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Plumbing Work in Green Market Based on Value Engineering

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A B S T R A C T

The green traditional market concept begins with the structure of the market section. This concept consists of various ideas that make markets environmentally friendly, these ideas include composting buildings, open gardens, bathrooms/toilets, parking areas and planting in the market. Understanding Value Engineering in general is a management technique that uses a systematic approach, creative and organized effort that is directed to analyze the function of a system with the aim of achieving the required function at the lowest possible cost. However, this remains within the established technical functions and limits. The method used is value engineering with the aim of understanding and identifying obstacles in the application of value engineering and lean six sigma methods in dirty water installation work in market buildings with the concept of green building. The research instruments were arranged in the form of variables which were formulated in the form of questions (questionnaires). Cost efficiency was obtained in clean and dirty water installation work of a savings of 9.8%.

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1. Introduction

Based on data from the Central Bureau of Statistics, traditional markets in Indonesia totaled 14,182 units and still dominate compared to modern shops with 1,131 units and shopping centers with 708 units (Miraj et al., 2019). Currently, the largest distribution of traditional markets is in East Java (1,823 units), Central Java (1,482 units), and South Sulawesi (940 units). While the areas that have the least number of traditional markets are the Bangka Belitung Islands (54 units), the Riau Islands (55 units), and North Kalimantan/Kaltara (57 units). The percentage of trade centers by market classification can be seen in Figure 1.

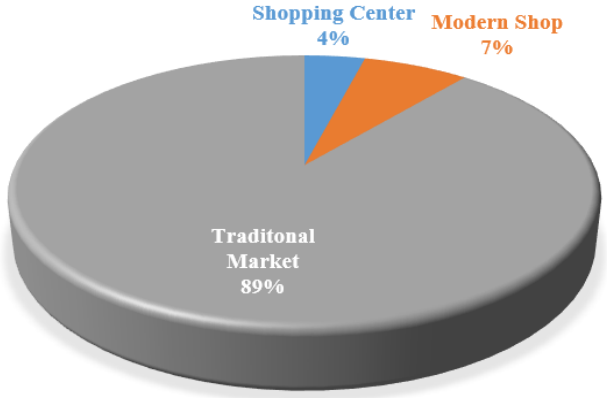

Figure 1. Percentage of Trade Centers by Market Classification

Based on the Environment Performance Index, the country which has the 1st ranking is Switzerland with the following results environmental performance (87.42), environmental health (93.57) and ecosystem vitality point of (83.32) (Ferdinand & Adianto, 2022). According to the Environment Performance Index, that Indonesia is ranked 133 below Vietnam and Bhutan with the following score points environmental performance (46.92), environmental health (45.44) and ecosystem vitality point (47.9). Ranking of Indonesia's sanitation can be seen in Table 1.

Table 1. Ranking of Indonesia's Sanitation and Drinking Water Systems

	Current Rank	Current Score	Baseline Rank	Baseline Score
Water and Sanitation	123	31.41	124	21.42
Drinking Water	125	29.88	124	21.67
Sanitation	119	32.94	123	21.17

Source : https://epi.envirocenter.yale.edu

In addition, Indonesia is ranked 123 for clean water and sanitation issues, for drinking water quality issues ranked 125th and for sanitation issues ranked 119th. It is known from that results that there is a lack of attention to the surrounding environment (Nandito et al., 2020). Nationally, the existence of drainage channels are really important for traditional markets, to which is 52.83 percent of traditional markets in Indonesia already have drainage channels, while 47.17 percent do not yet have drainage channels (Amelia & Sulistio, 2019). Percentage of the number of traditional markets according to the existence of drainage channels in Indonesia 2018 can be seen in Figure 2.

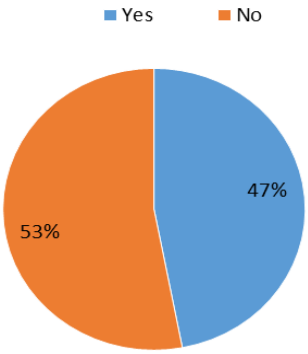

Figure 2. Percentage of the Number of Traditional Markets
Source: Central Bureau of Statistics (2018)

Nationally, if we look at the existence of clean water installations in traditional markets, 3.72 percent of the traditional markets already have clean water installations, but there are still very many traditional markets in Indonesia that do not have clean water installations, namely 96.28 percent (Santoso et al., 2020). Percentage of the Number of Traditional Markets According to the Presence of Clean Water Installations in Indonesia 2018. The illustration can be seen in Figure 3.

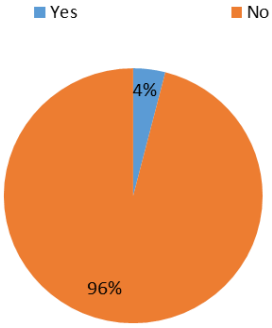

Figure 3. Percentage of the Number of Traditional Markets According to the Presence of Clean Water Installations in Indonesia
Source: Central Bureau of Statistics (2018)

Nationally, there are only 527 markets out of a total of 14,182 markets in all provinces of Indonesia that has the Presence of Clean Water Installations. The following is diagram data according to the 2018 Central Bureau of Statistics. Number of traditional markets by province and existence of market wastewater treatment plants. The illustrations can be seen in Table 2.

Table 2. Number of Traditional Markets by Province and Existence of Market Wastewater Treatment

No.	Province	Existence of Waste Water Treatment Plant		Amount
		Yes	No	
1.	Aceh	7	388	395
2.	Sumatera Utara	17	753	770
3.	Sumatera Barat	15	607	622
4.	Riau	14	730	744
5.	Jambi	13	424	437
6.	Sumatera Selatan	39	789	828
7.	Bengkulu	6	261	267
8.	Lampu	16	579	595
9.	Kepulauan Bangka Belitung	4	50	54
10.	Kepulauan Riau	9	46	55
11.	DKI Jakarta	39	119	158
12.	Jawa Barat	35	616	651
13.	Jawa Tengah	39	1.423	1.482
14.	DI Yogyakarta	42	360	402
15.	Jawa Timur	59	1.764	1.823
16.	Banten	21	167	188
17.	Bali	26	370	396
18.	Nusa Tenggara Barat	3	180	183
19.	Nusa Tenggara Timur	9	333	342
20.	Kalimantan Barat	7	169	176
21.	Kalimantan Tengah	12	391	403
22.	Kalimantan Selatan	6	376	382
23.	Kalimantan Timur	14	109	123
24.	Kalimantan Utara	2	55	57
25.	Sulawesi Utara	8	131	139
26.	Sulawesi Tengah	9	315	324
27.	Sulawesi Selatan	14	926	940
28.	Sulawesi Tenggara	9	473	482
29.	Gorontalo	12	136	148
30.	Sulawesi Barat	0	201	201
31.	Maluku	0	88	88
32.	Maluku Utara	0	108	108
33.	Papua Barat	0	72	72
34.	Papua	1	146	147
Total		527	13.655	14.182

Source: Central Bureau of Statistics 2018

According to Puteh (2022) the Green Building concept emphasizes the increasing usage efficiency of water, energy and building materials which can reduce the impact of new buildings on the environment and human health. For example, the double skin design on the outside of the building can reduce the heat load in the room by up to 30 percent, so that the use of air conditioning can be saved. The building materials chosen must also be of high quality and environmentally friendly. Several manufacturers have made products that are able to minimize the impact of damage to the environment and are also able to save energy.

The green traditional market concept begins with the structure of the market section. This concept consists of various ideas that make the market environmentally friendly, the ideas include the following: a composting building, an open garden, bathrooms/toilets, parking areas, planting in the market. Understanding Value Engineering in general is a management technique that uses a systematic approach, creative and organized effort that is directed to analyze the function of a system with the aim of achieving the required function at the lowest possible cost, but still in accordance with the functional and technical limits set. apply so that the results still guarantee the reliability of a project or product. In addition, VE can also be used to improve performance, quality and life cycle costs (Lu et al., 2021). Value engineering analysis in this study provides the right choice or alternative in dealing with the discharge of market waste water into the downtown canal without reducing the quality of the canal installation (Ferdinand & Adianto, 2022).

2. Methodology

The research method in order to understand and identify the obstacles in implementing the value engineering and lean six sigma methods in dirty water installation work in market buildings with a green building concept, research instruments were prepared in formulated variables in the form of questions (questionnare) (Amelia & Sulistio, 2019). The data that has been collected are analyzed and finally produces some findings. The next step, is the discussion of these findings are carried out and conclusions are drawn regarding the understanding and dominant factors that cause obstacles in implementing the value engineering method and lean six sigma in dirty water installation work (Bertolini, 2016). Respondents consist of project managers, site managers, engineering heads, site engineers and supervisors with more than 5 years experience with a minimum D3 education.

2.1. Data Collection

Secondary data collection was carried out based on literature studies from books, journals, proceedings, the internet and internal company data that are relevant to the research activities carried out. Furthermore, based on the secondary data, primary data collection was carried out through a questionnaire survey (Sugiyono, 2017). Primary data collection is carried out through several stages as follows:

1. The first stage is the construction validation stage, namely the stage before the questionnaire is distributed to respondents, expert validation will be carried out first so that the questionnaire distributed can be understood by respondents and the data obtained is in accordance with the expected research objectives. At this stage reduction or addition of existing sub-variables is also carried out based on the perceptions of these experts. The selected experts are at least 2 practitioners who have competence in the field of Value Engineering with a minimum of 10 y.
2. The second stage was the pilot survey: at this stage the construction validation questionnaire was distributed to 5 prospective respondents to determine the respondent's level of understanding of the questions or statements in the questionnaire and the respondent's level of difficulty in answering the questionnaire. At this stage, improvements were made to the editorial questions or statements in the questionnaire so that they were more easily understood by prospective respondents.
3. The third stage of data collection was carried out by distributing questionnaires to the respondents who were sampled. Sampling is done in the Project. Respondents selected as samples in this questionnaire survey consisted of 50-60 individuals involved in the Anandamaya Residences project at the project site.

2.2. Data Tabulation

Data tabulation is calculating the frequency of data from certain tables. There are 2 types of tables that are often used, namely data tables and work tables. The first table is the calculation of the average value of each variable in the factor. For example, factors 1 to n in the previous table have 3 variables, then respondents give answers from a score of 1 to 5. In the second table above, the category

column is filled with the components that are the main factors in this study. Whereas in the factor column are the variables that are the key success factors of each category.

2.3. Data Analysis

After the data is collected, appropriate data analysis is then carried out so that the results are in accordance with the objectives of the research. There are two methods that are generally used to analyze data, namely:

1. Qualitative data analysis, this method is used in qualitative research. In this method, statistical analysis is not used, but reads the available tables, graphs or figures and then performs descriptions and interpretations (Widyawati, 2022).
2. Quantitative data analysis is a method used in research with a quantitative approach. In this approach, using statistical tools. If the approach uses statistical tools, it means that data analysis is carried out according to statistical principles. There are two kinds of statistical tools, namely descriptive statistics and inferential statistics (Irwanto et al., 2020).

This study uses descriptive statistics. If by analyzing quantitative data an orderly picture of an event is obtained, then it is called descriptive statistics. This obtained the results of the data from the respondents

3. Results and Discussion

In the market building with the green building concept, starting from the planning, implementation, operation to the maintenance stage, it pays attention to aspects of protecting, saving, reducing the use of natural resources, maintaining the quality of both the building and the quality of market water treatment and paying attention to the health of its residents and around the market. The total cost of the entire project can be seen in Table 3. As for the details of costs can be seen in the attachment.

Table 3. Project Cost Recapitulation

No.	Work	Cost (IDR)
1.	Preparatory work	7,865,000,000
2.	Structure Work	34,245,000,000
3.	Architectural Work	31,235,000,000
4.	MEPs work	36,465,000,000
5.	Interior Work	18,850,000,000
Total		128,660,000,000

The pareto analysis was conducted to find out the highest cost of this project which has the potential to be used for value engineering analysis. The Pareto results for the total of the entire project can be seen in Table 4 and the Grafic of pareto can be seen in Figure 4.

Table 4. The Pareto Results

No.	Work	Cost (IDR)	Price Percentage	Cumulative Percentage
1.	Preparatory work	7,865,000,000	6.11%	6.11%
2.	Structure work	34,245,000,000	26.62%	32.73%
3.	Architectural work	31,235,000,000	24.28%	57.01%
4.	MEPs work	36,465,000,000	28.34%	85.35%
5.	Interior work	18,850,000,000	14.65%	100%
Total		128,660,000,000	100%	

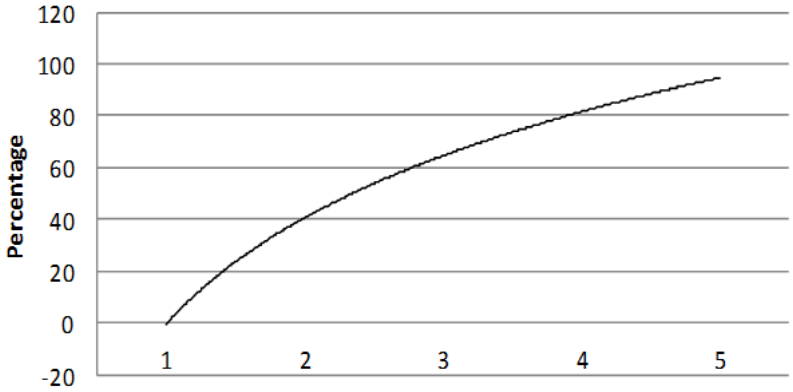

Figure 4. Pareto Graph

Based the pareto graph results Figure 4 of the entire project cost it can be seen that in this project the works of high weight are structural, architectural and market mechanical, electrical and plumbing work. Out of the three job components, then the highest job is analyzed using Pareto's law. Following are the results of a pareto analysis of mechanical, electrical and plumbing work can be seen in in Table 5.

Table 5. Pareto Analysis Results of Mechanical, Electrical and Plumbing Work

MEPs work	**Rupiah**	**Percentage**
Electrical installation and distribution	9,800,000,000	26,87
Air conditioning system	8,900,000,000	24,41
Fire extinguishing system	5,670,000,000	15.55
Installation of clean water and dirty water	10,200,000,000	27.97
Lightning protection installation	1,895,000,000	5,2
Total cost of work	36,465,000,000	100

Value (Value) is conceptually the ratio between Worth (price) and Cost (cost). Simple cost worth, cost worth vs functional analysis, simple initial design cost worth as can be seen in in Table 6 and Simple Cost Worth vs Functional Analysis Table 7.

Table 6. Simple Cost Worth

No.	**Work**	**Cost Rp**	**Worth Rp**	**Cost/worth**
1.	Preparatory work	7,865,000,000	7,865,000,000	1,00
2.	Structure Work	34,245,000,000	33,600,000,000	1.02
3.	Architectural Work	31,235,000,000	30,500,000,000	1.02
4.	MEPs work	36,465,000,000	34,580,000,000	1.05
5.	Interior Work	18,850,000,000	18,500,000,000	1.02
Total		128,660,000,000	125,045,000,000	1.03

Table 7. Simple Cost Worth vs Functional Analysis

MEPs work	**Cost Rp**	**Worth Rp**	**Cost/ worth**
Electrical installation and distribution	9,800,000,000	9,600,000,000	1.02
Air conditioning system	8,900,000,000	8,720,000,000	1.02
Fire extinguishing system	5,670,000,000	5,420,000,000	1.05
Installation of clean water and dirty water	10,200,000,000	9,200,000,000	1,12
Lightning protection installation	1,895,000,000	1,440,000,000	1,10
Total cost of work	36,465,000,000	34,580,000,000	1.05

Cost per Worth is based on prevailing market prices, so the cost per worth of mechanical, electrical and plumbing work has a large value engineering opportunity. Simple Cost Worth vs Functional Analysis, Initial design simple cost worth vs functional analysis. Obtained cost efficiency in clean and dirty water installation work of 9.8% savings obtained.

The results of this study have a positive impact on the environment because they have given the concept of processing waste into clean water. However, this research is not in line with Kartohardjono & Nuridin (2017) research that the apartment construction project being carried out has a negative impact on the environment. This is because cement processing waste is polluted in the environment around the project.

4. Conclusion

Value Engineering in general is a management technique that uses a systematic approach, creative and organized effort that is directed to analyze the function of a system with the aim of achieving the required function at the lowest possible cost, but still in accordance with the functional and technical limits set. The work component that has the most savings obtained is the work of installing clean water and dirty water. although this system has the potential for environmental pollution due to market waste. By conducting further value engineering analysis on clean water and dirty water installation work, an alternative market wastewater treatment with the same function at a lower cost is obtained. This value engineering study besides being able to streamline costs can also make buildings environmentally friendly. Future studies can analyze variables that are significant to environmental sustainability.

References

Amelia, H., & Sulistio, H. (2019). Analisis Value Engineering Pada Proyek Perumahan Djajakusumah Residence. *JMTS: Jurnal Mitra Teknik Sipil*, *2*(3), 209. https://doi.org/10.24912/jmts.v2i3.5831

Bertolini, V. (2016). Aplikasi Value Engineering Pada Proyek Pembangunan Gedung (Studi Kasus Hotel Grand Banjarmasin). *Jurnal IPTEK*, *20*(2), 53. https://doi.org/10.31284/j.iptek.2016.v20i2.32

Ferdinand, F., & Adianto, Y. L. D. (2022). Penerapan Value Engineering pada Proyek Pembangunan Gedung Serbaguna X di Kota Medan. *Journal of Sustainable Construction*, *1*(2), 10–18. https://doi.org/10.26593/josc.v2i1.5696

Irwanto, A., Arifin, D., & Arifin, M. M. (2020). Peningkatan Kualitas Produk Gearbox Dengan Pendekatan DMAIC Six Sigma Pada PT. XYZ. *Jurnal KaLIBRASI-Karya Lintas Ilmu Bidang Rekayasa Arsitektur Sipil Industri*, *3*(1), 1–17. https://doi.org/10.37721/kalibrasi.v3i1.638

Kartohardjono, A., & Nuridin. (2017). Analisis Value Engineering Pada Proyek Pembangunan Apartement di Cikarang. *Jurnal Konstruksia*, *9*(1), 41–58.

Lu, Y., Gong, P., Tang, Y., Sun, S., & Li, Q. (2021). BIM-integrated construction safety risk assessment at the design stage of building projects. *Automation in Construction*, *124*(2), 124–131. https://doi.org/10.1016/j.autcon.2021.103553

Miraj, P., Dofir, A., Andreas, A., Berawi, M. A., & Abd Karim, S. B. Bin. (2019). Systematic Review of Value Engineering Research Studies In Indonesia. *CSID Journal of Infrastructure Development*, *2*(2), 192. https://doi.org/10.32783/csid-jid.v2i2.93

Nandito, A., Huda, M., & Siswoyo. (2020). Penerapan Value Engineering Pada Proyek Pembangunan Puskesmas Rego Manggarai Barat NTT. *Jurnal Rekayasa Dan Manajemen Konstruksi*, *8*(3), 171–186.

Puteh, Z. (2022). Perancangan Small Office Home Office Dengan Pendekatan. *Jurnal KaLIBRASI - Karya Lintas Ilmu Bidang Rekayasa Arsitektur, Sipil, Industri.*, *5*(1), 1–21. https://doi.org/10.37721/kalibrasi.v5i1.970

Putra, A. P., Agung Yana, A. A. G., & Astana, I. N. Y. (2021). Penerapan Value Engineering Pada Proyek Pembangunan Rsud Sanjiwani Gianyar Di Masa Pandemi Covid-19. *Jurnal Spektran*, *9*(1), 21. https://doi.org/10.24843/spektran.2021.v09.i01.p03

Santoso, V. Y., Sugiyarto, & Sunarmasto. (2020). Penerapan Value Engineering Pada Struktur Bangunan Gedung (Studi Kasus: Proyek Gedung Kantor Dinas Pemadam Kebakaran Kota Surakarta). *Matriks Teknik Sipil*, 236–245. https://matriks.sipil.ft.uns.ac.id/index.php/MaTekSi/article/view/1104

Sugiyono. (2017). *Metode Penelitian Kuantitatif, Kualitatif, dan R&D* (1st ed.). CV Alfabeta.

Widyawati, L. (2022). Ruang Terbuka Hijau Permukiman di Jakarta Menuju Pembangunan Kota Berkelanjutan. *Jurnal KaLIBRASI - Karya Lintas Ilmu Bidang Rekayasa Arsitektur, Sipil, Industri.*, *5*(2), 148–159. https://doi.org/10.37721/kalibrasi.v5i2.1080