International Journal of Engineering and Advanced Technology (IJEAT)
ISSN: 2249-8958 (Online), Volume-8 Issue-2, December 2018

Cost Performance Review on Value Engineering Optimized Floor Cover Finishing Work of High-Rise Office Building

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Abstract*: The need for office space in urban areas could be considered really high because of the economic activities involved and because of its role in global economic growth. While Jakarta may seem to already possess a lot of office buildings, it turns out that they are not enough to compensate the growing demand for office spaces, with the demand reaching 6,928,500 m2 of rental office space at the end of 2013. Floor cover finishing is a generalized term for the permanent cover of the floor and the works involved. Floor cover itself is a term used to illustrate every finishing materials that would be applied on the floor structure to provide walking surfaces. The goal of this research is to acquire any work items that are viable to be value engineered. The floor cover finishing work is considered as the limitation of this research by the consideration of the said work to be the highest cost contribution to the interior architecture and could be the key factor in defining the image of the company that uses the office building. After the implementation of value engineering, the cost saving reached 12%, reducing the cost contribution of the floor cover finishing work to 4.7% from the initial 5.4%.

***Index Terms*: Floor cover finishing, High rise office building, Value Engineering.**

I. INTRODUCTION

The need for office space in urban areas could be considered really high because of the economic activities involved and because of its role in global economic growth. The rise of office space need has caused the blooming of high rise building construction as an office space especially in central city areas, provided with their high level of space and small footprint area [1]. Comfort level, aesthetics, and looks have defined the prestige level of an office building and eventually has become its main selling factor. Based on that fact, the cost benchmark has been a very crucial factor in the construction of a commercial high rise building.

The yearly demand level of office spaces and condominiums in Jakarta in 2010 have reached 37% and 58% respectively, much higher than its demand level in 2009, which reflects the improvement of Jakarta's property market while also considering its rental and sale prices. Therefore, the office building project itself has to possess high value and benefits in order to easily meet the stakeholder expectation and finally fulfilling the demand for office space in Jakarta [2].

Manuscript published on 30 December 2018.
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The jump in investment has fueled the massive growth in Jakarta's office demand [3]. The market analysis stated the demand for office spaces in Jakarta would rise for 14% and the office space rental would experience a growth of 46% for the year 2014. Today's office space is being emphasized of its roles as a source of information society to create and exchange the knowledge and as a pleasant space for workers [4].

While Jakarta may seem to already possess a lot of office buildings, it turns out that they are not enough to compensate the growing demand for office spaces, with the demand reaching 6,928,500 m2 of rental office space at the end of 2013.

The planning stage for office space construction is reflected in the organization structure and working technique that has to be determined from the early design phases. The project has to be able to include critical success factors in order to achieve the highest level of quality and value [5]. In order to improve the quality of the office space and the satisfaction level of the user, the interior of the office has usually been given more attention than the outside aesthetics of the building [6].

Finishing work means a series of subsequent work carried out after ground and structural construction in order to complete the final assessment of construction work also, it is relevant to various types of construction such as masonry construction, plasterwork, doors, and windows construction, waterproof construction, tile construction, interior finishing work, etc. [7].

Floor cover finishing is a generalized term for the permanent cover of the floor and the works involved. Floor cover itself is a term used to illustrate every finishing materials that would be applied on the floor structure to provide walking surfaces. These terms have been used alternatively although the floor cover itself is more inclined to the materials used, even sometimes includes carpeting, laminating materials, tiles, and vinyl. The occurring problem in planning phase is the incompatibility to the cost allocation due to the high requirements and demands from the stakeholders to increase the prestige of the construction project while the other problems that usually occur in the construction of a high rise building includes the drive for lower prices (33%), change of the existing operational model (28%), the increase of the price of goods and services (26%), and the complexity level of the supply chain (27%) [8]. The biggest funding needed for a high rise office building is on its MEP (Mechanical, Electrical, and Plumbing) and architectural works.

The architectural work itself consists of the flooring work, wall work, ceiling work, and its outer façade work with every work have its own contribution to the grand total of the project cost. The cost of the floor cover finishing itself contributes to 5.1% of the total project cost as shown in figure 1. Therefore, it is necessary to do some fine-tuning in the work involved to meet that budget limitation.

design phase, and to know how big the cost savings that could be achieved by implementing the value engineering method.

The floor cover finishing work is considered as the limitation of this research by the consideration of the said work to be the highest cost contribution to the interior architecture and could be the key factor in defining the image

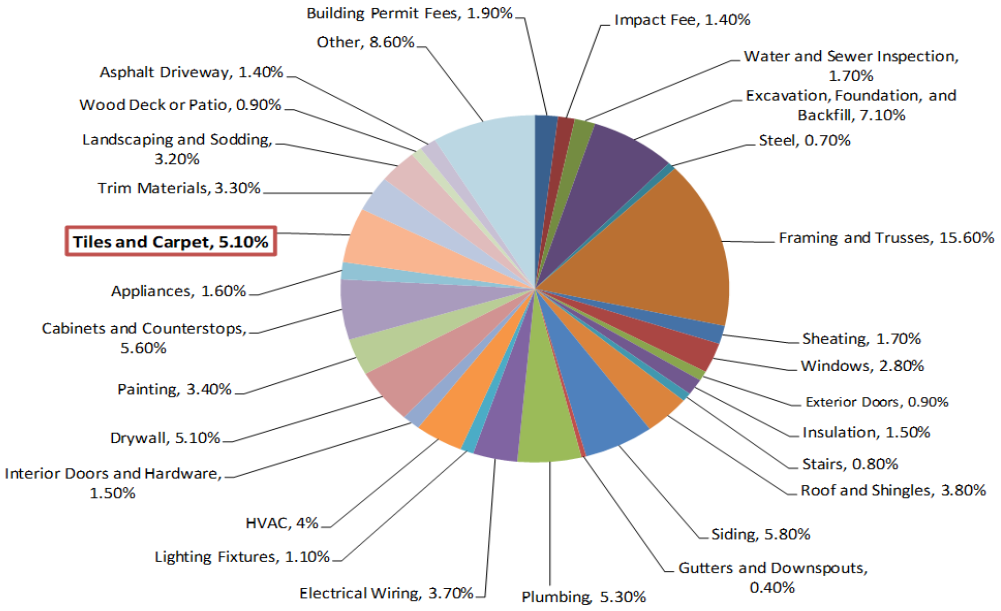

Fig 1. Construction Cost Breakdown

In this research, the cost percentage of the floor cover finishing work revolved around 5.44% so that the value engineering study by Pareto test, evaluation, and creative thinking must be done in order to reduce the cost and raise its function. This effort has been proven to be able to reduce the cost by eliminating any unnecessary secondary function and changing existing materials but still fulfilling the stated function of the office building.

II. RESEARCH METHODS

This research involved a case study of a high rise office building construction in Jakarta. The goal of this research is to acquire any work items that are viable to be value engineered,
to determine any alternatives for the initial items from the of the company that uses the office building. After the implementation of value engineering, the cost saving reached 12%, reducing the cost contribution of the floor cover finishing work to 4.6% from the initial 5.4%.

A.Key Success Factor

Implementation of VM workshops play an important role in managing the performance of projects, and critical success factors (CSFs) are essential to their success [9].

The primary data for this research was acquired from experts through questionnaires that were specifically made by considering every key success factors from the variables involved in this research [10]. After the processing was done, there are 11 influencing factors acquired from 40 sub-factors and 9 main factors as could be observed in table 1.

Table I. Key success factor

Value Engineering			
Var	Main Factor	Sub Factor	Reference
X1	VE STUDY	Data analysis	(Alan Perkins, 2003)
X2		Informationphase	(Qiping Shen and Guiwen Liu, 2003)
X3		Evaluation	(Ali baghert Fard, 2013)
X4		Creativity	(Al Ghamdi, 2004)
X5		Transfunctional relationship definition	(Mandelbaum and Reed, 2006)
X6		FAST Diagram	(John, S Borza, 2011)
X7		Project performance upgrade	(Dell'Isola, 1982)
X8		Time and priority	(The Tavistock Institute, 2000)
X9	VE IMPLEMENTATION	Development phase	(Mandelbaum and Reed, 2006)
X10		The decrease in cost	(Marlian Ronald. A Siamnjuntak & Wijono, 2017)
X11		Efficiency	(Marlian Ronald. A Siamnjuntak & Wijono, 2017)
X12		VE system control and the commitment of the company	(Sayles & Chandler,1970)

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High Rise Office Building			
X13	OFFICE FUNCTION	Company operation and activity	(Mohammad A. Hassanain, 2010)
X14		The need of office building	(Mohammad A. Hassanain, 2010 & Brian Conway, 2017)
X15		The classification of office building	(BOMA Quebec management, 2012)
X16		Commercial ability of high rise office building	(Jensen Hughes, 2016)
X17	OFFICE SPACE PRODUCTIVITY	Site analysis and architectural planning	(A Handbook of Planning of Office Building, CPW Department)
X18		Influencing trend of innovative office building	(Julie Wagner and Dan Watch, 2017)
X19		Finishing cost estimation from its schematics	(CPE Candidate, 2014)
X20		The evaluation of desire and needs	(CPM One Source, 2016)
X21		Fixed cost and provided time	(CPM One Source, 2016)
X22	OFFICE BUILDING DEVELOPMENT	The project's feasibility study	(Li Yin Shen, Et Al, 2010)
X23		Location and technical specification of the building	(Roman Direktovich, 2015)
X24		Workspace comfort level	(Si-Hwa Bae & Sung Moon Jung, 2013)
X25		The Functional aspect of a modern office building	(Waclaw Szarejko & Elzbieta Trocka -Leszczynska, 2015)
Floor Work			
X26	PLANNING	Initial planning	(Brian Conway, 2017)
X27		Schedule optimization	(Ahmad Hanafi, 2007)
X28		Floor plan pattern & aesthetic considerations	Fixing Guide For ceramic, Porcelain, Stone, and Glass Tile by Original Style & Titletoria, 2017
X29		Installation process & work technique	Fixing Guide For ceramic, Porcelain, Stone, and Glass Tile by Original Style
X30	MATERIAL SELECTION	Price estimation	(Hakan YAMAN, Elçin TAŞ,2007)
X31		Looks and aesthetics	(Robert Hodgkinson, 1988)
X32		Material stock availability	www. Ibisworld.com
X33		Floor materials and their application	(The Constructor.org)
X34	SPECIFICATION STANDARDS	Suitability and clarity of the specifications	(Pankaj P. Bhangale, 2016 & Fixing Guide For Ceramic)
X35		Availability, experience and the skills of the personnel	(Pankaj P. Bhangale, 2016)
X36		Schematic production	(WorldSkills Standart Specification Skill 12 Wall and Floor Tilling)
X37		Accuracy and measurability	(WorldSkills Standart Specification Skill 12 Wall and Floor Tilling)
X38	USAGE	Material application	(Michael C. Forde, Elsevier, 2018)
X39		Materials and tools	(Pankaj P. Bhangale, 2016)
X40		Office space functions	(Julie Wagner and Dan Watch, 2017)

B. Relative Importance Index

Relative Important Index (RII) is a method that could be implemented to analyze the most influential factors on the research object by utilizing statistical data acquired from the results of the questionnaire [11]. RII would later determine the most influential factors by building a ranking system integrated from the score of the respondent's questionnaire answers. Questionnaires were created in a structured manner to be easily filled out by the respondents [12].

The questionnaire was responded by 37 respondents consisting of planning consultants, construction managers, project managers, site managers, and supervisors on several similar construction projects. The statistical and tabulated results have proven that value engineering is a viable method to be used in order to decrease the cost of the floor cover finishing work, improving the overall project cost performance.

The data collected through the survey were enhanced if necessary through further contacts with the original respondent [13].

C. Value Engineering Application Stage

Value engineering can thus be said to have the following features: has a technical focus; involves using value techniques; selects the most cost-effective solutions to achieve the required function; removes unnecessary costs; reduces construction time and improves quality and maintainability [14]. The application of the value engineering method is best to be done in the early stages of the construction project, optimally in the planning phase in order saving that is corresponding to the main goal of the VE itself which is to increase the overall project performance and efficiency [15]. The value engineering study done in this research consisted of information phase, function analysis phase, the evaluation phase, development phase and implementation phase [16]. The data used for the value engineering study of this research is the secondary data that includes the technical data of the project and the material price.

III. RESULTS AND DISCUSSION

A. Project validation based on Value Engineering

Adjacent to the fact that value engineering is viable to be used to improve the cost performance of the construction project, this research utilized the value engineering method through the feasibility study [17]. The integration of the value engineering to the floor cover finishing work as the object of the research could be observed in figure 2 that showed their correlating factors.

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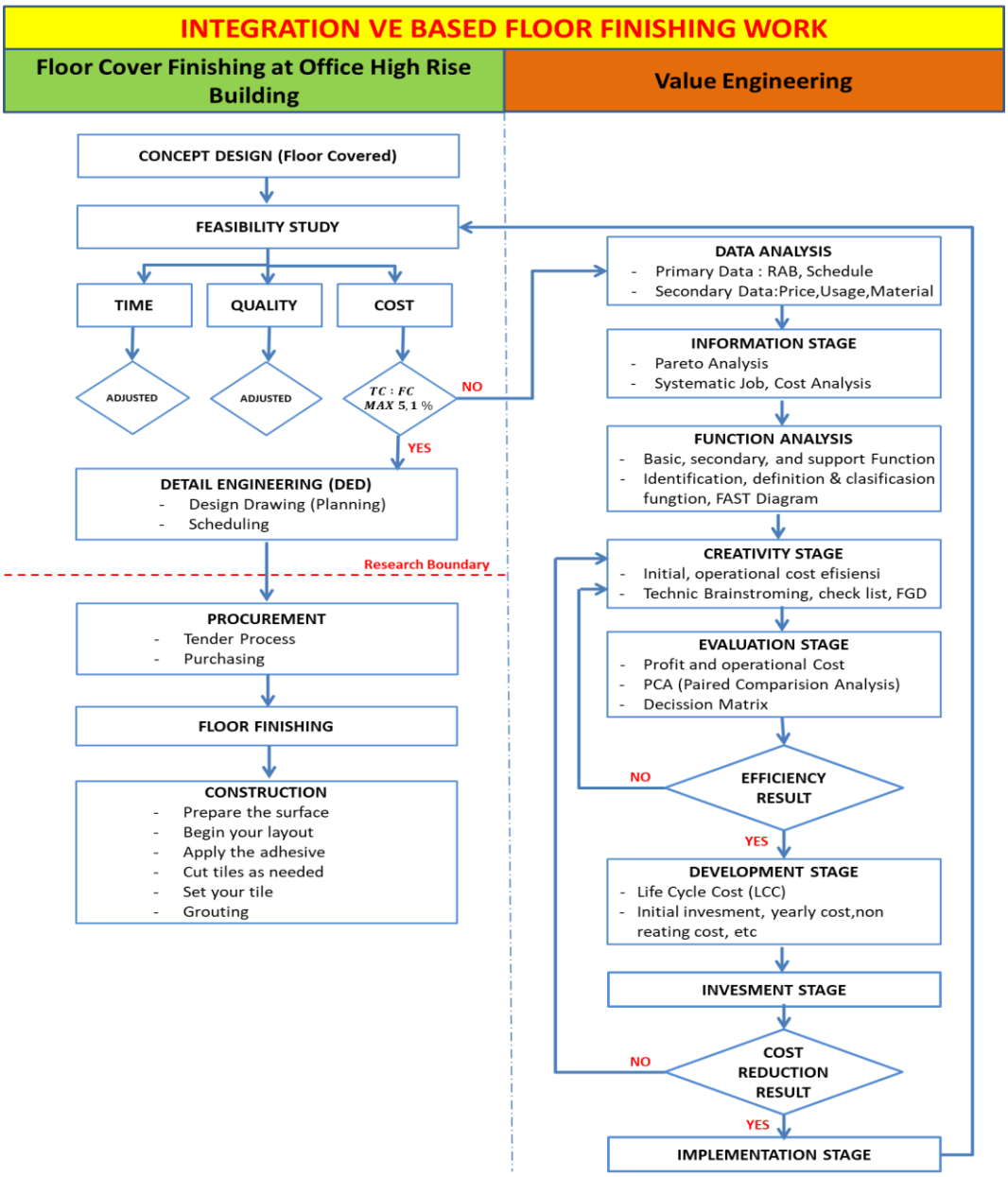

Fig 2. Value engineering implementation on the floor cover finishing work flow chart

B. Information phase

Information phase is the earliest stage of a VE implementation and done in order to acquire as much essential information as needed about the design planning of the project from the general data to the design limitations [18]. The information phase also involved identifying high-cost work items so that the value engineering could be accurately utilized, with the result shown in table 2.

Table II. The Weight The Primary

No.	Work Item	Cost		Cumulative	
		IDR	Weight (%)	IDR	Weight (%)
1	Preliminaries	30,000,000,000	10.3	30,000,000,000	10.37
2	Structure	76,417,460,680	26.41	106,417,460,680	36.78
3	Architecture	97,201,316,600	33.60	203,618,777,280	70.38
4	M E P	85,698,211,420	29.62	289,316,988,700	100
	Total	**289,316,988,700**	**100**		

As seen from the results listed in table 2, architectural works have the highest contribution to the overall workload of the project. Referring to the data provided in table 3, it is understood that from all of the works involved in the architectural work the flooring work has the highest contribution to the total cost with 5.44%.

Table III. The Weight The Primary

No.	Work Items	Total Cost (IDR)	Weight (%)
A.	Preliminaries	30,000,000,000	10.37
B.	Structure		
I.	Foundation	15,813,800,000	5.47
II.	Sub Structure	23,073,566,700	7.98
III.	Upper Structure	34,125,998,080	11.80
IV.	Steel	3,404,095,900	10.37

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C.	Architectural		
I.	Interior Architecture		
	a.Flooring Works	15,744,605,250	5.44
	b.Partition Works	15,279,730,600	5.28
	c.Wall finishing Works	11,826,849,800	4.09
	d.Ceiling Works	4,738,699,260	1.64
	e.Door Works	8,261,418,460	2.86
	f.Sanitary Works	1,638,119,500	0.57
	g.Others Works	2,039,166,460	0.70
II.	Exterior Architecture		
	a.Facade Works	37,672,727,270	13.02
D.	M E P		
I.	a.Electrical Works	26,506,405,630	9.16
II.	b.Electronic Works	7,442,599,370	2.57
III.	c.Mechanical Works	50,878,152,420	17.59
IV.	d.STP Works	871,054,000	0.30
	Total	**289,316,988,700**	**100.00**

The breakdown cost model analysis was also done with the result shown in table 4. The conclusion of this analysis also points out that the flooring work has the highest contribution of all other architectural works involved to the overall architectural works budget [19].

Table IV. Architectural Cost Breakdown Analysis

No	Work Item	Cost		Cumulative	
		IDR	Weight (%)	IDR	Weight (%)
1	Flooring Works	15,744,605,250	26.45	15,744,605,250	26.45
2	Partition Works	15,279,730,600	25.67	31,024,335,850	52.12
3	Wall finishing Works	11,826,849,800	19.87	42,851,185,650	71.98
4	Ceiling Works	4,738,699,260	7.96	47,589,884,910	79.94
5	Door Works	8,261,418,460	13.88	55,851,303,370	93.82
6	Sanitary Works	1,638,119,500	2.75	57,489,422,870	96.57
7	Others Works	2,039,166,460	3.43	59,528,589,330	100.00
	Total	**59,524,886,881**	**100.00**		

the method of Pareto law of distribution.

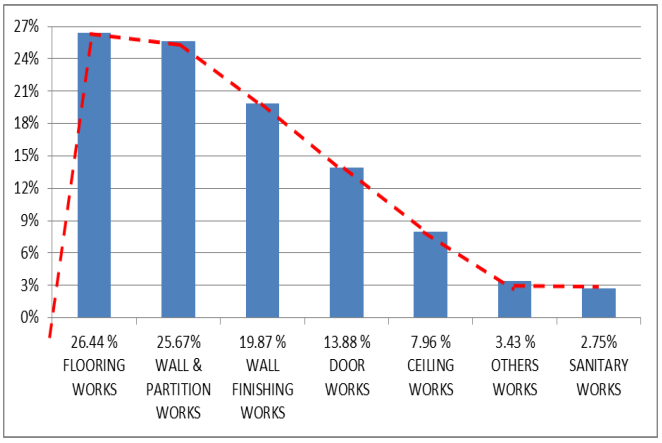

Fig. 3 Pareto Diagram Results

Compiling all the results from the preliminary analysis, a conclusion was made that the target of the value engineering implementation for this research should be focused on the architectural work of floor finishing with the specific weight of the work involved could be observed in table 5.

The floor cover finishing work as explained has major cost differences for every work involved in it and it could also be concluded that the work that has the biggest cost contribution is the work that involved locally sourced marble material.

Table V. Details of The Floor Cover Finishing Works

No.	Code	Work Item	Cost		Cumulative	
			IDR	Weight (%)	IDR	Weight (%)
1	ST –1	Imported Granite	6,103,462,500	38.77	6,103,462,500	38.77
2	HT - 1	600x 600 mm Homogeneous Tile polish	1,706,732,000	10.84	7,810,194,500	49.61
3	HT - 2	600x600 mm Homogeneous Tile unpolish	108,648,800	0.69	7,918,843,300	50.30
4	CT - 1	400x400 mm glossy ceramic tile	164,171,800	1.04	8,083,015,100	51.34
5	CT - 2	400x400 mm matt ceramic tile	9,581,400	0.06	8,092,596,500	51.40
6	CRT	Carpet Tile	1,988,354,250	12.63	10,080,950,750	64.03
7	WD	Wooden Deck	101,195,000	0.64	10,182,145,750	64.6
8	A	Andesite masonry	13,098,000	0.08	10,195,243,750	64.75
9	FH	Floor Hardener	2,826,069,000	17.95	13,021,312,750	82.70
10	SC	Floor Screeding (Bare)	1,920,155,250	12.20	14,941,468,000	94.90
11	DPP	Dust Proof Paint	157,313,750	1.00	15,098,781,750	95.90
12	EPY	Epoxy (Top Coat)	307,230,000	1.95	15,406,011,750	97.85
13	WP – CO	Water Proofing Coating	338,593,500	2.15	15,744,605,250	100.00
		TOTAL	**15,744,605,250**	**100.00**		

Referring to the previous analysis, breakdown cost analysis was also done in this step to acquire any high-cost work items
involved in the floor cover finishing work while also utilizing

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C. Function analysis phase

1). Function identification

The function identification is the preliminary step of executing a functional analysis. This phase involved function identification from the previous step then categorizing them according to each of their function. The function of each item contains an active verb and an unmeasurable noun, as could be observed in table 6.

Table VI. Function Identification Of The Floor Cov Finishing

Architecture works	**Flooring Works**	**Floor cover finishing**	The base of the room
			Strengthen the object's existence
			Supporting the indoor activities
			From the character of the room
			Beauty the aesthetics of the room
	Wall & partition finishing works		
	Wall Finishing works		
	Ceiling works		
	Door works		
	Sanitary works		
	Other works		

Meanwhile, the function identification focused on the floor cover work is specified in table 7.

Table VII. The Function Definition Of The Floor Cover Finishing Work

Work	Verb	Noun	Function
Floor Cover Finishing	Underline	Room	Primary
	Create	Ambiance	Secondary
	Support	Activities	Secondary
	Provide	Aesthetic	Primary

The value of a 'thing' can be measured from how well the 'thing' performs its designated functions and achieves its purpose. Since identifying functions enables us to propose alternative ways to perform those functions in the act of idea generation, an 'extended function' will set a new context (purpose and goal) of a system [20].

2). The Cost of worth analysis

The Cost of worth analysis could be simplified as a study to identify the cost and worth of each of the structural item. An earlier study stated that to measure the cost, the function and allocated the cost of every room must be defined. In this phase, the cost data involved is the same as the data from the plan estimator.

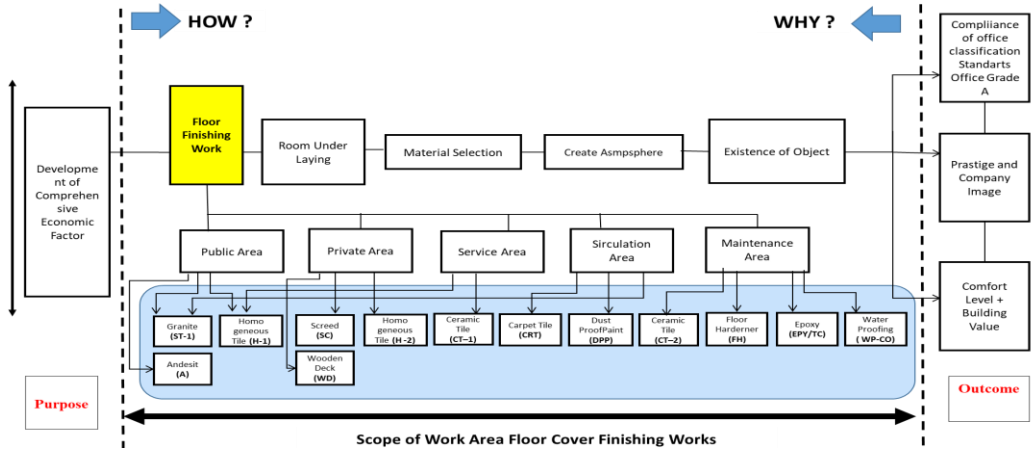
The cost to worth calculation done to every item involved in the floor cover finishing work could be observed in table 8 with the overall recapitulation provided in table 8.

In order to utilize this analysis, a rule was established. Every work item with the value of cost to worth ratio >1 indicated that it contains unnecessary cost.

Table VIII. Cost to Worth Analysis

No.	Code	Floor Cover Finishing Work	Cost (IDR)	Worth (IDR)	C/W Index	Information
1	ST – 1	Imported granite	3,424,000	3,345,000	1.0236	Reduce = 2.31 %
2	HT - 1	600x 00 mm homogeneous tile polish	589,000	585,000	1.0068	Reduce = 0.68 %
3	HT - 2	600x600 mm homogeneous tile unpolish	359,000	355,000	1.0113	Reduce = 1.11 %
4	CT - 1	400x400 mm glossy ceramic tile	189,000	185,000	1.0216	Reduce = 1.12 %
5	CT - 2	400x400 mm matt ceramic tile	180,000	176,000	1.0227	Reduce = 2.22 %
6	CRT	Carpet Tile	865,000	840,000	1.0298	Reduce = 2.89 %
7	WD	Wooden Deck	815,000	790,000	1.0316	Reduce = 3.07 %
8	A	Andesite masonry	570,000	555,000	1.027	Reduce = 2.63 %
9	FH	Floor Hardener	208,000	173,000	1.0236	Reduce = 16.83 %
10	SC	Floor Screeding (Bare)	865,000	840,000	1.0298	Reduce = 2.89 %
11	DPP	Dust Proof Paint	95,000	65,000	1.4615	Reduce = 31.58 %
12	EPY	Epoxy (Top Coat)	75,000	45,000	1,667	Reduce = 40.00 %

Fig 4. Floor Cover Finishing Works Technical FAST Diagram (Eksisting)



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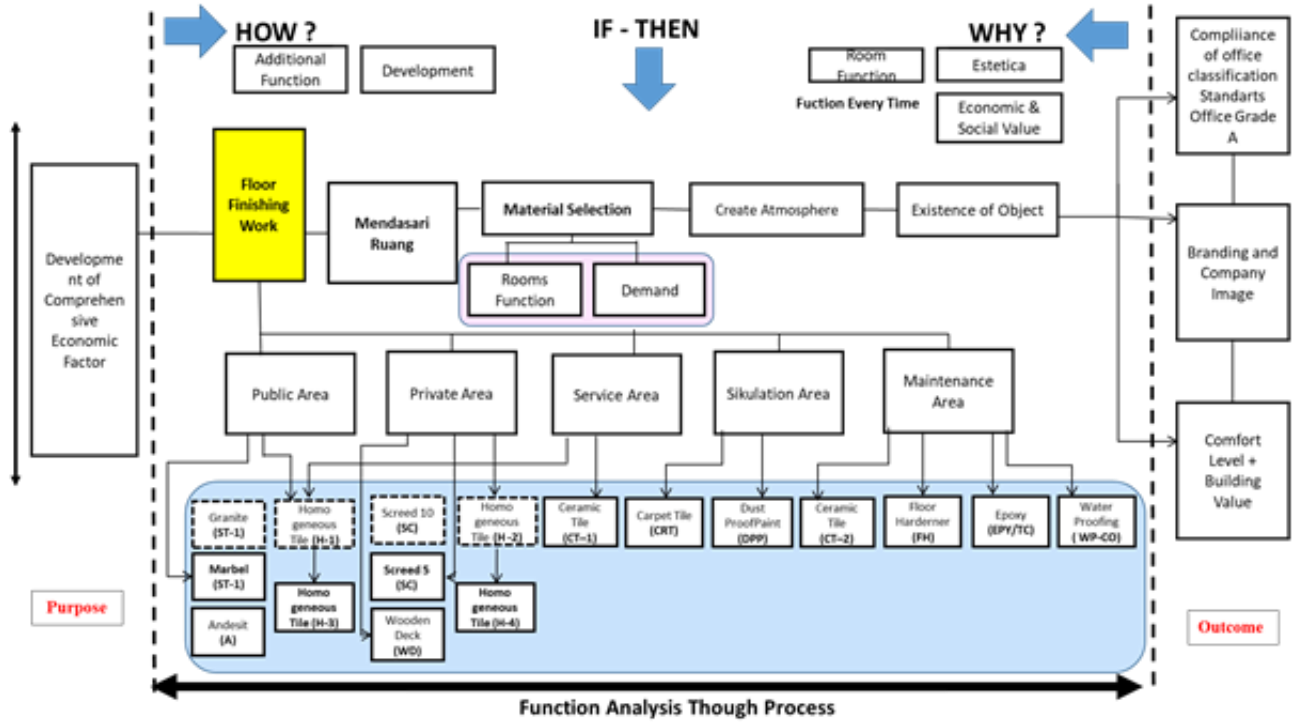

Fig 5. Floor Cover Finishing Works Technical FAST Diagram (Extended)

3). Floor cover finishing work FAST diagram analysis

The data provided in figure 4 describes the goal of the FAST diagram analysis which is to illustrate the relationship between each function and to ease the understanding of each function's verity [21].

The result of the FAST diagram analysis shown in figure 4 leads to the following conclusions :

a) The Output of the base function: the standard fulfillment of the office building, to reach the determined prestige level and the overall comfort level of the office building
b) Primary function: To be the base cover of the room
c) Hinted function: The Precise election of material
d) Cause function: Create the right comfort level
e) All-time supporting function: Aesthetics, economic and social value
f) Design object function: The utilization of floor cover finishing materials in the right areas of the rooms in order to meet the criteria of the materials, regulations, specifications, and ease of applications.

After the creative function adding work was done, then the changes in the FAST diagram is apparent as could be seen in figure 5. Every function that was added or alternated were all pointed to the direction of the utilization value optimization.

D. Creativity phase

This phase has the objective to dig and collect ideas in order to achieve new desirable functions. The creative phase involved the development of several alternative methods to achieve the base functions. Creative phase was mainly done to acquire the much needed alternative works that could be done to show the work's functional activities. The stated fact proves that this phase needs a good understanding of each problem so that for each work item alternative materials could be elected in order to achieve better cost efficiency without decreasing the overall quality of the work with the election method, bringing the conclusion of there are a lot of alternative materials that could be elected.

In the value engineering implementation to choose the best alternative material, the criteria for each of the floor cover work items could be referred to, such as the conclusion recapped in table 9. The criteria consist of components involved in designing and executing the floor cover finishing work.

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Table IX. Details of The Floor Cover Finishing Works

EXSISTING							EXTENDED FUNCTION						
NO.	CODE	FLOOR COVER MATERIAL	ROOM FUNCTION	Σ VOLUME (M2)	UNIT COST (IDR)	TOTAL COST (IDR)	NO.	CODE	FLOOR COVER MATERIAL	ROOM FUNCTION	Σ VOLUME (M2)	UNIT COST (IDR)	TOTAL COST (IDR)
1	ST-1	Imported granite	Main lobby, restaurant, 2nd Corridor, café, bank, lobby elevator, main staircase, hallway	2,151.00	2,837,500	6,103,462,500	1	ST-1	Local marble	Main lobby, restaurant, 2nd Corridor, café, bank, lobby elevator, main staircase, hallway	2,151.00	2,102,500	4,522,477,500
2	HT-1	600 x 600 mm Polished finish homogeneous tile	Executive toilet, building management, nursery, cafetaria, ECC, telecommuniation, security, ME meeting room, typical storage room	3,230	528,400	1,706,732,000	2	HT-1	600 x 600 mm Polished finish homogeneous tile Ex. Essenza	Lobby smoking area, obby elevator, M/F toilet, GF toilet, disabled toilet, musholla, ablution, VIP lobby elevator, executive toilet, nursery, ECC, telecommunication	2,081	528,400	1,099,600,400
3	HT-2	600 x 600 mm Unpolished finish homogeneous tile	Driver room, Convenience Store, R.Perhimpunan Penghuni	248.00	438,100	108,648,800	3	HT-2	600 x 600 mm Unpolished finish homogeneous tile Ex. Essenza	Convenience store, tenant society meeting room	90.00	438,100	39,429,000
							4	HT-3	600 x 600 mm Polished finish homogeneous tile Ex. Imported/ China	Other lobby elevators, toilet, building management, cafetaria, security, ME meeting room, typical storage room	1,148.00	370,900	425,793,200
							5	HT-4	600 x 600 mm Homogeneous tile Ex. Imported/ China	Driver room	158.00	344,650	54,454,700
4	CT-1	400 x 400 mm Polished ceramic tile	Driver room B1	542.00	302,900	164,171,800	6	CT-1	400 x 400 mm Polished ceramic tile	B1 driver room, pantry, janitor, storage, FCC, panel, typical pantry, typical janitor	542.00	302,900	164,171,800
5	CT-2	400 x 400 mm Unpolished ceramic tile	Panel Typical Lt. Atap 1, storage, RWT	36.00	266,150	9,581,400	7	CT-2	400 x 400 mm Unpolished ceramic tile	Panel Typical Lt. Atap 1, stc	36.00	266,150	9,581,400
6	CRT	Carpet Tile	Corridor	2,889.00	688,250	1,988,354,250	8	CRT	Carpet Tile	Selasar/Corridor	2,889.00	688,250	1,988,354,250
7	WD	Wooden Deck	Sky Garden	148.00	683,750	101,195,000	9	WD	Wooden Deck	Sky Garden	148.00	683,750	101,195,000
8	A	Andesite stone	Drop in/off zone	37.00	354,000	13,098,000	10	A	Andesite stone	Drop in/off zone, main lobby corridor	37.00	354,000	13,098,000
9	FH	Floor Hardener	Loading dock, parking area, exterior corridor, ramp, intake, panel, generator room, exhaust, pump room, electrical, trash room	15,443.00	183,000	2,826,069,000	11	FH	Floor Hardener	Loading dock, parking area, exterior corridor, ramp, intake, panel, generator room, exhaust, pump room, electrical, trash room	15,443.00	183,000	2,826,069,000
10	SC	Screeding (Bare)	Office, meeting room typycal	20,373.00	94,250	1,920,155,250	12	SC	Screeding (Bare)	Office, typical meeting roo	20,373.00	88,750	1,808,103,750
11	DPP	Dust Proof Paint	Mezzanine smoking area	935.00	168,250	157,313,750	13	DPP	Dust Proof Paint	Mezzanine smoking area	935.00	168,250	157,313,750
12	EPY /TC	Epoxy (Top Coat)	LMR, helipad, P3 concrete surface, L8, LMR, floor 22 to roof	2,926.00	105,000	307,230,000	14	EPY / TC	Epoxy (Top Coat)	LMR, helipad, P3 concretes	2,926.00	105,000	307,230,000
13	WP - CO	Water Proofing	All toilet, abulation, pump room, LMR, helipad, concrete surfaces	3,583.00	94,500	338,593,500	13	WP - CO	Water Proofing	All toilet, abulation, pump	3,583.00	94,500	338,593,500
					Total cost	15,744,605,250				13,855,465,250	Total cost		
					Total project cost before tax	289,316,988,700					Total project cost before tax		
					Work contribution	5.442%	4.79%				Work contribution		
						0.653%							
					Efficiency	12.00%					Efficiency		

E. Development and implementation phase

Finalizing all the previous phases, this phase's objective is to recommend which alternative material that should be used. For example, in the ST-1 work item, the initial plan was to use the imported granite, space, grouting, and resin with the total cost of IDR 6,103,462,500. After the finalization of value engineering, it is suggested that the imported granite is replaced by Ujung Pandang marble, making the grand total of IDR 4,522,477,500 while achieving cost saving intention without any reduction of function.

VE Capability to increase construction industry competitiveness is driven by the benefit provided to a construction project, in which one of them is generating creative ideas and innovation [22].

I. CONCLUSION

The statistical analysis concluded in 11 most influential factors regarding the value engineering implementation in floor cover finishing work which are the project feasibility study, data analysis, information phase, FAST diagram, creativity, evaluation, efficiency, cost reduction, development phase, initial planning, and schedule optimization.

It is feasible for value engineering to be used to search and elect alternative materials to be used in the floor cover finishing work in order to improve the project cost performance.

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After the implementation of value engineering, the work cost percentage was able to be suppressed to 4.7% from the initial percentage of 5.4%, which happens to be a 12% decrease which further proven the ability of value engineering method to be implemented in the floor cover finishing work as a project cost performance enhancer.

ACKNOWLEDGMENT

This research is supported by GI Project Management for provided help contribute stakeholders planner and improve research for next cases

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