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IMPLEMENTATION OF GREEN RATING SCHEME TO JABATAN KERJA RAYA MALAYSIA PROJECTS

SHAIFUL MUNIR BIN LEMAN

A capstone project report submitted in partial fulfilment of the requirements for the award of the degree of Master of Project Management

> Faculty of Civil Engineering Universiti Teknologi Malaysia

> > JANUARY 2014

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To Azie, Afiq & Ayra

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Thank you

ABSTRACT

The introduction of sustainable rating tools for construction project has a significant impact to the industry. Jabatan Kerja Raya (JKR) as an implementer agency for the government project also has introduced sustainable rating tools known as JKR Green Rating Scheme (ph JKR) in order to ensure their project is conducted in sustainable way. Previously, several studies were conducted only to focus on implementation of Green Building Index (GBI) Malaysia rating tool. There still no study conducted in assessing the JKR Green Rating Scheme (pH JKR) implementation. So, the objectives of this study are to determine current understanding level on pH JKR and Green Project Management approach among JKR staffs, to identify factors that affect the implementation of pH JKR and to develop Green Project Management framework for JKR. Data is gathered through survey questionnaire, interview and data collection process which targeted group is project management office and design office at headquarters level who involved in building projects. Based on the analysis, the current understanding level of JKR staff on pH JKR is at medium level and their knowledge for green project management is at low level. A part from that, five factors that affect the implementation of pH JKR is lack of budget, lack of understanding on the sustainable concept, clients' understanding and awareness on sustainable concept, low promotional and awareness activities, lack of experience in implementing sustainable project and contractors' experience in sustainable project.

ABSTRAK

Pengenalan alat penarafan hijau bagi projek pembinaan memberi kesan yang ketara kepada industri pembinaan. Jabatan Kerja Raya (JKR) sebagai agensi pelaksana bagi projek kerajaan juga telah memperkenalkan alat penarafan hijau yang dikenali sebagai Skim Penarafan Hijau JKR (ph JKR) untuk memastikan projek yang dilaksanakan adalah dengan cara yang lestari. Beberapa kajian telah dijalankan sebelum ini hanya memberi tumpuan kepada pelaksanaan Indeks Bangunan Hijau (GBI). Pada masa kini, tiada kajian dijalankan untuk menilai keberkesanan Skim Penilaian Hijau JKR (pH JKR). Objektif kajian ini adalah untuk menilai tahap kefahaman kakitangan mengenai pH JKR dan pendekatan pengurusan projek lestari. Selain daripada itu, kajian ini juga bertujuan untuk mengenal pasti faktor-faktor yang memberi kesan kepada pelaksanaan pH JKR dan akhir sekali untuk membangunkan kerangka kerja pengurusan projek lestari untuk JKR. Data dikumpul melalui soal selidik, temuduga dan proses pengumpulan data sedia ada dimana responden adalah terdiri daripada pasukan pengurusan projek dan pasukan rekabentuk projek di Ibu Pejabat JKR yang hanya terlibat dengan projek-projek bangunan. Berdasarkan analisis kajian, kefahaman semasa kakitangan JKR terhadap pH JKR adalah pada tahap sederhana dan pengetahuan mereka untuk pengurusan projek lestari adalah di Selain daripada itu, lima faktor utama yang mempengaruhi tahap rendah. pelaksanaan pH JKR adalah kekurangan peruntukan kewangan, tahap kefahaman masih rendah mengenai konsep lestari, tahap kefahaman pelanggan mengenai konsep lestari, aktiviti promosi dan kesedaran yang rendah, kekurangan pengalaman dalam melaksanakan projek lestari serta pengalaman kontraktor dalam melaksanakan projek lestari.

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LIST OF ABBREVIATIONS

ACEM	Association of Consulting Engineers Malaysia		
BREEAM	Building Research Establishment Environmental Assessment		
CAST	Cawangan Alam Sekitar dan Tenaga		
EPU	Economic Planning Unit		
ESCP	Erosion and Sediment Control Plan		
GBI	Green Building Index		
HODT	Head of Design Team		
НОРТ	Head of Project Team		
JKR	Jabatan Kerja Raya		
LEED	Leadership in Energy and Environmental Design		
MP	Malaysia Plan		
OSD	On-Site Detention		
PAM	Pertubuhan Arkitek Malaysia		
pH JKR	Skim Penarafan Hijau JKR		
РМВОК	Project Management Body of Knowledge		
PWD	Public Work Department		
SPB	Sistem Pengurusan Bersepadu		
SPSS	Statistical Package for Social Sciences		

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CHAPTER 1

INTRODUCTION

1.1 General

Sustainability is an important aspect that should be concerned in the implementation of projects. Apart from manufacturing activity, construction projects are also give very significant impact on the environment. Sustainable also associated with green (Guiliano et.al, 2012). Various measures have been taken by the government to control activities which are expected to have an impact on the environment. Among the most important measure is the enforcement of Environmental Quality Act. Fundamentally, sustainable development address three major areas; people living today are entitled to justice and equal rights; environmental degeneration must be alleviated or eliminated and future generations must not be impoverished as a result of current actions (Redclift, 1987).

For construction sector, sustainable is defined as towards a reduction of environmental and health impacts consequent to construction, building and built environment. From the definition, it clearly proofs that environmental protection element is very important for sustainable development.

Based on current situation, many organizations have focused on sustainability, where the management combine elements of sustainability along with the organization's strategic plan. Jabatan Kerja Raya (JKR) Malaysia is also embedding sustainability elements in JKR Strategic Framework 2012-2015. The aim is to produce sustainable infrastructure meaning that the product from infrastructure development should sustain the impact of environmental issues, economic growth and social needs. These strategic plans indirectly affect the method of project implementation for the organization (JKR Strategic Framework, 2012).

In ensuring sustainable project development can be successfully implemented, green rating tool has been introduced by several government and private organization. Through this tool, sustainable elements of a project can be applied at an early stage of the planning, design and construction until project completion. This tool serves as an evaluation tool where the project team can assess either their project meet the sustainability requirement or otherwise. Among established green rating tool are BREEAM (United Kingdom, 1990), LEED (USA, 2000) and Green Star (Australia, 2002). In year 2009, Green Building Index (GBI) was introduced in Malaysia which it is wholly-owned subsidiary of Malaysian Institute of Architects and the Association of Consulting Engineers Malaysia (ACEM). In order to achieve maximum point in green rating evaluation, a few new technologies is applied in the building project. Several technology related to sustainability are rain water harvesting system, water efficiency equipment, energy saving bulb, solar panel and double glazed glass panel.

Recognizing the importance of sustainable development, JKR as an implementer agency for government project has introduced JKR Green Rating Scheme (pH JKR) in year 2012. The main objective is to measure the sustainability of a development project undertaken by the department. This step is also consistent with 10th Malaysia Plan (MP) where one of the main ideas in the plan is to appreciate the environment. JKR as a technical and implementer agency for government project must take full responsibility in ensuring the government projects fulfil sustainable requirement.

Even though Malaysia is quite late compare to United Kingdom and USA in developing the green rating tool, but the action taken is good to ensure the sustainable development can be carried out for the benefit of future generation.

1.2 Problem Statement

Implementation of a JKR Green Rating Scheme (pH JKR) is still less widespread in many building projects due to lack of publicity. Other than that, there is a doubt that who should proposes the implementation of green criteria for the project personally initiates by the client, initiative by the project manager, design team or based on project cost. Besides, there is still doubt the effectiveness of green rating tool. The main thing that causes this is due to the assumption of an impending increase in project cost. This matter will be exacerbated by the limited budget of a project. There also no study conducted in order to determine current level of understanding on pH JKR among staffs.

1.3 Importance of Study

There are a few studies conducted earlier in order to determine the effectiveness of green rating tools in Malaysia. This tool is quite new to Malaysia because it just recently introduced in year 2009. The previous study is mainly focusing on Green Building Index (GBI) Malaysia but not yet on JKR Green Rating Scheme (ph JKR). The related studies are:

- Ang Huang Yau (2010). The Implementation of Green Building Index Malaysia. Bachelor Degree, Universiti Technologi Malaysia, Skudai
- Liew Phik Yin (2012). Achievability of Green Building Index Malaysia.
 Bachelor Degree, Universiti Tunku Abdul Rahman

Based on this scenario, this study is conducted to assess the implementation of JKR Green Rating Scheme (pH JKR) to government project.

1.4 Aim of Study

The aim is to assess the implementation of JKR Green Rating Scheme (pH JKR) to Jabatan Kerja Raya Malaysia projects.

1.5 Objectives of Study

This research is concerned with the implementation of the most recent green rating tool called "JKR Green Rating Scheme" (pH JKR) for any construction project conducted by Jabatan Kerja Raya Malaysia. Due to short implementation period, no study was conducted in reviewing the implementation of JKR Green Rating Scheme (pH JKR) for building project.

The main objective of this research is to assess the implementation of JKR Green Rating Scheme (pH JKR) on current building project. The three sub objective for this study are summarised as follow:

- To determine current understanding level within JKR staffs regarding on JKR Green Rating Scheme (pH JKR) implementation and Green Project Management approach.
- 2. To identify factors that affects the implementation of JKR Green Rating Scheme (pH JKR).
- 3. To develop Green Project Management Framework for JKR.

1.6 Scope of Study

Information related to JKR Green Rating Scheme (pH JKR) is studied. Data is collected from Jabatan Kerja Raya personnel who involve in project management and technical design at headquarters office only. This research only focuses on the building project run by Jabatan Kerja Raya in Peninsular Malaysia.

1.7 Expected Findings

The expected findings for this research are as follows:

- The understanding level among JKR staff regarding on pH JKR and Green Project Management concept is high because everybody knows the importance of sustainable development.
- 2. Main factor that affect pH JKR implementation is budget allocation by client for the project.

1.8 Thesis Outline

I. Chapter 1: Introduction

This chapter described on the concept of sustainable development, importance of sustainable development and initiatives by the JKR in order to achieve sustainable development projects. Aims and objectives of this study also have been described where the main objective is to assess the implementation of JKR Green Rating Scheme (pH JKR) on current building project.

II. Chapter 2: Literature Review

Several topics related to this research are discussed such as concept of project management, project life cycle, detail concept of sustainability as well as the concept of green project management in Chapter 2. It also described on the existing green rating tools such as LEED, Green Mark and GBI along with the evaluation criteria. Recognizing the importance of sustainable development, JKR as an implementer agency for government project has introduced the JKR Green Rating Scheme (pH JKR) in year 2012. The main objective is to measure the sustainability of a development undertaken by the government.

III. Chapter 3: Methodologies

The relevant methodologies are explained in Chapter 3. Three types of method were used to collect data which are distribution of questionnaire, interview session and data collection process. A set of questionnaire is distributed to JKR office. The main purpose is to determine understanding level pH JKR among staffs. Targeted respondents are those involved in general building project at JKR headquarters. Building Works Branch is selected due to the largest branch for project management activities at JKR headquarters. Survey form also distributed to four main design offices which act as supporting offices for technical design for the building project. The total number of survey form distributed is 120 nos. Data analysis is carried out by using average index analysis.

IV. Chapter 4: Analysis and Discussion

In Chapter 4, the collected data were analysed through average index analysis. The data is tabulated in form of average index and bar chart. The data is analysed to fulfil the research objectives. Research findings are clearly described in next section.

V. Chapter 5: Case Study

In Chapter 5, a case study is presented. Data is gathered through interview session and data collection process with respondent from Environment and Energy Branch as responsible party in monitoring pH JKR. Views and opinions are obtained to determine factors affect the pH JKR implementation.

VI. Chapter 6: Recommendation and Conclusion

Chapter 6 described conclusion of this research. Findings for each objective have been explained. Limitation and recommendation of the research is also highlighted for future study.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Awareness of sustainable development has increased among the players in the construction industry. In achieving sustainable development for construction projects, sustainable or green rating tools have been introduced by the government or private organization. It is intended to ensure construction carried out to meet the sustainable aspects. Jabatan Kerja Raya as an implementer for government projects in Malaysia has introduced 'JKR Green Rating Scheme' as a green rating tool in order to manage their project in a sustainable way. In general, criterias emphasized in the tool are sustainable site planning and management, energy efficiency management, indoor environmental quality management, resources and materials management, water efficiency management and innovation. In this literature, generally it's covered the project management concept, sustainable in project, sustainable rating tool for construction project and evaluation criteria.

2.2 **Project Definition**

According to PMBOK Fifth Edition (2013), a project is defined as a temporary endeavour undertaken to create a unique product, service, or result. It has a definite beginning and end. A project is considered success when it meets the

project objectives. The criteria in determine the project success is; it must complete within the time, cost and quality which also known as 'The Iron Triangle' (Chan *et al.*, 2002; Atkinson, 1999). Atkinson (1999) has argued that there should be a new criteria's in determining the project success. Atkinson (1999) has proposed to make improvement to the existing criteria's. Besides time, cost and quality, the project is considered success if it could benefits the organization, stakeholder community and the project information system is well managed. This new criteria is known as 'The Square Route' which represent in Figure 2.1 and Table 2.1 below.



Figure 2.1: The Square Route (Source: Atkinson, 1999)

Table 2.1: Cr	riteria in	'The Square	Route' (S	Source: Atkinson,	1999)
---------------	------------	-------------	-----------	-------------------	-------

Iron	The Information	Benefits	Benefits (Stakeholder
Triangle	System	(Organization)	Community)
CostQualityTime	 Maintainability Reliability Validity Information- quality use 	 Improved efficiency Improved effectiveness Increased profits Strategic goals Organizational learning Reduced waste 	 Satisfied users Social and environment impact Personal development Professional learning Contractor profits Capital suppliers, content project team, economic impact to surrounding community

2.2.1 Project Management

Project management is the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements (PMBOK Fifth Edition, 2013). Project management can be implemented with the application of integration of project management process which is categorized into five process groups. These five process groups are initiating, planning, executing, monitoring and controlling, and finally, closing. The process is shown in Figure 2.2.

2.2.1.1 Initiating

This process is considered as an initial process in project implementation. Within the process, the project scope and financial resources is defined. Besides that, internal and external stakeholders who influence the overall outcome of the project are identified (PMBOK Fifth Edition, 2013). Define the project scope is the most crucial in this process. Peter (1997) has stated that poor project scope definition will lead to project failure. This also will lead to poor project cost estimation (Gordon, 1987).

2.2.1.2 Planning

It involved process to establish the scope of the project, refine the objectives, and define the course of action required to attain the objectives that the project was undertaken to achieve (PMBOK Fifth Edition, 2013). Success project planning will resulted to strong strategy and action in implementing the project. A study by Bon-Gang and E-Sin (2013) shows that an adequate planning and control techniques will ensure the project is success in term of cost, time, and quality. Clear and specific project scope and measurable project objectives are essential to the project success.

2.2.1.3 Executing

The executing process is the process performed to complete the work defined in the project management plan to satisfy the project specifications. It involves coordinating people and resources, managing stakeholder expectations, as well as integrating and performing the activities of the project in accordance with the project management plan (PMBOK Fifth Edition, 2013). In construction, constructability during project execution is an important factor to ensure the works progress. Constructability is defined as a measure of the expediency with which a facility may be constructed (Bon-Gang and E-Sin, 2013). High constructability will reduce the difficulties and rework during executing process. It can save time and cost without compromising the project objectives, quality and specifications prescribed in the early stages (Bon-Gang and E-Sin, 2013).

2.2.1.4 Monitoring and Controlling

This process requires review, tracking, monitoring the project performance and to identify changes during the execution stage (PMBOK Fifth Edition, 2013). Performance monitoring should be a part of any project which involves many uncertainties. Performance monitoring program can reduce consequences of unexpected performance (Allen, 2007). Tool like Quality Management System can be applied in this process.

2.2.1.5 Closing

The closing process consists of processes performed to conclude all activities across all project management process groups to formally complete the project, phase, or contractual obligations (PMBOK Fifth Edition, 2013). At this stage, several procedures may occur (PMBOK Fifth Edition, 2013):

- i. Obtain acceptance by the customer or sponsor to formally close the project or phase
- ii. Conduct post-project or phase-end review
- iii. Archive all relevant project documents and prepare document for lessons learned
- iv. Close out all procurement activities ensuring termination of all relevant agreements





2.3 Sustainability and Green Concept

There is confusion between the terms of sustainability and green. Sustainable also associated with green (Guiliano et.al, 2012). Ernest *et.al* (2009) described green can be associated with a product and a process while sustainability is related to whole system, of which individual consumer products and other commercial materials are a part. Green is strongly related to the environment while sustainability is consisting of three element – economic, environment and social.

In order to achieve sustainable infrastructure development, the developer must incorporate green element into their project. The green element can be from a green product, green design, green construction and others related. Green rating tool such as GBI and pH JKR will help the project team in implementing the green concept. This tool will help project manager and designer to include green element in project execution process. Another approach to ensure sustainable development is by using green project management approach. Green project management practices can significantly improve the ability of a sustainable development to be delivered within acceptable cost constraints (Lauren and Vittal, 2011).

2.3.1 Sustainability in Project

Sustainability in projects is about integrating economic, environmental and social aspects in the management and delivery of projects (Silvius and Schiper, 2011). This is important because due to the method in using natural resources is no longer sustainable where there are a lot of negative impacts to the environment. Elkington (1997) had introduced 'The Triple-P' (People, Planet, Profit) concept which describe the sustainability is related to the balance between economic sustainability, social sustainability and environmental sustainability. The concept is shown in Figure 2.3.



Figure 2.3: The 'Triple-P' Concept (Source: Elkington, 1997)

A study was conducted by Liyin *et.al* (2011) to determine the key assessment indicator for project sustainability based on the sustainability concept. Liyin *et al.* (2011) conclude that the project is considered sustainable if it can meet the assessment indicator. The key assessment indicator for infrastructure project sustainability is shown in Table 2.2.

In order to achieve sustainable development, most organizations have to incorporate sustainable elements in their daily work procedures. According to Turner (2010), six concepts of project management that are relevant for incorporating aspects of sustainability are project objectives, project scope and schedule, project resources, cost, income, and risk, project organization, project context and design of the project management process. The introduction of sustainable rating tools by several countries will improve the knowledge and implementation of sustainability for the project (Richard *et al.*, 2009). This also will help organization to incorporate sustainable concept in project and project management.
	Economical		Social	Ι	Environment
i.	Analysis on the	i.	Public safety	i.	Effect on water
	market supply and	ii.	Effects on local		quality
	demand		development	ii.	Effect on land
ii.	Financial risk	iii.	Scale of		pollution
iii.	Life-cycle		serviceability	iii.	Ecological effect
	benefit/profit	iv.	Provision of	iv.	Effects on air
iv.	Project budget		ancillary amenities		quality
v.	Internal return		to local economic	v.	Environment
	ratio (IRR)		activities		protection
vi.	Life-cycle cost	v.	Public sanitation		measures in
vii.	Technical				project design
	advantage			vi.	Influence on
viii.	Payback period				public health
				vii.	Energy saving

Table 2.2: Key Assessment Indicators for Infrastructure Project Sustainability(Source: Liyin *et al.* (2011)

2.3.2 Green Project Management

In order for project managers to deliver sustainable project according to client expectations, modification must be made to traditional project management process and practices (Laure, 2011). The major modifications involve cross-discipline coordination on-site selection, construction techniques and building systems and subsystems early in project life cycle. If the green issue is addressed earlier in project life cycle, the impact in term of cost is less compare at the project implementation stage (Laure, 2011).

Laure (2011) has introduced green project management approach where modification has been made at the project process to incorporate green element.

Table 2.3 below shows the green project approach requirement.

Project Process	Green Project Management Approach
Phase 1: Feasibility	
Project need	Need definition, in addition to market conditions,
assessment	physical needs, etc., includes environment goal, green
	rating target for certification level and budget allocation
	toward green initiatives.
Project manager	Hire an experienced green building consultant/project
selection	manager who is familiar with the product type and market
	and has exposure to all phases of sustainable project. A
	professional who has an accredited in green rating
	certification is highly recommended.
Preliminary site	Finalize economic and ecological goals based on
analysis and plan	cost/benefit analysis. Consider site characteristics and
	weigh building needs against ecological issues. The
	preliminary budget is aligned with the project's unique
	goals and is often accomplished by creating a cost model
	that align resources with program goals to ensure project
	priorities are not mismatched to resources.
Design charrette	Must include all key external stakeholders including
	surrounding property owners and other community
	representatives. Diverse representation from the project
	team functions (design, architecture, building contractor,
	environmental engineer, real estate consultant etc) is
	optimal. The final report serves as one of the guiding
	documents for the design and construction process.

Table 2.3: Green Project Management (Source: Laure <i>et al</i>	. (2011)	
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Project Process	Green Project Management Approach
Final site selection	Select site based on stakeholder involvement including
	community input. At this point, the construction team is
	in place (the owner, the project manager, the architect and
	the contractor) and all parties have a stake in site
	selection.
Phase 2: Design	
Initial budget and	Complete preconstruction estimates with input from the
schedule	builder, project manager, architect and real estate
	consultant. Estimating cost associated with the
	specialized areas like green building product require
	experience. The budget may also include an emphasis on
	life cycle costing, shifting focus from short-term return on
	investment (ROI) to long term gains from operational
	savings.
Zoning approval	The zoning approval process can often go more smoothly
	after an inclusive charrette process has been completed
	because the project will be less likely to face community
	resistance. The charrette process also encourages
	feedback from local government planners and other
	regulatory agencies in the early stages so that zoning
	consideration are factored in to the site plan well in
	advance.
Design team selection	Usually, the core design team has already been selected
	by this time. Additional experts for technical systems
	may be interviewed and selected.
Construction document	Because the integrated team has participated in the
development	planning and design process, construction documents can
	be developed more efficiently and with little design
	modification.

 Table 2.3: Green Project Management (Source: Laure et al. (2011) (Cont')

Green Project Management Approach
Government stakeholders are involved at earlier stages to
ensure compliance with local, state and federal guidelines
such as wastewater and erosion control.
Reed and Gordon (2000) recommend and 'overhead/fee
bid with an open book subcontracting processes for green
projects. Stipulations for minimum number of bids and
cost savings allocations can also be included. 'Open
book' subcontracting allows the owner to have access to
estimates and pricing submitted by subcontractors.
Contract should include performance agreements,
incentives and bonuses for implementing sustainable
practices and exceeding sustainability goals. Contract
should also include specific provision for green rating
tool assessment, the use of recyclable materials, on-site
recycling requirements and agreements to return unused
materials to vendors among others.
Launch construction with kick-off meeting that includes a
sustainable education component for on-site construction
personnel; monthly on-site meetings are required by
entire site workforce and include periodic education and
training sessions on green building. Sustainability
requirements are reviewed with each subcontractor prior
to commencing work.
At this point, government regulators are working as a
partner in the project, as opposed to an outside influence.

Table 2.3: Green Project Management (Source: Laure et al. (2011) (Con	t')
---	-----

Project Process	Green Project Management Approach
	Less rework and field adjustments decrease the chances
	of having to request reinspections.
Green certification	The ongoing efforts of the project manager, coupled with
	the benefits of an integrated team and specialized
	technology, can make compiling and submitting
	documentation more efficient for the project's schedule
	and budget.
Phase 4: Close out	
Occupancy and	Building commissioning is an essential step in ensuring
operations	the building systems function as intended and set forth in
	the project criteria. The commissioning authority has
	been hired from the onset and understands the owner's
	goals and investments.

Table 2.3: Green Project Management (Source: Laure et al. (2011) (Cont')

2.3.3 Sustainable Rating Tool

2.3.3.1 History

First sustainable rating tool was introduced in year 1990 called Building Research Establishment Environmental Assessment Method or BREEAM in United Kingdom. Until now, 250,000 buildings were assess by BREEAM assessment ratings and over a million registered for assessment since it was launched. Then, this was followed by the French system HQE in 1996 and then by U.S LEED (Leadership in Energy & Environmental Design) in 2000. This rating tool development has grown rapidly as seen in many countries have been developing it. Table 2.4 below shows the rating tools in different country.

Country	Rating Tool	Year
UK	BREEAM	1990
France	HQE	1996
USA	LEED	2000
Japan	CASBEE	2001
Australia	GreenStar	2002
Canada	GreenGlobe	2002
India	LEED India	2005
Singapore	Green Mark	2005
German	DGNB	2006
UAE	LEED Emirates	2006
Poland	GBC	2006
South Africa	GreenStar	2007
Brazil	LEED Brazil	2008
Netherland	BREEAM Netherland	2008
Romania	GBC	2008
Vietnam	GBC	2008
Malaysia	GBI	2009
Malaysia	pH JKR	2012

Table 2.4: Rating Tool

All tools have common objectives which to focus on sustainability in project. Many rating tools have been modified and get influenced by earlier rating model which are BREEAM and LEED (Richard et al., 2009).

From the table above, sustainable rating tool was first introduced in Malaysia in year 2009 known as Green Building Index (GBI) which it is wholly-owned subsidiary of Malaysian Institute of Architects and the Association of Consulting Engineers Malaysia (ACEM). The GBI tool is developed specifically for the Malaysian-tropical climate, environmental and developmental context, cultural and social needs. The aim is to promote sustainability in the built environment and raise awareness among developers, architects, engineers, planners, designers, contractors and the public about environmental issues. The GBI rating tool will help developers and building owners to design and construct green, sustainable buildings that can provide energy savings, water savings, a healthier indoor environment, better connectivity to public transport and the adoption of recycling and greenery for their projects and reduce impact on the environment. (GBI.org, 2013)

2.4 JKR Green Rating Scheme (pH JKR)

Recognizing the importance of sustainable development, JKR as an implementer agency for government project has introduced the JKR Green Rating Scheme (pH JKR) in year 2012. The main objective is to measure the sustainability of a development undertaken by the government. This action is consistent with 10th Malaysia Plan (MP) where one of the main ideas is to appreciate the environment. This also is aligned with JKR Strategic Framework 2012-2015 shown in Figure 2.4 which to produce sustainable infrastructure and development. This rating tool is created to be friendly to government project because the committee is incorporating the government requirement into this rating tool. The government requirement for the project is based on Economic Planning Unit (EPU) guideline.



Figure 2.4: JKR Strategy Map 2012-2015 (Source: JKR Strategic Framework, 2012)

2.4.1 Objective of JKR Green Rating Scheme (pH JKR)

The objectives of JKR Green Rating Scheme (pH JKR) are as follows:

- i. Become a measuring instrument to determine the level of sustainability for government development project
- ii. To facilitate improvements from time to time
- iii. To encouraged sustainable development

2.4.2 Benefits of JKR Green Rating Scheme (pH JKR)

It is expected that by using JKR Green Rating Scheme (pH JKR) in project development will give benefit as below:

- i. Reducing the carbon footprint
- ii. Reduce pollution- greenhouse gas, water and air
- iii. Reduce the use of raw materials
- iv. Produce energy
- v. Reduce water consumption

2.4.3 Evaluation Criteria

According to JKR Green Rating Scheme Manual (2012), there are six (6) main criteria to be evaluated to determine the level of sustainability. Criteria

developed are includes the planning stage, design stage, site management and also element of innovation of a project.

2.4.3.1 Sustainable Site Planning and Management

Most of the government project sites have been identified in advance. The selection freedom is quite limited. However, the selected sites are needed to be managed and need to minimize the impact on the environment during the construction period. Earthworks, erosion and sediment control and storm water management should be carried out in a sustainable manner. Rehabilitation and preservation of the environment also should be considered.

2.4.3.2 Energy Efficiency Management

Energy efficiency can be improved optimizing the orientation, facade and roof design. The use of natural daylight and renewable energy is one of effective strategies. Control of external air from infiltrate into the building will also increase the energy efficiency of the buildings.

2.4.3.3 Indoor Environmental Quality Management

Indoor environments quality can be enhanced by planning and manage the space systematically, the use of daylight, natural ventilation, thermal comfort, visual and acoustic as well as good air quality.

2.4.3.4 Resources and Materials Management

Encourage the use of green-rated materials by a recognized body. Expanding the use of IBS which clearly has many advantages in terms of sustainability. Solid waste management should also be considered.

2.4.3.5 Water Efficiency Management

Encourage reuse water and rain water while save water by using water efficiency products to reduce dependence on treated water. The management of water consumption and leakage should also be considered.

2.4.3.6 Innovation

Initiatives and innovative designs in line with the government's mission.

2.4.4 JKR Green Rating Scheme Point and Rating Classification

The point of each criteria and rating classification are presented in Table 2.5 and Table 2.6 below:

No.	Criteria	Point	Percentage (%)
1.	Sustainable Site Planning	22	19
	and Management		
2.	Energy Efficiency	43	37
	Management		
3.	Indoor Environmental	26	23
	Quality Management		
4.	Resources and Materials	8	7
	Management		
5.	Water Efficiency	10	9
	Management		
6.	Innovation	6	5
	Total	115	100

Table 2.5: JKR Green Rating Scheme Point (Source: JKR Green Rating Scheme Manual, 2012)

 Table 2.6: Rating Classification (Source: JKR Green Rating Scheme Manual, 2012)

Percentage (%)	Star	pH JKR Rating
40-49	* *	Potential Recognition
50-69	* * *	Best Management Practices
70-84	* * * *	National Excellence
85-100	** * * *	Global Excellence

2.4.5 Comparison between Sustainable Rating Tools

It is accepted that the current era of rating tools commenced in 1990 with the introduction of BREEAM rating tool in U.K (Richard *et al.*, 2009). After that, many rating tools have been modified and adopted from earlier models that generally developed in other countries (Richard *et al.*, 2009). Richard et al. (2009) also conclude that the country where it has sustainable rating tools is considered as good in economy and the property market is well expanding. Each sustainable rating tool is quite different from each other because of different policies and regulation set by the government (Richard et al., 2009). Table 2.7 and Table 2.8 below show the comparison between BREEAM, Green Mark and pH JKR. BREEAM is selected because it is the first sustainable rating tool in the world and Green Mark is selected because Singapore is the first country in South East Asia to introduce the sustainable rating tool.

	BREEAM	Green Mark	GBI	pH JKR
Country	United	Singapore	Malaysia	Malavsia
	Kingdom	8 B T		
Owner	BRE Global	Building and	Pertubuhan	Jabatan Kerja
	Limited - An	Construction	Arkitek	Raya
	independent	Authority	Malaysia &	Malaysia,
	third party	(BCA),	Association of	Ministry of
	approvals	Ministry of	Engineers	Works
	body offering	National	Consulting	Malaysia
	certification of	Development	Malaysia	
	fire, security	Singapore	(ACEM)	

Table 2.7. Comparison of DICLEAW, Oreen Mark, ODI and pit J	1 able 2.7:	: Comparison	1 OI BREEAM,	Green Mark,	GBI and	рн укі
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	BREEAM	Green Mark	GBI	pH JKR
	and			
	sustainability			
	products and			
	services to an			
	international			
	market.			
Lounah	1000	2005	2000	2012
Date	1990	2003	2009	2012
Ratings	Outstanding >	Platinum >	Platinum > 86%	Global
Kuthigs	85%	90%		Excellence \geq
	Excellent >	GoldPlus >	Gold > 76%	85%
	70%	85%		
	Very Good \geq	Gold \geq 75%	Silver $\geq 66\%$	National Excellence \geq
	3370	Certified \geq		70%
	$Good \geq 45\%$	50%	Certified $\geq 50\%$	
	12 /0			Best
	$Pass \ge 45\%$			Management Practices \geq
	Unclassified <			50%
	30%			
				Potential
				$\begin{array}{c} \text{Recognition} \geq \\ 40\% \end{array}$
Assessment	Yes	Yes	Yes	No
Fees	100	105		110

Table 2.7: Comparison of BREEAM, Green Mark, GBI and pH JKR (Cont')

BREEAM (UK)	Green Mark (SINGAPORE)	GBI (MALAYSIA)	pH JKR (MALAYSIA)
• Management	• Energy	• Energy	Sustainable Site
• Health and	Efficiency	Efficiency	Planning and
wellbeing	• Water	• Indoor	Management
• Energy	Efficiency	Environmental	• Energy Efficiency
• Transport	• Environmental	Quality	Management
• Water	Protection	• Sustainable	• Indoor
• Materials	• Indoor	Site Planning	Environmental
• Waste	Environment	and	Quality
• Land use &	Quality	Management	Management
Ecology	• Other Green	• Materials and	• Resources and
• Pollution	Features and	Resources	Materials
• Innovation	Innovation	• Water	Management
		Efficiency	• Water Efficiency
		• Innovation	Management
			• Innovation

Table 2.8: Comparison of Assessment Criteria

CHAPTER 3

METHODOLOGY

3.1 Introduction

In this chapter will be explained the process of collecting data in order to get the relevant information. The methodology must be systematic, effective and efficient in order to achieve the research objectives. A comprehensive literature review is also very important to support the methodology.

Three methods are used for data collection process such as interview, distribution of questionnaire and collecting of existing data. Data collection methods for each objective are different accordingly. Further explanation will be made in the next section. Data analysis process is carried out after completed data is obtained. The research flow chart is presented in Figure 3.1 below.



Figure 3.1: Research Flow Chart

3.2 Research Method

The methodology used in this study is summarized as per Table 3.1 below.

	Objectives		Tasks		Methodology
1.	To determine current	1.	To understand the	1.	Literature review-
	understanding level		sustainable concept.		Review related
	within JKR staffs				research papers,
	regarding on JKR	2.	To review sustainable		journals, books and
	Green Rating Scheme		rating tools from		website.
	(pH JKR)		other country.		
	implementation and			2.	Interview with the
	Green Project	3.	To gather information		responsible officer
	Management		related to JKR Green		who monitor JKR
	approach		Rating Scheme (pH		Green Rating
			JKR) and Green		Scheme (pH JKR) -
2.	To identify factors		Project Management		Environment and
	that affects the		approach.		Energy Branch JKR
	implementation of				
	JKR Green Rating			3.	Distribute survey
	Scheme (pH JKR)				questionnaire to
					Head of Project
3.	To develop Green				Team (HOPT) and
	Project Management				Head of Design
	Framework for JKR				Team (HODT) at
					JKR Headquarters
				4.	Process of
					collecting data for
					case study

 Table 3.1: Research Methodology

3.2.1 Literature Review

To ensure well-executed study, reading journals, articles, thesis and documents related to sustainable and green rating tool have been made in order to obtain accurate information.

Literature review will ease in defining the topic, study background, prepare questionnaire and process of interview.

3.2.2 Data Collection and Interview

This study involved case study which the purpose is to explain pH JKR implementation in the project. The related data such as project scope, project team, project implementation and element of green for the project is gathered. Besides that, interview session is conducted with responsible officer who manage and monitor the pH JKR. Through interview, factors that affect implementation of the tool were discussed.

3.2.3 Questionnaire

A set of questionnaire is prepared. The main purpose is to determine understanding level pH JKR among staffs. To ensure the questionnaire to meet research objectives, it was verified by senior officer who part of pH JKR committee members. The purpose is to examine and identify the weakness before it is distributed to JKR staff at headquarters level.

Generally, the questionnaire is designed to ensure it meet the research objectives. The survey form is divided into four sections which consist of open ended and closed ended questions. For open ended questions, respondents can fill up the form based on their opinion and closed ended questions are based on 5-point likert scale rating which are easy and straightforward.

Background of respondents was also collected. They need to answer related questions such as working experience, profession and nature of their work. There is also a question related to respondent experience in applying pH JKR to their project.

3.2.3.1 Pilot Test

The questionnaire was reviewed in advance by experts to ensure the questions posed to meet the objectives of the study and easily understood by targeted respondents. This process is very important to ensure the question and the data collected is accurate and align with the research objective. The survey form is distributed to two personnel in September 2013 who has experiences in managing and design building project. One of the experts is a committee member of pH JKR. Their comments as per Table 3.2 below:

 Table 3.2: Comments by Experts

Expert 1	Expert 2
a. Check the suitability of asking	a. Rearrange questions sequence
respondents position grades	b. Include more factors in question
b. To review back question no 6 and 10 in	no. 1, Section D
Section B	c. Rephrases back few questions
	d. Add a new question in Section B

3.3 Population and Sample Size

One of research method is to distribute survey forms in order to collect relevant data. Determination of size samples is very crucial to ensure the data

Table 3.3: Relationship between Population and Sample Size (Source: Krejcie &Morgan, 1970)

N	S	N	S	N	S
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	34
80	66	420	201	3500	340
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	1000000	384



Figure 3.2: Relationship between Population and Sample Size (Source: Krejcie & Morgan, 1970)

3.3.1 Project Management Overview in JKR

In this study, respondents were among officers in project management and design office at JKR headquarters level who involve in building project only. Generally, there are five branches in JKR that involve in project management activities for building project i.e. General Building Works Branch, Health Works Branch, Security Works Branch, Education and Higher Learning Works Branch and Airbase and Maritime Works Branch. Each branch is managing the project received from related ministry. This project management office is also known as Head of Project Team (HOPT).

For building design activities, there are five main branches involve which are Architect Branch, Road and Geotechnical Branch, Civil, Structure and Bridge Branch, Mechanical Engineering Branch, Electrical Engineering Branch and Quantity Survey Branch. This design office is also known as Head of Design Team (HODT). Each HODT will be appointed by HOPT when they are required to do the design works.

Tender will be called at JKR headquarters after completion of design activities. After tender evaluation process, contractor will be appointed to carry out the works. Then, the project will be delegated to JKR State or JKR District as Supretendant Officer (S.O) to monitor the work performs by the contractor at site.



Figure 3.3: JKR Organization Chart (Source: JKR Strategic Framework 2013-2015)

3.3.2 Target Respondent

Due to large number of population and time constraint, the survey form is only distributed to a project management and four design offices. The target respondents are as per Table 3.4 below:

 Table 3.4: List of Respondents

Project Management Office (HOPT)	Design Office (HODT)
1. Building Works Branch	1. Architect Branch
	2. Civil, Structure and Bridge Branch
	3. Electrical Engineering Branch
	4. Mechanical Engineering Branch

Targeted respondents are those involved in general building project at JKR headquarters. Building Works Branch is selected due to the largest branch for project management activities at JKR headquarters. Survey form also distributed to four main design offices which act as supporting offices for technical design for the building project.

3.3.2.1 Building Works Branch

Building Works Branch is the largest branch of project management office in JKR headquarters and is led by Senior Director. These branches provide services of project management and technical support to 19 ministries and related agencies. Among their customer are Prime Minister's Department, Ministry of Youth and Sports, Ministry of Transport and the Ministry of Finance. In 2012, they had received a total of 232 projects. Total of 127 projects have been completed and the rest are still in the implementation stage either in design or construction stage.

3.3.2.2 Architect Branch

Main duty of this branch is to provide input and expert services in the implementation of various building and facility design for the project. In project design process, architect will lead the design team (HODT) to ensure technical aspects and requirements are aligned with each other. Architect also responsible for obtaining approval from local authority before commencing construction of a project

3.3.2.3 Civil, Structure and Bridge Branch

This branch serves as designer for civil works and structure works for projects. In addition, it is also involved with bridges design and structures forensic works. This branch is led by Senior Director. In general, the branch is divided based on design activities i.e. civil, structure and bridge. Every design unit will be appointed as project designer from various Head of Project Team (HOPT). In year 2012, this branch had received a total of 723 projects. Total of 467 projects have been completed and the rest are still in the design stage.

3.3.2.4 Electrical Engineering Branch

This branch is led by Senior Director which their main service is to provide technical design for electrical works for building project and road project. In year 2012, this office has received a total of 383 projects. This branch also has offices in each state which aim to focus on maintenance of the state-owned electrical equipment such as street lights, traffic lights and electrical equipment at government buildings.

3.3.2.5 Mechanical Engineering Branch

Main function of this branch is to provide technical design for mechanical works for building project. Besides that, they are also responsible in purchasing and inspection of vehicles and machineries for JKR and other government agencies. This branch is led by Senior Director. In year 2012, they had implemented 162 projects and also 810 for mechanical services specialist projects.

3.4 Case Study

This research also includes process of data collection through case study. Interviews were made in conjunction with representatives of Environmental and Energy Branch as a department that is responsible in monitoring the implementation pH JKR. Information related to projects that adopt this tool is obtained to further strengthen this study. Detailed explanation of case studies is described in Chapter 5 of this report.

3.5 Data Analysis and Interpretation

After received back the survey form from respondents, the data received is gathered and compiled together in order to answer the research objectives. Analysis of data was done by using statistical method such as frequency analysis and average index analysis.

3.5.1 Frequency Analysis

Frequency analysis is defined as the number of time the event occurred in an experiment or study. These frequencies are often graphically represented in histogram or pie chart and the value is in form of frequency number or percentages according to total respondents (Noraziah, 2008).

3.5.2 Average Index Analysis

The collected data were analysed using Average Index Analysis method. Several questions were provided to determine agreement level, knowledge level and importance level. Based on likert scale, average index for each variable was calculated by using method proposed by Abd Majid and McCaffer (1997) as follows:

Average Index (I) =
$$\frac{\sum ai \cdot xi}{\sum xi}$$

 $\begin{array}{rll} \mbox{Where:} & a_i & = & \mbox{Index of a class} \\ & x_i & = & \mbox{Frequency of response} \end{array}$

 Table 3.5: Rating Classification (Source: Abd Majid & McCaffer, 1997)

Average Index	Classification	
$4.50 \le I \le 5.00$	Very Important / Very High / Strongly Agree	
$3.50 \le I < 4.50$	Important / High / Agree	
$2.50 \le I < 3.50$	Moderate / Medium / Fair	
$1.50 \le I < 2.50$	Less Important / Low / Disagree	
$1.00 \le I < 1.50$	Not Important / Very low / Strongly Disagree	

CHAPTER 4

ANALYSIS AND DISCUSSION

4.1 Introduction

This study is only focus on the office performing project management (HOPT) and design activity (HODT) for building project in Jabatan Kerja Raya headquarters only. A set of questionnaire was distributed to respondents from engineer, architect and others in process of obtaining valuable data.

4.2 Response Rate

About 120 of questionnaires were distributed personally and sent via email to project management office and project design office from 27 September 2013 until 11 October 2013. From the amount, a total of 41 completed forms were returned and the rest were unreturned. Table 4.1 and Table 4.2 below show the breakdown of total responses for this study.

Status	Frequency	Percentage (%)
Returned		
a. Complete Form	41	34.2
b. Incomplete Form	0	0
Unreturned	79	65.8
Total	120	100

Table 4.1: Total Number of Responses

 Table 4.2: Respondents

Branch	Frequency	Percentage (%)	
Building Works Branch	11	26.8	
Architect Branch	4	9.8	
Civil, Structure and	18	43.9	
Bridge Branch	10	1017	
Electrical Engineering	3	7.3	
Branch	U U		
Mechanical Engineering	5	12.2	
Branch			
Total	41	100	

4.3 **Respondents Profile**

Respondents were asked about their employment background. Some of related questions are their current office, work experiences, job title and grade and job responsibility. The analysis of respondents' background is tabulated in Table 4.3 and Figure 4.1 below.

Grade	Frequency	Percentage (%)		
Professional Group				
JUSA	0	0		
54	3	7.3		
52	3	7.3		
48	8	19.5		
44	6	14.6		
41	12	29.3		
	Implementer Group			
38	0	0		
36	1	2.4		
29	3	7.3		
26	1	2.4		
22	2	4.9		
17	2	4.9		
Total	41	100		

Table 4.3: Respondents' Current Position

From the table above, it shows that the majority respondents are from professional group which consist of 78% from the total respondents. Based on position grade, the majority respondents are from grade 41.



Figure 4.1: Group of Respondent

The background of respondents were analysed through their working experiences. The finding is tabulated in Table 4.4 below where majority of respondents have working experiences between 5 to 9 years.

Experience	Frequency	Percentage (%)
4 years & Below	3	7.3
5-9 years	20	48.8
10 – 14 years	6	14.6
15 – 19 years	2	4.9
20 – 24 years	5	12.2
25 years & Above	5	12.2
Total	41	100

 Table 4.4: Respondents' Working Experiences

Table 4.5 below shows that the majority of respondents are involve in project design activity and the second highest are from project management activity.

 Table 4.5: Respondents' Nature of Works

Nature of Work	Frequency	Percentage (%)
Project Management	9	21.9
Project Design	29	70.7
Project Supervision	2	4.9
General Management	1	2.4
Total	41	100

4.4 Reliability Test

The purpose of reliability test is to measure the consistency of the data obtained by using Cronbach's alpha value. According to Mohsen and Rag (2011), reliability is concerned with the ability of an instrument to measure consistently. The acceptable value is ranging as per below (Hair et.al, (2007)):

i.	Less than 0.6	-	Poor
ii.	0.6 to < 0.7	-	Moderate
iii.	0.7 to < 0.8	-	Good
iv.	0.8 to < 0.9	-	Very Good
v.	≥ 0.9	-	Excellent

A poor alpha value could be due to a low number of questions, poor interrelatedness between items or heterogeneous constructs. By using SPSS, the Cronbach's alpha value for this study is 0.9.

4.5 Analysis and Results

4.5.1 Research Objective: Current Understanding Level of pH JKR

The first objective of this research is to determine current understanding level within JKR staffs regarding JKR Green Rating Scheme (pH JKR) implementation. Questions related to this objective are placed in Section B in the questionnaire consist of 10 questions.

For the first and second question, respondents were asked about the existence of JKR Green Rating Scheme (pH JKR) and their views on the measure taken by department to introduce this scheme. From the Table 4.6 below, it shown that majority of respondents knew the existence of pH JKR. Only 2% of respondents didn't know about pH JKR. Even though the percentage is very low, it is quite surprise to know that several staffs at headquarters didn't aware of pH JKR. Probably, this is due to no involvement in projects that require applying pH JKR.

All respondents also agreed with the introduction of pH JKR with an average index of 3.95 as shown in Table 4.7. From the result, 71% of respondents are agree with the step taken by JKR to introduce pH JKR. Only 29% of respondents chose scale 3 (Fair).

Table 4.6: Response on the Existence of pH JKR

Response	Frequency	Percentage (%)
'Yes'	39	98
'No'	2	2
Total	41	100

Table 4.7: Respondents' Agreement on Introduction of pH JKR

		No. o	of Respon	Total	Average			
Criteria	Scale					(N)	Index	Rating
	1	2	3	4	5	(14)	(Mean)	
Level of	0	0	12	19	10	41	3.95	Agree
agreement		-						

(1) Strongly Disagree (5) Strongly Agree

Std. Deviation=.73997

Regarding respondents' level of knowledge, they also were asked a few related questions. From the Table 4.8 and Figure 4.2 below, the result indicates that respondents have a medium knowledge of pH JKR with average index of 2.78 and their main source of knowledge is from JKR Green Rating (pH) Scheme Manual. A few respondents also informed that they gain pH knowledge from 'others' source which are through discussion during project coordination meeting, discussion with colleagues and from JKR Website. According to JKR Strategic Framework 2013-2015, it stated that the concept of sustainability in JKR is still new. So, it is

acceptable when the finding shows that the respondents' knowledge on pH JKR is at medium level only.

Criteria	No. of Respondent Scale					Total (N)	Average Index	Rating
	1	2	3	4	5	(14)	(Mean)	
Level of knowledge	4	6	26	5	0	41	2.78	Medium

|--|

(1) Very Low (5) Very High

Std Deviation=.79095



Figure 4.2: Source of Knowledge

Based on the survey conducted, it is clearly shows that only 71% of respondents applied pH JKR to their project. This is a good indicator when more than 50% of respondents have used the tool. The result is indicated in table below.

Response	Frequency	Percentage (%)
Apply pH JKR	29	71
Not Apply pH JKR	12	29
Total (N)	41	100

Table 4.9: pH JKR in Project

According to Figure 4.3, 38% of respondents indicated that they applied pH JKR in their projects based on instruction by Head of Project Team (HOPT). Several respondents also mention that they applied pH JKR based on client request (24%), by Head of Design Team (22%) and Own Initiatives (8%). A few respondents also inform that they applied pH JKR when there is a requirement from local authority which fall under 'others' category. According to Environment and Energy Branch representative who involves in monitoring pH JKR implementation, HOPT is a responsible party in initiating pH JKR to their projects.



Figure 4.3: Responsible Party for initiating pH JKR

In addition, 43% of respondents agreed that Head of Project Team (HOPT) is responsible to set sustainability as one of project objectives. This is based on the feedback received and are shown in Figure 4.4. 35% of respondents also think that clients should make sustainability as one of the project objectives. However, 10% of

respondents think that government should introduce a policy to ensure sustainability is part of project objectives (others category). Through government, they also suggest that JKR as an implementer agency should ensures sustainability is part of the project objectives. Regarding to the policy, JKR has introduced Green Mission Policy in year 2008 which focus on the protecting the environment during construction period. In year 2012, JKR has established Sustainable Development Committee which main objective is to produce sustainable development action plan for department. From this, we can conclude that JKR already have policies but due to no publicity and awareness program, some of staffs still don't aware about the policy. This can be proven when respondents still expressed the need for specific policy to implement sustainable development project.



Figure 4.4: Responsible Party for Including Sustainability as a Project Objective

Results in Table 4.10 shows that all respondents agreed that pH JKR will lead benefit to projects with an average index of 4.05.

		No. o	f Respon	Total	Average			
Criteria	Scale					(\mathbf{N})	Index Rati	Rating
	1	2	3	4	5	(11)	(Mean)	
Level of agreement	0	0	9	21	11	41	4.05	Agree

 Table 4.10:
 Benefit of pH JKR

(1) Strongly Disagree (5) Strongly Agree

Std Deviation=.70538

Figure 4.5 and 4.6 show the advantages and disadvantages of applying pH JKR to the project. Majority of respondents believe that by implementing pH JKR will reduce effect on environment during project implementation (31%) and they also believe that by using pH JKR will increase project cost (37%). These findings are slightly different with research conducted by McGraw Hill Construction (2006) when the results showed that 54% of respondents stated green projects can reduce energy costs and only 24% of respondents stated green project could have a positive effect on the environment. In term of cost, the result is aligns with this study where higher initial cost is the greatest obstacle in implementing green project.

Respondents chose environmental protection over the future of the cost savings may be due to no JKR sustainable projects have been completed yet and can be experienced by respondents themselves.


Figure 4.5: Advantages of pH JKR Implementation



Figure 4.6: Disadvantages of pH JKR Implementation

4.5.2 Research Objective: Level of Understanding on Green Project Management

The second objective of this research is to determine the level of understanding within JKR staffs on the 'Green Project Management' concept. Questions related to this objective are placed in Section C in questionnaire consisting of 5 questions. There is also question related to project life cycle.

At the first place, respondents were asked on the concept of green project management. From the survey, 59% of respondents are not aware with green project management approach and their level of knowledge is at low level. This result is tabulated in Figure 4.7 and Table 4.11 respectively. It is acceptable when respondents' knowledge at low level because currently JKR didn't apply Green Project Management approach in managing projects.



Figure 4.7: Awareness on Green Project Management

Criteria		No. o	f Respor	ndent		Total	Average Index	Rating
	1	2	3	4	5	(11)	(Mean)	
Level of knowledge	9	17	11	4	0	41	2.24	Low

Table 4.11: Knowledge on Green Project Management

(1) Very Low (5) Very High

Std Deviation=.99509

From Table 4.12, majority of respondents were agreed that by using pH JKR will lead to green project management approach. This is proved by high rating of average index score.

Criteria		No. 0	f Respon	ndent		Total	Average Index	Rating
	1	2	3	4	5		(Mean)	
Level of agreement	0	0	19	21	1	41	3.56	Agree

Table 4.12: pH JKR lead to Green Project Management

(1) Strongly Disagree (5) Strongly Agree

Std Deviation=.63149

Majority of the respondents also agreed that by incorporating pH JKR with project life cycle process will lead to green project management approach. The result is tabulated in Table 4.13.

Criteria		No. of Respondent Scale				Total	Average Index	Rating
	1	2	3	4	5	(11)	(Mean)	
Level of agreement	0	0	18	21	2	41	3.61	Agree

Table 4.13: Incorporating pH JKR with Project Life Cycle

(1) Strongly Disagree (5) Strongly Agree

Std Deviation=.58121

In order to define which activity can be carried out in each phase of project life cycle in achieving green approaches during project management activities performed, respondents were asked on the importance of each activity to be undertaken and the results are as follows:

i. Initiating Phase

a. Budget allocation toward green initiative

From Figure 4.8, it shows almost 73% of respondents agreed that financial allocation towards green initiatives is important to give consideration at the initiating phase. The average index score is 4.07 as shown in Table 4.14. Yuan et al (2011) had also identified adequate budget is one of the critical success factors for green project. Project manager should advise their client to ensure they are ready to provide some allocations for green elements and features in their project.

Criteria		No. of Respondent Scale					Average Index	Rating
	1	2	3	4	5	(11)	(Mean)	
Level of importance	0	0	11	16	14	41	4.07	Important



(1) Not Important (5) Highly Important

Std Deviation=.75789



Figure 4.8: Financial Allocation towards Green Initiative

b. Sustainable element must clearly define in project scope

Figure 4.9 shows that 88% of respondents were agreed that it is important to ensure the element of sustainable must clearly define in project scope. The average index score is 4.32 as shown in Table 4.15. When this element is clearly defined in project scope, it will help the project manager to prepare cost budgeting for related green elements and features. Mehmet and Clayton (2010) expressed the importance of scope verification which project team need to determine the level of commissioning, formulate green team, understand the building specifics and requirements and finally to determine the level of green commitment for the project.

Criteria		No. of Respondent Scale					Average Index	Rating
	1	2	3	4	5	(N)	(Mean)	D
Level of importance	0	0	5	18	18	41	4.32	Important



(1) Not Important (5) Highly Important

Std Deviation=.70797



Figure 4.9: Sustainable Element in Project Scope

c. Site characteristics consideration

In term of site characteristic consideration, 76% of respondents were agreed that it is important to give consideration. Only 2% of respondents think that this element is less important to give attention. This is shown in Figure 4.10. The average index score is 4.07 as per Table 4.16. It is important to determine the characteristic of site where it will help the design team in make decision. For example, if the site is at hilly place, it is important for the designer to provide slope protection.

	No. of Respondent					Total	Average	De t ier e
Criteria	1	2	Scale 3	4	5	(N)	(Mean)	Kating
Level of importance	0	1	9	17	14	41	4.07	Important

Table 4.16: Consideration of Site Characteristic

(1) Not Important (5) Highly Important

Std Deviation=.83081



Figure 4.10: Consideration of Site Characteristic

ii. Planning Phase

a. Sustainable is one of project objectives

Figure 4.11 shows that 78% of respondents were agreed that it is important to include sustainable as part of project objectives. The average index score is 4.07 as shown in Table 4.17. Lapinski et al (2006) expressed there is a need to adopt sustainable objectives at the very early stage. This will give a clear understanding to

project team and generate support from top management. In addition, sustainable objective at early stage will give a clear direction to project team

Criteria		No. of Respondent Scale					Average Index	Rating
	1	2	3	4	5		(Mean)	
Level of importance	0	1	8	19	13	41	4.07	Important

Table 4.17: Sustain	able as	s Proiec	t Obiectiv	ve
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(1) Not Important (5) Highly Important

Std Deviation=.76827



Figure 4.11: Sustainable as Project Objective

b. Project team selection with good competency and experience in green building project

Figure 4.12 shows that 78% of respondents were agreed that it is important to ensure project team members have good experiences in implementing green building project. Only 29% of respondents agreed that this requirement is highly important. The average index score is 4.05 as shown in Table 4.18. Research by Ahadzie (2007)

revealed that there is a relation between project success and competency. Competent project manager is a key personal for project success. Study by Frank (2002) proved that project manager has direct influence over 34 - 47% of project success. Skill workforce and training are important factors for project team successful (Peng & Sui, 20120). Experiences project team member will generate more practical ideas and possess a better understanding (Mehmet & Clayton, 2010).

 Table 4.18: Project Team Experiences in Green Building Project

		No. o	f Respo	ndent		Total	Average	
Criteria			Scale			(N)	Index	Rating
	1	2	3	4	5		(Mean)	
Level of importance	0	1	8	20	12	41	4.05	Important

(1) Not Important (5) Highly Important

Std Deviation=.77460



Figure 4.12: Project Team Experiences in Green Building Project

c. Obtain opinion from key stakeholders including surrounding property owner at the proposed project site

The average index of these criteria is 3.80 which is important to give consideration. Only 7% of respondents think that this criteria is less important. The result is tabulated in Table 4.19 and Figure 4.13. Early involvement from key project participants will affect the project outcomes (Sinem et. al, 2009). Yuan et. al.(2011) also confirmed that commitment of all project participants is one of the critical project management factors for green project. Public engagement is one of the methods to gather information from stakeholders. Stakeholders' important decision will affect the entire project implementation.

	No. of Respondent					Total Average		
Criteria			Scale			(\mathbf{N})	Index	Rating
	1	2	3	4	5	(11)	(Mean)	
Level of importance	0	3	9	22	7	41	3.80	Important

Table 4.19: Key S	Stakeholders	Opinion
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(1) Not Important (5) Highly Important



Figure 4.13: Key Stakeholders Opinion

iii. Execution Phase

a. Using green rating tool such as Skim Penarafan Hijau (pH) JKR as a guideline in design stage

Figure 4.14 shows that 86% of respondents were agreed that it is important to apply green rating tool in design stage in order to achieve green project management approach. The average index score is 4.22 as per Table 4.20. By using green rating tool, it will regulate impacts to activities in construction and also channel construction into sustainable direction (Ruffina and Vikki, 2011)

Table 4.20:	Green	Rating	Tool
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		No. o	f Respo	ndent		Total	Average	
Criteria			Scale		(N)	Index	Rating	
	1	2	3	4	5	(1)	(Mean)	
Level of importance	0	0	6	20	15	41	4.22	Important

(1) Not Important (5) Highly Important



Figure 4.14: Green Rating Tool

b. Contract should include performance agreement and incentive for implementing sustainable practice and exceeding sustainable goal

Figure 4.15 shows that 78% of respondents were agreed that performance agreement incentive is important in order to achieve green project management approach in execution phase. Only 5% of respondents think that this criteria is less important while 17% of respondents are in neutral position. The average index score is 4.07 as shown in Table 4.21. Sinem et. al (2009) suggested to include green element in contracts (contract condition) which it will give positive influence to project performance. Project team strategy, contracting approaches and incentive are key project delivery practices for green building project (Sinem et. al, 2009).

 Table 4.21: Performance Incentive

Criteria		No. o	f Respo Scale	ndent		Total (N)	Average Index	Rating
	1	2	3	4	5	(1)	(Mean)	
Level of importance	0	2	7	18	14	41	4.07	Important

(1) Not Important (5) Highly Important



Figure 4.15: Performance Incentive

c. The use of recycle material at project site

From Figure 4.16, in term of material usage, 71% of respondents were agreed that there is important to use recycle material at project site. Only 5% of respondents think that this element is less important to give attention. The average index score is 3.88 as per Table 4.22. Adopting materials with recycled contents is one of the relevant steps to be taken (Peg and Sui, 2010). Besides that, managing equipment and material through JIT concept (Just in Time) in green building construction can save energy and cost (Peg and Sui, 2010).

Table 4.22: Recycle Material

Criteria		No. o	f Respo Scale	ndent		Total	Average Index	Rating
	1	2	3	4	5	(N)	(Mean)	
Level of importance	0	2	10	20	9	41	3.88	Important

(1) Not Important (5) Highly Important



Figure 4.16: Recycle Material

d. Implement best management practice (BMPs) in protecting environment during construction phase

Figure 4.17 shows that 83% of respondents were agreed that it is important to implement best management practices. Only 17% are in the neutral position. The average index score is 4.17 as per Table 4.23. According to Manual Mesra Alam Malaysia (2012), BMPs can be used to reduce environment impact from development project. BMPs such as storm water quality control facility and sediment control should be planned, analyzed and designed for all project development and it must follow requirements and guidelines imposed by the authority.

Fable 4.23 :	Best	Management	Practices
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		No. o	f Respo	ndent	Total	Average		
Criteria	1	2	3	4	5	(N)	Index (Mean)	Rating
Level of importance	0	0	7	20	14	41	4.17	Important

(1) Not Important (5) Highly Important



Figure 4.17: Best Management Practices

e. Sustainable education component for site personnel

Figure 4.18 shows that 86% of respondents were agreed that it is important to provide sustainable education component for site personnel. The average index score is 4.22 as per Table 4.24. Skilled workforce is a must to ensure project success. Training is required to increase awareness of sustainable construction among project team and it will helps to reduce waste during project implementation (Peng and Sui, 2010).

 Table 4.24:
 Sustainable Education Component for Site Personnel

Criteria		No. o	f Respo Scale	ndent		Total	Average Index	Rating
	1	2	3	4	5	(N)	(Mean)	
Level of importance	0	0	6	20	15	41	4.22	Important

(1) Not Important (5) Highly Important



Figure 4.18: Sustainable Education Component for Site Personnel

iv. Monitor and Control Phase

a. Site monitoring and assessment using green rating tool

Figure 4.19 shows that 73% of respondents were agreed that it is important to implement site assessment during monitor & control phase. The average index score is 4.05 as per Table 4.25. Green rating tool is useful to ensure green criteria required are achieved and properly recorded (Mehmet et. al, 2010). This will assist project team during certification process.

Table 4.25: Site Monitoring and Assessmen	ıt
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Criteria		No. 0	f Respo Scale	ndent	Total (N)	Average Index	Rating	
	1	2	3	4	5	(11)	(Mean)	
Level of importance	0	0	11	17	13	41	4.05	Important

(1) Not Important (5) Highly Important



Figure 4.19: Site Monitoring and Assessment

b. Compiling the related document for green certification

From Figure 4.20, it shows that 78% of respondents were agreed that there is important to compile related documents for green certification. The average index score is 4.02 as per Table 4.26. Peng and Sui (2010) mentioned one of requirement to achieve effective project management for green building project is to receive feedback and prepare documentation for continuous improvement. Good documentation also will assist project team during certification process.

Table 4.26: Compiling Related Documents for Green Certification

Criteria		No. 0	f Respo Scale	ndent		Total	Average Index	Rating
	1	2	3	4	5	(11)	(Mean)	
Level of importance	0	0	9	22	10	41	4.02	Important

(1) Not Important (5) Highly Important



Figure 4.20: Compiling Related Documents for Green Certification

v. Closed Phase

a. Sustainable education component for client as end user for the project

Figure 4.21 shows that 81% of respondents were agreed on the important of sustainable education component for end-user in order to achieve green project management approach. The average index score is 4.10 as shown in Table 4.27. Several green buildings are installed with equipment in order to meet the green requirement such as rainwater harvesting system, energy efficiency bulb and solar panels. With this equipment, it is important to educate end user and maintenance team on how to operate such equipment. This is important to ensure end user to understand and follow the sustainable operating conventions (Pui and Sui, 2010). As known, normally there will be a post rating evaluation after project completed and this will continue every two years for purpose of renewing the rating certification.

 Table 4.27: Sustainable Education Component for End-User

Criteria		No. o	f Respo Scale	ndent		Total	Average Index	Rating
	1	2	3	4	5	(N)	(Mean)	8
Level of importance	0	1	7	20	13	41	4.10	Important

(1) Not Important (5) Highly Important



Figure 4.21: Sustainable Education Component for End User

4.5.3 Research Objective: Factors that affect pH JKR Implementation

The third objective of this study is to identify factors that affect the implementation of JKR Green Rating Scheme (pH JKR). In the questionnaire, several factors were listed where respondents had to state their level of agreement on a scale of 1 to 5 for each factor. From Table 4.28 and Figure 4.22, it found that the majority of respondents agreed with the list of factors that affect the implementation of pH JKR.

		Ι	No. of	Resp	onden	t		Average		
No.	Factor			Scale			(N)	Index (Mean)	Rating	
		1	2	3	4	5				
A.	Lack of understanding on the sustainable concept	0	1	7	24	9	41	4.00	Agree	
B.	Lack of budget	0	0	7	17	17	41	4.24	Agree	
C.	Low staff competency	0	0	14	22	5	41	3.78	Agree	

 Table 4.28: Factors that affect pH JKR implementation

(1) Strongly Disagree (5) Strongly Agree

		Γ	No. of	Resp	onden	t		Average	
No.	Factor			Scale			Total (N)	Index	Rating
		1	2	3	4	5	(14)	(Mean)	
D.	Clients' understanding and awareness on sustainable concept	0	1	11	19	10	41	3.93	Agree
E.	Lack of monitoring and supervision at construction stage by JKR project team	0	3	18	16	4	41	3.51	Agree
F.	Lack of monitoring at design stage	0	4	22	14	1	41	3.29	Fair
G.	Resistancetochangeandinnovation	0	5	15	15	6	41	3.54	Agree
H.	Sustainable element not include in project objectives	0	3	15	17	6	41	3.63	Agree
I.	Designers have no skills and knowledge in using Green Rating Scheme (pH JKR)	0	2	15	16	8	41	3.73	Agree
J.	Low promotional and awareness activities	0	0	12	20	9	41	3.93	Agree
K.	Lack of expert in pH JKR	0	1	17	16	7	41	3.71	Agree
L.	Low commitment from HOPT	0	5	23	8	5	41	3.32	Fair
M.	Low commitment from HODT	0	7	23	7	4	41	3.20	Fair
N.	Low commitment form contractor	0	1	16	18	6	41	3.71	Agree
O.	Lack of experience in implementing sustainable project (Green Building Project)	0	1	9	24	7	41	3.90	Agree
P.	Contractors' experience in sustainable project implementation is not considered during selection process	0	1	11	21	8	41	3.88	Agree

 Table 4.28: Factors that affect pH JKR implementation (Cont')

(1) Strongly Disagree (5) Strongly Agree



(1) Strongly Disagree (5) Strongly Agree

Figure 4.22: Factors that Affect pH JKR Implementation

Six factors that have the highest average index are lack of budget (4.24), lack of understanding on the sustainable concept (4.00), clients' understanding and awareness on sustainable concept (3.93), low promotional and awareness activities (3.93), lack of experience in implementing sustainable project (3.90) and contractors' experience in sustainable project (3.88). Only 3 factors fall under fair rating which is low commitment from HOPT (3.32), lack of monitoring at design stage (3.29) and low commitment from HODT (3.20).

The highest average index is 4.24 which refer to lack of budget. This finding is in line with Nazirah (2009) and Lauren & Vittal (2011) which expressed cost constraint is one of the barriers in sustainable project implementation. According to Nazirah (2009), there is perception where sustainable practice in project will lead to increase project cost because the project team need higher amounts of capital upfront. Higher project cost means higher price. A study was conducted by Schedler and Udall (2005) to determine the impact of LEED Green Rating Tool to the project. From the findings, it indicated that the cost associated in achieving green certification can become as high as 17% for platinum certification for a small building. The same study indicated that for 10,000 square-foot building, the added cost is around \$50,000 from the normal project cost.

There is a different view among those who have applied sustainable concept in their project especially from big and well-established developer. They agreed to implement sustainable projects due to the company's strong financial position. In order to deliver sustainable project according to cost expectation, Lauren and Vittal (2011) suggested that traditional project management methods and practices have to be modified. One of the approaches is through greening project management practices where it will help project manager to monitor and control project cost to achieve sustainable project implementation. Lauren and Vittal (2011) also expressed that there is a long term cost saving in sustainable project. Green buildings are expected to decrease operating costs between 8-9%, increase total building value by 7.5% and increase occupancy rates by 3.5% (U.S Green Building Council 2006a,b)

The second highest average index is lack of understanding on the sustainable concept (4.00). From the result, respondents perceived that there is an issue on understanding level among JKR staffs in order to carry out sustainable project. This is also in line with the result related to respondents' knowledge of pH JKR where their current knowledge is at medium level with an average index of 2.78 and respondents' knowledge on Green Project Management also is only at low level with average index of 2.24. Nazirah (2009) expressed that awareness and knowledge will jumpstart sustainable movement. With that, come interest and demand, and follow

with the implementation. Therefore, it is important for JKR top management to increase the level of knowledge among JKR staffs regarding sustainable development, green project management and also pH JKR. Based on JKR Strategic Framework 2013-2015, in leading sustainability theme, JKR has listed one of the initiatives which is to develop sustainable champion in context of knowledge of sustainability, practice sustainability, strong belief in concept of sustainability, leadership skills in including influencing skills and able to inculcate sustainability culture. Hence, it was proved that JKR top management has identified the problem and are working to implement the initiatives in order to increase awareness and knowledge level among staffs.

Figure 4.22 also shows the lowest average index is 3.20 (Fair) which refer to low commitment from Head of Design Team (HODT). Apart from good project management practices, efficient team work among stakeholders and design team commitment is much needed to ensure the success of sustainable projects (Ferah & Farnaz, 2010). From the result, 56% of respondents choose scale 3 (Fair) and 7 nos of respondents disagree with this factor representing 17% from total respondent, probably due to excellent commitment and cooperation from the design team. On the other hand, 27% of respondents were agreed with this factor.

CHAPTER 5

CASE STUDY

5.1 Introduction

Apart from distribution of questionnaires, this study also includes case studies intended to strengthen the research verification. Data were collected through interviews with the desk officer at Environment and Energy Branch, JKR as responsible office for monitoring the implementation of pH JKR. One project was selected for this case study.

5.2 Background of Environment and Energy Branch JKR

History of Environmental and Energy Branch started in year 2002 when there is a requirement for JKR to focus on environmental aspects in projects. At that time this branch was known as *Environmental Branch*. In 2008, this branch turns to Environment and Energy Branch when they were engaged in energy efficiency projects as part of the government's mission to reduce electricity consumption in government office buildings. This branch has begun to move towards sustainable development. A scheme to measure the sustainability of a development has been established through a newly established division known as Eco-Efficiency Division. One of the main tasks for this division is to facilitate and monitor the implementation of pH JKR.

5.2.1 Sustainable Development Policy

JKR sustainable development policy was introduced in 2012 which the aim is to integrate, coordinate and monitor the sustainability initiatives undertaken by JKR. There are five main objectives as listed below:

- a. To ensure sustainable projects implemented
- b. To integrate and coordinate the sustainable activities carried out by each branch in JKR in ensuring benefits to whole department
- c. To actively involved with the green movement in Malaysia
- d. Harnessing, optimize and expand existing expertise in the JKR for mutual benefit
- e. To outlines the policies and corporate objectives of sustainable development as the basis of all sustainable development projects

In order to make sure the objectives achieved, a main committee known as *JKR Sustainable Development Committee* was established. This committee have nine working committees that focus on their areas of expertise for each branch. The working committee has a major role in ensuring the main committee can achieve their objectives. The committee is shown in Figure 5.1 below.



Figure 5.1: JKR Sustainable Development Committee

5.3 Challenges in Implementation of pH JKR

Interview session was carried out on 3 October 2013 with personnel from Environment and Energy Branch JKR. The discussion is intended to find problems in implementing the pH JKR. Below is the result of the discussion held.

i. Readiness for Certification

Currently, green certification for any projects is implemented on a voluntary basis. It was done through Head of Project Team (HOPT) where they need to apply for pH JKR certification. Top management of JKR until now still has not issue any instruction stating that all projects managed by the department need to apply pH JKR. This matter is very important as one of the objectives in JKR Strategic Framework is to achieve sustainability development projects. The use of pH JKR as green rating tool is very effective in achieving this objective.

ii. Lack of Facilitator

When a project has been proposed for green rating certification, Environment and Energy Branch will appoint officer to facilitate the related process in pH JKR. At present, the number of facilitators is still low. The facilitator is responsible to facilitate and make assessment on pH JKR criteria that adopted in the project. In addition, they act as liaison person between project team and Environment and Energy Branch. Currently, the existing facilitators are appointed through voluntary basis. No special incentive is provided. Based on this scenario, maybe other staffs are not interested with the task. The workload is quite high because they must make assessment during planning, construction and until the project is completed. This process will consume a lot of time besides their current workloads.

iii. Bad Perception

At present, project team has blamed pH JKR as one of the reason for cost increment in their project. This is due to the design team must fulfill the criteria in order to achieve the targeted rating. It is recognized that to achieve green rating certification will affect the project cost due to the use of new technology and green materials such as rainwater harvesting system, energy efficiency equipment, double glaze glass panel and others. If this scenario always occurs, JKR objectives in achieving sustainable project are distracted. Nowadays, pH JKR is only the relevant instrument owned by the department in order to achieve those objectives. Project team should fully utilize the tool which has been developed by JKR experts.

iv. Process of Monitoring

Monitoring process is only made at the headquarters level only. Officer in charge only go to project site if there is an issue occur. Thus, site personnel need to update officer in charge at headquarters on the progress of pH criteria implementation. There is no special post for pH coordinator at site. If this post is established, it will improve communication process between site personnel and responsible officer at headquarters. The pH coordinator will monitor closely the performance of contractor in meeting the green requirements and also will resolve any 'green' problems associated at site without referring staff at headquarters. This will expedite the problem solving process.

5.4 Case Study: The Construction of '*Crops for the Future*' Research Centre in Semenyih, Selangor

5.4.1 Project Background

This project is located at Semenyih, Selangor and it is owned by Ministry of Agriculture and Agro-Based Industries. The main objective of this project is to be a training and research centre to study the potential of under-utilized crops. Expected benefits of this project are as follows:

- a. Research centre for local and international researchers
- b. Improve food and non-food crop which have the potential global value

Project cost is around RM 100 million which includes construction of a laboratory buildings, acquisition of research equipment and also infrastructure works such as internal road access, water supply system, sewerage system, electrical and mechanical works. Currently, this project is still in construction phase.

5.4.2 **Project Implementation**

This project is carried out through conventional-consultant design process where General Building Works Branch JKR act as a Project Manager (HOPT) and the design works are carried out by the appointed consultants. This project was divided into two phases; first phase is for earthwork while second phase is for building work. Each design consultants must submit their design reports to Head of Design Team (HODT) JKR for reviewing and checking process. At present, earthworks is being carried out and supervised by JKR Selangor as Superintendent Officer (S.O) and JKR Hulu Langat District as Representative Superintendent Officer (R.S.O). Figure 5.2 below shows the organization chart for this project.



Figure 5.2: Project Organization Chart

5.4.3 JKR Green Rating Scheme (pH JKR)

Green objective of this project is to achieve 4 stars rating - National Excellence category. This objective was set by Head of Project Team (HOPT) JKR. Several green elements that are provided in this project are as follows:

i. Erosion and Sediment Control Plan (ESCP)

In pH JKR manual, this criteria is put under sustainable site planning and management which consist of 1 mark. This measure intended to control silt and soil erosion from earthwork carried out during construction. According to Manual Mesra Alam Malaysia (2012), erosion and sediment control consist of 8 elements as shown in Figure 5.3 below:



Figure 5.3: ESCP Principles (Source: Manual Mesra Alam 2nd Edition, 2012)

In this project, the designer has applied several practices to control the erosion such as:

- a. Temporary earth drain
- b. Sediment basin
- c. Assess stabilization

ii. Rainwater Harvesting System

Manual Mesra Alam Malaysia (2012) has describes rainwater harvesting is a process of collecting rainfall where end-user can reuse back the water for landscape watering, livestock water and irrigation for agriculture. In this project, rainwater is use for landscape works only. The pH JKR allocates 3 marks for rainwater harvesting system in water efficiency criteria. There are five basic components for rainwater harvesting system:

- a. Catchment area to collect rainfall.
- b. Conveyance system which consist of channel or pipe to transport the collected rainfall from catchment area to storage tank.
- c. First flush equipment to filter any debris.
- d. Storage tank to storage collected rainwater.
- e. Distribution system for deliver rainwater to the point of use.

Figures 5.4 and 5.5 below show the process and typical components of rainwater harvesting system.



Figure 5.4: Rainwater Harvesting Process (Source: Manual Mesra Alam 2nd Edition, 2012)



Figure 5.5: Typical Components for Rainwater Harvesting System (Source: Manual Mesra Alam 2nd Edition, 2012)

iii. Storm Water Management

In these criteria, pH JKR has allocates 2 marks. The designer must ensure that storm water is managed well to avoid any consequences led to flood. Drainage system and water retention facility is provided. The designer must follow the Manual Mesra Alam Malaysia (2012) for design guideline. In this project, 2 main facilities are provided in order to manage the storm water:

- a. Drainage system
- b. On-site detention (OSD)

Surface runoff will flow into the drain. Then, the runoff is channelled to on-site detention (OSD) facility. The purpose of OSD is to retain surface water before it discharges to public main drain. This process is to control peak flow produce at site. This is due to impervious area is increase after the project is completed. According to Manual Mesra Alam Malaysia (2012), the designer must make sure that peak flow discharge from site after development is equal or less than with peak flow before the development. There are several types of water detention facility which are above ground tank, below ground tank, multiple storages and pond. For this project, the designer provides detention pond. Figure 5.6 below shows the typical OSD storage facility.



Figure 5.6: Typical OSD Storage Facility (Source: Manual Mesra Alam 2nd Edition, 2012)

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This chapter reflects the research findings by reviewing the objectives. Summary of each chapter is explained. In final part, recommendation and limitation of this research is highlighted for future study.

6.2 Conclusion

In achieving research objectives, survey questionnaire, interview session and data collection process is conducted in order to obtain the relevant data. The survey form is distributed to project management and design office at JKR headquarters only. Targeted respondents are those who involved in building project. Following are the findings according to research objectives.

6.2.1 Objective 1: To determine current understanding level within JKR staffs regarding on JKR Green Rating Scheme (pH JKR) implementation and Green Project Management approach

Analysis in Chapter 4 has shown that JKR staffs have medium level of knowledge on pH JKR with average index of 2.78. This is reflecting with their involvement in project when only 71% of them have applied the tool. According to JKR Strategic Framework 2012-2015, it was stated that the concept of sustainability in JKR is still new. So, it is acceptable when the finding shows that the respondents' knowledge on pH JKR is at medium level only. Majority of respondents (71%) also agree with the introduction of pH JKR while others in neutral position. 31% of respondents agreed that by applying pH JKR will reduce impacts to environment during project implementation phase. Only 37% of respondents agreed that pH JKR will lead to increase the project cost.

The overall level of understanding among JKR staffs with Green Project Management is at low level with average index of 2.24. The result is acceptable due to JKR currently didn't apply Green Project Management approach in managing projects. Majority of respondents were agreed that by using pH JKR will lead to green project management approach. This is proved by high rating of average index score (3.56). They also agreed that incorporating pH JKR with project life cycle process will lead to Green Project Management. The average index score is 3.61. Project life cycle is as per described in PMBOK Fifth Edition (2013) which refer to initiating, planning, executing, monitoring and controlling and finally, closing.
6.2.2 Objective 2: To identify factors that affects the implementation of JKR Green Rating Scheme (pH JKR)

About 16 factors that probably affect the implementation of pH JKR is listed in the survey form. From the analysis, five factors that have the highest average index score are lack of budget (4.24), lack of understanding on the sustainable concept (4.00), clients' understanding and awareness on sustainable concept (3.93), low promotional and awareness activities (3.93), lack of experience in implementing sustainable project (3.90) and contractors' experience in sustainable project (3.88).

6.2.3 Objective 3: To develop Green Project Management Framework for JKR

The Green Project Management framework is developed and described in next section.

6.3 **Recommendations**

6.3.1 Implementation of Green Project Management

Majority of respondents believed that by incorporating pH JKR in project life cycle will lead to green project management. Based on this finding, Green Project Management framework is developed. This model is recommended to be applied by JKR project management team (HOPT) to ensure sustainable objectives for the project can be achieved. Suggested criteria for green project management are easy to implement and no cost involves. Green Project Management framework is shown in Figure 6.1 below.



Figure 6.1: Green Project Management Framework

In order to strengthen the implementation of green project management approach, it is suggest that to incorporate it with JKR Green Rating Scheme (pH JKR). JKR Green Rating Scheme (pH JKR) needs to revise with green project management criteria. Peng and Sui (2010) suggested that 20% from the total point of green rating score need to allocate for project management criteria. The model also can be combined with traditional project management approach. This can be done by incorporating green project management criteria in Sistem Pengurusan Bersepadu (SPB) JKR. As known, SPB document is a main guideline contains management and operation procedure in managing project for JKR.

Project manager must alert with the green requirement during managing their project to ensure it meet the green criteria. Peng and Sui (2010) stressed that project manager should not limit themselves with the traditional project management practice but also to process of achieving green objective.

6.3.2 Awareness and Training Programme

Majority of respondents have a medium level of knowledge on pH JKR. So, to improve their knowledge, awareness programme must be conducted from time to time in ensuring JKR staffs are aware with the tool application. Besides that, Environment and Energy Efficiency Branch as an owner of the tool must aggressively in providing training to project team. Training can be conducted through Training and Research Division, Project Complex Branch (PROKOM) JKR. It is important to give detail explanation on each pH JKR criteria to project team members.

6.4 Limitation of Study

This study only focuses on building projects where the project management and design activities carried out at the JKR headquarters only. Questionnaires were distributed only to JKR staff at headquarters level without involving the staff at states, districts and also the clients. It is better to get opinion from clients on the application of green element for their project.

The use of term 'Green Project Management' in questionnaire may be confusing due to lack of exposure among respondents compare to the concept of sustainability. Furthermore, this research did not investigate each of pH JKR in details in order to identify any problems occur when incorporate pH JKR in project life cycle. It is also better if this study is extended to measure the implication and effectiveness of each pH criteria to JKR building project.

Distribution of questionnaires only focuses on offices that manage general building projects at the headquarters level only. To strengthen this study, survey form must also be distributed to other branches perform project management activities for building projects such as Health Works Branch, Security Works Branch, Education and Higher Learning Works Branch and Airbase and Maritime Works Branch.

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APPENDIX A

IMPLEMENTATION OF SKIM PENARAFAN HIJAU (pH) TO JABATAN KERJA RAYA MALAYSIA						
	By: Shaiful Munir Lema Supervisor: D UTM Razak School of En	n [Master of Project Management] r Mohd Khairi Abu Husain gineering and Advanced Technology				
MAIN	OBJECTIVE: To assess the impl current building pr	ementation of Skim Penarafan Hijau (pH) JKR on oject				
<u>Questi</u>	onnaire (Please tick (v) at the ap	propriate box)				
<u>Sectior</u>	<u>n A</u> : Respondent Ba	ckground				
1.	Office :					
	(i.e: Cawangan	Kejuruteraan Awam, Struktur & Jambatan)				
2.	Working Experience:	_ years				
3.	Designation Field					
	[] Engineer (Civil/Electrical/Me	chanical) [] Technical Assistant				
	[] Quantity Surveyor	[] Technician				
	[] Architecture	[] Drafter				
	[] Other (Please state) :					
4.	Grade					
	i. Professional [] 41 [] 44	[]48 []52 []54 []JUSA				
	ii. Implementer [] 17 [] 22	[] 26 [] 29 [] 36 [] 38				
5.	Nature of Work					
	[] Project Management	[] Project Design [] Project Supervision				
	[] General Management	[] Other (Please state):				

Section B

Object	ive 1 : To determine the level of understanding within JKR staffs on Skim Penarafan Hijau (pH) JKR
1.	Do you know about Skim Penarafan Hijau (pH) JKR? []Yes []No
2.	Do you agree with the introduction of Skim Penarafan Hijau (pH) JKR? [] 1:Strongly Disagree [] 2: Disagree [] 3:Fair [] 4:Agree []5:Strongly Agree
3.	What is the level of your knowledge on Skim Penarafan Hijau (pH) JKR on a scale of 1 to 5? [] 1:Very poor [] 2: Low [] 3:Moderate [] 4:Good [] 5:Excellent
4.	What is your main source of information on Skim Penarafan Hijau (pH) JKR? (Check all that apply)[] Personal research[] Media/Articles[] Seminars
	[] Course [] Skim Penarafan Hijau Guidelines [] Other (Please state):
5.	Do you apply Skim Penarafan Hijau (pH) JKR in any of your projects? [] Yes [] No
6.	If your answer in Q5 is "Yes", which party instructed to apply the tool? Please ignore if 'No'. []Client []Head of Project Team (HOPT) []Head of Design Team (HODT) []Own Initiative []Other (Please state):
7.	In your opinion, who is supposed to put sustainable or green elements as one of the project objectives? [] Client [] Project Manager (HOPT) [] Design Office (HODT) [] Others:
8.	Do you agree the implementation of Skim Penarafan Hijau (pH) JKR would lead to any benefits? [] 1:Strongly Disagree [] 2: Disagree [] 3:Fair [] 4:Agree [] 5:Strongly Agree
9.	Is it any of the below mentioned benefits of Skim Penarafan Hijau (pH) JKR implementation for the project? (Check all that apply) [] Cost saving in operation and maintenance in future [] Opportunity for growth in green product and green project [] Reduced impacts on the environment
10.	Is it any of the below mentioned disadvantage of Skim Penarafan Hijau (pH) JKR implementation for the project? (Check all that apply) [] Increase project cost [] Delay the project

[] Require of highly skilled project team

Section C

Objective 2 : To determine the level of understanding within JKR staffs on Green Project Management approach

1. Do you agree that by using Skim Penarafan Hijau (pH) JKR can achieve 'Green Project Management' concept?

[] 1:Strongly Disagree [] 2: Disagree [] 3:Fair [] 4:Agree [] 5:Strongly Agree

2. Please rate your level of knowledge about 'Green Project Management' concept on a scale of 1 to 5

[] 1: Very poor [] 2:Low [] 3: Moderate [] 4: Good [] 5: Excellent

3. Do you agree that it is important to include Skim Penarafan Hijau (pH) JKR in project life cycle process in achieving 'Green Project Management' concept?

[] 1: Strongly Disagree [] 2: Disagree [] 3: Fair [] 4: Agree [] 5: Strongly Agree

4. In your opinion, which stage to include 'Green Project Management' concept in project life cycle process?

Please tick (v) at the appropriate box

1: Not Important 2: Less Important 3: Important 4: Very Important 5: Highly Important

No.	Project Life Cycle	1	2	3	4	5
а.	Initiating					
	Budget allocation toward green initiative					
	Sustainable element must clearly define in project scope					
	Site characteristics must give full consideration					
b.	Planning					
	Sustainable is one of the project objectives					
	 Project team selection with good experiences in green building project 					

	Obtain opinion from all key stakeholders including surrounding property owner at the proposed project site			
C.	Executing			
	 Using green rating tool such as Skim Penarafan Hijau (pH) JKR as a guideline in design stage 			
	 Contract should include performance agreements and incentives for implementing sustainable practice and exceeding sustainable goal 			
	The use of recycle material at project site			
	 Implement best management practice (BMPs) in protecting environment during construction phase 			
	 Sustainable education component for site personnel 			
d.	Monitor & Control			
	Site assessment using green rating tool			
	Compiling the related document for green certification			
e.	Close			
	 Sustainable education component for client as end user for the project 			

Section D

Objective 3 : To identify factors that affects the implementation of Skim Penarafan Hijau (pH) JKR

1. Factors that affect the implementation of Skim Penarafan Hijau JKR (pH)

No	Question	Strongly Disagree	Disagree	Fair	Agree	Strongly Agree
		1	2	3	4	5
a.	Lack of understanding on sustainable concept					
b.	Budget constraint					
C.	Inadequate skills and experience					
d.	Client awareness					
e.	Lack of monitoring and supervision at project site					
f.	Lack of monitoring and supervision at design stage					
g.	Resistance to change					
h.	Sustainable is not include in project objectives					
i.	Designers' lack of knowledge and skill on pH JKR					
j.	Lack of awareness program on pH JKR					
k.	Lack of expert					
Ι.	Less commitment from HOPT					
m.	Less commitment from HODT					
n.	Less commitment from contractor					
0.	Lack experience in sustainable					

Please tick (v) at the appropriate box

	project implementation			
p.	Not putting the experience of contractors in the implementation of sustainable projects as one of the criteria for selection of contractors			

::Thank You::



MANUAL PENARAFAN HIJAU JKR

SEKTOR BANGUNAN

Bangunan Baru Bukan Kediaman - KB1 (Keluasan ruang berhawa dingin > 4000m²)

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SENARAI KRITERIA PENARAFAN

No	SKOP		
		PM	MM
TL	PERANCANGAN DAN PENGURUSAN TAPAK LESTARI		
TL1	PERANCANGAN TAPAK	1	
TL2	KERJA TANAH LESTARI	3	
TL3	SISTEM PENGURUSAN ALAM SEKITAR	3	
TL4	KAWALAN HAKISAN KELODAK DAN ENDAPAN	1	
TLS	PENGURUSAN AIR RIBUT	2	
TL6	LANDSKAP STRATEGIK		
а	Memulihara pokok-pokok yang matang	1	6
b	Kawasan hijau dalam pembangunan	1	
c	Penanaman pokok teduhan	1	·
d	Pemilhan bahan binaan siarkaki (walkway) yang mempunyai daya pantulan haba yang tinggi.	1	
e	Sistem turapan berumput (berongea)	1	<u> </u>
TL7	BUMBUNG HUAU & DINDING HUAU		<u> </u>
а	Indeks Pantulan Suria (SRI) mengikut jenis & kecerunan bumbung	1	1
b	Menggalakkan Reka Bentuk bumbung/dinding hijau.	3	
TL8	TEMPAT LETAK KENDERAAN	1	
TL9	MANUAL PENGGUNA BANGUNAN	1	<u> </u>
TL10	REKA BENTUK MESRA ORANG KELAINAN UPAYA (OKU)	1	
	Markah TL		22
KT	PENGURUSAN KECEKAPAN TENAGA		
KT1	ORIENTASI BANGUNAN		
а	Fasad Utama : menghadap UTARA - SELATAN	2	
Ь	Meminimumkan bukaan di fasad yang menghadap TIMUR -BARAT	1	
KT2	REKA BENTUK FASAD		6
а	Pemilihan Kaca Tingkap	2	
b	OTTV – Kadar pindahan haba keseluruhan permukaan luar bangunan	1	
121	Fasad TIMUR-BARAT mempunyai penghadang suria luaran secara menegak atau	12	
C	melintang	1	
KT3	REKA BENTUK BUMBUNG		
а	Kadar Pemindahan Haba (U-value)	1	
b	RTTV – Kadar Pindahan Haba Melalui Bumbung	1	5
c	Penggunaan penebat bumbung	1	(
KT4	ZON PENCAHAYAAN (BUKAN SEMULAJADI)		
а	Pembahagian ruang mengikut zon pencahayaan	4	
b	Lighting Power Density (LPD)	1	
с	Pengesan automatik	2	
d	Kawalan lampu di ruang umum	2	
e	Kawalan lampu kawasan	1	
KT5	SUB-METER	1	
KT6	TENAGA DIPERBAHARUI	6	
KT7	PENYUSUPAN UDARA	3	6
KT8	INDEKS TENAGA BANGUNAN	7	(

No	SKOP		
		PM	MM
KT9	PENGUJIAN DAN PENTAULIAHAN	1	
KT10	VERIFIKASI	1	
KT11	PENYELENGGARAAN MAPAN	2	
а	Ruang pejabat untuk pasukan penyenggaraan	1	
b	Kontraktor Penyenggaraan	1	
С	Pelan Penyenggaraan	1	
d	Sistem Pengurusan Kawalan Tenaga	1	
	Markah KT		43
PD	PENGURUSAN KUALITI PERSEKITARAN DALAMAN (IEQ)		
PD1	PERANCANGAN RUANG		
а	Susunatur ruang pejabat terbuka sepanjang permukaan fasad	1	
b	Dinding sesekat dalaman yang telus cahaya	1	
-	Memastikan pemandangan ke luar yang maksima untuk ruang yang berdekatan	1	
	dengan perimeter teras bangunan	1	
d	Lebar bangunan yang efektif (no deep planning).	1	
e	Ketinggian siling yang efektif.	1	
f	Warna cerah di permukaan dinding dan siling.	1	
PD2	PENCAHAYAAN SIANG		1
а	Reka Bentuk tingkap yang bersesuaian mengikut faktor cahaya siang yang diperlukan.	1	
Ь	Menggunakan rak cahaya (light shelves)	2	
PD3	PENGUDARAAN SEMULAJADI	1	
PD4	KESELESAAN TERMAL :REKA BENTUK & SISTEM KAWALAN	3	
PDS	KESELESAAN VISUAL(TAHAP KESILAUAN, TAHAP KECERAHAN, PEMANDANGAN)		
а	Susun atur ruang tanpa halangan binaan kekal	1	
b	Kawalan tahap kesilauan	1	
С	Tahap Pencahayaan Bilik	1	
PD6	KESELESAAN AKUSTIK	1	
PD7	KUALITI UDARA DALAMAN	5 S	
	Penggunaan bahan pembinaan yang rendah Volatile Organic Compound (VOC)	1	-
a	terutama pada bahan-bahan cat, perekat(adhesives), coatings dan sealants	ೆ	
b	Larangan merokok di dalam bangunan	1	
C	Prestasi Kualiti Udara Dalaman	1	
PD8	KAWALAN PARAS KARBON DIOKSIDA	1	
PD9	PENCEGAHAN KULAPUK	2	
PD10	KAJI SELIDIK KESELESAAN PENGHUNI	3	
	Markah PD		26
SB	PENGURUSAN SUMBER DAN BAHAN		
SB1	PRODUK HIJAU	1	
SB2	SISTEM BINAAN BERINDUSTRI (IBS)	1	
SB3	3R (KURANGKAN, GUNA SEMULA, KITAR SEMULA)	3	
SB4	BAHAN TEMPATAN	1	
SB5	PENGURUSAN SISA BINAAN	2	
	Markah SB	5 B	8
PA	PENGURUSAN KECEKAPAN PENGGUNAAN AIR		
PA1	SISTEM PENUAIAN AIR HUJAN (SPAH)	3	

No	SKOP	Pemar	kahan
		PM	MM
PA2	KITAR SEMULA AIR SISA	2	
PA3	PRODUK KECEKAPAN AIR	2	
PA4	SUB-METER AIR	2	3.3
PAS	SISTEM PENGESAN KEBOCORAN AIR	1	
-	Markah PA		10
IN	INOVASI		
IN1	REKA BENTUK BERINOVASI	6	
	Markah IN		6
	Jumlah Keseluruhan		115

PETUNJUK:

PM - Pecahan Markah

MM – Markah Maksimum