PERFORMANCE INDICATORS ANALYSIS FOR CONTRACTORS IN MALAYSIAN HOUSING CONSTRUCTION PROJECTS

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For my beloved mother and father, family and fellow friends for all their love, support and understanding and the sacrifices they made to make it possible.

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ABSTRACT

Housing construction project is one of the main segments in Malaysia's construction industry with contractors as the major stakeholders during its construction phase. However, contractors' performance as monitored by the clients is found declining due to lack of reliable standardised systems that detail the project monitoring concepts to guide its development. To improve the performance of the contractors in Malaysia, there is a need for the performance indicators analysis for the housing construction project. Thus, this study developed a framework of performance indicators for contractors in Malaysian housing construction projects by identifying the current contractor's performance, investigating the critical success factors (CSFs) for housing construction projects, assessing the Key Performance Indicators (KPIs) of contractors, and examining the relationship between project time, quality and cost in housing construction project. This study began with a literature review, followed by questionnaire development which was tested via a pilot test involving 10 experts. Subsequently, data collection via a survey on 250 construction stakeholders was undertaken. The data was analysed using Statistical Package of Social Science (SPSS) version 2015. The results showed that the current contractor's performance in the housing construction project is poor, where contractor does not try to reduce wastage of materials used, contractor does not well maintain the client's expectations, and contractor does not work effectively with the client to ensure costs are maintained at the acceptable level. Meanwhile, the most important CSFs are contractor has clear communication lines, followed by the contractor maintains a professional relationship with client, and construction costs must remain within the stipulated budget. Furthermore, the most important KPIs are contractor's compliance on site security regulation, followed by contractor's formulation on a clear working programme for construction of statutory compliance according to the legal regulations, and the client satisfaction with the progress of the project and deliverables by the contractor. The results also showed that the project time, quality, and cost of housing construction projects determine the income and profit of the project as the project time defines the quality and investment ratio of the housing construction projects. The proposed framework was validated via criterion related validity test. The framework of performance indicators analysis for contractors of the housing construction project in Malaysia consists of three variables: current contractor's performance in housing construction project with six indicators, CSFs for housing construction project with ten indicators, and KPIs of contractor in the housing construction project with eight indicators. This framework is useful to help the client to appraise and improve the contractor's performance towards the betterment of future housing construction projects in Malaysia.

ABSTRAK

Projek pembinaan perumahan merupakan salah satu segmen utama dalam industri pembinaan Malaysia dengan kontraktor selaku pemegang taruh utama semasa fasa pembinaan. Walau bagaimanapun, prestasi kontraktor yang dipantau oleh pelanggan didapati menurun kerana kekurangan sistem piawai yang boleh dipercayai yang memperincikan konsep pemantauan projek untuk membimbing perkembangannya. Untuk meningkatkan prestasi kontraktor di Malaysia, terdapat keperluan analisa petunjuk prestasi untuk projek pembinaan perumahan. Oleh itu, kajian ini membangunkan rangka kerja petunjuk prestasi bagi kontraktor dalam projek pembinaan perumahan di Malaysia dengan mengenal pasti prestasi kontraktor semasa, mengkaji faktor kejayaan kritikal (CSFs) untuk projek pembinaan perumahan, menilai petunjuk prestasi utama (KPI) kontraktor, dan mengkaji hubungkait antara masa, kualiti dan kos projek dalam projek pembinaan perumahan. Kajian ini dimulakan dengan kajian literatur diikuti dengan pembangunan soal selidik yang diuji melalui ujian rintis yang melibatkan 10 pakar. Selanjutnya, pengumpulan data melalui tinjauan terhadap 250 responden dalam kalangan pemegang taruh pembinaan dilaksanakan. Data dianalisis menggunakan Pakej Statistik Sains Sosial (SPSS) versi 2015. Hasil kajian menunjukkan bahawa prestasi kontraktor semasa dalam projek pembinaan perumahan kurang baik, di mana kontraktor tidak berusaha mengurangkan pembaziran bahan yang digunakan, kontraktor tidak memenuhi jangkaan pelanggan dengan baik, dan kontraktor tidak bekerja secara berkesan dengan pelanggan untuk memastikan kosnya dikekalkan pada tahap yang boleh diterima. Selain itu, CSFs terpenting adalah kontraktor mempunyai komunikasi yang jelas, diikuti oleh kontraktor mengekalkan hubungan profesional dengan pelanggan dan kos pembinaan harus tetap sesuai dengan anggaran yang ditetapkan. Tambahan pula, KPIs terpenting ialah pematuhan kontraktor terhadap peraturan keselamatan tapak, diikuti oleh formulasi kontraktor mengenai program kerja yang jelas untuk pembinaan pematuhan undang-undang mengikut peraturan perundangan dan kepuasan pelanggan dengan kemajuan projek dan penyampaian oleh kontraktor. Hasil kajian juga menunjukkan bahawa tempoh, kualiti dan kos projek pembinaan perumahan menentukan pendapatan dan keuntungan projek kerana tempoh projek menentukan nisbah kualiti dan pelaburan projek pembinaan perumahan. Kerangka kerja yang dicadangkan itu disahkan menerusi ujian pengesahan berkaitan kriteria. Kerangka kerja analisa petunjuk prestasi untuk kontraktor dalam projek pembinaan perumahan di Malaysia terdiri daripada tiga pemboleh ubah: prestasi kontraktor semasa dalam projek pembinaan perumahan dengan enam petunjuk, CSFs untuk projek pembinaan perumahan dengan sepuluh petunjuk dan KPIs kontraktor dalam projek pembinaan perumahan dengan lapan penunjuk. Kerangka kerja ini berguna untuk membantu pelanggan menilai dan meningkatkan prestasi kontraktor ke arah peningkatan projek pembinaan perumahan pada masa akan datang di Malaysia.

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ASWP	-	Actual Cost of Work Performed
BB	-	Building Block
BCWP	-	Budgeted Cost of Work
BSC	-	Balanced Scorecard
CIDB	-	Construction Industry Development Board
CIMP	-	Construction Industry Master Plan
CPI	-	Cost Performance Index
CPM	-	Construction Project Management
CPM	-	Critical Path Method
CSFs	-	Critical Success Factors
CSH	-	Code for Sustainable Homes
DLP	-	Defect Liability Period
EPU	-	Economy Planning Unit
GDP	-	Gross Domestic Product
HSE	-	Health, Safety and Environment
ISO	-	International Organization for Standardization
KMO	-	Kaiser Meyer Olkin
KPIs	-	Key Performance Indicators
LFM	-	Logical Framework Method
M & O	-	Management and Operating
NPV	-	Net Present Value
PMs	-	Project Managements
PMPF	-	Performance Measurement Process Framework
PMS	-	Project Management System
PMS	-	Project Management Success
PMS	-	Performance Measurement System
PMT	-	Project Management Triangle
PP	-	Project Performance
PS	-	Project Success
PSC	-	Project Success Criteria

QMS	-	Quality Management System
SFs	-	Success Factors
SPSS	-	Statistical Package of Social Science
TQM	-	Total Quality Management
11MP	-	11th Malaysia Plan

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CHAPTER 1

AN INTRODUCTION TO THE STUDY

1.1 Background

The housing sector is one of the major sectors that contribute to Malaysia's economic growth (Mirawati et al., 2015). In the last 20 years, this sector has contributed between 3 percent and 5 percent of Gross Domestic Product (GDP) in Malaysia. According to Chan and Adabre (2019), the dynamic construction sector is currently a significant contributor to Malaysia's social and economic infrastructure, which, in turn, drives industrial production (Hamzeh et al., 2019). The growth of the construction sector such as the construction of airports, roads, hospitals, houses, schools, ports, etc., is a sign of the commitment of the Malaysian government to improve the quality of life and living standards of its citizens (Mirawati et al., 2015).

According to the Construction Industry Development Board (CIDB) (2018), infrastructure forms the bulk (76.7 percent) of construction work overall. The Malaysian housing sector contributed a massive RM 9.53 billion to the country's Gross Domestic Product (GDP) in the year 2015, equal to 4.2 percent of Malaysia's GDP. This figure consequently increased to 12.9 percent in 2017. The sector further increased its GDP contribution in 2018, specifically driven by an increase in the residential subsector (29.7 percent), and reinforced by the growth in the civil engineering subsector as a result of sustained implementation of bulky transport-related structures as well as oil and gas projects. The housing sector further sustained its strong economic contribution with the help of housing-related service subsectors, especially the real estate sector, which has seen massive investment inflow. The housing sector output in Malaysia is projected to record a Compound Annual Growth Rate (CAGR) (Hamzeh et al., 2019). The country's growing economy and increased government spending on infrastructure have sustained the growth of the housing

sector, which recorded a CAGR of 11.48 percent from 2015 to 2017. Besides, several major economic indicators related to CAGR have also signalled a major boom in the housing sector (Chong et al., 2014).

The housing sector is a major employer and is therefore crucial to Malaysia's economic growth. This sector only is predicted to grow for 11.2 percent, at the moment, it occupied around 3.3 percent of the country GDP (Department of Statistics Malaysia, 2017). In 2015, 9.2 percent of the overall labour force of the country comprised of worker from this sector (Department of Statistics Malaysia, 2017). On top of that, since the sector also involved extensively with other industries in the supply chain, it will also boost the growth of other sector including manufacturing, transportation, as well as financial services. Although the huge volume and complexity of projects in the Malaysian construction sector pose a great challenge for the government, it also provides many profitable opportunities for various companies in the housing sector (Lee et al., 2014).

In Act 520 enforced by Construction Industry Development Board (CIDB) Malaysia (CIDB, 2018), the construction industry focuses in developing housing construction projects that include buildings, installation, repair, care, restoration, removal, renovation, and the demolition of buildings (Ng et al., 2018). The Malaysian construction industry includes housing construction plans for buildings, erections, structures, walls, fences or chimneys, whether they are constructed wholly or partly or above ground level. Also included are drainage, irrigation, or river control work, electrical and mechanical works, water, gas, petrochemical, telecommunication, bridges, viaduct, dam, reservoir, earthwork, pipeline, sewer, culvert, driveshaft, tunnel, as well as reclamation (Becker et al., 2016).

The construction scene in Malaysia post-independence is gearing towards developing improved housing construction projects (CIDB, 2018). Similar to the United States of America (USA), the United Kingdom (UK), and China; in Malaysia, the development of housing construction projects is regarded as an important productive undertaking as attested by this sector's output, which has risen from RM 25.33 billion to RM 26.66 million in 2016 and 2017 (Central Bank of Malaysia,

2018). The construction sector is ranked as one of the top-three key economic areas that have contributed to Malaysia's GDP and considered as one of the critical sectors for the country to realise Vision 2030. In 2019, the housing construction project contributed 9.8 percent of the country's GDP, where this figure increased from 8 percent GDP in 2017 followed by a significant rise in 2018 (CIDB, 2018).

Despite its significant contribution to the economy, the housing sector also faces various challenges such as low productivity, poor quality, and delays due to bureaucratic systems, besides suffering from a poor image, cost overruns, and economic volatility (Mirawati et al., 2015). The sector has been criticised for its inability to deliver quality products that meet acceptable levels and has even failed to operate on schedule or meet the required budget. Research reveals that 90 percent of housing projects cannot be delivered within the required deadlines (Chong et al., 2014). It was also observed that both the Public and Private Sectors face project overruns (Diana and Mejia, 2014).

This study identifies the housing sector as being prone to fraudulent activities because it provides an environment rife with unethical dilemmas due to its low-price mentality, fierce competition, and paper-thin margins. This sector is considered to be very susceptible to unethical practices because it involves substantial capital investments, besides providing large-scale opportunities for rent extraction, as well as investments that cannot be redeployed after implementation (Lee et al., 2014). Unethical practices can take place at every phase of a housing construction project during the planning and design, pre-qualification and tendering project execution and operation, and maintenance. The listed mal-practices are known to yield delayed projects that are regarded as unnecessary, unsuitable, overly complex, and overpriced (Hamzeh et al., 2019).

Unethical practices have long-term impacts on the construction industry. Among practices are tender value wastages, inaccurate tendering amount, crime, blacklisted companies, and bad reputation. In fact, discussions on professional ethics, initiated by the general public, is an ongoing endeavour as it generates concerns not only to the public but the professional world as well. The issue of professional ethics

has sparked enthusiastic concern and pragmatic discussion among the general public (Lee et al., 2014). There is now a growing demand in the current literature for good ethical practices and professional behaviour in the construction sector. Since the housing sector is so massive and universal, it is often cited as being plagued with political grafting and malpractices. Common issues highlighted are dodgy tendering practices, substandard quality of construction work, a bad safety culture, payment woes, corruption, and most importantly, no public accountability for funds spent on public buildings and infrastructure (Ahola et al., 2019).

All construction activities may have some risks and uncertainties, especially in developing countries, which based on this study observation, has contributed to risks in housing construction project environment. Contractors must continually improve construction project management, project quality, and operations. Performance measurement is key to continuous improvement (Lee et al., 2014). This exercise aims to offer managers and all levels of staff the ability to develop the direction, traction, and speed for their organisation. As a rule, benchmarking is the next step to improve contractor efficiency and enhance the effectiveness of contractor products and processes (Nasir et al., 2015), particularly contractors of housing construction projects.

Housing construction projects are often criticised for their poor performance and for ineffectively delivering on the desired goals. In most cases, this issue is due to the complexity and uniqueness of housing construction project. At the same time, projects often involved changes which is dynamic continuous throughout project phases. In this environment, it is paramount to control project performance (Lee et al., 2014). This is because, the projects in this sector had limited focus on process of the delivery and mostly on goals which is product-based approach. However, in a housing construction project, project control aims to ensure that projects are completed on time and within budget and all other project objectives are achieved. Project control is a complex task undertaken by project managers in practice, which constantly involves measuring progress, evaluating plans, and taking corrective actions as required (Horta et al., 2015).

In recent years, clients and contractors alike have given more and more emphasis on process-oriented goals as they begin to realise the importance of such goals. In other words, it is crucial to constantly control the project delivery process in order to control the quality of the product throughout the project cycle (Lee et al., 2014). However, in general, the researcher has found that the process performance during the housing construction phase and how it impacts the reaching the objectives of project is mostly not understood. Hence, it is essential to investigate the factors affecting housing construction project performance to improve the construction industry as a whole (Omran and Hooi, 2018).

1.2 Problem Statement

Studies have found that contractor's performance is declining, such that they are no longer able to deliver quality construction products (Lee et al., 2014). Although the Malaysian government has attempted to reform its contracting procedures, these efforts have not yielded lasting positive results. The government continues to view housing construction projects as a high-risk investment vulnerable to fraud, abuse, and mismanagement. Lee et al. (2014) also revealed that housing contractors with Management and Operating (M&O) contract usually fail to control costs because project expenses are not subsidised by the government.

Aouad et al., (2017) observed that in general, only 30 percent of construction projects, including housing construction projects, would be completed within the scheduled completion dates, where the average time overrun was between 10 percent and 30 percent. In a study done earlier by Alvesson and Kärreman (2015), the results revealed that 70 percent of projects suffered time overruns, where the usual time delay would span from 10 percent to 30 percent of the initial time of the project. Alvesson and Kärreman (2015) also detected six main causes of delay: change orders, delays in progress payment, ineffectual planning and scheduling of the project by the contractor, insignificant site management and control by the contractor, scarcity of labourers, and inadequate backing of the project by the contractor. All are vital factors that contribute to time overruns. Although

performance indicators for houses constructed by contractors in Malaysia include completion within the required time, quality houses, and client satisfaction, the indicators currently used are not satisfactory (Kiew et al., 2016).

On the other hand, Azlan et al. (2019) argued that the quality of the house built, the budget used, and the time of the housing construction projects are all linked. Interruption could occur whereby some parts of the housing construction project has been delayed or not followed through because of unexpected circumstances. When mandatory, the contractor may need to apportion a supplementary budget for counteractive actions to make sure the housing construction project runs or the contractor may face liquidated indemnity charges for failing to meet the house owner's specifications. Therefore, a good framework could lead to the construction of quality houses, whilst poor frameworks could lead to project failure (Azlan et al., 2019). A good project framework is focused on appraising housing construction companies based on their quality practice. Quality companies are valuable from the house buyer's perspective, as they offer information about what to anticipate from the housing contractor and the company's opinion in the form of self-assessment prototypes to identify improvement prospects (Azlan et al., 2019).

Housing construction projects are crucially interconnected with other sectors (Mirawati et al., 2015). According to Kiew et al. (2016), it is challenging to monitor a housing construction project and ensure that it succeeds. Housing contractors are being pressured to improve their performance and productivity because of the high competition, very slow economic growth, and the restructuring of the housing sector (Samee and Pongpeng, 2015).

It is also important to note that the Malaysian building sector, including housing, is also a significant contributor to the nation's economic development (Bae and Kim, 2008). The sector develops buildings and infrastructure works needed for socio-economic development that in turn, drives general economic growth. The sector also supports works for many individuals, ranging from professionals, such as architects, engineers, and surveyors to main contractors, subcontractors, suppliers,

and manual labourers who work for the contractors. As such, the housing construction project is a key industry in Malaysia (Lee et al., 2014).

In this modern age, project performance or project success is examined based on specific criteria (Teck-Hong, 2016). Various project management styles will produce different outcomes, so the project team members are the ones responsible for selecting the most ideal criteria for their construction business to survive and generate profit (Kerzner, 2017). Consequently, it is important to understand the criteria set by the clients, the consultant, and the contractors in real-world practice to measure the performance of construction projects. This step is crucial to enable all parties to improve the project performance and deliver a successful construction project (Teck-Hong, 2016).

Many performance measurements studies have been done in the past (Teck-Hong, 2016; Langston, 2016). However, there is now increasing demand for the evaluation and management of such performance measures. As such, there are various Key Performance Indicators (KPIs) that may be implemented in the housing sector to measure company and contractor performance (Langston, 2016).

KPIs have relative importance (Das et al., 2016); many contractors use different sets of KPIs, namely client satisfaction, internal processes, and organisational innovation and improvement activities for their housing construction projects, particularly in Malaysia. These KPIs will not be adequate if the contractors do not consider other operational measures that are also important drivers of future financial performance. Companies that rely entirely on a set KPI with little regard of other important aspects such as competition, employee capability, the type of construction project or supplier, will not perform very well; thereby creating a gap, which this study aims to address. In other words, there is a need to understand the KPIs used, their effectiveness and whether or not they meet international standards so that housing construction projects in the country will not experience high profile problems later on (Das et al., 2016).

The current research problem involves the issue of identifying performance indicators in the housing construction projects. Most of the construction projects, including housing are not built to last long (Mirawati et al., 2015). Hence, this study seeks to address the gaps that exist in the construction sector, specifically in housing construction projects and to address common problems that the sector faces. Early prediction and a thorough diagnosis of the problems can help prevent housing construction project delays and ensure that the projects are completed within the allotted time and budget, as well as with expected quality (Mirawati et al., 2015).

Generally, the Malaysian housing construction projects are viewed as underperforming overall, as the country's construction industry is often characterised as opportunistic behaviours, poor communication, and adversarial attitudes due to inefficient and ineffective construction practices (Abdul-Aziz et al., 2015). Studies have found that delay of payment, project delays, budget burst, and conflicts are common challenges plaguing housing construction projects. Therefore, although the overall number of industrial accidents in Malaysia has decreased by 35 percent over eight years starting since 2005, the construction sector has observed a hike in accidents of 5.6 percent in the same period. Fatalities also increased by a staggering 60 percent. Teck-Hong (2016) identified this hike is due to several factors which includes inadequate inspection programme, insufficient safety policies being practiced, and a shortfall of safety educations, risky working methods. Many contractors are not legally compliant, so very few would care about going above compliance standards (Lee et al., 2014).

Seeing the current situation, the Malaysian government has sought to improve the performance of local housing construction contractors through the establishment of the Construction Industry Development Board (CIDB) in 2007 (CIDB, 2018). However, despite the support given by the Malaysian government, this study found that the pace of development in the local construction sector has been sluggish so far due to the recent Asian Financial Crisis, which drastically reduced the volume of housing construction work in the country; as well as the conservative nature of the sector, which has hampered the adoption of innovations in housing construction processes and methods, including project financing techniques, corporate structuring,

and administrative methods. Although these innovations are generally slow and incremental, there is still a need to adopt technology as part of the engineering designs, which could add value to housing construction projects (Kale et al., 2019).

Despite the national Gross Domestic Product (GDP) contributions of the housing construction projects, housing construction projects still faced various challenges, such as low productivity, poor quality, and delays due to bureaucratic systems, poor image, cost overruns, and economic volatility. Housing construction projects have been criticised for their inability to deliver quality products that meet acceptable standards, besides failing to operate on schedule or meet the required budget, where both the public and private sectors face the same problems of project overruns. Hence, it is important to improve the performance of contractor undertaking the housing construction projects, which is translated via the quality and level of projects handed over to the clients.

1.3 Research Question

This study aims to answer the following research questions:

1. What is the current performance of contractors of housing construction projects in Malaysia?
2. How can a housing construction project successfully perform in Malaysia?
3. What are the Key Performance Indicators (KPIs) of contractors in housing construction projects in Malaysia?
4. How do project time, project schedule, and project cost affect the housing construction projects in Malaysia?

1.4 Aim and Objectives

The main aim of the study is to develop a framework for performance indicators analysis for contractors in Malaysian housing construction projects. This study is driven by the following objectives:

1. To identify the current performance of contractors of housing construction projects in Malaysia.
2. To investigate the critical success factors (CSFs) of housing construction projects in Malaysia.
3. To assess the KPIs of contractors of housing construction projects in Malaysia.
4. To examine the relationship between project time, project quality, and project cost in housing construction projects in Malaysia.

1.5 Research Methodology

The intention of having a research methodology is to explain and justify the choice of research design, data collection, and data analysis, as well as to detail the steps for conducting the study and to ensure that the study is conducted ethically. The overall research design is a mixed-mode (quantitative and qualitative). A questionnaire was designed as the research instrument to collect data. For the data analysis, statistical techniques were used. The findings were then interpreted, and a report was written.

There are various parameters, which are fundamental for the setting of objectives, designing the variables (dependent and independent), and collecting the data in line with the objectives of the study. The first step, defining the research problem, provides the study with the grounds to select the proper research methodology and to narrow the scope of the study, which, in turn, offers a clear course for the review of the literature. In the second step, previous research is reviewed, mainly by examining articles and journals related to contractor

performance. In the third step of reviewing the literature, hundreds of articles on Key Performance Indicators (KPIs) are searched. The obtained articles and journals are reviewed to identify the gaps in previous research. Based on the research gap, the study variables and the research problem are formulated, making up the fourth step. The fifth step involves the research design, where all the steps are incorporated, especially considering the research problem while formulating the research design. Step five helps to create avenues for data collection in the sixth step. In the seventh step, the data collected via the questionnaire is analysed. This step is followed by data interpretation and the last step, thesis writing.

A pilot study is a preliminary investigation that is done to provide necessary information to help the research design. It is used to assess the time required to collect information, to estimate the variations is key variables, and to determine the quality of the questionnaire that is proposed for the actual survey. It can also be used to refine field procedures and research design. During this investigation, challenges are identified and improvements or corrections are made to the research approach to ensure the research is conducted successfully. The pilot study in this work focused on the required data, the collection of data, the recording of data, and the analysis of data.

1.6 Scope of Research

Essentially, this study consists of two parts. Firstly, the study focuses on all the indicators that affect contractor performance. Secondly, this study reviews the performance indicators of housing construction projects. The performance of housing construction projects is then measured and compared using these performance indicators analysis.

A structured survey was carried out in Seremban, Negeri Sembilan, Malaysia, particularly for housing construction projects valued between RM 400,000 and RM 800,000. As for the contractors, this survey involved three large contractors' grade (G7) in housing construction projects selected from a list of contractors provided by

the Malaysian Construction Industry Development Board (CIDB). The target respondents are those involved in the housing construction project, specifically the construction management personnel who have had experience in constructing houses. The respondents are housing construction stakeholders, namely private clients, consultants, and contractors involved in housing construction projects, where a total of 250 questionnaires were sent via email to them.

1.7 Significance of Study

A few issues and barriers have prevented contractors from performing as translated in the performance indicators appraisal and other construction standards in Malaysian housing construction projects. For example, a lack of clear plans is a pressing issue that impedes the realisation of performance indicators analysis. Planning is needed to set out the project objectives and to identify the mechanisms for realising these objectives. Once drafted, the plan is implemented and the progress of the housing construction project is monitored accordingly.

The intention of the study is to look into the capacities and skills that are paramount to the delivery of optimal performance indicators analysis in Malaysia. This study also intends to explore the requirement of new skills and a possible increase in the existing skillsets of the construction workers in operationalising the plans.

Also highlighted by the study is the exploration and comparison of the existing literature and analysis on how the Malaysian construction sector uses different performance indicators. The study critically examines how Malaysia deals with housing construction projects that fail. An outcome is a tool that can be used by contractors of housing construction projects to better understand how to meet project performance indicators analysis and ensure client satisfaction. The framework for the performance indicators analysis developed in this study will increase the contractor's awareness of the importance of executing successful housing construction projects. The framework also provides a practical approach to conduct performance

assessments that can readily be adopted by housing construction project contractors to help highlight opportunities to increase efficiency. The resultant framework includes product and service quality standards for the construction process, people and their culture, and quality improvement methods.

The findings of the study will benefit housing construction project contractors and assist them to evaluate their companies' performance, within or in between companies. The findings will also help private clients to appraise suitability of contractor based on their performance, before contract award. The results showed that different set of performance indicators analysis have already being utilised by stakeholders in the construction industry to assess contractor performance. However, it will be demanding for project stakeholders to discuss project performance using multiple sets of different performance indicators analysis. Therefore, it is critical to develop a standardized and common list of performance indicators analysis for housing construction projects to encourage a better evaluation.

In Malaysia, there is a need to house 50,000,000 populations by 2030, with the projected housing supply currently expected to meet the demand for this year (EPU, 2018). The challenge is to provide good quality housing projects within the allocated budget and time. Also, it is important to develop performance indicators analysis for housing construction projects to achieve Malaysia's Vision 2030. As part of the effort to house the 50,000,000 population, 1,000,000 houses have been built and restored for rural communities (EPU, 2018). It will be a great challenge for the government to ensure that this project is successful and for the houses to be completed as scheduled within the budget and with minimal defects. Therefore, this study posits that the development of performance indicators analysis could help better monitor the performance of housing construction project contractors.

The standardisation of performance indicators analysis can contribute to increased performance for the construction sector by improving project productivity, efficiency, and cost-effectiveness and, in turn, provide a comparative advantage to the economy. It is for these reasons that the government has developed a Construction Industry Master Plan (CIMP). Moreover, according to the 11th Malaysia

Plan (11MP), the government will provide adequate, quality, and affordable housing to the poor, low- and middle-income households in Malaysia (EPU, 2018). Therefore, a set of performance indicators analysis is needed for the housing construction project to rectify any weaknesses and to improve its performance and the quality of life of Malaysians.

Finally, to measure the performance of housing contractors, it is the objective of this research to test and develop a set of clear and definitive performance indicators analysis. As a result, the performance indicators analysis will be used to set benchmarks for housing construction projects in Malaysia. The study has contributed to the existing knowledge in this area by formulation and experimentation of performance indicators analysis framework for the construction sector which is the first step towards benchmarking. This study concludes with remarks and guidelines for the implementation of performance indicators analysis in real practice.

1.8 Limitation of Study

Limitations are inevitable. Although extensive efforts were taken in this study, the focus was only on housing construction projects, while other civil engineering projects were not included. Future studies may extend the scope of this research by including more Key Performance Indicators (KPIs) and sub-indicators. Furthermore, it is conditional upon the stakeholder to choose housing construction project contractors that best suit their needs. The findings of this study cannot be generalised across Malaysia as a whole because the study was conducted within one Malaysian State only, which is Seremban, Negeri Sembilan. The study also had to deal with time, cost, and quality constraints. Due to small sample size used in the research, the quantitative observation is selected as the indicative observation. Thus, future studies should expand upon the understanding of performance indicators analysis to various geographic locations, which are defined by different market, culture and practice like East Malaysia. Besides, the confidence of reliability and validity of this study can be further improved by increasing the sample size as well as

the variation of the sample. This finding is useful to be utilised as the beginning for future empirical research, which focuses of the causal effect of behaviours in the housing construction projects.

Moreover, this study has several limitations on the sample size. The data collection was limited to the number of project managers, who are considered as major stakeholders. The final potential limitation of this study is that the data was based on self-report, which means that the responses may have been affected by social desirability. Also, one of the limitations of this study is the insufficient response obtained from the survey conducted. Finally, another path for future studies would be to explore how contractors in housing construction projects are compared to other business sectors, such as manufacturing, retail, or mining. This would allow future works to define enhanced strategies for performance improvement, and to disseminate the best practices observed in other sectors into the construction sector.

1.9 Structure of Thesis

Chapter 1 discusses the importance of measuring the performance of contractors in housing construction projects in Malaysia. This chapter focuses on the background of the study, the problem statement, the research questions, the research objectives, the research methodology, the scope of the study, the significance of the study, the limitation of the study, and provides a brief review of the relevant literature to demonstrate the justification to conduct this study.

Chapter 2 presents the development and application of the housing performance evaluation framework for housing construction projects. This framework aims to encourage initiatives to achieve better housing performance and to support client decision-making when comparing and selecting contractors. It also explores the significance of Key Performance Indicators (KPIs) from the perspective of various construction stakeholders (clients, contractors, and consultants).

Furthermore, Chapter 2 also intends to identify the causes of overruns in cost and time. Limited research has focused on studying indicators that inhibit the ability of practitioners to effectively control their projects. The developed framework sheds some light on a hitherto unknown aspect of project management and provides an increased awareness of the importance of the requirements of major Malaysian construction contractors to execute successful projects.

Even though numerous researches have been done to determine the critical success factors (CSFs) of projects in construction industry, very few are relevant to Malaysia. The human-related indicators in the housing construction industry is one of the indicators that is not explored extensively, both locally or internationally. Therefore, one of the objectives of this study is to recover a new understanding of CSFs from the viewpoint of various stakeholders of local housing construction projects as an emerging trend. This objective was accomplished via comparative study of the various construction stakeholders in Malaysia. The related stakeholders were categorised into three groups, namely the private client, the consultant, and the contractor.

Following the extensive literature review, an initial framework was designed to highlight the important variables specifically for construction packages, activities, and subcontractors. A series of contractor current practices are reviewed to determine its compliance with the framework requirements. Project performance is measured based on completion within budget and within the scheduled time, compliance with quality standards, and satisfaction of the client.

In Chapter 3, the data for the study and the data collection method was identified. A survey was conducted among three construction professionals, namely private clients, consultants, and contractors. To meet the objectives of this study, primary data on the significance of indicators affecting project overheads were collected from the contractors. Of the various data collection methods, the questionnaire survey was observed to be the most cost-effective for collecting information about attitudes, opinions, and behaviours and has also been widely used by researchers in the construction management discipline. Other methods for data

collection include observations and documentation studies. The structure of implementation is similar for all projects and includes three sequential phases (preparation, development, and implementation), where each phase is considered to be complete when specific objectives are reached.

This study identified the current performance of housing construction project contractors and examined the CSFs of housing construction projects in Malaysia. Chapter 4 details this analysis, which is related to the literature reviewed in Chapter 2. Tests and validation are performed based on a comprehensive gap analysis of each CSF and then the result is compared using theoretical information and respondent opinions and experience obtained from the interviews. The study of KPI data for the performance indicators establishment is explained in Chapter 4 via statistical analysis tools. The investigation aims to identify the connection of the theoretical proposition based on the findings in chapter 3. Subsequently, the performance indicators were then validated and prioritised and, in the process, a graphical chart is drawn to represent it. The validation of performance indicators by the selected respondents is elaborated in Chapter 4.

Finally, Chapter 5 delivers a summary of the findings and the conclusion to this study. The contemporary benchmarking framework for housing construction project contractors was perceived as relevant and appropriate for improving sector performance. A new evaluation methodology for housing construction project contractors that matches client satisfaction and meets the needs of project schemes were then developed for bidding purposes. Besides, using the information from limitation of study, the proposal for future development is made.

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APPENDIX A QUESTIONNAIRE SURVEY

RESEARCHER:

LEE MAO RUI

(maorui_86@yahoo.com.my)

Questionnaire Survey: **Framework of Performance Indicators Analysis for Contractors in Malaysian Housing Construction Projects**

Introduction

Dear respondent,

Thank you for accepting to take part in this survey, which this questionnaire is designed to collect the information on improving performance indicators analysis for contractors in Malaysian housing construction projects. By accepting to take part in this survey, you will help in providing data that will be used to fulfill the objectives of the study and I take this opportunity to assure you that the data gathered from this survey will only be used for the academic purposes and will be treated with utmost confidentiality.

The questionnaire contains four parts that are related to contractor's KPIs for housing construction project in Malaysia. Kindly take your time and respond to the questions

in all the five sections. If you have any questions or comments, please do not hesitate to contact the researcher by email at maorui_86@yahoo.com.my. Thank you for your participation.

1) Section A: General Information
2) Section B: Contractor's current performance in housing construction project in Malaysia
3) Section C: Critical success factors (CSFs) for housing construction project in Malaysia
4) Section D: Key Performance Indicators (KPIs) for contractors in housing construction project in Malaysia
5) Section E: Relationship between project time, project quality and project cost in housing construction project in Malaysia

Section A: General Information

Instruction: Please choose one (1) only the most appropriate answer

1. Type of organisation

a. Client b. Consultant c. Contractor d. Others (Please Specify: …….)

2. Job position

a. Project Manager b. Site Engineer c. Site supervisor d. Others (Please specify :…….)

3. Years of working experience

a. ≤ 5 years b. 6-10 years c. 11-15 years d. 16-20 years

e. ≥ 20 years

4. Highest academic qualification

a. Professional Certificate

b. Diploma

c. Bachelor Degree

d. Master Degree

e. Doctor of Philosophy

f. Others (Please specify :……..)

5. Competency and professional qualification

a. Ar b. Ir c. Sr d. Others (Please specify :……)

6. Number of housing construction projects delivered by your company in the last five years

a. ≤5 years b. 6-10 years c. 11-20 years d. >20 years

7. Total value of delivered housing construction projects in the last five years (in RM)

a. <RM 10 million b. RM 10-50 million c. RM 51-100 million

d. >RM100 million

8. What are the most dominant types of housing construction projects that have been delivered since you started working for the organisation?

a. Apartment b. Condominium c. Terrace house d. Others (Please specify :…….)

Section B: Current Contractor's Performance in Housing Construction Project in Malaysia

The following are the current contractor's performance in housing construction project in Malaysia.

Instruction: Please tick (/) at the most appropriate answer

Level of agreement:

(**1=strongly disagree, 2=disagree, 3=not sure, 4=agree, 5=strongly agree**)

No	Item	Level of Agreement				
		1	**2**	**3**	**4**	**5**
1	Contractor meets or exceeds service delivery standards specified in the contract					
2	Contractor meets or exceeds service delivery times where defined					
3	Health safety and environment standards are frequently monitored, reviewed and maintained in line with all necessary legal					

	and regulatory obligations					
4	Equipment used by the contractor is up to the standard					
5	Contractor does not cause defects					
6	Contractor tries to reduce wastage of materials used					
7	Contractor works effectively with the client to ensure costs are maintained at an acceptable level					
8	There are minimal client's complaints about the contractor					
9	Any client complaints are well handled and managed					
10	Contractor well maintains client's expectations					

Section C: Critical Success Factors (CSFs) for Housing Construction Project in Malaysia

The following are the critical success factors (CSFs) for housing construction project in Malaysia.

Instruction: Please tick (/) at the most appropriate answer

Level of agreement:

(**1=strongly disagree, 2=disagree, 3=not sure, 4=agree, 5=strongly agree**)

No	**Item**	**Level of Agreement**				
		1	**2**	**3**	**4**	**5**
11	Contractor strictly adheres to clear retention policy and motivation guidelines					
12	Contractor complies with programme for construction of statutory					

13	Contractor has clear communication lines					
14	Contractor maintains professional relationship with client					
15	Contractor responds to trouble-shooting and feedback					
16	Contractor consistently delivers service to high standards					
17	Contractor delivers the project as per set delivery schedule					
18	Contractor provides safe and inspiring environment for project stakeholders					
19	Client's acceptance of the project					
20	Construction costs must remain within the stipulated budget					

Section D: Key Performance Indicator (KPIs) of Contractor in Housing Construction Project in Malaysia

The following are the Key Performance Indicators (KIPs) of contractor in housing construction project in Malaysia.

Instruction: Please tick (/) at the most appropriate answer

Level of agreement:

(**1=strongly disagree, 2=disagree, 3=not sure, 4=agree, 5=strongly agree**)

No	**Item**	**Level of Agreement**				
		1	**2**	**3**	**4**	**5**
21	All pertinent standards are regularly examined/ monitored, reviewed and preserved in keeping all legal and regulatory obligations					
22	Client satisfaction was met					
23	Service delivery times, where defined, are					

	being met or exceeded					
24	Project delivery standards in the contract arrangement are being met or exceeded					
25	Site security regulations are not being breached					
26	Contractor is having good working relationship with the employer					
27	Contractor has formulated a clear working programme for construction of statutory compliance according to the legal regulations in Malaysia					
28	Client is satisfied with progress of the housing construction project and deliverables by contractors					

Section E: Relationship between Project Time, Project Quality and Project Cost in Housing Construction Project in Malaysia

29. What are the relation of project quality on project costs in housing construction project in Malaysia?

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30. What are the relation of project time on project cost in housing construction project in Malaysia?

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31. What are the relation of project quality on project time in housing construction project in Malaysia?

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APPENDIX B OVERALL RESULTS OF VALIDATING FRAMEWORK ON PERFORMANCE INDICATORS ANALYSIS FOR CONTRACTORS IN MALAYSIAN HOUSING CONSTRUCTION PROJECTS

Aim	Objectives	Factors	Questions	Results
Develop a framework on improving contractor's performance in Malaysian housing construction project via Key Performance Indicators (KPIs)	Identify the current performance of contractors of housing construction projects in Malaysia	CCP 1	Contractor meets or exceeds service delivery standards specified in the contract	Valid
		CCP 2	Contractor meets or exceeds service delivery times where defined	Valid
		CCP 3	Health, safety and environment standards are frequently monitored, reviewed and maintained in line with all necessary legal as well as regulatory obligations	Valid
		CCP 4	Equipment used by the contractor is up to the standard	Valid
		CCP 5	Contractor does not cause defects	Valid
		CCP 6	Contractor tries to	Valid

			reduce wastage of materials used	
		CCP 7	Contractor works effectively with the client to ensure costs are maintained at an acceptable level	Valid
		CCP 8	There are minimal client's complaints about the contractor	Valid
		CCP 9	Any client complaints are well handled and managed	Valid
		CCP 10	Contractor well maintains client's expectations	Valid
	Investigate the critical success factors (CSFs) of housing construction projects in Malaysia	CSF 1	Contractor strictly adheres to clear retention policy and motivation guidelines	Valid
		CSF 2	Contractor complies with the programme for statutory	Valid
		CSF 3	Contractor has clear	Valid

			communication lines	
		CSF 4	Contractor maintains professional relationship with client	Valid
		CSF 5	Contractor responds to trouble-shooting and feedback	Valid
		CSF 6	Contractor consistently delivers service to high standards	Valid
		CSF 7	Contractor delivers the project as per set delivery schedule	Valid
		CSF 8	Contractor provides safe and inspiring environment for project stakeholders	Valid
		CSF 9	Client's acceptance of the project	Valid
		CSF 10	Construction costs must remain within	Valid

			the stipulated budget	
	Assess the Key Performance Indicators (KPIs) of contractors of housing construction projects in Malaysia	KPI 1	All pertinent standards are regularly examined/ monitored, reviewed and preserved in keeping all legal and regulatory obligations	Valid
		KPI 2	Client satisfaction was met	Valid
		KPI 3	Service delivery times, where defined, are being met or exceed	Valid
		KPI 4	Housing Construction Project delivery standards in the contract arrangement are being met or exceeded	Valid
		KPI 5	Site security regulations are not being breached	Valid
		KPI 6	Contractor is	Valid

			having good working relationship with the employer	
		KPI 7	Contractor has formulated a clear working programme for construction of statutory compliance according to the legal regulations in Malaysia	Valid
		KPI 8	Client is satisfied with progress of the housing construction project and deliverables by the contractors	Valid

APPENDIX C LIST OF PUBLICATIONS

Journals

1. Lee Mao Rui, Syuhaida Ismail, Mohammad Hussaini (2014). Contractor's Performance for Construction Project: A Review. *International Journal of Engineering Research and Applications*, 4(4) 131-137.

2. Lee Mao Rui, Syuhaida Ismail, Muhamad Hussaini (2015). Professional Development of Project Management for Contractor in the Construction *Project. Social and Behavioral Sciences*, 174, 2940-2945.

Conference Proceedings

1. Lee Mao Rui, Syuhaida Ismail, Muhammad Hussaini (2014). Professional Development of Project Management for Contractor in the Construction Project. *International Conference on New Horizons in Education* Organizer by Sakarya University. **(Indexed by SCOPUS)**

2. Lee Mao Rui, Syuhaida Ismail and Mohammad Hussaini (2014). Sustainable Construction Management for Housing Project. *International Conference on Sustainable Urban Design for Liveable City*.

3. Lee Mao Rui, Syuhaida Ismail, Muhammad Hussaini (2014). Key Performance Indicators (KPIs) of Contractor on Project Performance for Housing Construction in Malaysia. *1st International Conference on Human Capital and Knowledge Management (HCKM 2013)*. Universiti Teknologi Malaysia.

APPENDIX D LIST OF AWARD

1. Gold Metal awarded to Lee Mao Rui, Syuhaida Ismail, Mohammad Hussaini for invention entitled “Framework of Improving Housing Construction Project Performance in Malaysia Via Contractor’s Key Performance Indicator” during 2019 International Innovation and Invention Competition. Organised by Chinese Innovation and Invention Society