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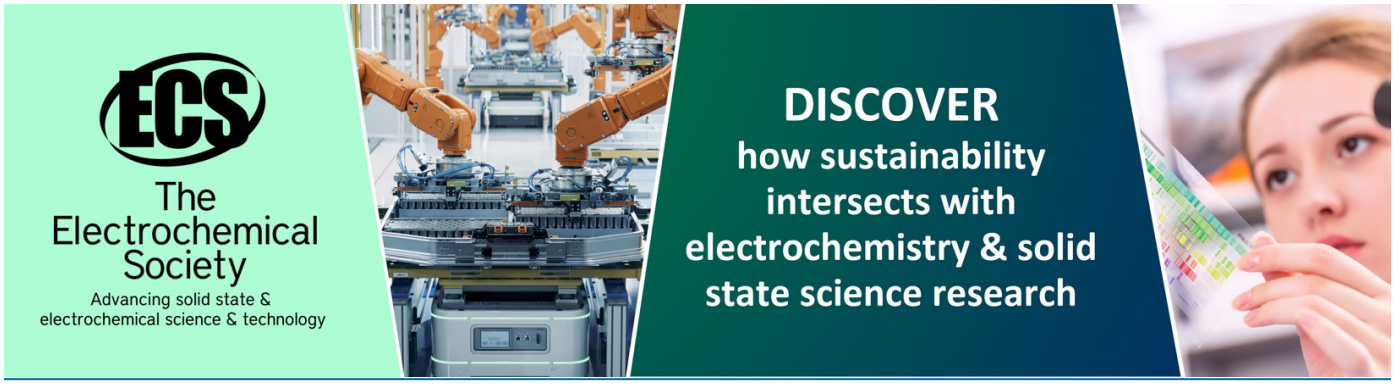

Model management assessment of building waste material on impact cost during construction stage (case study in Makassar city)

J Thoengsal[1] , R U Latief[1] , S Hamzah[1] and I R Rahim[1]

[1]Department of Civil Engineering, Faculty of Engineering, University of Hasanuddin
Jl. Poros Malino, Km. 6, Sungguminasa, Gowa, 92171 South Sulawesi, Indonesia

E-mail: rusdiul@gmail.com

Abstract. The progress of multi-story building construction in Indonesia especially in developing regions such as Makassar City during the last ten years has experienced significant development. Where the proportion of overcast contributions due to the emergence of remaining material during building construction ranges (3- 13.5)% which of course directly impacts the overall construction costs. The purpose of this study is to identify the remaining management factors of construction materials that are ideal for implementation by construction operators, conduct control assessments on the relationship of the effect of the application and potential management of the remaining construction materials to the impact of construction cost performance. The method used in this study was carried out by determining the population and sample number of building construction projects currently underway and a survey of the number of contractor representatives in Indonesia then collecting primary data in the form of distributing questionnaires to construction organizers, especially to experienced contractors, then subsequently. The expected results of this study are to obtain a management model concept for the remaining cost of building construction materials in the ideal construction stage that can be applied by the construction operators in this case to the implementing parties/contractors.

1. Introduction

The State of Indonesia is a developing country in recent years, especially in Makassar City, located in the eastern part of Indonesia, so that in carrying out economic, trade, business and government activities it is necessary to provide supporting facilities and infrastructure such as building construction. Building construction currently leads to vertical and horizontal spans of development, this is due to the growing need for human activities that require a lot of building facilities.

Previous studies generally examined more at the stage of the study of identifying the emergence of the remaining construction materials, but there are still very few research references in Indonesia that examine how the potential application of building material waste management in reducing the impact of cost inefficiency during construction. Data sources from previous studies have shown the impact of cost inefficiency due to the occurrence of the remaining material during the building construction process due to the lack of application of waste management. The proportion of Material Costs is around 40-60% of the total project cost [1]. Where the proportion of overcast contributions due to the emergence of the remaining material during construction of buildings ranging from 3- 13.5)%.

Based on the background of the above problems, the formulations of the problem in this study can be described as follows:

- How to find out the type of construction and material items that have an impact on costs due to the generation of material waste during the construction phase?
- How to identify the concept of ideal material waste management to reduce the cost inefficiency of building construction projects?

The objectives of this study are to identify the type of construction and material items that have an impact on costs due to the generation of material waste during the construction phase.

2. Literature review

2.1 Waste material management

Management of waste material management is the responsibility of each construction organizer, starting from the planners, executors, suppliers, supervisors and building owners [2,3]. Poor management certainly affects the emergence of material waste. The occurrence of construction material waste can be caused by one or a combination of several sources and causes. Formoso (2002), distinguish the remaining sources of construction materials over six categories: (1) design; (2) material procurement; (3) material handling; (4) implementation; (5) residuals; (6) others [4]. The results of Bossink and Browers' research method in the Netherlands, concluded the source and causes of the occurrence of the remaining construction material based on the categories of causes of waste material.

Construction waste management includes the collection, transportation, storage, treatment, recovery, and disposal of waste and is defined as a comprehensive, integrated, and rational system approach to achieving and maintaining environmental quality and supporting sustainable development [5]. Besides, waste management as a tool to control construction waste disposal costs and also facilitates the evaluation of alternative disposal methods such as recycling and reuse to reduce waste to landfill.

2.2 Impact of construction material waste

The impact of material waste has affected several aspects. From several literature studies, 3 (three) categories of material waste impacts have been identified including environmental, social and cost aspects. Some reference factors that cause negative impacts on the cost aspects of the results of construction material waste [5-7].

2.3 Positive potential for application of construction waste material management

Implementation of construction material waste management has become a standard that must be applied by each stakeholder to reduce the impact [8]. The potential implementation of construction material waste management will have a significant positive impact if carried out simultaneously and continuously, especially on the type of building projects. Positive potential in implementation will certainly affect environmental, social and cost aspects. Some reference factors that become a potential positive in reducing the impact on the cost spec.

3. Research methodology

The type of research conducted in the form of survey research with inferential-development methods by conducting a study by making a model that can predict the effect of management of waste material management affects the impact of project costs, and can dynamically predict the effect of the application of waste material management on reducing potential the cost of building construction project inefficiency, especially in big cities in Indonesia. Respondents in this study are directors, staff managers, and implementers who work for contractors and consultants in South Sulawesi. Contractor

data obtained through the list of contractor membership at Gapensi in Makassar in 2019 amounted to 170.

The type of data used in this study consists of primary data and secondary data, with data collection techniques, primary data collection techniques in this study include:

- Observation, that is by direct observation in the field, to observe how the process of managing waste material is actually on the field in the construction phase.
- Distribute questionnaires using a list of questions filled out by respondents, with answers provided in the form of a rating (rating scale), both the client, consultant and building contractor in Makassar.
- In-depth interviews with respondents

Secondary data collection techniques in this study in the form of library data, namely data collection in the form of literature studies in the form of journals, textbooks, and data / supporting documents and other documents related to the problem under study.

3.1. Population and sample

The population in this study is the building owner, consultant planners and implementing contractor companies that often handle building projects in Makassar City. The research sample is the architect and engineer of the consultant planner, implementing supervision both the project manager, quantity surveyor and quality surveyor at the contractor company that understands the problem being studied at the specified project study location and building owners who generally understand the research topic. Sample selection is done by using purposive sampling technique, which is sample selection that is adjusted to the needs. The sampling technique used is using the Slovin method with the following equation.

3.2. Data management analysis method

The data analysis technique used by using centralized size analysis, validity and reliability tests, influence diagrams, conditional probabilities using SPSS Statistics and Microsoft Excel 2007. Descriptive statistics are meant by calculating the average value/mean, mode (mo), median (me), standard deviation and variance of the opinions of respondents on the distribution of questionnaire data obtained. Item validity test is a data instrument test to find out how accurate, valid, accurate a data is in measuring what you want to measure, while the reliability test is used to determine the reliability, stability or consistency of the measuring instrument [8-12]. In this study, the validity test was carried out using the corrected item-total correlation method. For the reliability test, the Cronbach's Alpha method was used, where both tests were carried out using the SPSS Statistics program. In this stage, a study was carried out to identify the management factors of the remaining ideal and significant building construction materials to be applied in the model development process. This stage uses descriptive statistical analysis to present the results of ideal management factors in the process of developing a management model of the remaining building construction materials.

4. **Results and discussion**

From the results of the initial survey research conducted in Makassar City, the proportion of building type qualifications was obtained based on the number of floors that were running, namely building projects <5 floors by 4%, housing by 23% and buildings> 5 floors by 73% with the following proportions on figure 1.

A comparative level of risk arising from the remaining material on each construction work item on the impact of project costs, where work items that have a moderate level of risk (medium) occurs in the upper structure work items with a risk scale of 4.9 and followed by sub-structure work items with risk scale 4.4 (Medium), finishing work with scale 3.5 (low) and utility work with risk scale 1.3 (very low). It can be seen from the results of previous studies where the greatest impact on work items occurs in upper structure work items with a high enough frequency of occurrence, so based on the risk analysis table, the risk scale variation is obtained for each construction work item.

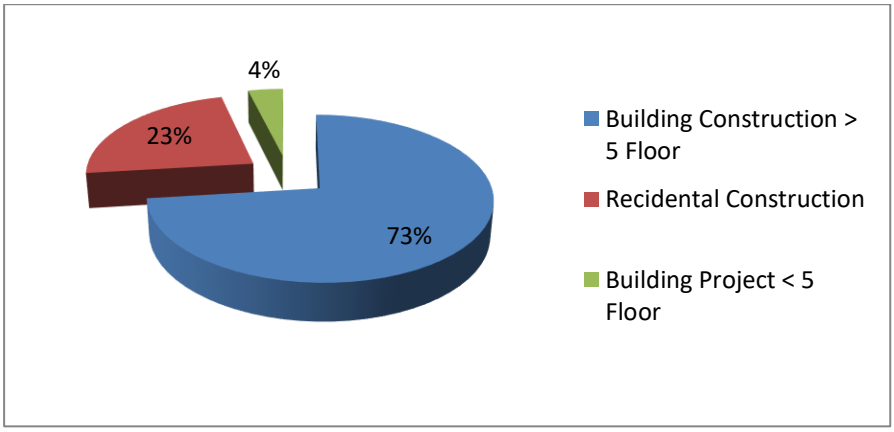

Figure 1. The proportion of the number of building types at the construction stage in Makassar city

The expected results of this study are the data obtained where the type of construction that has the potential to have an impact on costs due to the generation of material waste during the construction phase generally occurs in the type of building > 5 floors and from the results of the risk analysis obtained data that the upper structure work items have a risk level medium and utility work have a small risk level of cost impacts during construction as can be seen in table 1.

Table 1. Risk index for the occurrence of material waste in building construction work items on cost aspects in the construction phase

Multi-storey building construction work items	Rate of risk toward cost	Category
Upper Structures	4.991666667	Medium
Sub Structures	4.422222222	Medium
Finishing Work	3.580555556	Low
Utility Work	1.35	Very Low

Based on the construction material items, it can be seen that the material items that have the highest frequency of occurrence are in concrete formwork woodblock items and multiplex material items with a scale of 5 (Very often), then followed by spash pile material items, reinforcing iron (rebar), concrete aggregate with a scale of 3. Then for material items with the smallest frequency, events generally occur in finishing materials (plastering, bricking, tile, tiles) and utility materials (cables, pipes) with an event scale of 1 as can be seen in figure 2.

So it is expected to conduct a study of the concept of developing an ideal management model for the remaining costs of construction materials that can be applied by the construction organizers in this case addressed to the executor / contractor, especially private contractors and planning consultants in an effort to reduce the impact of the disparity in material costs during construction process in Indonesia. The development of the concept of the research model will consist of measuring variables consisting of 10 Category Variables and 81 sub-categories of measuring variables. Where the main variable consists of the Design Phase consisting of the Construction phase consisting of: Material reused/recycle, Fabrication Material, Worker Competence, Management, Supervision, Policy, Storage, Method, Field Handling and Handling of Shipment.

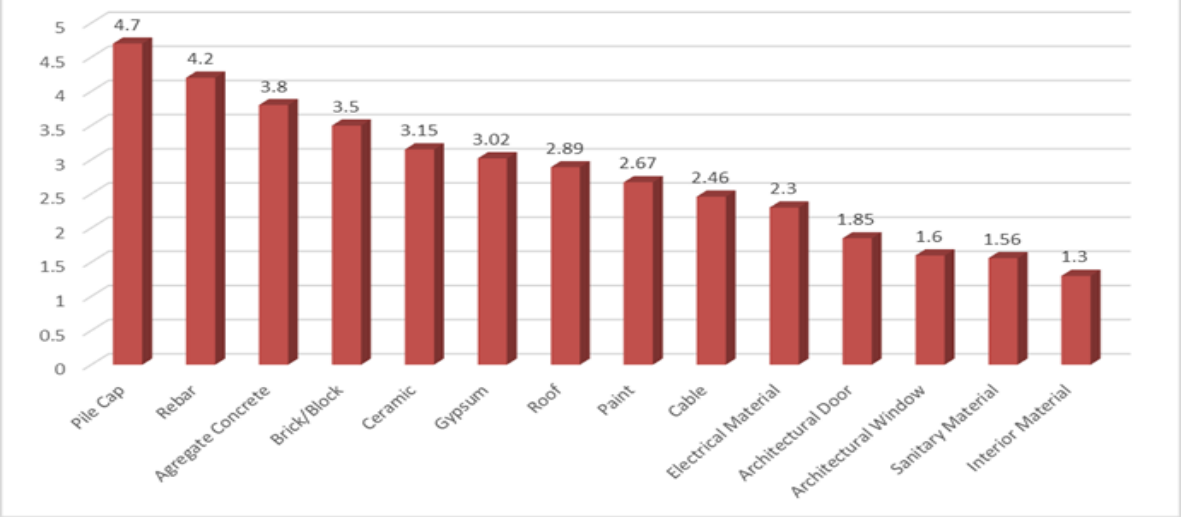

Figure 2. Distribution of frequency diagrams of occurrence of waste material occurrence in construction work material items

While the variable cost impact consists of the financial costs of construction and the cost of implementing the management of the remaining construction materials as can be seen in figure 3.

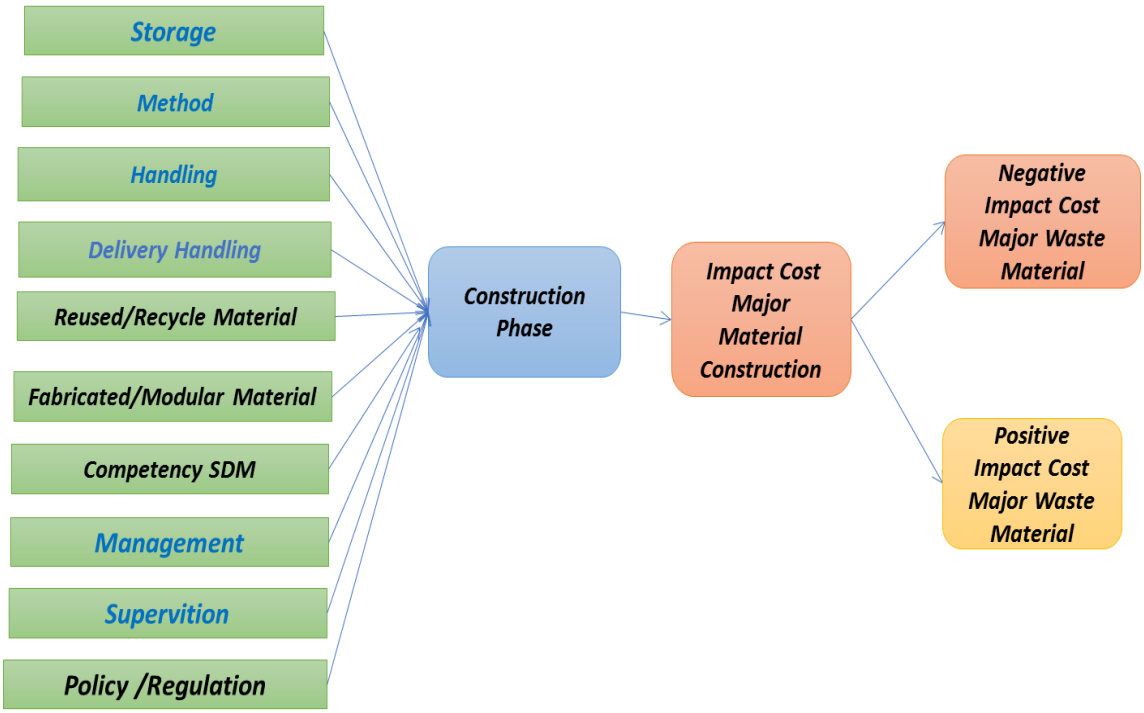

Figure 3. Concept of the management model of recognizing construction material residual costs against the impact of costs in the construction stage

5. Conclusion

From the results of the risk analysis, it is obtained that work items that have the highest risk index based on the project cost aspects are upper structure work with an average risk index of 4.99

(Medium), sub-structure work with a risk index of 4.42 (Medium), finishing work with an index of 3.5 (Low) and utility work with a cost risk index of 1.3 (Very low).

Waste material items that have an impact on direct costs that have the highest frequency of occurrence are in concrete formwork woodblock items and multiplex material items with a scale of 5 (Very often), then followed by spash pile material items, reinforcing iron (rebar), concrete aggregate with a scale of 3. Then for material items with the smallest frequency, events generally occur in finishing materials (plastering, bricking, tiles, tiles) and utility materials (cables, pipes) with an event scale of 1. So it is expected to conduct a study of the concept of developing an ideal management model for the remaining costs of construction materials that can be applied by the construction organizers in this case Addressed to the executor / contractor, especially private contractors and planning consultants in efforts to reduce the impact of the disparity in material costs during the construction process in Indonesia.

Acknowledgments
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References

[1] Chen Z, Li H, and Wong TC 2000 Environmental management of urban construction projects in China. *J. Const. Eng. Management* **126** 320–324.
[2] Construction Waste Management Plan Guidelines. walga.asn.au.
[3] Elizar, Suripin, and Mochamad A W 2017. Model of Construction Waste Management Using AMOS-SEM for Indonesian Infrastructure Projects. *Matec. EACEF* J. 20(17) 123-130.
[4] Formoso C T, Asatto E l, and Hirota 1999. *Method for Waste Control in the Building Industry*. Proceedings IGLC-7, 325-334.
[5] Formoso C T, Soibelman L M, Aniyra S C E, and Cesare C D 2002. Material Waste in Building Industry: Main Causes and Prevention. *Journal of Construction Engineering and Management*, 15 (4) 316-340.
[6] Green Building Council Indonesia (GBCI), 2011. Greenship Rating Tools For Existing Building. www.gbcindonesia.org
[7] Intan I, Alifen R S, and Arijanto L 2005. Analysis and Evaluation of Remaining Construction Materials: Sources of Causes, Quantities, and Costs. *Civil Engineering Dimension*,. 7 (1) 36-45.
[8] Irmawati 2015. *Waste Material Control in Multilevel Building*, Post-graduate Thesis UNHAS, Hasanuddin University, Makassar.