MODEL FOR ORGANIZATIONAL COMPETENCY AND PERFORMANCE

3.1 Construction Organizational Competency Measures

After a comprehensive review of the literature, two sets of organizational competencies were identified (shown below in Table 1): functional and behavioural competencies. These metrics are proposed on the basis of their relevance to the overall operations of construction organizations. Additionally, metrics commonly used at the organization level in previous studies have also been considered. Furthermore, these identified metrics will be verified through a focus group conducted with construction experts.

Table 1: Proposed organizational competency measures

Category	Cluster	Competencies
Functional	General administration	Goal-orientation, Human resource, Manage/support diversity, Talent (staff) development/training, Team orientation/team work
	Cross-functional	Communication skill/management, Cooperation/cooperativeness, Customer support, Customer value/focus, Delegation, Internal cooperation and coordination,

Category	Cluster	Competencies
		Public and governmental relations, Stakeholder focus/responsiveness
	Technical	Attention to detail, Business acumen/ business management skills, Commitment to safety, Creativity, Critical and analytical thinking, Finance management, Marketing, Planning and organizing, Problem solving, Prevention & decision making, Technical knowledge/job knowledge,
	Production/operational	Construction technology/ integration management, Manufacturing and construction, Material management, Operations and maintenance, Process engineering/management, Product engineering
	Engineering R&D	Business, Legal and public policy, Construction law and regulation, MIS/computer IT, New product/technology development
	Project management	Change mastery/management, Commissioning and start-up, Conflict management, Design development, Information management skills, Managing performance, Procurement and contract management, Professional ethics, Program management, Project monitoring & controlling system, Quality management, Risk management, Safety, Health, Security and environment, Scheduling and coordinating, Sustainability and societal impact, Team building
	Managerial/supervisory	Engagement (people, organizations, partners), Management excellence, Resource management, Values and ethics
Behavioural	Core organizational	Achievement drive/oriented, Adaptability/flexibility, Building trust, Competitive, Culture and values, Innovation, Risk taking
	Top management	Strategic thinking/planning/policy, Analytical ability, Initiative, Leadership, Judgment
	Middle management	Consultation, Interpersonal skills, Reasoning
	First-line Managers	Influence/assertiveness, Integrity/high standards, Responsiveness,
	Individual/personal	Commitment, Creativity, Enthusiasm, Motivation, Reliability/dependability, Sales mind set/selling skills, Self-confidence, Self-regulation/control, Sensitivity

3.2 Construction Organizational Performance Metrics

Our review of various organizational performance measurement frameworks forms the basis for the proposed performance metrics in such a way that enables future validation. Accordingly, the performance metrics are organized into three categories that are in line with those proposed by Radujković's et al. (2010): KPIs, KPOs and PerMs. The selection of these metrics also considers the extent to which these metrics have been used in past research, as well as their relevance to construction performance at the organizational level.

Table 2: Proposed organizational performance metrics

Category	Measures	Metrics
KPI (Leading)	Cash flow	Cash flow
	Quality of work/service	PAF model, Rework factor
	Market share	Market share, Market returns
	Safety	Accident cost, Accident frequency Rate/ratio, Incidents rate, Safety performance, Time lost
	Financial stability	Debt ratio

Category	Measures	Metrics
KPO (Lagging)	Profitability	Economic value added, Financial autonomy, Hanging invoice, Liquidity, Net income, Profitability, Return on assets, Return on capital, Return on equity, Return on investment, Return on sales, Value added
	Growth	Sales growth, Revenues growth, Volume of works growth rate
	Business efficiency	Efficiency ratio, Net profit margin
	Effectiveness of planning	Change Cost Factor, Predictability Cost, Predictability Time, Time/schedule increase
PerM (Leading/Lagging)	External customer satisfaction	Customer retention/loyalty, Customer satisfaction survey, Number of complaints, Percentage of repeat customers
	Internal customer satisfaction	Average remuneration per employee, Employee turnover rate, Employees' satisfaction, Profit per employee, Turnover per employee
	Competitiveness	Company image/reputation, Competitive advantage, Market advantage

3.3 Proposed Construction Organizational Competency and Performance Model

Using the competency measures and performance metrics developed in the previous section, this paper proposes a model (shown in Figure 1) that will permit the measurement of competency as well as the evaluation and prediction of performance. This model also enables assessment of the relationship between organizational competencies and performance. Groups of functional and behavioural organizational competencies function as inputs for the model. The functional competencies are organized into seven clusters, based on the area of specialization or department within the organization. This arrangement helps to capture the interdependence of competencies within a business unit in towards achieving corporate goals. In contrast, the behavioural competencies are grouped into five clusters, based on a generic organizational hierarchy developed from a managerial-level perspective. These competencies are grouped according to the managerial level they are most important to and where they demonstrate the best representation. For instance, analytical ability and judgement more are critical for top management than they are for middle- or lower-level management, though they are still important for all sets of individuals in the organization. Likewise, motivation is more important to an individual employee operating on the first line of production or construction activity, as compared to those in middle or top management. Furthermore, industry and context factors are introduced in the model as control variables to account for variation in organizational elements such as size, the speciality or construction type that the organization operates in, economic factors, and environmental conditions. The output of the model is organizational performance, which is structured into three performance measures: KPIs, KPOs and PerMs. The KPIs and KPOs are each organized into five and four clusters of KPI and KPO measures; in turn, each cluster includes metrics that can be computed mathematically. In contrast, PerMs consist of three clusters of subjective measures related to internal/external satisfaction with and competitiveness of the construction organization.

4 METHOD OF MEASURING CONSTRUCTION ORGANIZATIONAL COMPETENCIES AND PERFORMANCES

This section describes the method used to measure both organizational competency and organization performance. Since the proposed model encompass both quantitative and qualitative measures, competency and performance indicators are measured in such a way to capture those evaluation criteria for different construction professionals working in various construction organizations such as owners, consultants, contractors and labour associations. This arrangement allows for assessment of the model in terms of applicability in these different forms of construction sector organizations.

Functional competencies
- General administration
- Cross-functional
- Technical
- Operational/production
- Engineering R&D
- Project management
- Managerial/supervisory

KPI (Leading)
- Cash flow
- Quality of work/ service
- Market share
- Safety
- Financial stability

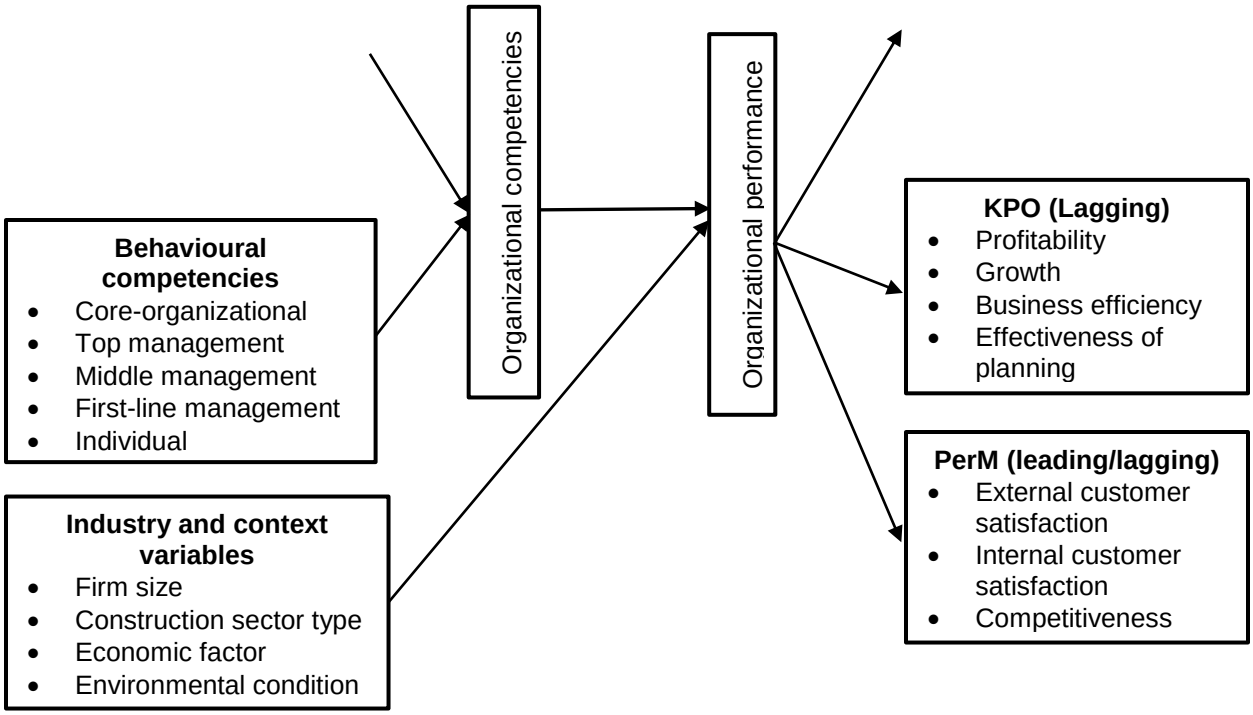

Figure 1: Proposed construction organizational competency and performance model

4.1 Selecting Measurement Scale for Construction Organizational Competencies and Performance

Omar (2015) and Omar and Fayek (2016) identified two scales (i.e., maturity and importance scales) for measuring evaluation criteria for functional competencies. The five-point maturity scale (levels 1–5) measures organizational maturity, focusing on practices and processes to assess the existence of different evaluation criteria (Willis and Rankin 2012, Omar and Fayek 2014, Omar 2015). The maturity levels in the aforementioned rating scale are ordered as follows: 1) Informal (use of practice is ad hoc or inconsistent for each project and organizational unit); 2) Documented (disciplined processes exist for each individual project and organizational unit); 3) Integrated (defined processes exist across the organization); 4) Strategic (quantitatively managed process control exists across the organization); and 5) optimized (there is continuous process improvement across the organization). The importance rating scale (1–7) is applied to prioritize and rank the evaluation criteria for functional competencies. The importance rating scale is ordered as follows: 1) Extremely unimportant, 2) Unimportant, 3) Slightly unimportant, 4) Neither important nor unimportant, 5) Slightly important, 6) Important, and 7) Extremely important. If two criteria have equal importance, their maturity level will govern their rank and priority. Likewise, Omar (2015) and Omar and Fayek (2016) used two sets of seven-point bipolar measurement scales for behavioral competencies, which measure agreement and importance. The agreement rating scale is ordered as follows: 1) Strongly disagree, 2) Disagree, 3) Somewhat disagree, 4) Neither agree or disagree, 5) Somewhat agree, 6) Agree, and 7) Strongly agree. This scale is used to measure the extent to which respondents agree that the different evaluation criteria for behavioral competencies exist within an organization (Omar 2015). Furthermore, numerical scales are assigned to measure quantitative performance indicators (Omar and Fayek 2014). For example, annual profitability and annual growth can be assigned percentage points on numerical scale. Qualitative performance indicators, such as company image/reputation under competitiveness, can be measured using predetermined rating scales. In general, qualitative performance measures include subjective PerMs (satisfaction and competitiveness) and some measures under KPIs (quality of service, and market returns). Satisfaction rating scales are ordered as follows: 1) Very dissatisfied, 2) Dissatisfied, 3) Neither satisfied nor dissatisfied, 4) Satisfied, 5) Very satisfied. Measurement scales for construction organizational competencies and performance are shown in Table 3.

Table 3: Measurement scales for construction organizational competencies and performance metrics

Metric Category	Example Of Measures	Data Type	Scale Of Measure
Functional competencies	Goal-orientation, Communication skill, Attention to detail, Business acumen, Change mastery, Managing excellence, Resource management	Qualitative	Maturity rating scale (1–5) and Importance rating scale (1–7)
Behavioural competencies	Adaptability/flexibility, Strategic thinking/policy, Judgement, Interpersonal skills, Integrity, Responsiveness, Commitment, Reliability, Creativity, Reasoning	Qualitative	Agreement rating scale (1–7) and importance rating scale (1–7)
KPI	Cash flow, Rework factor, Market share, Accident frequency rate, Incident rate, Debt ratio	Quantitative	Number, Percentage
KPO	Profitability, Return on investment, Sales growth, Revenue growth, Change cost factor, Schedule increase	Quantitative	Number, Percentage
PerM	Customer retention, Customer satisfaction, Employee satisfaction, Company image/reputation, Competitive advantage	Qualitative	Satisfaction (1–5) rating scale (perception metrics)

4.2 Data Collection Approach

In the next step, the different measurement scales identified in the previous section (Table 1 and Table 2) are organized to collect all aspects of organizational competencies and performance measures. It is important that the identified measures and metrics be verified with a focus group prior to data collection; the verification process will help to maximize the quality of the measures and metrics. To collect the appropriate data, interviews will be conducted with members of the management team, and a survey questionnaire will be administered to various construction experts and other personnel across the organization. The data collection process will be designed in such a way that enables measures to be captured through survey, assessed for importance, and rated accordingly. To accomplish this task, detailed evaluation criteria (i.e., organizational processes and practices) will be provided for each competency measure. These measures will then be used to relate the evaluation criteria to the documented performance metrics. This approach will help construction organizations to identify measures that will support the continuous improvement of their processes and practices, leading to better organizational performance. Table 4 presents a sample measurement scale that enables the collection of data related to engineering R&D competencies. Furthermore, the data collection method will consider the variability of organizations operating in the construction sector, as well as differences among personnel in regards to their qualifications, experience, and specific discipline.

Table 4: Sample engineering R&D competencies measurement scale

Competency Evaluation Criteria	Maturity Scale (1-5)					Importance Scale (1-7)						
1. Business, legal, and public policy												
1.1 Integrating and updating business, legal, and public policies in line with the organization's corporate goals	1	2	3	4	5	1	2	3	4	5	6	7
1.2 Application and updating of organizational business operation procedures according to market and economic factors	1	2	3	4	5	1	2	3	4	5	6	7
1.3 Update business plans, policies and procedures within construction law and regulation	1	2	3	4	5	1	2	3	4	5	6	7
2. New technology development												
2.1 Innovating new technologies (design, scheduling, and estimation software, construction materials, construction methods) to stay competitive in the construction sector	1	2	3	4	5	1	2	3	4	5	6	7
2.2 Implementation and upgrading new construction methods and procedures to optimize resource utilization	1	2	3	4	5	1	2	3	4	5	6	7

Competency Evaluation Criteria	Maturity Scale (1-5)					Importance Scale (1-7)						
2.3 Continuous development of staff to cope with new technologies and products developed	1	2	3	4	5	1	2	3	4	5	6	7

5 CONCLUSIONS AND FUTURE RESEARCH

This paper has provided a comprehensive review of organizational-level competency and performance, spanning both construction and non-construction domains. In completing this assessment, the proposed model will help to bridge critical gaps in the literature. This study has also contributed to the development of a comprehensive list of 83 competency measures (56 functional and 27 behavioural) and 43 performance indicator metrics (consisting of 10 KPIs, 21 KPOs, and 12 PerMs) for use at the organizational level. Finally, this paper has proposed a novel technique for measuring organizational competencies and performance.

This study is part of a larger, ongoing research project on construction organizational competencies and performance, and it has been designed to enable the development of additional competency measures and performance indicator metrics during the verification process. After the verification process has been conducted and the appropriate measures and metrics are finalized with a focus group, detailed evaluation criteria (i.e. processes and practices) for each competency measure will be developed (Table 4) to collect overall organizational aspects of competency and performance. Once the data are collected, the next stage entails aggregating experts' opinions into a single, representative value for different competency and performance measures. These values will then be used in the proposed model to assess the relationship between organizational competencies and performance. Since measures of organizational competencies are qualitative, while the majority of performance metrics are quantitative, a fuzzy hybrid modeling technique will be used to capture both sets of subjective and numerical data. As the research progresses, a specific fuzzy hybrid model for organizational competency and performance will be selected on the basis of suitability and efficiency.

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