Analysis of key criteria and requirements in implementing green procurement for green construction projects in Malaysia

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Abstract. Construction industry is one key driver in stimulating Malaysia’s economic growth. Green procurement is known as procurement that is consistent with the principles of sustainable development, such as ensuring a strong, healthy and just society, living within environmental limits and promoting good governance. Malaysian government has published a standard guideline of green procurement known as Government Green Procurement (GGP) guideline; however, it does not merely used for the construction development. Hence, this paper aims to analyse the criteria and requirements to implement green procurement for construction projects. Questionnaires were distributed to 60 respondents, comprising of project stakeholders that has experience in the development of green construction projects. Limiting to category commercial and office building projects only, hence, the respondents' population was drawn using purposive method. The analysis uses descriptive statistics via mean score, and the standard deviation was used to measure the variables and the mean's dispersion. It is revealed that all of the criteria stated are important and one or more criteria are more important than the rest. This study recommends that the government focus on these criteria to help implement green procurement for green construction projects in Malaysia.

1. Introduction and background of study
The construction industry is one key driver in exhilarating Malaysia’s financial growth for being a high income technologically advanced country. It is anticipated to increasingly develop at a rate of 10.3% per annum that amounting to RM327 billion (5.5%) to the national Gross Domestic Product [1]. It also provides employment opportunities to roughly 1.2 million employment in Malaysia’s total labour force each year [2]. The construction sector and its activities are considered crucial sources of financial growth, development, and economic activities, as stated by [3]. Inevitably, it can generate more
employment and offer job opportunities to millions of unskilled, semi-skilled and skilled workforces. Therefore, sustainability in construction is vital to develop the nation further while properly conserving and preserving the environment. Hence, it has led the Malaysian government as the most significant enabler of national development towards the importance of green procurement and green growth in the construction industry. This also helps to sustain the performance of buildings during the occupancy stage by identifying important environmental elements during initial project planning [22].

In Malaysia, the promotion of green procurement and green growth are highlighted in the 11th Malaysia Plan (2016-2020) and focusing on the pursuance of green for sustainability and community resilience comprises one of the plans. Other than that, green growth was addressed in the Construction Industry Transformation Plan (CITP) 2016-2020. The policy of CITP is further continued with the current announcement of National Construction Policy 2030 (NCP2030) under the Ministry of Works Malaysia, as stated in Thrust 2. Under this thrust, the NCP2030 embraces the sustainable built environment through two strategic points; i) to develop quality, reliable, sustainable, and resilient infrastructures, and ii) to promote environmentally friendly construction materials and strengthen the waste management system.

Moreover, the significance of green procurement in the public sector is also mentioned in the United Nation Sustainable Development Goals (UN SDG) [5]. As highlighted in the SDG, the particular target that is in relation to green procurement is under goal number 12 (Responsible Consumption and Production), namely, target 12.7, which is to encourage public procurement practices that are sustainable and by Malaysia’s national policies and priorities (see Figure 1). In target 12.7 under SDG no. 12, resource decoupling and impact decoupling are needed to promote sustainable consumption and production patterns [5]. It was known that the global faces challenges in integrating environmental sustainability with economic growth by decoupling environmental degradation. Hence, green procurement can ensure sustainable consumption and production practices necessarily entails respecting the biophysical boundaries of the planet, including in the construction sectors. Green procurement helps to promote the practices and usage of environmentally friendly construction products during the planning phase. Therefore, it is crucial to address green procurement in the construction industry.

![Figure 1. Sustainable Development Goals (SDG) and SDG Goal 12.](image)

By encouraging the usage of GP, it enormously profit the country and help in achieving the SDGs. The usage of GP in construction able to help the projects owners and construction stakeholders such as the consultants, the contractors and the product manufactures in increasing their awareness to achieve sustainability solutions by orienting the green practices and process from the early planning of the project [4]. Sustainable or green procurement had first arisen in the year of 1992 [6]. According to Walter [13], green procurement is defined as acquisition of products, services and works (construction) that considers environmental elements and criteria that able to minimise negative impact of human activities. Thus, in construction, green procurement is a practice of underlying the sustainable principles and process to ensure that the construction project is in a green orientation.
In recent, green procurement is rapidly growing and could be a vital component of companies’ corporate obligation, green procedure and also organisation’s strategies [7]. Such obligations and strategies may encourage green areas to be further enhanced in the next development phase. The main areas of green procurement are in relation with waste, writing materials, building upkeep, information technology (IT) equipment and food [7]. Furthermore, green procurement aids companies in influencing the manufacturers and the buyers to be bind with agreement on the purchasing of environmental friendly products [8].

2. Problem statement
Due to embark more strategies on green development, the need for the government of Malaysia to start implementing Government Green Procurement (GGP) practices in the construction industry has also been staggering [5]. Reduction of carbon is one of the numerous efforts recognized to address the climate change problems and advance sustainability. Apart from that, the government has embarked on achieving buildings with low carbon and high sustainability. The initiative also includes establishing the first version of the Government Green Procurement (GGP) Guideline for products and services in 2014 and continued to the second version of the GGP guideline in 2018. The first version of the guideline allocated six (6) green products and was next upgraded to twenty (20) green products and services. However, these established guidelines are not focussing merely on the construction sectors because the green products and services in the guidelines are for general requirements for the government buildings [4]. Not all officers that handle procuring the products and services are aware of the effects of procurement toward the ecological [9]. These circumstances will cause many environmental difficulties such as carbon dioxide emissions, change in climate, greenhouse effects, deforestation, and pollution. Subsequently, research in addressing the usage of green procurement in the construction sectors is critically needed to encourage green construction [10].

Even though the green awareness in construction industry was addressed in the abovementioned policy such as CITP (2016-2020), NCP2030, and also highlighted in the SDG, implementation of green procurement for construction works has yet to be established. Despite much previous research being carried out on the green procurement studies in the Malaysian context (for example:[4], [11], [12], [13], [14], [15] and [16] implementation criteria, documentations to address or requirements to adopt green procurement for construction works in each of the phases of a project are lacking. Therefore, this paper is intended to analyse the key criteria in implementing green procurement for green construction projects in Malaysia. Hereafter, this research is useful in enabling the government stakeholders to address the green criteria in construction works and achieving a developed and sustainable country. This study shall also focus on the necessities needed for green projects specifically to office buildings (non-residential category). Offices or commercial buildings are the main asset of business and commerce operations [17]. However, energy has become one of the excessive trackable emissions in office buildings, therefore, more green projects are focusing more on office buildings.

3. Methodology
The study adopts a quantitative method approach whereby questionnaires were used as the survey instrument. The questionnaires were distributed to 60 respondents using a purposive sampling method. Purposive sampling is a non-probability sampling with the intention of selecting informants where researchers rely on their judgment when choosing population members to participate in the study [18]. Since the purposive sampling method is used where the respondents shall be those who are only used to involve in green construction projects, the screening has shortlisted 60 numbers of registered consultant’s firms. Figure 2 shows the methodology process used for this study, where the survey is under Phase 2 as the study is still ongoing. The respondents were the consultant team in green construction projects, i.e. architects, engineers and quantity surveyors, that worked in the registered consultant firms located in Kuala Lumpur. The survey was carried out via an online platform by email.
to the shortlisted company due to the pandemic outbreak situation that has restricted the researchers from traveling. The online survey has received 40 responses from the targeted sampling, where the response rate is 66.7%, out of 60 respondents. According to [19], data is valid to have more than 50% responses from the total sampling population. Hence, the data is sufficient and relevant to the purposive sampling concept. The data collected was analysed using standard deviation and mean ranking using a 5-point Likert scale whereby "1" is very unimportant and "5" is very important.

**Figure 2.** Methodology design process.

### 4. Analysis of results and discussion

#### 4.1. Demographic background

General demographic data were compiled from the respondents, which includes their academic background, years of involvement in the green projects and their designation level in the organisation. Table 1 presents the summary of the respondents’ demographic background. In terms of academic background, 42.5% of the respondents are from quantity surveying background, followed by 22.5% of the respondents that are from civil engineering background, and 12.5% are from architect background. This is due to majority of the survey distribution was retrievable by the quantity surveyors’ firms and the procurement process was majorly handled by the quantity surveyors. Hence, the items in the questionnaire are more likely answered by the quantity surveyors. In terms of involvement in the green project, the results showed that the majority which equals to 50% of the respondents had 5-10 years of experience in green project, followed by 27.5% which had less than five years of experience and 20% had 11-15 years of experience. This is due to most projects not specifically being classified as “green” projects even though there may be some “green” elements incorporated in them. Lastly, in terms of designation level, majority or 45% of the respondents are manager level, followed by 32.5% from senior or executive level and 22.5% from the technical assistant level.

| Demographic Criteria | Responses | Frequency (n) | Percentage (%) |
|----------------------|-----------|---------------|----------------|
| Academic Background  | Architecture | 5 | 12.5 |
|                      | Quantity Surveying | 17 | 42.5 |
|                      | Structural Engineering | 3 | 7.5 |
|                      | Civil Engineering | 9 | 22.5 |
|                      | Electrical Engineering | 2 | 5 |
|                      | Mechanical Engineering | 1 | 2.5 |
| Others:              | i) Building Surveying | 2 | 5 |
|                      | ii) Construction Management | 1 | 2.5 |
5 Years of Involvement in green projects

| Years of Involvement | Less than 5 years | 5 – 10 years | 11 – 15 years | More than 15 years |
|----------------------|-------------------|--------------|--------------|-------------------|
| Years                | 11                | 20           | 8            | 1                 |
| Percentage           | 27.5              | 50           | 20           | 2.5               |

Designation / position in the organisation

| Designation / position | Manager Level | Senior / Executive Level | Technical Assistant Level |
|------------------------|--------------|--------------------------|---------------------------|
| Numbers               | 18           | 13                       | 9                         |
| Percentage             | 45           | 32.5                     | 22.5                      |

*Total sample numbers = 40

4.2. Level of importance on the criteria and requirements towards green procurement implementation

The listed criteria and requirements towards implementing green procurement of construction works are retrievable through the literature analysis and preliminary survey, i.e. semi-structured interview, which was previously conducted in this research. Hence, in this section, the criteria and elements are listed under the five phases; i) Inception phase, ii) Design phase, iii) Tender phase, iv) Construction phase and v) Operation Phase. The listed criteria and requirements are comprising of required process that need to be executed by the project stakeholders and consultants in implementing green procurement for construction. Hence, it will ensure the smoothness of the project delivery and achieving green construction. The results on the importance of criteria and requirements of green procurement are summarised in Table 2. The data collected for the importance level of the criteria for green procurement implementation was analysed using mean score and standard deviation.

The equation formula for mean ($\bar{x}$) is as follows:

$$\bar{x} = \frac{\sum x}{n}$$

Where,

- $\sum x$ is sum of all data values
- $n$ is number of data items in sample

For standard deviation, the equation formula shall be:

$$s^2 = \frac{\sum (x_i - \bar{x})^2}{n-1}$$

Where,

- $x_i$ is the data value
- $\bar{x}$ is mean score
- $n$ is number of data items in sample

### Table 2. The result of importance level on green procurement implementation using mean and standard deviation.

| Project phase | Criteria and requirements | Mean | Standard deviation | Rank (based on mean value for each project phases) |
|---------------|---------------------------|------|--------------------|--------------------------------------------------|
| 1.Inception and planning phase | The client state and includes targeted green rating tool (MyCREST / PhJKR / GBI / GreenRE / BEI, etc) | 4.43 | .747               | 2                                                |
| Activity                                                                 | Score | Priority |
|-------------------------------------------------------------------------|-------|----------|
| Stating the budget approval incorporating green procurement for the projects | 4.35  | 5        |
| A clear “green project” is used as the title                            | 4.37  | 4        |
| Incorporates environmental and energy efficiency requirements in the project brief | 4.43  | 3        |
| Capability and green knowledge of appointed consultants                 | 4.45  | 1        |
| Incorporate energy consideration (passive and active design)            | 4.33  | 6        |
| Decision on the list of approved green materials                        | 4.33  | 7        |
| Green specification tailored to comprehensive criteria                   | 4.30  | 8        |

2. Design phase

| Activity                                                                 | Score | Priority |
|-------------------------------------------------------------------------|-------|----------|
| Carry out life-cycle cost (LCC) and total ownership cost for the project | 4.25  | 5        |
| Determine the value of carbon emission                                   | 4.30  | 3        |
| Comply with green construction materials listed in the MyHIJAU directory | 4.20  | 8        |
| Integrate detailed building criteria as listed in the targeted rating tools (MyCREST / PhJKR / GBI / GreenRE / BEI, etc) | 4.25  | 4        |
| Integrate detailed specifications from MyBIM library, MyHIJAU directory, or specify at least 80% of the materials to be green materials | 4.20  | 7        |
| Executing Value Management (VM) exercise                                 | 4.25  | 6        |
| Feasibility study and analysis of green cost                             | 4.42  | 1        |
| The usage of Malaysian Standards MS1525 (Code of Practice on Energy Efficiency and Use of Renewable Energy for Non-Residential Buildings) | 4.35  | 2        |
### 3. Tender phase

| Tender incorporates the green monitoring evaluation | 4.20 | .966 | 1 |
| Considering contractor’s capability in handling green projects | 4.20 | 1.018 | 4 |
| Specify “green project” in the tender notice | 4.20 | .966 | 2 |
| Include green project as mandatory requirements in the Instruction to Tenderers | 4.20 | .992 | 3 |
| Green compliance on the criteria for tender evaluation | 4.15 | 1.001 | 6 |
| Special points given for contractors for having green knowledge and capability | 4.15 | .975 | 5 |

### 4. Construction phase

| Quality of workmanship to Quality Assessment System for Building Construction works (QLASSIC) | 4.28 | .905 | 6 |
| Health & safety in compliance with OSHA | 4.45 | .876 | 3 |
| Compliance to environmental assessment | 4.52 | .751 | 2 |
| Executes environmental monitoring | 4.53 | .716 | 1 |
| Capability of auditor for counter-propose green materials during construction execution | 4.33 | .730 | 5 |
| Appoint project manager or site officer that have knowledge and experience in green construction | 4.28 | .905 | 6 |
| Verification on the design and product compliance | 4.37 | .868 | 4 |
### 5. Operation phase

| Task                                                                 | Mean Score | Standard Deviation | Rank |
|----------------------------------------------------------------------|------------|--------------------|------|
| Compliance and approval of the green project from local authorities | 4.28       | .987               | 6    |
| Tenant’s guideline to be provided by designers                        | 4.35       | .834               | 4    |
| Green ratings certification (MyCREST / PhJKR / GBI / GreenRE / BEI, etc) | 4.45       | .783               | 2    |
| Facilities management contract stating “green” consideration         | 4.28       | .847               | 5    |
| Data management and record for future green project                  | 4.40       | .871               | 3    |
| Carry out energy monitoring and building performance evaluation      | 4.52       | .877               | 1    |

Based on the results shown in Table 2, the mean score is ranged from 4.15 to 4.53, which shows that the listed criteria and requirements are all important as green procurement implementation. The standard deviation score also shows that the data dispersion is smaller scatter, ranging from .716 to 1.018, which remarks a low standard deviation. The measurement of the dispersed data of standard deviation is clustered around the mean. Since it is close to zero and not broadly spread out, thus the achieved mean score or mean value for each criteria is acceptable and reliable. The smaller the standard deviation, hence, the better the mean score.

The criteria and requirements are ranked based on the highest mean score at each project phase. In the inception phase, the top three ranked criteria are capability and green knowledge of appointed consultants (mean= 4.45), project brief to includes targeted green rating tool (mean=4.43), and, incorporates environmental and energy efficiency requirements in the project brief (mean=4.43). The results showed that this information is crucially needed during inception phase, as it highlights a clear intention of a client for green projects. As supported by [15], project brief is the key document in green construction project and information from the clients’ brief will evolve through the project brief stage to consultants and stakeholders. Allocating requirement of energy efficiency in the project brief helps a clear path of green projects’ objectives. Energy efficiency and savings to GHG has been the core concern for the green projects. This is parallel to [20] that mentioned energy consumption cost as the key component in reducing the LCC and the significant annual expenditure.

Next project phase is the design phase, where at this stage, the project team members will present conceptual sketch and allocating other crucial information such as cost planning. The most important criteria and requirements rated by the respondents are green analysis cost through the design and feasibility study, construction cost, and operation and maintenance cost (mean=4.42), mandatory usage of Malaysian Standards MS1525 (code of practice on energy efficiency and use of renewable energy for non-residential buildings) (mean=4.35), and carry out carbon emission calculation exercise (mean=4.30). The results determined that these studies are important during the design phase because the design correlates directly with the overall costs of the project and the total carbon emission of the building. The costs are important as it is one of the most important considerations for projects as agreed upon by [17].

In the tender phase, the most important criteria and requirements rated by the respondents are tied between tender notice specified requirement for green project and green monitoring evaluation in the tender instruction (mean=4.20). This is followed by include in the Instruction to Tenderers (ITT) as mandatory process (mean=4.20). This indicates that the need for a specific requirement for a project to be “green” is crucial during the tender phase as to make sure that the tenderers know that the project is...
required to be green. This is supported by [10] whereby states that environmental considerations must be placed in tender assessments as this process helps the client in choosing the optimum building products with less waste and less energy consumption.

Next, the most important criteria and requirements in the construction phase rated by the respondents are executes environmental monitoring (mean=4.53), compliance to environmental assessment (mean=4.52) and health & safety in compliance with OSHA (mean=4.45). This is because compliance to standards and rules set are important during the construction phase to ensure that everything will run smoothly without much delay or interference. This is supported by [21] which states that better compliance towards policies can lead to better management and best practices of an organisation.

Lastly, in the operation phase, the most important criteria and requirements rated by the respondents are carry out energy monitoring and building performance evaluation (mean=4.52), green ratings certification (mean=4.45) and data management and record for future green project (mean=4.40). This phase is the longest period of a building life cycle; hence, more attention is needed in this phase. The strategy should be allocated earlier, before the building is occupied. This is in line with [22, 23] that argues that during this stage, buildings consume large amounts of water and energy. Additionally, they are also responsible for adverse environmental effects such as gas emission, noise pollution and waste generation. However, this may be minimised if the appropriate monitoring and evaluation is executed as shown by the high ranking by the respondents.

5. Conclusions
Following the ever-increasing problems of our environment, precautions such as green procurement has become more crucial. Green procurement will help mitigate some of the adverse effects on the environment which is caused by construction activities. Presently, this has a huge impact due to high greenhouse gas emissions, pollution and poor waste management. This study gives a clear indication on which criteria are the most important to help implementation of green procurement for a better future. It also hoped this study will provide benefits for the Economic Planning Unit (EPU) Malaysia and United Nations Development Program (UNDP) Malaysia for the policy of National Sustainable Consumption and Production Blueprint (SCP-GGP). The outcome of this study will help to finalise the National SCP Blueprint through pilot demonstration of Government Green Procurement (GGP) best practices in the construction sector. Hence, this study is hoped to provide benefits to the Ministry of Works and their agencies (Public Works Department and Construction Industry Development Board) in promoting green construction through green procurement practices. It is wished that this study may be used to further the progress on establishing green procurement in Malaysian construction industry.

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