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Analysis of Key Success Factors on the Improvement Façade Performance of High-Rise Hotels Based on Green Building and Value Engineering Using the RII Method

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ABSTRACT

Background: From a total of 180 countries in the world, Indonesia is ranked 116th in the EPI data ranking. This EPI ranking shows data on a country with a success rate in overcoming environmental challenges. This paper describes the innovative design of a high-rise hotel building that carries a green building concept which utilizes the outer wall area of the hotel building as an object in this study.
Methods: Application of the work analyzed will be carried out through a VE workshop study and implementation of green building methods. The data process was carried out using qualitative methods, namely analyzing research based on green building and value engineering.
Result and Conclusion: The results of the statistical analysis of RII show that F count > F table means H_1 is accepted and H_0 is rejected, where there is a significant relationship between green building methods and value engineering with façade work in high-rise hotels. The results of the engineering value and function analysis of the facade work through case study analysis where the percentage of façade work is ≤ 6.21%, with the use of PhotoVoltaic (PV) material as much as 100% (1st floor to 10th floor) from 2 sides of the wall surface facade (east and west) can produce ± 1,050 KVA of electricity from PLTS and can reduce electricity usage from PLN by 991 KVA, from the total electricity demand of hotels which reaches 2,041 KVA, meaning that it reduces by 47.32%.

Keywords: Façade, Green Building, Hotel, PhotoVoltaic (PV), Relative Important Index (RII), Value Engineering

INTRODUCTION

The goal of this research is to acquire any work items that are viable to be value-engineered (Husin, et al., 2018). Many concepts of implementing green buildings have provided various benefits in developed countries, but implementation is still largely not beneficial in developing countries, including Indonesia (Berawi et al., 2019, pp-81-93). According to (Law Number 28 of 2002) concerning buildings, it is explained that each building has a different function. The number of 3-star hotels in DKI Jakarta in the 2014-2018 period has increased by 53.05% or from 213 hotels in 2014 to 326 hotels in 2018. Meanwhile, the number of hotels throughout Indonesia has reached 1,302 hotel units built (Source: BPS, 2018).

Facade as the outermost part of the building's architecture that reflects the image and expression of all parts of the building, it can even become the soul of the building, the exterior will be the most critical former part and is vulnerable to extreme and rapid weather changes. The composition of a façade, taking into account all its functional requirements (windows, doors, sun shading, roof plane) is principally carried out by creating a harmonious unity

using a proportional composition, structured vertical and horizontal elements, materials, colors, and decorative elements. Other things that are no less important to get more attention are the proportion of openings, building height, the principle of repetition, a good balance of composition, and the themes that are included in the variations (Krier 1988: 72).

The use of the Value Engineering method will certainly be more valuable with a combination of the Green Building method. Based on previous research (2019 Global Status Report for Buildings and Construction, IEA & United Nations) that buildings and their construction consume 36% of the world's energy, and cause 39% of greenhouse gas (CO2) emissions, therefore the façade design concept. This will be reduced by using the Green Building method to reduce the dangers of natural damage.

Figure 1: Building Energy Consumption Graph

Besides, it can also be seen that the percentage of external heat gain from the use of the facade (window) is the highest load of the main cooling system, which reaches 60%. Thus the facade can be optimized with energy-saving consumption using value engineering methods and green building concepts. The implementation of the green building concept can be applied by utilizing solar energy sources (PLTS). Under PP. 79 of 2014 concerning the National Energy Policy, the target of the new and renewable energy mix (EBT) in 2025 is at least 23% and 31% in 2050. Indonesia has the potential for new and renewable energy which is large enough to achieve the target of the primary energy mix, as seen in the table below:

Table 1: Renewable Energy Potential.

Energy Types	Potential
Hydro Power	94,3 GW
Geothermal	28,5 GW
Bioenergy	PLT Bio : 32,6 GW
	BBN: 200 thousand Bph
Solar Power	207,8 GWp
Wind	60,6 GW
Ocean Energy	17,9 GW

Currently, the local government has installed as many as 24 power plants from new and renewable energy sources (EBT) with a capacity of 354.08 MW of the total planning of 1,771.41 MW and have been operating in the first semester of 2020. (source: KESDM, 2020). The application of a working system using VE and green building can achieve innovations in quality and cost efficiency and energy conservation obtained during planning until the value of benefits is calculated in the future. With this innovative achievement, it can reduce the

use of electricity that comes from solar power (photovoltaic), this is a novelty in this research.

In this study, success factors indicate factors that have a positive impact on certain project performance metrics. Using the existing literature, the following are the key success factors that have been identified from 49 points to the 10 most influential main factors, which are listed in table 2 below. Determine the feasibility of previous studies before starting the project (Kim et.al. 2017). The formulation of the Detailed Engineering Design (DED) is also very decisive at the start of the project (Haowen, 2015). The formulation in the use of project costs (Venkataraman et.al. 2019). Planning data analysis before starting work (Jun Ma et.al. 2016). Analyze data according to project requirements (Hwang et.al. 2017). Determine the design to be used at the project development stage (Venkataraman et.al. 2019). Calculate the cost reduction that will be obtained by using this method (Wooliams, Jessica, 2001). Determine the selection of the design concept on the facade material that will be used (Wooliams, Jessica, 2001). Checking the specification of working drawings before starting work in the field (Wooliams, Jessica, 2001), and Determination in the selection of materials and systems that must be adapted to the environmental conditions around the project (Wooliams, Jessica, 2001).

Table 2: Success Factors.

Number	Success Factors	Reference
1	Feasibility study (FS)	Kim et.al (2017)
2	Detailed Engineering Design (DED)	Haowen (2015)
3	Usage Fee	Venkataraman et.al (2019)
4	Data analysis	Jun Ma et.al (2016)
5	Function Analysis	Hwang et.al (2017)
6	Development Stage	Venkataraman et.al (2019)
7	Cost reduction	Wooliams, Jessica (2001)
8	Selection of Design Concepts	Wooliams, Jessica (2001)
9	Shop Drawing Specifications	Wooliams, Jessica (2001)
10	Material and System Selection (Reduce / Select)	Wooliams, Jessica (2001)

From the combination of these key success factors, it can determine that the novelty aspect of this study is a description of the position of the dissertation in other similar studies. Regarding added value and innovation, according to Berawi, M.A. & Woodhead, R.M. (2008), by grouping concepts into the results and goals we want to achieve, how the sequence of processes can be executed, and why it is necessary to perform a function, we are led to a shared understanding and a better ability to generate new ideas to stimulate innovation and add it. product value. Value addition is intended to evaluate why, what, where, how, and who can innovate in the process to produce the desired project/product for the benefit of shareholders (Berawi, 2009). In this case, the researcher tries to study the existing journal journals in terms of strengths, weaknesses, conclusions, updates, and their relation to the research that is being compiled.

RESEARCH METHODS

A research instrument is a tool selected and used by researchers in collecting data so that its presence can be more systematic (Arikunto, 2010). Meanwhile, the research instrument is a tool used to record the state and activity of psychological attributes (Suryabrata, 2003). So it can be concluded that a research instrument is a tool used by researchers to collect qualitative and quantitative data and information about the variables being

studied. The instrument used in this study was a questionnaire survey.

In this study, Microsoft Excel 2006 and RII were used to analyze the data obtained from the questionnaire survey.

The analysis method used is the descriptive statistical method to describe the basic characteristics of the data and the inferential statistical method to conclude from the data to more general conditions (Trochim, 2006). The variables used by using the independent variable (X) statistical method consist of several variables which are the results of the details of research factors, indicators, and sub-indicators, with the main variables being: identification of cost efficiency, application of the VE method, application of the Green Building method. The dependent variable (Y) of the study is a high-rise hotel building as the object of research.

In this study, the target respondents required to fill out the questionnaire consisted of several respondents, with the aim that the results of the questionnaire were more optimal because they were filled in by professionals in their fields. There are 4 target respondents in this research, namely: Project Manager, Constitutional Court Consultant, Green Building Consultant, and supervision/licensing. Respondents used in this study were 44 respondents.

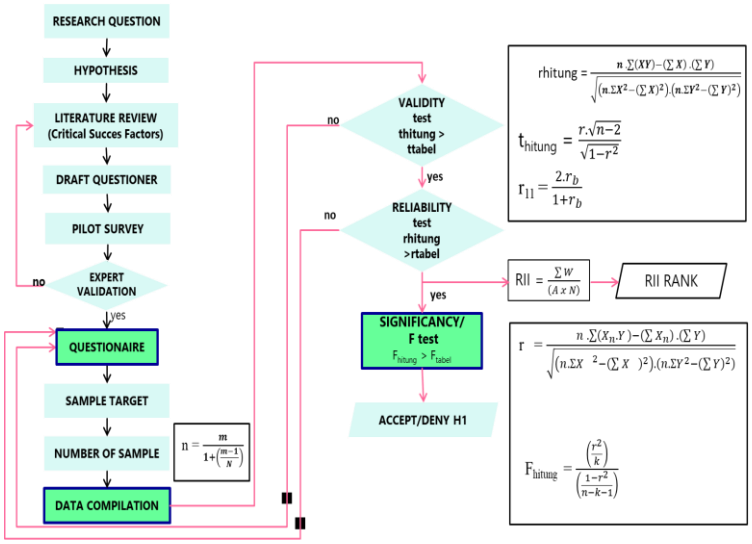

Figure 2: Research Flow Chart.

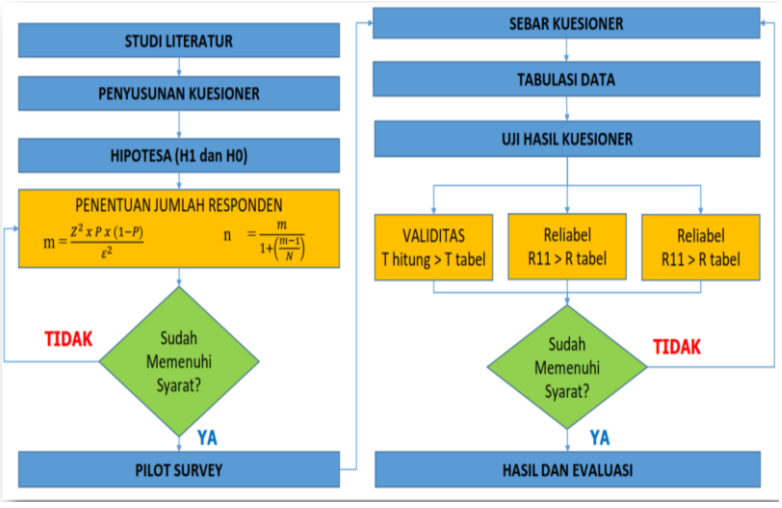

Figure 3: RII Calculation Flow Chart.

From the steps above, we can count the number of respondents that we will distribute for the questionnaire. The calculations are as follows:

Where :

Z = 1.96
P* = 0.5
ε = 0.05
N = 49 Question Variable

Determination of the number of random samples:

$$m = \frac{Z^2 \times P^* \times (1-P^*)}{\varepsilon^2}$$

$$= \frac{3.8416 \times 0.5 \times 0.5}{0.0025}$$

$$= 384.16 \approx 385$$

$$n = \frac{m}{1 + \frac{m-1}{N}}$$

$$= \frac{384.16}{1 + \frac{383.16}{49}}$$

$$= 43.55757 \approx 44 \text{ Respondents}$$

Where:

m = the sample from the population is unlimited

n = the sample from the population is limited

Z = Score (e.g. 1,96 for 95% safe level)

P^* = degree of variation between population elementsi (0,5)

ε = fault tolerance limit (0,05)

N = number of samples represented

From these calculations, then we analyze the results of distributing questionnaires based on certain groupings. The qualifications of respondents consisted of multi-stakeholder, namely: Project Manager, Constitutional Court Consultant, Green Building Consultant, and Supervision / Licensing can be described in the following pie chart based on the qualifications of the respondents:

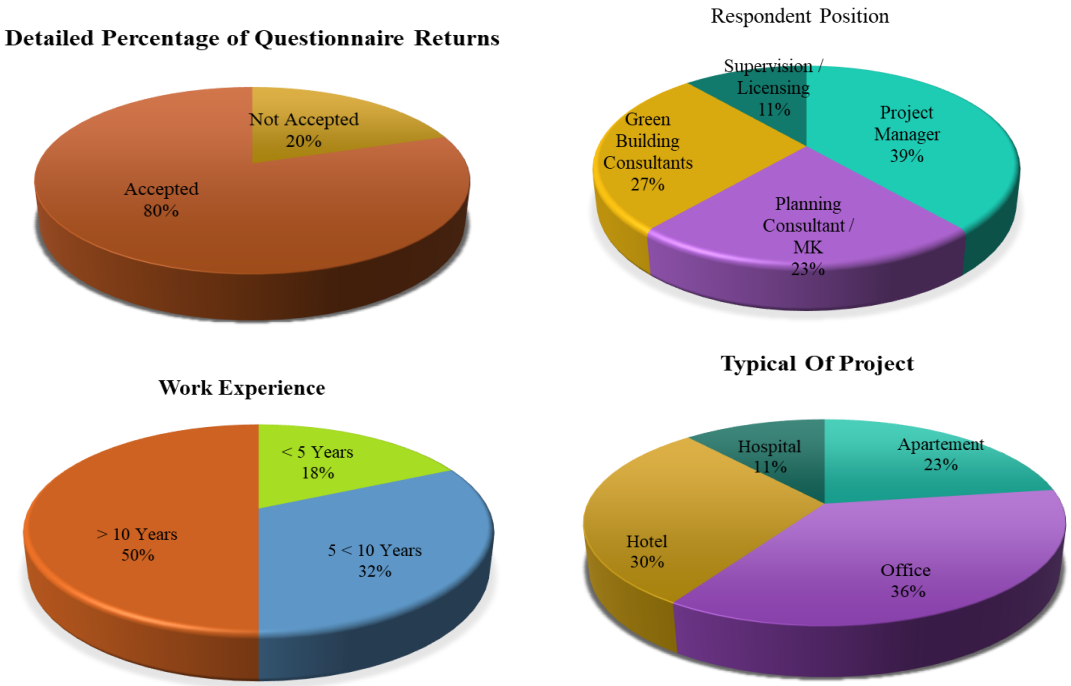

Figure 4: Pie Diagram Qualification of Respondent.

RESULT N DISCUSSION

From the RII statistical analysis carried out, 10 factors that most influence the application of Green Building and VE methods on facade work with the highest index value are: 1) Project Feasibility Study, 2) Detailed Engineering Design (DED), 3) Usage Cost, 4) Data Analysis, 5) Function

Analysis 6) Development Phase, 7) Cost Reduction, 8) Design Concept Selection, 9) Image Specifications, 10) Material and System Selection (Reduce/Select).

From the results of RII analysis, there are 2 hypothesis results, namely the 1st hypothesis, the relationship between the independent and dependent variables, where H1 = there is a relationship between Green Building and Value Engineering on the façade work of high-rise hotel buildings, and H0 = there is no relationship between Green Building and Value Engineering for the façade work of high-rise hotel buildings. While the second hypothesis is the influence between the independent and dependent variables, where H1 = there is an influence between Green Building and Value Engineering on the façade work of high-rise hotel buildings and H0 = there is no influence between Green Building and Value Engineering on the façade work of high-rise hotel buildings.

In the façade work, it is known that the percentage of the total cost of building the façade is 6.21% of the total budget. So that if a figure that exceeds the minimum standard is achieved, it is necessary to conduct a VE study to improve performance in terms of costs. To conduct the VE study process stage through several analyzes, it is hoped that it can reduce costs and increase its function. The following is a diagram of applying the VE and Green Building methods to the façade work:

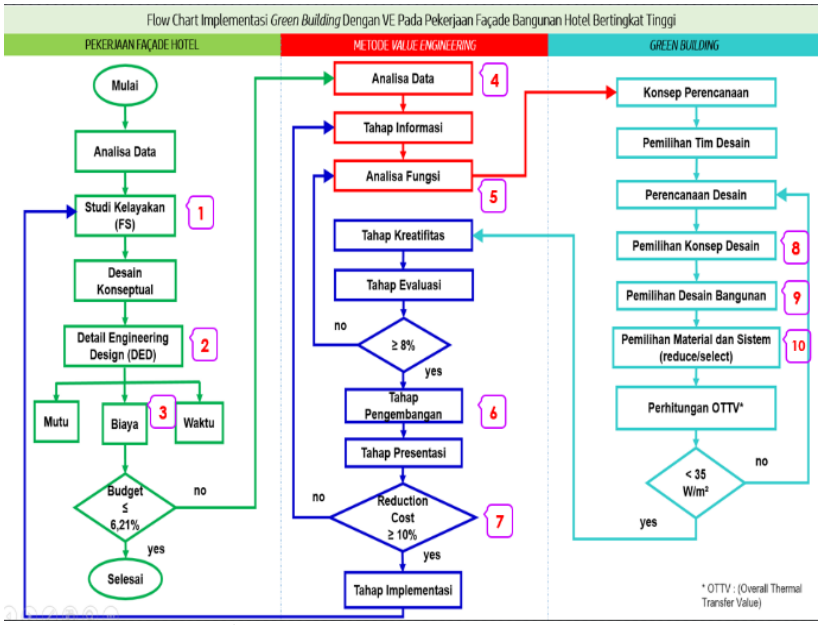

Figure 5: Flowchart of Façade Work Implementation with VE and Green Building.

To test the validity of the measuring instrument, first look for the correlation value between the parts of the measuring instrument as a whole by correlating each item of the measuring instrument with the total score which is the sum of each item score with the Pearson Product Moment formula in the equation and so on. calculated by the T-test with an equation. The following is an example of the results of the validity test shown in Table 3 below:

Table 3: Validity Test.

No.	Variable Code	R Count	R Table	R Count	T Table	Result
1	X1	0.7825	0.2973	8.1433	1.6849	Valid
2	X2	0.8529	0.2973	10.5881	1.6849	Valid
3	X3	0.8529	0.2973	10.5894	1.6849	Valid
4	X4	0.7028	0.2973	6.4027	1.6849	Valid
5	X5	0.8379	0.2973	9.9470	1.6849	Valid
6	X6	0.4883	0.2973	3.6261	1.6849	Valid
7	X7	0.5540	0.2973	4.3132	1.6849	Valid
8	X8	0.6041	0.2973	4.9130	1.6849	Valid
9	X9	0.8515	0.2973	10.5226	1.6849	Valid
10	X10	0.6145	0.2973	5.0485	1.6849	Valid

Valid Results = if t value $t_{counts} > t_{table}$
Invalid Result = if t value $t_{counts} < t_{table}$

Besides the validity test, there is also a reliable test. It is a test of the consistency of the instrument when it is measured repeatedly. The reliability test can use the Spearman-Brown formula. The questionnaire instrument can be said to be reliable if it meets the following requirements:

Table 4: Reliability Test.

No.	Variable Code	R Count	R Table	RII	Result
1	X1	0.7825	0.2973	0.4852	Reliable
2	X2	0.8529	0.2973	0.5556	Reliable
3	X3	0.8529	0.2973	0.5556	Reliable
4	X4	0.7028	0.2973	0.4055	Reliable
5	X5	0.8379	0.2973	0.5406	Reliable
6	X6	0.4883	0.2973	0.1910	Reliable
7	X7	0.5540	0.2973	0.2567	Reliable
8	X8	0.6041	0.2973	0.3068	Reliable
9	X9	0.8515	0.2973	0.5542	Reliable
10	X10	0.6145	0.2973	0.3172	Reliable

Reliable Results = if t value $r_{\Pi} > t_{table}$
Inreliable Result = if t value $r_{\Pi} < t_{table}$

The reduced production of fossil energy, especially petroleum, and global commitments to reduce greenhouse gas emissions, encourage the Government to continuously increase the role of new and renewable energy as part of maintaining energy security and independence. Indonesia has the potential for new and renewable energy which is large enough to achieve the target of the primary energy mix, especially for solar energy which reaches 207.8 GWp. (Directorate General of EBTKE, 2018).

Therefore, based on the concept of planning a Green Building by utilizing solar energy sources by referring to one of the main aspects in the guideline for determining the evaluation of a building's Green Building assessment, namely in terms of Energy Efficiency & Conservation which This is applied to façade work using the PV system. The determination of the PV installation method depends on the needs, which can be installed using the on-grid method or the off-grid method. In the design of the hotel building, it is designed using the On-Grid installation method which aims to reduce the use of electricity from PLN (IESR, 2019).

Table 5: Influencing Factor.

RANK	KEY SUCCESS FACTORS	INDEX VALUE RII
1	Feasibility study (FS)	0,996
2	Detailed Engineering Design (DED)	0,992
3	Usage Fee	0,985
4	Data Analysis	0,981
5	Function Analysis	0,981
6	Development Stage	0,973
7	Cost Reduction	0,973
8	Selection of Design Concepts	0,970
9	Shop Drawing Specifications	0,966
10	Material and System Selection (Reduce / Select)	0,962

CONCLUSION

The implementation of high-rise hotel building façade work based on Green Building and VE can be seen in the implementation flow chart, where several factors that influence cost performance are seen as research variables as indicators of success and the achievement of hypotheses in facade work performance. From the statistical analysis carried out, it was found 10 factors that most influence the application of the Green Building and VE methods on facade works that have the highest index value:

1. Project Feasibility Study,
2. Detailed Engineering Design,
3. Usage Cost,
4. Data Analysis,
5. Function Analysis,
6. Development Phase,
7. Cost Reduction
8. Design Concept Selection
9. Image Specifications
10. Material and System Selection (Reduce/ Select).

The hypothesis of this research is based on the results of statistical analysis and case studies. It can be concluded and proven that the application of the Green Building and VE methods can improve the cost performance of high-rise hotel building façades. This is a novelty of the research.

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