Importance of Sustainability and Engineering Economics in Waste Infrastructure Projects

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ABSTRACT

This paper presents the understanding of current practice of waste management through reviewing past similar research and the way to improve waste management system. The results obtained via exploratory interviews revealed the insufficient of Malaysian Construction Industry waste management systems. To rectify this problem, this paper reports the progress to date activities of extending contemporary models in the evaluation of waste management infrastructure sustainability. To ensure a sustainability waste management infrastructure in the future, the on-going research aims to design and a working model will be established to serve as a suitable tool for project stakeholders in dealing with this type of infrastructure’s investment decisions.

KEYWORDS: Sustainability, engineering economics, waste infrastructure, construction, stakeholders

1. INTRODUCTION

The increasing population in Malaysia has causes the increase of municipal solid waste (Manaf, Samah, and Zukki, 2009). Malaysian construction industry has produced many wastes and it directly contributes to the amount of waste in land fill. Bai and Sutanto (2002) also stated that the amount of waste is increasing from time to time. Hence, a proper way of managing the large amount of waste is required to ensure a proper lifestyle in future can be obtained while the advancement of construction industry.

Municipal solid waste management encompasses the functions of collection, transfer, resource recovery, recycling and treatment to protect the health of the population, develop sustainability and provide support to economic productivity (Henry, Yongsheng, and Jun, 2006). There is an urge for Malaysia waste management infrastructure to upgrade in order to cope with the fast growing construction industry.

Waste management infrastructure plays an important role in dealing with the waste produced by construction industry to achieve sustainable construction. Among the waste management infrastructure available in Malaysia is landfill.

2. LITERATURE REVIEW

More than a century of industrial development has come at a price of global warming, ozone depletion, air and water pollution are widely recognized as global environmental problems and is demanding immediate solutions (Banerjee, 2002). Construction industry has led to major environmental issues. Hence, the sustainability concept is increasingly important in this industry, more specifically in the waste-management infrastructure.
However, there is no optimal system for waste management due to the wide different in geographic locations, characteristics of waste, energy sources, availability of some disposal options, and size of markets for products derived from waste management (Abduli, Naghib, Yonesi, and Akbari, 2011). Poor servicing of municipal solid waste collection vehicles, poor state of infrastructure and lacking of funding has goes against the optimization of municipal solid waste disposal service (Henry et al., 2006).

Although the researchers realize the need for a tool in assist in the planning, design, and selection of appropriate waste management strategies, however, the earlier developed models did not pay attention on the different processes and stages of waste management system (Hanandeh and Elzein, 2010).

2.1 Land filling

According to (Manaf et al., 2009), land filling at the present stage is the only waste management method used in Malaysia. The lack of proper management of land filling has causes a few matters arises such as the open dumping area affects the environment at the surrounding area, and the existing land fill are filling up very fast.

Henry et al. (2006) mentioned that political interference and economic constraints have caused the construction practitioners unable to perform proper waste management in the disposal to the land fill. Jusoh and Samsudin (2007) also stated that the information on landfills in Malaysia is still relatively inadequate, the issues of inappropriate managing of landfills in Malaysia have long been recognized by authorities.

Besides, Jusoh and Samsudin (2007) also describes the criteria in the selection of a landfills such as landfill size, land ownership distance to main waste generation areas, and landfill age and closure date. All these criteria to select landfill may be functional to the development of decision support system

3. RESEARCH METHODOLOGY

This paper is done through reviewing past similar research. Besides, this study has been conducted by having exploratory interview with 6 person in charge in either private and government sector in Malaysia. Specifically, all of the interviewee held senior to top management positions and possessed decision-making roles in their respective organisations. The professions of the respondents are classified into four categories: Manager, Site Engineer, Assistant Environmental Control Officer and Contractors (15%).

4. RESULT AND DISCUSSIONS

The result of this study will be presented by using a matrix table and focus on a few main elements extracted from the interview session. The elements highlighted are shown in Table 1:

4.1 Management of Waste on Site

With the increasing quantities of waste on site, it is crucial to develop proper waste management in order to ensure the environment’s protection. All the six respondents agreed that on site there was provision of ‘bin’ for sorting out all the construction waste for recycling or collecting into the ‘bin’ for sending out to landfill. However R1, R3 and R4 mentioned that they do not have a proper schedule or checklist; and they also do not have any waste management system on site.

4.2 System Used in Waste Management in Malaysia

According to R1, R6 and R2, they have been adopting the concept 3R in their company for each on-going project in line the requirement of JKR. R2 mentioned that concept 3R can be divided into recycle such as wood, renewable such as system hydraulic, kinetic, and electricity and reused such as
R1 stated that although concept 3R is an ideal concept for sustainability, it is yet to be implemented in all projects due to low awareness across Malaysia.

On the other hand, R3, R4 and R5 have different point of view in waste management system which is incinerator, landfill ancillary system, and sanitary system is pointed out as the system used in their company. Among the most frequent way to dispose construction waste are through landfill.

4.3 Type of Construction Wastes

Construction waste can be categorised into two different groups based on the respondents’ opinions. R1, R6 and R2, stated that the construction waste can be divided into recyclable and non-recyclable while R2 included hard to recycle. Wastes that can be recycled are such as steel, wood; wastes that cannot be recycled are concrete in formwork and waste that is hard to be recycled is plastic. On the other hand, R3, R4 and R5 agreed that construction waste can be divided into structural and architectural waste. Structural wastes are such as wood, plastering, steel whilst architecture wastes are wire, paint, and soil.

Table 1: Summary of the interview responses

<table>
<thead>
<tr>
<th>Respondent</th>
<th>(4.1) Is there any Management of Waste on Site?</th>
<th>(4.2) System used</th>
<th>(4.3) Type of construction waste</th>
<th>(4.4) Factors influencing sustainability in waste management</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1, R6</td>
<td>&quot;Bin&quot; is provided.</td>
<td>Concept 3R is applied as required by JKR</td>
<td>Divided into: - Recyclable - Non-recyclable</td>
<td>Professional - Awareness - Economics - Tender project - Uses green development technique - Sustainability incur high cost</td>
</tr>
<tr>
<td>R2</td>
<td>Steel ‘bin’ used for the storage of waste.</td>
<td>Apply concept 3R. Recycle: wood Renewable: system hydraulic, kinetic, and electricity. Reused: steel</td>
<td>Divided into: - Recyclable (steel, wood), non-recyclable (concrete in formwork) - Hard to be recycle (plastic)</td>
<td></td>
</tr>
<tr>
<td>R3, R5</td>
<td>No Specific Schedule, Checklist.</td>
<td>Incinerator Landfill-ancillary system Sanitary system</td>
<td>Divided into: - Structural (cement, concrete) - Architectural waste</td>
<td>Finance - Public Works Department specification too general - Awareness - Construction professional</td>
</tr>
<tr>
<td>R4</td>
<td>No waste management is carried out on site</td>
<td>Usually burn the waste though incinerator or send to landfill</td>
<td>Divided into: - Structural (wood, plastering, steel, cement) - Architectural waste (wire, soil)</td>
<td>Lack of skilled workers - Lack of awareness - High maintenance cost</td>
</tr>
</tbody>
</table>

4.4 Factors influencing sustainability in waste management

All respondents pointed out that finance is one of the factors influencing their decision in applying sustainable concept into waste management. Insufficient awareness and lack of professionals or skilled workers were also mentioned by most of the respondents to be influencing factors. In addition, R4 and R2 mentioned implementing concept of sustainability into waste management will attract high cost. R1 and R3 mentioned that the specifications in the tender project or Public Works Department specification should state clearly about waste management. Lastly, R2 suggested the use of green development technique in achieving sustainability in waste management.
5. CONCLUSION

This paper has pointed out current waste management trend in Malaysian Construction Industry through the result obtained. The pursuit of sustainability in waste management infrastructure may have long-term financial implications to the involved stakeholders. By understanding the overall status and current industry practice has provided the foundation and the need of a decision support model that is capable of handling long-term investment decisions for sustainability waste management infrastructure. Such innovation will help ensure that decisions on the investment can be made on a scientific and systematic basis, particularly when they are concerned with sustainability issues.

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