[CON 13] THE KNOWLEDGE OF MATERIALS MANAGEMENT IN CONSTRUCTION INDUSTRY

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ABSTRACT

The construction project involves many stages and complex. In construction, materials management is very important, especially in terms of planning and scheduling reservation stock, the required quantity and composition at the construction site. There are reports stated that some contractors do not have the knowledge or do not have experience in managing the materials. The aim of this study is to identify the level of materials management knowledge among contractors. Besides that, the purpose of this study is also to identify the consequent of poor materials management in the construction industry and to investigate the relationship between materials management knowledge with poor materials management in construction industry. This study was conducted in Kedah and there are three companies that had been interviewed for this study. Data were analyzed using average index. From this study, the method being studied is an analysis of Activities Based Costing (ABC), Just in Time analysis (JIT), Economic Order Quantity analysis (EOQ), and First In First Out analysis (FIFO). The study found that companies that adopt materials management having a lower materials waste. This shows that the contractor has the knowledge in terms of materials management. In the future research, it is recommended to determine additional analysis that is pertinent to current knowledge of materials management among contractors.

Keywords: *materials management, construction industry, level of knowledge*

INTRODUCTION

According to Rahman (2014), materials management is the process by which the flow of supplies into, through and out of an organization to achieve every effort to ensure that the materials received are sent to the right place at the right time in the quantity of the right to finest quality, and at the right cost. Materials management is also included in the acquisition, handling and storage. In addition, transport and associated information systems and their application throughout the supply, manufacturing, services and distribution sectors were also one of the activities in materials management.

Knowledge has been identified as the key to understand the task and information need. It means that knowledge is one of the most important assets for an organization to create values and hence, sustainable competitive advantage. According to Drucker (1993), an

economic theory lead to the centre of the wealth-producing process is required. Such a theory can analyze the present economy and a theory can also define innovation.

STATEMENT OF THE PROBLEM

The demand for construction development is increasing every year increasing in parallel with the growth of population. A lot of development has been carried out which comprise of the housing development, infrastructure, industry, institutions, health care and others to fulfil the demand. Based on previous research by Nasir (2008) and El-Ghazali et al. (2011) identified that 50-60% from the total project costs are material cost. Therefore, knowledge management is an important ingredient in reducing project costs and also reduce the production of waste materials. Good management is needed in addressing this matter. In fact, elimination of waste is a main focus for process improvement in the Lean Production paradigm. Based on both the Total Quality Management (TQM) and Just in Time (JIT) production philosophies, originated in Japan, waste elimination is an important development trend in manufacturing. However, the principles and concepts become a new source in other industries, including the construction industry.

This study intends to identify the level of materials management knowledge among contractors in construction industry. The level of knowledge is important for contractors to apply that in the projects. Besides that, the consequent of poor materials management is investigated in this study. When the consequent of poor materials management is identified, it will be easier for companies to control it from spreading. Last but not least, this study is to investigate the relationship between materials management knowledge with poor materials management in construction industry.

LITERATURE REVIEW

Materials management in construction industry
Materials are physical resources used in the construction of a project. For example in construction site is a bricks, windows, plasterboard, cement, nails and wood. Materials are goods that will be used in the construction site where it helps run the construction process. Management is the process of organization, including strategic planning, setting objectives, managing resources, deploying the human and financial assets that serve to achieve its objectives and measure results. It also covers the process of data storage for use by the other or in the future (Knowledge Management Terms, 2009).

Materials management is an important issue in construction waste management. Ignoring the benefits of materials management can lead to a reduction in daily productivity up to 40% by material wastage. Thus, the benefits of effective management must also be understood by the reduction of waste. Another fact to convince the rest of the site is that the poor management of the biggest factors contributing to the generation of waste. Thus, the site condition is very important in developing effective materials management.

Waste can be reduced at the design stage where designs that were produced must be uniform and consistent. In practice, design standards were adopted to improve buildability and reduce the quantity of outside wounds. The construction and structure work with standards in design will help to cut costs and reduce waste. Poor site management has always been considered a major cause of waste generation. Recycled materials are the result of the reuse, reduce and recycle efforts in reducing waste such as waste reduction approach often supported by financial incentives from the relevant agencies.

Knowledge of materials management in construction industry
ABC analysis
Norton and Kaplan (1996) are the publisher of "Harvard Business Review" and founder of the "Balanced Scorecard". "Harvard Business Review" elaborated on the analysis of ABC or "Activities Based Costing" approach as an analysis to solve problems in traditional cost management analysis. These traditional analysis are unable to determine the actual cost of the activity accurately. This caused the manager to make decisions based on inaccurate data. The purpose of this analysis is to prevent the occurrence of shortages (stock-outs) and reduce excessive stockpiling (capital lock-up). For the process of this analysis, the stock is divided into three groups:

Table 1
The process based on groups

Groups	Process
A	Materials that will affect the project if it is not enough. This material is required in large quantities and expensive.
C	Materials that are less expensive demands or not. This material also has no impact on the project if it is not enough.
B	Ingredients other than group 'A' and 'C'.

To ensure the effectiveness of management practices, there are some steps that need to be considered. The group 'A', the contractor need accurate information including forecasts of requirements and lead times for ordering. Next, the group 'B' stocks should always be checked and have regular inspections. While the group 'C' normally only need to be revised in order to avoid insufficient materials.

JIT analysis
"Just In Time" is an analysis of continuous delivery of materials with the aim to reduce and eliminate waste, and to add value of the raw materials as the actions through a multi-step process to the end of finished products. Implementation of this analysis requires the elimination of all forms of "buffer". There are three forms of "buffers" that should be considered:
1. Inventory buffer: Raw materials or ingredients used during the process and the finished product can be classified according to the nature and purpose in the supply chain.
2. The buffer capacity: In determining the amount of capacity that can be placed in a project, the budget is very important environmental area. With "inventory buffer", the table design is done so that materials and manpower are at an early stage and equipment prepared in advance.

3. Time buffer: "Time Buffer" is used for scheduling management. "Time buffer" provides the flexibility to determine the date of scheduling activities without delay to the project.

There is a fundamental concept of JIT. The following 7 wastes were recognized by Shingo which are overproduction, waiting, transporting, too much machining (over processing), inventories, moving, and making defective parts and products. Elimination of waste through continuous improvement of operations, equipment and processes is another cornerstone of JIT.

EOQ analysis

The Economic Order Quantity (EOQ) formula is often used to obtain optimal EOQ. This formula is also used in the engineering and business disciplines. Engineers use this formula in economically engineering and industrial engineering courses. EOQ business discipline also examines the operational and financial courses. In addition, the EOQ formula is more practical and specific in showing the concept of trade-offs; as well as specific applications in inventory (Roach, 2005).

EOQ Inventory Formula: $Q = \frac{\sqrt{2DS}}{HC}$ where,

Q= the EOQ order quantity.
D= the annual demand of product in quantity per unit time.
S= the product order cost.
C=Unit cost,
H= Holding cost per unit as a fraction of product cost.

FIFO analysis

The First In First Out analysis (FIFO) means that which comes first will be carried out directly, while what come next need to waits until the first is end up. In other words, the FIFO inventory valuation based on the assumption that goods sold or used provided the same chronological purchase. This analysis explains the techniques of processing or service to the overlapping claims between the ordering processes by first come, first serve behavior. The crisis of rising prices, the results of this analysis is to a higher ending inventory, a lower cost of goods sold, a higher gross profit, and a higher taxable income. However, FIFO costing can be used although physical withdrawal is in a different order.

RESEARCH METHODOLOGY

Sampling and data collection

The scope of this study is within the construction companies in Kedah. There are three types of construction companies that have been chosen for the interview which is SecondBase Entreprise (SBE), JSA Pantas Resources (JSA), and ZM Onal Entreprise (ZMO). Each interview was conducted directly with the contractors for information and opinions through their experience as a contractor.

Measurement scale

A survey instrument was developed and pretested with business executives and managers. A five-point Likert scale was mainly used in this study to indicate the degree of agreement for each criterion. For the question types A is about the level of understanding the term in materials management. This method is using five category scales to indicate the frequency, with 1 (very understand) as the minimum and 5 (uncertain) as the maximum. For the question types B is about the frequency of the consequent poor materials management with using scale 1 (never) as the minimum and 5 (very often) as the maximum.

Data analysis

In this study, the average index based on the following formula (Al-Hammad et.al, 1996) is used to get the result.

$$\text{Average Index} = \frac{\Sigma a_i \text{-} x_i}{\Sigma x_i}$$

Where, a_i = constants as weighting variables to i,
        x_i = variables as frequency response for i = 1, 2, 3, 4, and 5.

x_1 = "statement", the frequency of a_1 = 1
x_2 = " statement ", the frequency of a_2 = 2
x_3= " statement ", the frequency of a_3 = 3
x_4= " statement ", the frequency of a_4 = 4
x_5 = " statement " for the frequency a_5 = 5

Classification of the average index is based on Abd Majid and R. McCaffer (1997). For the scale 1 (very good), the average index (X) is 0.00 until 1.50 and for the scale 2 (good) is from 1.50 until 2.50. For average index 2.50 until 3.50 is to scale 3 (average). Next is scale 4 (poor) and the average index is 3.50 until 4.50. The last one is scale 5 (very poor) and the average index from 4.50 until 5.00.

RESULT AND DISCUSSION

The level of understanding materials management in construction industry: A study case in SecondBase Entreprise (SBE), JSA Pantas Resources (JSA) and ZM Onal Entreprise (ZMO)

The first company that had been interviewed was represented by Mr. Zakiyuddin Bin Mohd Osman himself as a Manager of SecondBase Entreprise. SBE has been established for 17 years and has run almost 10 projects from January 2016 until October 2016. SBE is a company registered under the company's contractors and registration class F. Secondly, the interview conducted involved Mr. Jamil Bin Zakaria himself as a Manager of JSA Pantas Resources Company. JSA has experience in the construction industry for 21 years. Mr. Jamil also estimated that JSA have been involved in nearly 500 projects throughout the company's organization. JSA is a contractor company and registration under class F. Thirdly, Mr. Zahidi Bin Zahri who is the Manager of the ZM

Onal Entreprise Company was interviewed. ZMO has been operating for 10 years and has over 50 projects. ZMO is a contractor company and registered under class E.

Analysis the level of understanding the term in materials management among contractors is based on several important matters related to materials management such as "Site Layout Design", ABC analysis, JIT analysis, and others. The analysis results are shown in Table 2 of the level of understanding the term in materials management among contractor.

Table 2

The level of understanding the terms in materials management among contractors

The level of understanding the terms in materials management	Statement of understanding		
	Company SBE	Company JSA	Company ZMO
Site Layout Design	very understand	very understand	understand
Scheduling Ordering Stock	understand	very understand	understand
Safety Stock	understand	very understand	understand
Security System	understand	very understand	very understand
ABC Analysis	understand	Understand	understand
JIT Analysis	understand	very understand	understand
EOQ Analysis	understand	Understand	understand
FIFO Analysis	understand	Understand	understand
Overall of level understanding score	1.88	1.38	1.88

According to Table 2, it shown that all the three of companies understands about the ABC Analysis, JIT Analysis, EOQ Analysis and FIFO Analysis. For the term site layout design, SBE and JSA understand well while ZMO only understand about the term. Besides that, for the term scheduling ordering stock and safety stock, SBE and ZMO only understand about the term. But JSA very understands the term. For the term of security system, SBE only understands the term while JSA and ZMO are very understands about the term.

Based on the interviews, the study found that the three contractors have knowledge in materials management before starting construction. Based on the table above, the results showed that the respondents understand the terms in materials management. This is because the average index for JSA is at scale very good (1.38) and good (1.88) for the SBE and ZMO. The average index for the very good is between 0:00 to 1.50 and the average index for good is between 1.50 until 2.50. Although this company from registration class E and F, the contractors understand the terms given. It also shows other companies that have the class registration as A and B has a better understanding of these terms.

Analysis of the frequency of the consequent poor materials management is based on some important issues related to certain situations such as low quality of product, poor management plan and so on. The results are shown in Table 3 for the frequency of the consequent poor materials management.

Table 3
The frequency of the consequent poor materials management

The consequent poor materials management	Statement of frequency			Overall of consequent of poor materials management score
	Company SBE	Company JSA	Company ZMO	
Material damage during shipping	Rarely	Never	Sometimes	2
Material damage caused by a machine failure	Rarely	Never	Sometimes	2
Substance abuse during the reimbursement process	Rarely	Rarely	Never	1.67
Storage areas unsuitable material	Rarely	Never	Rarely	1.67
Low quality of product	Never	Never	Never	1
Poor management plan	Rarely	Never	Never	1.33
Errors of supplier	Sometimes	Rarely	Rarely	2.33
Errors in the process of purchasing materials	Never	Rarely	Never	1.33
Mistakes suppliers provide materials	Sometimes	Rarely	never	2

According to Table 3, it shown that the most important consequence of poor materials management is from errors of supplier. The second consequence of poor materials management is from damage during shipping, material damage caused by a machine failure and mistakes suppliers in providing the materials. According to the interview, low quality of product rarely happened because the suppliers always improve the quality of product. The average index for the frequency of the consequent poor materials management is shown that it at good category. It means that all the consequence has the impact.

DISSCUSSION AND IMPLICATIONS

The result of data analysis shown that the average value obtained from the level of understanding the terms in materials management among contractor with the average value of the frequency of consequent of poor materials management causes is positive. This is because the company that practice materials management in the projects have materials waste that is lower than companies which do not practice materials management. Besides that, the relationship between materials management knowledge and poor materials management in construction industry can be clearly seen from the results of this study. This relationship is shown by the company JSA where the company have been practicing JIT analysis and the frequency in the production materials waste

were also lower compared to the other two companies. It is shown that the knowledge of materials management is important because it can help to reduce the materials waste.

Site management can be improved in terms of waste classification. Differences in the types of buildings would result in the implementation stage of the construction process.

Site management team must able to manage waste by the type of waste collected. Contractors also should be able to exercise the rights on the disposal of waste and costs recovered through recycling methods by maintaining responsibility for waste management. JIT analysis is a highly recommended approach in dealing with poor materials management. This is because this approach can reduce the potential damage that the materials experience resulting from poor handling of materials that will be accepted in the right quantity and in the nearest proximity to the commencement of the work. Good relationships between contractors and suppliers have to be nurtured especially during the process the delivery of materials and resources.

LIMITATIONS AND SUGGESTIONS FOR FUTURE RESEARCH

This study implies some limitations and scarcity. Logic suggests that future researchers increase the sample size, because small sample size makes it very difficult to generalize result of the construction sector. Therefore, it is very important to include and make a comparison between class registration and the environmental features of the construction site. Apart from the four analysis in this study, it is recommended for future study to determine additional analysis that is pertinent to current knowledge of materials management among contractors. Future researchers should also extend the research by investigate the ways to effectively managing materials in construction industry. The impact of the ways can be long-term strategy or short-term strategy.

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