Productivity Improvement Strategies in Green Construction Project: Formulation of a Theoretical Framework

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Abstract. Productivity is regarded as one of critical importance aspects of construction projects success and persistently deliberated in research topics in the construction industry. Previous researchers have determined different factors that influence construction productivity in conventional construction project, but there is limited research on productivity particularly in green construction projects. To respond to the issue, this paper aims to explore a comprehensive literature review to examine the existing knowledge of construction productivity, particularly in green construction projects. Content analysis is used to identify related matters concerning issues and key factors affecting construction productivity, henceforth, a dynamic strategies of productivity improvement are established. Findings from literature are summarized and a theoretical framework of construction productivity improvement strategies is constructed and proposed. The framework highlights the identified factors affecting productivity in green construction projects, as well as determines the improvement strategies to enhance the construction productivity. The framework will be the instrument for the future development and will assist the construction practitioners to plan efficient approaches for achieving productivity growth in green construction projects. An improved understanding on the key factors of the productivity performance would help policy makers and industry to prioritize their policies and actions, whilst keeping of the eminence in Malaysian construction productivity.

1. Introduction
The construction industry is an industry of major strategic importance. Its level of productivity has a significant effect on national economic growth and contribute to Gross Domestic Product (GDP)’s growth as an indicator of sustainable economic and development in the country. Under the Construction Industry Transformation Programme (CITP), the Government of Malaysia has placed productivity high on the agenda. According to Construction Industry Development Board [3], (under strategic thrust number three) productivity is the primary engine of growth towards Malaysia’s high-income target. As a vital sector to the nation’s advancement, the construction industry will lead with high productivity levels through efficient adoption of new technologies and modern practices coupled with high-skilled, highly paid workforce. Productivity was given high priority in the programme because of: (a) a low IBS adoption rate; (b) a largely unskilled workforce; and (c) high proportion of subscale SMEs and Bumiputra firms [3].

Understanding the importance of productivity, the topics has received a great attention of research in construction and engineering management literature, due to the significant influence on the wide economy [1][2][18]. To enhance the construction productivity, a lot of research on strategies to improve construction productivity has been done [12][20][22]. While such studies had improved productivity measurement methods and quantified the impact of influencing factors, there is still a persistent need to
explore the strategies for enhancing construction productivity at the industry level [18][25]. A recent study found that construction productivity could be enhanced or hindered by multiple factors within the business environment [12]. The key issues, such as technologies, procurement and workforce, were reflected in the specific political, economic, social and industrial concerns of an economy ought to be the parameter as the strategies in enhancing construction productivity [20].

In the light of the previous research, the present literature of construction productivity are lacks evidence on constraints and strategies concerning productivity improvement particularly in Green Construction Projects (GCP). Such kind of research is important because the construction of green projects differs from that of traditional in terms of the design, materials, and processes [21]. To response to the issues, this paper aims to explore a comprehensive literature review to examine the existing knowledge of construction productivity. Findings from the literature will establish a foundation for dynamic strategies of productivity improvement, particularly in GCP. An improved understanding of the key factors of productivity in GCP would help policy makers and industry to prioritize their policy and action, whilst keeping of the growth of construction productivity performance.

2.0 Literature Review

‘Productivity’ has been the subject of much debate in the construction industry in many countries for many decades. To formulate and implement measures to improve productivity performance, it is necessary to identify and understand the factors which have an influence on it, as well as the relationships among them [23]. There are many factors that can affect the productivity from the problem of workforce motivation, issues of supervisory, issues of management and project management till weather problems, methods, occupational safety and health, and so forth. In this case, there has been numerous studies about factors that affect productivity in conventional construction projects, however, there is limited research upon productivity in GCP.

Green Building Projects in Malaysia Construction Industry
The construction industry of Malaysia is aware of the importance of sustainable construction to create a high quality living environment for all. As reported in Green Building Index (GBI), as of December 2018, there is 467 numbers of GBI certified Green Building projects in Malaysia. As the target goal in Green Technology Master Plan (2017 – 2030), the numbers will be increased by 550 number of Green Building by 2020, inclusive of green buildings certified by various agencies and organisations such as MyCREST, Green Building Index, Green RE etc. According to [15], green development in Malaysia is still new and researching how these components would contribute towards green development achievement is extremely significant. Henceforth, understanding these variables and uniting all the key components towards green development is critical. Because green buildings use more technologies and material with less environmental impact, they are more complicated than traditional buildings. Moreover, many requirements to achieve a green certificate and shareholders’ unfamiliarity with the requirements and technologies tend to lead to cost overruns, project delays, and productivity losses [4] and [16].

Productivity of Green Building Projects
Green building projects generally have more complex designs as compared with traditional building projects [26]. In order to achieve sustainability, green building projects generally require the use of special specifications, materials, construction methods, and building practices [27] and [28]. Moreover, the productivity of the design and construction of green building projects is currently lower than that of traditional projects because practitioners still need time to learn and become proficient in these technologies [11]. Furthermore, unfamiliarity with green technologies and technical difficulties during the construction process can not only affect the project schedule but can also lead to cost increases through rework [29] and [30]. Previous research done by [11] identified the critical factors affecting the productivity of green building construction projects by assessing the likelihood, impact, and criticality of the factors with comparisons against traditional projects. Twenty six (26) factors were identified from
a comprehensive literature review and interviews with industry experts. The results indicated that workers’ experience, technology, design changes, workers’ skill level, and planning and sequencing of work were the top five most critical factors affecting the productivity of green building construction projects.

3.0 Research Methodology

This paper is part of an on-going research to develop a procedural framework for construction productivity improvement in GCP. To accomplish the research, key strategies in productivity improvement particularly in GCP will be investigated. The findings are very important and will be useful as a starting point for future study, especially in formulating a clear guide for the development of upcoming procedural framework. For the purpose of this paper, qualitative analysis technique was used to analyse and interpret the literature. According to [31], content analysis technique is one of the various qualitative techniques that can be used to analyse literatures, whether representing qualitative, quantitative or mixed research that contains numerous sources of qualitative data such as theoretical framework, author’s conclusion and interpretation - thereby, justifying within-case qualitative analyses. The process of content analysis involves simultaneous coding of raw data and the construction of categories that capture relevant characteristics of the document’s contents [32]. To conduct a literature search, the first step was to identify well known articles relating to productivity in the construction industry. During this process, factors contribute to productivity in GCP as well as key strategies in productivity improvement will be determined. The crucial step in conducting content analysis for this research is to develop a list of strategies to improve productivity, whereby, the references found are mainly from the traditional construction project. The identified attributes were then selected and removed where unneeded, irrelevant and redundant, those that do not contribute to the accuracy of GCP.

4.0 Framework Development Process:

This paper introduced a framework for productivity improvement strategies in GCP. The proposed framework development process is as presented in Figure 1. The framework consists the lists of factors affecting GCP and the strategies to enhance the project productivity throughout construction process. The framework will consider the productivity improvement strategies in Malaysian context, particularly in GCP through the involvement of the local building project stakeholders’ expertise, views and preferences in the data collection.

![Figure 1. Framework Development Process](image-url)

The literature findings offered a list of factors contribute to project productivity, and the improvement strategies that can be adopted in GCP. Findings from [11] will be the elementary source of this research to determine the factors affecting productivity in GCP in Malaysia. The research finding by [11]...
indicates that there are twenty-six (26) factors affecting green construction productivity in Singapore, and the factors were grouped into five major categories – project, manpower, management, technical and external factor. To identify the crucial and critical factors affecting GCP in Malaysia, a questionnaire survey will be distributed among professional who have been involved in GCP. Prior to the distribution of the questionnaire, a pilot study (pre-survey) will be carried out with the experienced researchers and industry specialists to review the appropriateness, structure, readability and validity of the survey questions. Their feedback will be incorporated to revise the survey questions.

Productivity Improvement Strategies
Main contribution of this on-going research is to identify the key strategies of productivity improvement in GCP, therefore, the findings from previous literature on the construction productivity improvement strategies were identified. In this study, author only highlight the findings of productivity improvement strategies of three recent research studies, from year 2016 to 2019. The outcome from the research done by [12] [20] and [23] shows the productivity improvement strategies are limited to conventional construction projects only. However, the outcomes will be addressed and practice in the formulation of a theoretical framework.

A study from [12] investigated the complex interdependence of the factors in driving or hindering construction productivity at the industry, project and activity levels in a systemic manner. The study conceptualised and validated a systemic framework for examining construction industry productivity, and developed three causal loop diagrams (CLDs) for illustrating the dynamic structures that underpin the complex systems of the drivers and constraints. Whilst, [20] adopted PESTEL (political, economic, social, technological, environmental, legal) framework for analysing the macro business environment external to a firm. The research revealed the commonalities of the constraints and strategies shared by the contemporary construction and built environments concerning productivity enhancement through a multi-case lens scrutinizing the construction industries of Singapore, Hong Kong, and the UK. The framework recognizes the potential to explain productivity within the dynamic construction business environment by studying the complexity of the strategies, thereby making a significant contribution to the construction productivity literature. Nevertheless, a study done by [23] recommended ways to help the industry improve productivity and enable the government to devise better policies and programmes. The study suggested that in order to enhance the productivity of Singapore construction firms and practitioners, there is a need to create strategies to have firms compete through performance improvement and have productivity targets and attainments in line with all sectors of the economy.

Critical analysis from the findings of [12] [20] and [23] are summarized and classified into six groups. Proposed recommendation for productivity improvement in GCP will be categorized according to the nature of each factor. The process of grouping of the strategies into its own category was quite challenging as many issues do not fall neatly under one sector. Although the proposed strategies were put under certain categories, it is accepted that other interpretations are possible, as there are conflicts in categorization between published works. Anticipated categories are 1) Government Regulation & Policies, 2) Work Force Development, 3) Project management and administration, 4) Innovative construction technology & technique adoption, 5) Procurement and 6) Effective Site Management. Table 1 signify the detailed of the finding from the [12] [20] and [23] and the proposed categories of strategies aspect.

The key Strategies for Productivity Improvement (as shown in Table 1) will be used as a basis for preparing a discussion guideline in the interview meeting with the experience practitioners in GCP. Result from questionnaire survey and interview meeting then will be triangulated and analysed. Validation of the end-result findings will be reviewed by Expert Panels. Apart from reviewing the findings, the experts will also evaluate the significance of the issues identified from the previous data collection. Once the significance of the findings is validated by the experts, the issues can be properly evaluated based on the expert’s evaluation. The research output is in a form of a procedural framework for construction productivity enhancement strategies. This framework can act as a reference for the policy makers and stakeholders to improved understanding of the key drivers of the construction
industry’s productivity performance, whilst keeping of the eminence in Malaysian construction productivity improvement.

| Strategies Aspect | Key Strategy for Productivity Improvement / LR Supporter |
|-------------------|----------------------------------------------------------|
| 1. Government Regulation & Policies | • Policy formation & regulatory requirements [12]  
• Development of stable and transparent government policies [20] |
| 2. Work Force Development | • Development of sustainable construction workforce [20]  
• Human resource management [23] |
| 3. Project management and administration | • Planning and design, project management and administration [12]  
• Project management [23]  
• Management at company level [23] |
| 4. Innovative construction technology & technique adoption | • Application of new construction technologies and Design standardization [20]  
• Technology adoption [23] |
| 5. Procurement | • Collaborative procurement [23] |
| 6. Effective Site Management | • Site construction management [12]  
• Constructability and offsite management [20] |

### 5.0 Conclusion

This paper is part of an on-going research to develop a construction productivity enhancement strategies framework for GCP. The data presented here is primarily based on preliminary review of available relevant literature materials. From the above literature it is concluded that there are many methods of increasing productivity in construction industry. However, the previous research is limited to the conventional construction projects only. It has been noted that increasing the productivity by such above methods for conventional construction projects have reduced cost and time. In the vein of this scenario, this research is intended to identify the key strategies that can sustenance to improve the productivity of GCP. The paper has identified the significant drivers concerning construction productivity in driving or hindering the productivity improvement. The results of this study can also help the practitioners make specific adjustments to traditional project management processes and practices achieving a more productive delivery of green building projects. It is also recommended to establish productivity benchmarks and metrics for different types of green projects which will help practitioners to measure and improve their productivities and competitiveness in green construction.

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