Factors Affecting the Implementation of Green Procurement in Indonesia Construction Industry

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Abstract*—A construction industry is often described as inefficient, irresponsible towards environment and society. This research aimed to analyze the factors affecting the implementation of green procurement in Indonesia construction industry. The research project specifically focuses on a construction material procurement. For this purpose, 26 factors were identified and project managers who worked on construction companies with large grade of national / international scales belonging to the association of construction in Surabaya were interviewed. The relative importance on these factors were quantified by Relative Importance Index and Confidence Interval. The result showed that the factors affecting implementation of green procurement in Indonesia construction industry were requirement document (contract) and cost efficient from energy and waste saving.

Keywords*—green procurement, eco-label, sustainable, construction.

I. INTRODUCTION

In many countries, the construction industry has, however, attracted criticism for inefficiencies in outcomes such as time and cost overruns, low productivity, poor quality, and inadequate customer satisfaction [1].

The construction project is considered to have a major role to change an environment on the surface of the earth, starts from the planning stage and continues after the construction team has left the site [2]. It cannot be separated from the utilization of natural resources which are more limited in number. The use of materials and hazardous substances during the process of construction and maintenance, transportation during construction, and energy use during maintenance have been identified as aspects of the most important environment. [3]. Green procurement has increasingly been recognized as an effective means of addressing and reducing negative environmental impacts related to the production and consumption around the world.

As a developing country, Indonesia is facing many problems in development, specifically in the construction industry. Surabaya city is a pilot of the implementation of green procurement. Green Procurement concept has been proved to be able to support the economy, social and environment development [4].

This policy will encourage adoption of sustainable production in industry, as well as promote the availability of products to be more environmentally friendly in the consumer market.

A number of a preliminary survey of some project managers in Surabaya city revealed that the implementation of green procurement in the construction project was not yet optimally carried out. It was because the application of green procurement that concerned with the environmental and social development was not fully implemented. Economic considerations were still dominant and final decisions were still on the project owners. Also, the actual content of demands on the environmental aspects of calls for tenders was no often clearly defined.

Based on the above issues, the aim of this research was to analyse the factors affecting the implementation of green procurement in Indonesia construction industry. Green procurement was seen as a means towards improving products and operations from an environmental perspective to reduce risk, the total cost of ownership, and improve supply chain performance.

II. METHOD

A questionnaire was developed to assess the perceptions of project managerson the relativeimportance offactors affecting the implementation of green procurement in Indonesia construction industry. The data collection was conducted in three stages. First, questionnairescovered some general questions in the size of the project managers as respondents. These were followed by a number of questions about the profile data of respondents. The second questionnairescovered 26 factors affecting green procurement in Indonesia construction industry especially in construction materials (see Table.1) and completed the questionnaire forms by assigning values to the factors ranging from 1 (strongly disagree) to 5 (strongly agree). An initial list was selected based on a literature review. And the third questionnairescovered some green products as databases.

The sampling method used in this study was purposive sampling. Data collected from purposive sampling may still be valid for certain studies. When a sample is a representative, it becomes valid over the realm it represents, and provides external validity.When a sample is measured correctly, it becomes valid forthe sample, thus it produces internal validity [2].

The weighted average for each item for the second questionnaire was determined and ranks (R) were assigned to each item. The collected data were analysed using Relative Importance Index (RII) method and Confidence Interval (CI).

Therelative importance index (RII) was calculated for eachitem as follows [7].

$$RII = \frac{4n1 + 3n2 + 2n3 + 1n4 + 0n5}{4N}$$

where n1=number of respondents for ‘strongly disagree’; n2=number of respondents for ‘disagree’; n3=number

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of respondents for 'neutral'; n4=number of respondents for 'agree'; n5=number of respondents for 'strongly agree'; N=total number of respondents.

$z = \frac{\bar{x} - \mu}{\sigma / \sqrt{n}}$ Confidence Interval is one of the parameters to measure how accurate a sample representing Mean value of the actual population is. In this study, the number of respondents was 40 (n≥30) and 95% confidence intervals, the average distribution of samples to be normal, with the average value (population) μ with σ STD. There is a probability (1-α) that the average sample size n would be located between -zα / 2 and zα / 2, then P (-zα / 2 <Z <zα / 2) = 1-α with.

III. Result and Discussion

A. Overview Of The Research Object

A project manager is a person who makes project goalsand usesskills as well as expertise to inspire a sense of shared purpose within the project team.

Sixty (60) project managers were selected from construction companies with a large grade of national / international scales belonging to the association of construction in Surabaya and were given the questionnaires. And 40 managers returned the questionnaires representing aresponse.

A potential project manager is someone who has a technical background. Fundamental skills are needed to be a successful project manager. The result showed that from the total 40 respondents, 90% respondents had a background of an educational degree in Civil Engineering; 10% respondents had backgrounds of Bachelor Architecture (see Figure 1).

Project managers had the responsibility of the planning, procurement and execution of a project, in any domain of engineering. Project managers werethe first point of contacts for any issues or discrepancies arising from or within the heads of various departments in an organisation before the problem escalates to higher authorities. So, experience in the field is very important. The result showed that the respondents who had experiences under 10 years were 17.5%. While long experiences in the field of building construction projects over a period of 10-20 years was 15%. And respondents who had experiences above 20 years were 67.5% (see Figure 2).

Green Procurement is one of the effective ways to change an inefficiency in energy, land and material use of the industry into efficiency in energy, land and material use of the industry. The procurement process is very necessary to ensure the government's policies. The result showed that 45% respondents had knowledge and understood of green procurement in building construction projects. 33% respondents were still at the level of understanding only. And 13% respondents were at the level of knowing and not understanding the green procurement and 10% respondents did not know and did not understand green procurement.

B. Overview Of Preliminary Survey To Respondents' Characteristics

From a preliminary survey, according to project managers showed that the implementation of green procurement in material construction procurement depending on the kind of the project. For small projects, using locally source materials at the construction site helped reduce distance for deliveries, therefore reducing the project's impact on the environment. Significant cost savings were also achieved. And for large-scale projects,all goods deliveries were pre-arranged in order to provide a robust just-in-time material deliveryschedule, so that materials arrived when they were required for use. This negated the need for on-site storage of materials, which did not only improve the construction site of logistics but also reduced the risk of damage or loss of materials as well as reduced congestion and the associated risks such as safety incidents.

C. Data Analysis

The primary data collected from the second part of the questionnaire were analyzed from the perspective of project manager. The relative importance index, RII, was computed for each factor to identify the most significant factor. The factors were ranked based on RII (see Table 2).

Based on the ranking in Table 2, the data were analyzed using Confidence Interval (CI) method (see Figure3).

Figure 3describes that there are 7 factors affecting the implementation of green procurement in Indonesia construction industry (see Table 3). Research showed that 6 of 7 factors were included in the cost efficient (energy and waste saving). Factors of energy efficient are as follows:

1. A precise placement of logistic materials on site intime and energy efficient(RII = 0,880);
2. Material productproduced has an adaptability and an endurance to all weather (RII = 0,875);
3. Distributionof material products is in time and energy efficient (RII = 0,870);
4. Materialproduction process consumes low energy and low emissions (RII = 0,865).

And factors of waste saving are:

1. Material productproduced hasraw materials with a lower chemical content and non-toxic substances (RII = 0,875);
2. Material product produced has an availability of spare parts and repair services (RII = 0,865)

One factor included in the green document where environmental criteria are presented incalls for tenders is relevant with respect to environmental impact. The important factor of green procurement is the requirement of environmental specification on the tender document (RII = 0,865).

D. Discussion

According to the ranking of the factors, the seven factors affect the implementation of green procurement in Indonesia construction industry are discussed hereunder:

1) A precise placement of logistic materials on site intime and energy efficient (RII = 0,880)

The study result shows that materials used to build the objects are mixed together to form the construction project. During the construction, some materials will also be retracted from the construction site. Even the land is limited, all activities involving retraction, production, transportation or utilization of materials will have an

impact onthe environment. Sustainability can be achieved through the responsible and efficient use of materials, as well as through the promotion of recycling of retracted resources.

2) *Material product produced has an adaptability and an endurance to all weather (RII = 0,875);*

According to the respondents said that material productslike exterior/interior materialshad been based on the function, durability, easy care, and environmentally friendly ones.

3) *Distribution of material products isin time and energy efficient (RII = 0,870);*

Project delivery time affects cost and construction hindrances to the community. Short delivery times will require more construction workers, but minimizes hindrance to the community. Longer delivery times reduce costs but increase construction hindrance. An optimum result has to be found. Time can also be an important factor during maintenance works.

4) *Material production process consumes low energy and low emissions (RII = 0,865).*

Chemical products, losses of energy and materials, and thevolume of waste have been considered to be the most importantenvironmental impact, although awareness of the emissions of chemical substances from thematerial during its utilization is increasing [7].

The study result reveals that the selection of material construction depends on the scope of projects. Cement, sand, wood, steeletc. are common raw-materials used in construction industry. Production process of each materials should consume low energy and low emissionsalthough carbon monoxide (CO) and organiccompounds may be emitted.

5) *Material product produced has raw materials with a lower chemical content and non-toxic substances (RII = 0,875);*

Toxic materials in products or packaging canbe replaced with non-toxic substitutes. Source reduction mayhappen by using packaging that reduces the number ofdamages or spoilages to the product, or reusing products orpackages already manufactured [9]

Based on the research result reveals that chemical content has been a criterion to support theeco-design strategy of'selection of low-impact materials'.

6) *Material product produced has an availability of spare parts and repair services (RII = 0,865)*

The respondents said that a half of cost projectswasspent for construction material.Timeliness of services should be considered as related to waiting time and the delivery time of the materials. Itwas also related to the usage / installation time of materials at the project site. So, material product produced has an availability of spare parts and repair services.

7) *The importance factor in green procurement is the requirement of environmental specification on tender document (RII = 0,865)*

Planning and management of construction projects in accordance with the contract documents should be ableto minimize the effect of the construction process on the environment [5].

According to the respondents, the contract consisted of a basic agreement and the program of requirements. The basic agreements set administrative provisions, like price-setting, project responsibilities, division of risk and sustainability. And the other requirements were environmental plans, environmental management systems, and technical specifications. Environmental consideration can include demands on a return of packaging, environmental consideration in transport, and use an eco-label product, etc.

IV. CONCLUSION

Based on the research results and discussion, the conclusion can be drawn that the factors affecting the implementation of green procurement in Indonesia construction industry arethe requirement of technical specifications in the procurement documents based on standards of environmental engineering or eco-label criteria and cost efficient from energy and waste saving.

The implementation of the green procurement is particularly important in the construction industry that has spent the enormous expenses of materials and equipment that are part of an overall cost of the project.

By implementing the green procurement in the construction project, the production of waste, the use of materials, the emission of carbon dioxide, and the use of energy can be minimized. So that it can bring an efficiency in project and maintenance costs.

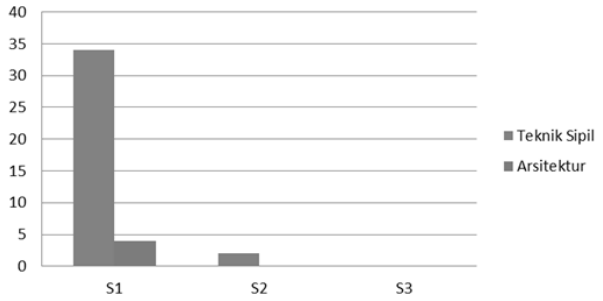

Figure. 1. Eduction Background of Respondents

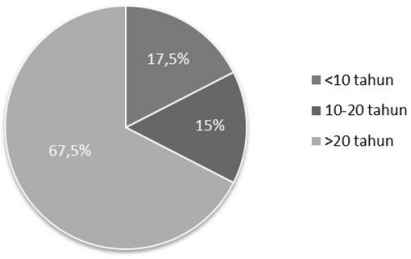

Figure 2. Experiences in Project Construction

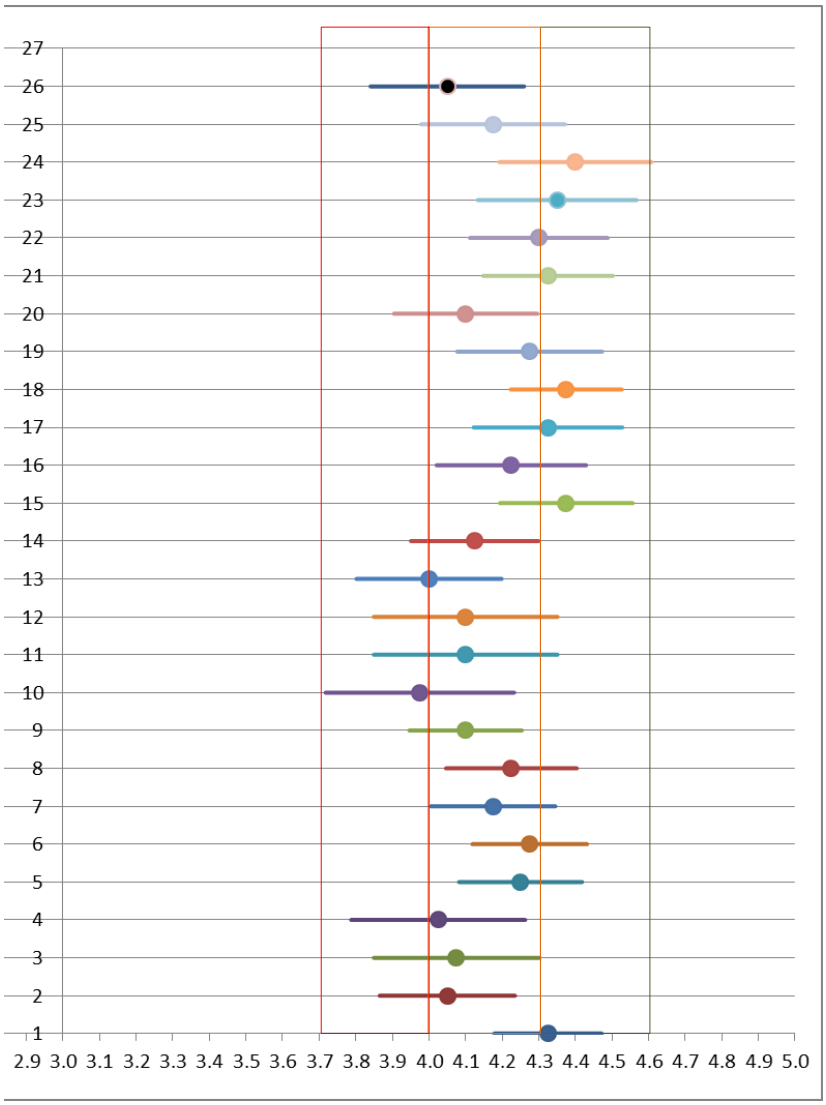

Figure.3. The Result of Confidence Interval Test

TABLE 1.
VARIABLES OFFACTORS AFFECTING GREEN PROCUREMENT IN INDONESIA CONSTRUCTION INDUSTRY

Variables		Indicator
Technical specifications	X1	The requirements of technical specifications in the procurement documents based on standards of environmental engineering or eco-label criteria
Selection criteria	X2	The requirements of the selection criteria for evaluating suppliers who have the capacity and technical capabilities needed to fulfil the contract
Award criteria	X3	Determining the value of the contract is more based on the selection of environmentally friendly products than the lowest price
Contract clauses	X4	The inclusion of environmental criteria in the performance of such a contract clause demands the return of packaging, transportation and environmental considerations
Management comptencies	X5	The company hasan ability to maintain the operation and competitiveness based on knowledge and information
	X6	The company reinforces the operations through staff training activities
	X7	The company increases competitiveness by cooperating with environmentally friendly materials
	X8	Supporting management can strengthen the operations of the company
Green Image	X9	The company involvement and cooperation with all staff members in different departments organization are important to be executed
	X10	The company carries out market analysis to determine the availability of environmentally sound alternative suppliers
Design for environment	X11	The company takes into account the problem of disposal, dismantling, reuse and recycling of waste materials
Environmental Management System	X12	The company has ISO 14000 or EMAS (environmental management system) where the company focuses on continuous improvement of environmental performance
Environmental competence	X13	The company has the capability of handling retrieval and pollution reduction, and producing material

	X14	The company has the capability of producing environmentally friendly material with clean technologies
Optimization of initial lifetime	X15	Material product produced has adaptability and endurance to all weather
	X16	Product manufactured material are easily assembled and disassembled
	X17	Product manufactured material has an availability of spare parts and repair services
Ecological profile of materials	X18	Product manufactured material has a raw material with a lower chemical content and non-toxic substances
	X19	Product manufactured material issourced from sustainable, natural (eco-label certified) , and renewable resources
Environmentally sound packaging	X20	The product packaging material produced is packaging that can be recycled or reused
Optimization of production techniques	X21	Material production process consumes low energy and low emission
	X22	Product manufactured material should be able to minimize waste and hazardous chemical productions
Optimization of distribution system	X23	Distribution of material product is in time and efficient energy
	X24	Precise placement of logistic material in the location should be in time and efficient labors
New product or development concept	X25	Material productshould have an integrated and optimized product functions
	X26	Products should be certified and have eco-label materials.

TABLE 2.
RII AND RANKING OF FACTORS AFFECTING GREEN PROCUREMENT IN INDONESIA CONSTRUCTION INDUSTRY

Variable	Indicator	Weight	Mean	RII	Rank
Technical specifications	X1	173	4,325	0,865	5
Selection criteria	X2	162	4,050	0,810	22
Award criteria	X3	163	4,075	0,815	21
Contract clauses	X4	161	4,025	0,805	24
Management competencies	X5	170	4,250	0,850	11
	X6	171	4,275	0,855	9
	X7	167	4,175	0,835	14
	X8	169	4,225	0,845	12
Green Image	X9	164	4,100	0,820	17
	X10	159	3,975	0,795	26
Design for environment	X11	164	4,100	0,820	18
Environmental Management System	X12	164	4,100	0,820	19
Environmental competence	X13	160	4,000	0,800	25
	X14	165	4,125	0,825	16
Optimization of initial lifetime	X15	175	4,375	0,875	2
	X16	169	4,225	0,845	13
	X17	173	4,325	0,865	6
Ecological profile of materials	X18	175	4,375	0,875	3
	X19	174	4,275	0,855	10
Environmentally sound packaging	X20	164	4,100	0,820	20
Optimization of production techniques	X21	173	4,325	0,865	7
	X22	172	4,300	0,860	8
Optimization of distribution system	X23	174	4,350	0,870	4
	X24	176	4,400	0,880	1
New product or development concept	X25	167	4,175	0,835	15
	X26	162	4,050	0,810	23

TABLE 3.
THE RESULT OF RII AND CI TEST

Rank	**Variable**	**Indicator**	**Mean**	**RII**	**Rank of CI**
1	Optimization of distribution system	X24	4,400	0,880	1
2	Optimization of initial lifetime	X15	4,375	0,875	1
3	Ecological profile of materials	X18	4,375	0,875	1
4	Optimization of distribution system	X23	4,350	0,870	1
5	Specification technique	X1	4,325	0,865	1
6	Optimization of initial lifetime	X17	4,325	0,865	1
7	Optimization of production techniques	X21	4,325	0,865	1

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