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Procedia Technology 16 (2014) 1037 – 1046

Procedia Technology

CENTERIS 2014 - Conference on ENTERprise Information Systems / ProjMAN 2014 - International Conference on Project MANagement / HCIST 2014 - International Conference on Health and Social Care Information Systems and Technologies

Enhancing Value for Money of Mega Infrastructure Projects Development Using Value Engineering Method

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Abstract

Infrastructure development plays an important role to stimulate the nation's economic growth. During 2011, infrastructure industry contributed 5.5% to the GDP of Indonesia with real growth of 9.3%. Two mega infrastructure projects have been developed in the past few years: Sunda Strait Bridge (SSB) to connect Sumatra and Java Islands, thus increase economic integration between the two major islands, and; Soekarno-Hatta International Rail Link (SHIARL) as an alternative mass transportation which is expected to provide accessibility and mobility for people and goods around Greater Jakarta area to the airport. The two mega infrastructure projects listed in MP3EI program in 2011 required comprehensive study in the aspects of planning, funding, and techniques of projects developments. This research is proposed to produce a conceptual design of SSB and SHIARL in order to gain maximum result and generate added values to the projects. This research employed a combination of quantitative and qualitative methods through questionnaire survey distributed to the related stakeholders of the projects and focus group discussion (FGD). The results identified additional functions for innovation to both mega infrastructure projects. Life cycle cost analysis confirmed that there is an increasing in value for money from the additional functions in respective projects.

Peer-review under responsibility of the Organizing Committee of CENTERIS 2014.

Keywords: Innovation; Bridge; Railway; Value Engineering; Value for Money, Infrastructure

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Peer-review under responsibility of the Organizing Committee of CENTERIS 2014.
doi:10.1016/j.protcy.2014.10.058

1. Introduction

Indonesia is a vast archipelago country with large and dynamic economic activities reflected by an average economic growth reaching 6% per annum [1] and has various potentials that can be developed. In order to achieve the acceleration of economic development, the government of Indonesia, through the National Medium Term Development Plan (RPJMN) 2010-2014, is targeting economic growth gradually from 5.5%-5.56% in 2010 to 7.0%-7.7% in 2014 or an average growth rate of 6.3%-6.8% in 5 years.

Sunda Strait Bridge is one of the mega projects offered by the Indonesian government that would spend about ± US$ 25 billion [2]. SSB development is promoted to be one of the longest bridges in the world with 30 kilometers in length and is expected to be an efficient means for transporting people and goods between the two islands. In line with the SSB development, potential functions have been explored in the past three years including installation of liquid and gas pipes, fiber optics, industrial area development, tourism and energy utilization [3, 4].

On the other hand, Soekarno–Hatta Airport Rail Link (SHIARL) is one of mega infrastructures in railway transportation initiated by the Indonesian government. As one of the busiest airports in the world, Soekarno–Hatta airport has significant growth of passengers that serves 44 million passengers per year. Access to the airport, which depends largely on the intercity road and Toll Sediyatmo, causes congestion and travel time uncertainty during peak hours. Therefore, SHIARL project is expected to increase punctuality, to improve airport accessibility and to provide a better mass transportation for the public.

The key success in SSB and SHIARL projects realization lies in the project readiness preceded by feasibility study aiming to obtain benefits and to create proper distribution line. The use of value engineering (VE) in these two project designs is expected to increase and to improve the project's feasibility. VE has been systematically applied to analyze the function of a system and is expected to produce optimum outcome, particularly for project quality [5,6], by combining various knowledge among stakeholders [7], producing technology breakthrough [8], stimulating efficiency as well as innovation in order to obtain maximum value for the project [9,10] and increasing competitiveness, particularly for construction industries. Implementation of VE in this study follows the stages that exist in the VE Job Plan. However, this paper only presents the function analysis shown in the FAST diagram and the evaluation phase to calculate the feasibility of the project using Life Cycle Cost (LCC) analysis.

This research is aimed to produce a comprehensive study by considering the existing challenges, strengths and opportunities in order to achieve project realization. This research presents value creation in projects development by creating additional functions and evaluating value for money of the projects. Research outcome is expected to be a knowledge that will be disseminated to the academic community and as a contribution to the strategic policy of Indonesia's government in increasing the nation's competitiveness in global scale.

2. Function and Innovation

Value engineering (VE) is defined as a multi-disciplinary approach to conduct a systematic way to analyze and improve function, cost and value of a product, design, system or service. In many countries, value engineering implementation is a proven method to solve problems and to increase further projects' competitiveness in the construction industry [11]. 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 [12,13]. Innovation has been seen as idea generation in the creativity stage [14,15], formalization processes [16] and the successful application of concept in terms of output or product [17].

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. It also leads to an improvement of products. Figure 1 demonstrates that the ability to consider alternative ways or processes that can perform the same set of tasks with added benefit will stimulate inquiry and explore further the original ideas [6].

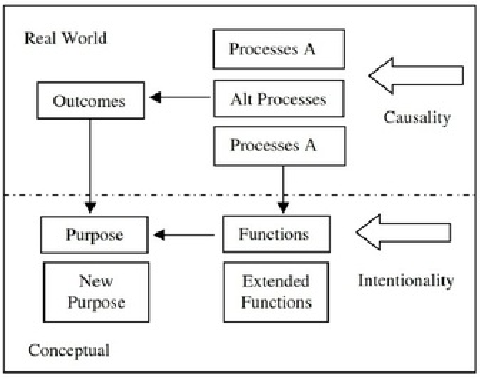

Fig.1. Functional Thinking Enables Innovation

Innovation in Sunda Strait Bridge (SSB) is driven by seeking potential resources located around the Sunda Strait. There are natural resources, such as great wind, ocean wave caused by tidal current, potential tourism to be integrated in Sangiang and Prajurit Islands around the Sunda Strait, efficient distribution of oil and gas as well as development of internet network between Java and Sumatra Islands, which have been the inspiration to create additional functions in the Sunda Strait Bridge. Furthermore, kinetic energy generated by wind power plant and tidal current can be used to produce electricity and provide power supply for minimum-lighting remote areas in both islands. In addition, Sunda Strait Bridge span can be used as an alternative to place oil and gas transmission pipelines as well as fiber optic cables in order to enhance information technology.

Meanwhile, innovative ideas for SHIARL project are generated from various problems found in Jakarta region, development targets set by the Government in a period of 20 years and potential transportation development to be integrated in the project.

Table 1.Innovative Ideas for SHIARL Project

Reference	Innovative Ideas
Limited land	Underground Infrastructure
Lack of public transportation	MRT integration
Flood	Flood tunnel integration
Needs in communication	Fiber optics integration
Renewable energy	Utilizing natural resources (solar, kinetic energy)
Increase regional economy	Developing commercial areas (residences, business center)

3. Methodology

This research was conducted by using qualitative and quantitative approaches with structured questionnaire and focus group discussion (FGD) as research instruments. FAST diagram was used as an idea generation tool to map the functions of the projects based on multidisciplinary views that include benchmarking, expert judgments and others. Furthermore, questionnaire survey was mainly used to identify the stakeholders perception on the ideas generated from the FAST diagram. The questionnaires were distributed through online (softcopy) and offline (mail/hardcopy).

Online distribution was conducted via e-mail through various mailing lists related to practitioners of construction industry and value engineers in Indonesia, such as Indonesian Society of Construction Management (HAMKI), Indonesia Contractor Association (APAKSINDO), Indo Energy, Indonesian Institute of Architects (IAI) and others. The respondents for offline questionnaires were government and companies holding key positions in various institutions, including Ministry of Transportation, Indonesia Investment Coordinating Board, Ministry of Industry, Coordinating Ministry for Economic Affairs, Indonesian Railways, PT Railink, PT Sarana Multi Infrastructure (SMI) and others.

The data collected from the questionnaire survey was then analyzed by using descriptive analysis and inferential statistics. Frequency distribution and mean in descriptive analysis were used to provide conclusion on the samples and subsequently, in combination with graphic analysis to measure the data. Meanwhile, Cronbach's Alpha and one-sample t-test in inferential statistics were used to show the proportion and reliability of the questionnaire responses based on 95% confidence level.

The questionnaire survey process took a month with 35 returned questionnaires for Sunda Strait Bridge. Most of the respondents worked at private companies with a coefficient of 43% and the second largest part of respondents of 26% worked at government agencies. More than 40% of the respondents were post graduate holders. Over 40% of the respondents were architect/engineer and 20% of them held managerial and general director positions. Meanwhile, from 32 returned questionnaires of SHIARL, most of the respondents worked for private companies with a coefficient of 43% and the second largest part worked for government institutions. On the other hand, more than 50% of the respondents were post graduate holders and 26% of them held managerial and general director positions. Once the analysis of questionnaire survey completed, the next stage was Focus Group Discussion (FGD). FGDs were conducted as a validation and verification in order to gain more inputs from various stakeholders on the findings.

Finally, by having new innovative designs of SSB and SHIARL (PRASTI Tunnel), an evaluation of LCC was conducted to estimate the current and the future values of investment as represented by NPV and IRR values.

4. Result and Discussion

4.1. Additional Functions (Innovation) in Sunda Strait Bridge Project

Questionnaire survey result showed three major additional functions, namely fiber optic lines, tourism development, and oil and gas distribution. On the other hand, Focus Group Discussion respondents acknowledged energy function as the main point in developing the Sunda Strait Bridge and thus required additional data to support the identified function, for example, the Sunda Strait current, to operate the tidal turbines. Questionnaire survey and FGD have led to the development of FAST diagram shown below.

Table 2.Additional Functions from Questionnaire Survey

Additional Function Variables	Response	%
Power Plant (tidal energy, wind energy, solar energy)	18	16%
Tourism Development	26	23%
Oil and Gas Distribution Pipelines	23	21%
Fiber Optic Lines	28	25%
Industrial Area Development	17	15%

FAST diagram was produced during the function analysis and the creativity stages of VE process. Beside transportation, as the Sunda Strait Bridge main function, FAST diagram also produced additional functions that could be divided into four major items: energy function which comprised of tidal power plants, wind power plants and oil and gas pipelines distribution; telecommunication function; tourism function; and industrial area development. Figure 2 shows the FAST Diagram of the Sunda Strait Bridge development.

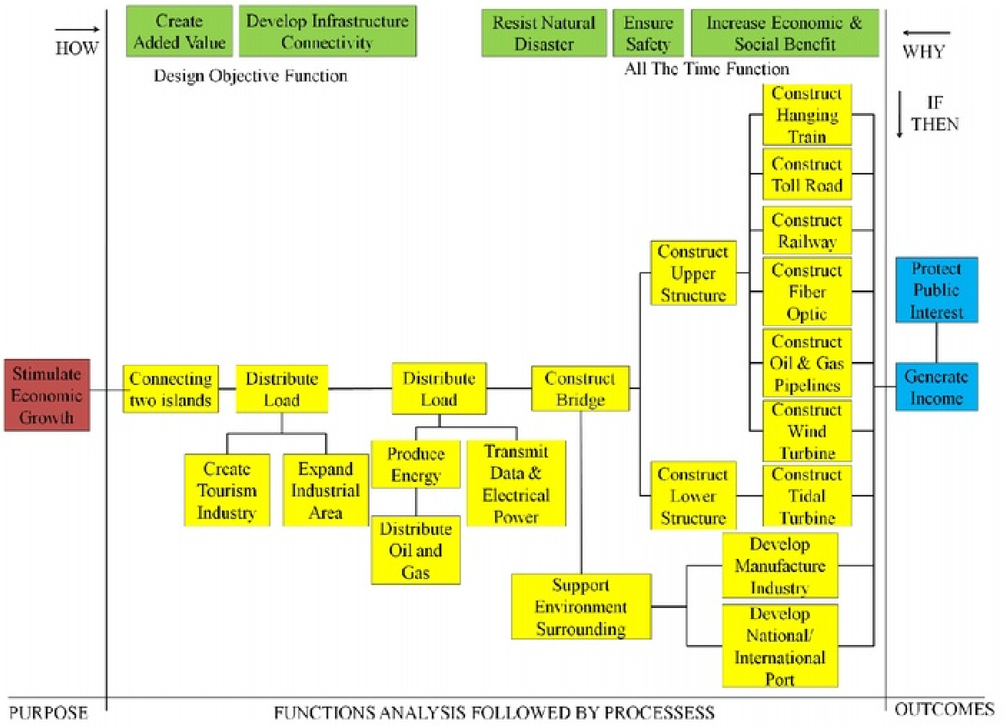

Fig. 2. FAST diagram of Sunda Strait Bridge Development

Additional functions identified from the value engineering process were then developed into a visualization concept of Sunda Strait Bridge. The design can be seen in Figure 3.

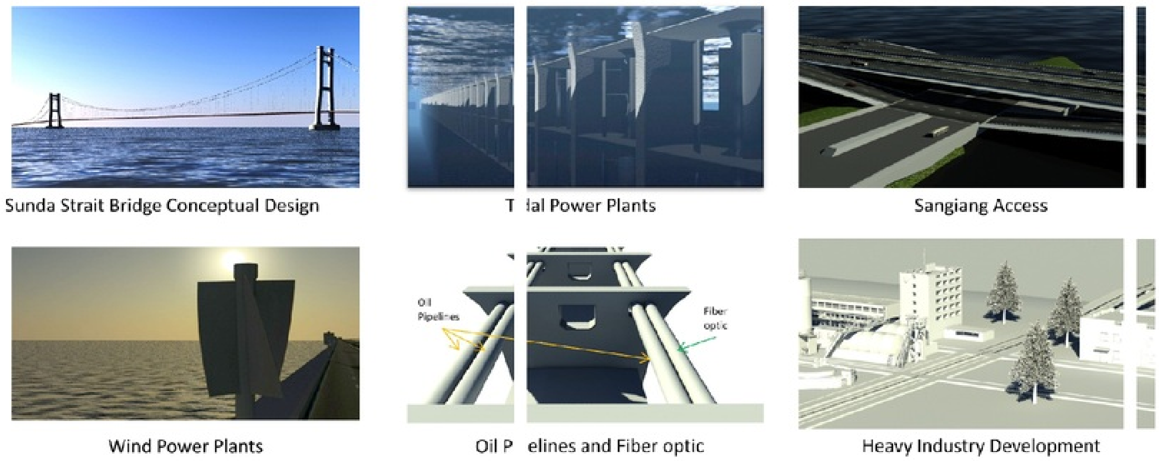

Fig. 3. Visualization of Sunda Strait Bridge

4.2. Life Cycle Cost Analysis

Firstly, the transportation function in SSB conceptual design consists of bridge structure that is divided into two types: 7.4 km of suspension bridge and 21.4 km of concrete viaduct bridge. Messina Bridge in Italy is used as a benchmark to calculate the initial cost due to similar transportation facility and technology. Therefore, the estimated construction cost for transportation function is 102,013.88 billion rupiah with operational and maintenance cost around 629.50 billion rupiah per year.

Secondly, energy function comprises of tidal power, wind power and oil & gas distribution. Davis turbine technology is used for tidal power turbine in the Sunda Strait Bridge conceptual design. Assuming that the Sunda Strait tidal velocity is around 2 m/s and the efficiency of turbine in generating electricity is 35%, the potential output of the turbine is expected to reach 500 mW. In the meantime, 42 inch oil and gas pipeline will be built along 90 km to connect two oil depots with 3,000 BOE capacities in Banten and Lampung. Thus, the initial cost required for energy function is 10,980.29 billion rupiah with operational and maintenance cost about 152.68 billion rupiah per year.

Thirdly, tourism function that is divided into hanging train, which is located on the bridge, and cable car and theme park to be located in Sangiang Island. Hanging train, cable car and theme park concepts are selected based on similar system in Germany, Malaysia and Hongkong. Therefore, the initial cost required for the tourism function is 39,967.80 billion rupiah with 17.45 billion rupiah for annual operational and maintenance cost.

On the other hand, by assuming that the civil works is covered by the SSB span, the initial cost for telecommunication function is 32% from the overall fiber optic construction or 0.15 billion rupiah/km. The operational and maintenance cost for fiber optic is about 11.4 million rupiah/km/cable/year. Considering that the Sunda Strait Bridge is 29 km in length, the fiber optic construction cost is about 4.43 billion rupiah with 0.33 billion rupiah for annual operational and maintenance cost.

Furthermore, industrial areas will be located in Banten province (Java Island) for 2,000 Ha and Lampung province (Sumatra Island) for 3,000 Ha. Several considerations are made as follows; land acquisition cost is 500,000 rupiah/m^2 and infrastructure development for industrial area is 200,000 rupiah/m^2. Therefore, the construction cost for the industrial area function is35,000 billion rupiah. Since the area is proposed to be sold gradually, the operational and maintenance cost is not taken into account. The summary of the analysis can be seen in Table 3.

Table 3.Life Cycle Cost Analysis Summary

Function Components	Construction cost (Billion Rupiah)	Annual O&M cost (Billion Rupiah)
Transportation	102,013.88	629.50
Energy	10,980.29	152.68
Telecommunication	4.43	0.33
Tourism	39,967.80	17.45
Industrial Area	35,000.00	-
Total	187,966.40	799.96

The overall result showed that the SSB investment indicated a prospective financial feasibility with 7.26% of IRR and a positive NPV. Yet, the IRR value was ranging between 1.14% and 29.13% among the identified functions. Therefore, incremental ROR analysis was conducted as a capital share (initial cost sharing) calculation, which was expected to provide a balanced IRR above the discounted rate (6.81%) among the identified functions. The summary of the incremental analysis and the capital share is shown in Table 4.

Table 4.Incremental RoR Analysis and Capital Share

Function	Capital Share (%)	Initial Cost Before (Billion Rupiah)	Initial Cost After (Billion Rupiah)	IRR Before (%)	IRR After (%)
Tourism	40.00	39,967.80	80,773.35	13.01	7.23
Energy	11.30	10,980.29	22,507.86	14.72	7.27
Industrial development	4.00	35,000.00	39,080.55	8.30	7.28
Telecommunication	0.03	4.43	29.94	29.13	7.24
Transportation	-	102,013.88	45,574.70	1.41	7.29

4.3. Additional Functions (Innovation) for Soekarno–Hatta International Airport Rail Link (SHIARL) Project

According to the respondent's answer, the most possible additional functions to be integrated into SHIARL project are area development (residential, business center) and city check–in. Focus Group Discussion (FGD) was then conducted to confirm the questionnaire result and to obtain input from stakeholders related to the project. The discussion suggested additional functions that should be considered. Various problems that occurred in Jakarta and the potency of development provoke innovative ideas for the project. Underground infrastructure was proposed as a solution for the limited land in Jakarta by integrating MRT line and flood tunnel that would be used to solve Jakarta's lack of public transportation and annual flood problems. Economic aspect was also considered by proposing commercial area and fiber optic integration to generate regional income. Questionnaire Survey and FGD led to the development of FAST diagram as shown in Figure 4.

Table 5.Additional Functions From Questionnaire Survey

Additional Functions for SHIARL Project	Number of Respondents Replied	%
Generate Electricity (Solar, Kinetic Energy)	16	19%
Area Development (Residential, Business Center)	28	33%
City Check – In	23	27%
Cargo Services	18	21%

These functions were then developed into a conceptual design of a multi–function tunnel called Public Railways and Storm water Infrastructure (PRASTI) Tunnel. It is aimed to overcome congestion, reduce flood in greater Jakarta area and increase accessibility from and to Soekarno–Hatta airport by integrating three main functions, i.e. MRT, airport railway and flood control, in one tunnel development. The tunnel will be divided into three levels: the first level serves as flood control, the second level serves as airport access through SHIARL and the third level is expected to increase public transport through MRT line. The cross–section visualization of PRASTI Tunnel is shown in Figure 5.

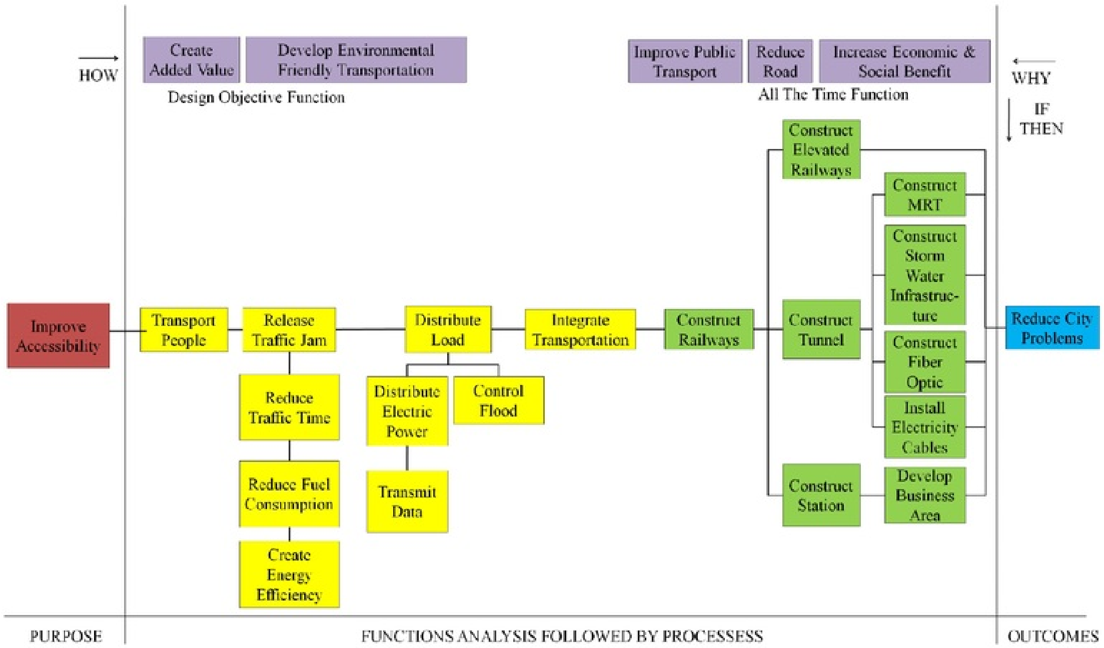

Fig. 4. FAST Diagram of Soekarno-Hatta International Airport Railway Link (SHIARL)

The SHIARL route will span along 38.5 kilometer, connecting Halim airport in the eastern Jakarta to Soekarno–Hatta airport by using median road of intercity toll road. This route is divided into three sections: the first section is from Halim airport to Dukuh Atas with elevated lane along 12 kilometer; the second section is from Dukuh Atas to Toll Sedyatmo near Pluit, which will be built by using PRASTI tunnel along 9 kilometer; and the third section is from Toll Sedyatmo near Pluit to Soekarno–Hatta airport with elevated lane along 17.5 kilometer.

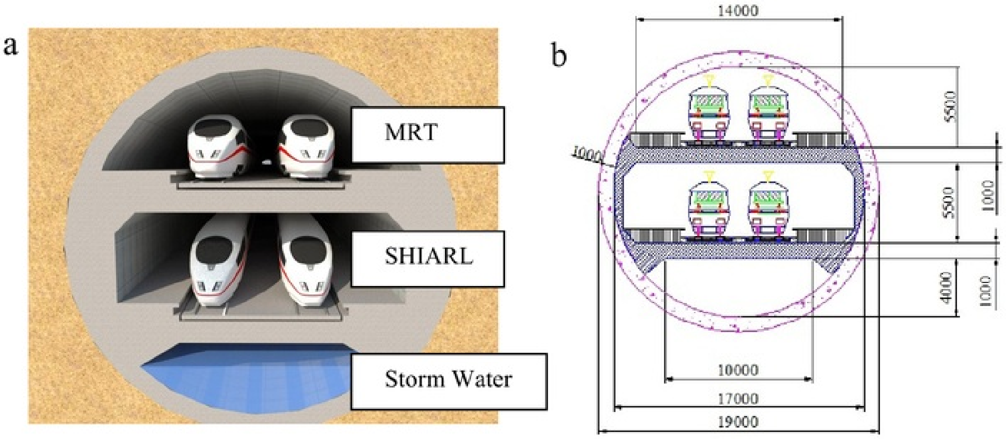

Fig. 5.(a) Cross Section of PRASTI Tunnel; (b) Diameter Analysis of PRASTI Tunnel.

The route selection also considers flood area mapping in Jakarta and connects the existing West Flood Canal to Pluit Reservoir. Detail of the route can be seen in Figure 6.

Fig. 6. Route of PRASTI Tunnel

4.4. Life Cycle Cost Analysis

Cost estimate for construction of SHIARL project uses two calculations: first, initial cost plus operational and maintenance cost of elevated SHIARL; second, initial cost plus operational and maintenance cost of PRASTI Tunnel. The construction cost for PRASTI tunnel will be divided into four functions, i.e. Flood; Transportation, which consists of Airport train and MRT; Telecommunication; and Commercial Area Development.

Although the construction cost for tunnels around the world may vary depending on various factors, the initial cost for PRASTI Tunnel will be determined through benchmarking the PRASTI Tunnel with tunnels having similar diameter and functions. Comparative unit prices for the tunnel were gathered from benchmarking different tunnel projects in the world, from SMART Tunnel in Malaysia to Channel Tunnel in UK. Since 19 m diameter of PRASTI Tunnel is much larger compared to 13.2 m diameter of SMART Tunnel, interpolation approach is then used for calculating PRASTI Tunnel's initial cost. Conversely, operational and maintenance for the tunnel is assumed 0.5% from the initial cost [18] and increasing with annual inflation per year for respective functions [19].

Initial cost for elevated train will be 9,331.93 billion rupiah with operational and maintenance cost around 204.51 billion rupiah per year. Meanwhile, transportation function in PRASTI tunnel will have initial cost of 894.89 billion rupiah with operational and maintenance cost around 12.89 billion rupiah per year. On the other hand, initial cost for flood control is about 15,710.84billion rupiah with operational and maintenance cost of about 78.55 billion rupiah per year.

By considering the fiber optic construction data from PT Telkom, an Indonesia's state owned enterprise for telecommunication, which is about 152.96 million rupiah/km, the 9 km fiber optic construction in PRASTI Tunnel will cost about 1.38 billion rupiah. Meanwhile, the operational and maintenance cost for fiber optic of the tunnel will require about 0.1 billion rupiah per year. Furthermore, there are 5,600 m^2spaces for commercial area development located in 6 MRT underground stations and Dukuh Atas station. Estimation of construction cost for the commercial area is about 3,673.71 billion rupiah with operational cost assumed to be 2% from initial cost, which will cost about 73.47 billion rupiah. Summary of the analysis can be seen in Table 6.

Table 6.Summary of LCC Analysis

Function Components	Construction cost (Billion Rupiah)	Annual O&M cost (Billion Rupiah)
SHIARL, Elevated	9,331.93	204.51
PRASTI Tunnel		
a. Transportation Function		
• Airport Train	423.95	5.98
• MRT	470.93	6.92
b. Flood Control Function	15,710.84	78.55
c. Telecommunication function	1.38	0.10
d. Commercial Area Function	3,673.71	73.47
Total	29,612.74	369.53

Simulation of SHIARL-PRASTI feasibility analysis consists of three scenarios based on the assumption of potential passengers of SHIARL-PRASTI. Based on the LCC analysis, additional functions in SHIARL, by utilizing several functions in PRASTI Tunnel, are contributed to the increased value of IRR. These data shows that the project is confirmed technically and financially viable. Furthermore, the additional functions not only improve the feasibility of the project from economic value but also provide benefits to the community by reducing floods in Jakarta area. The comparison of NPV and IRR value between no–additional function SHIARL and SHIARL–PRASTI Tunnel is shown in Table 7.

Table 7.NPV and IRR SHIARL VS SHIARL–PRASTI

Demand	SHIARL		SHIARL + PRASTI	
	NPV	IRR	NPV	IRR
20%	(2,700,253,187,341)	5.50%	14,178,000,000,000	10.56%
30%	5,670,741,614,402	9.11%	23,617,000,000,000	12.50%
40%	10,403,582,949,318	10.73%	33,440,000,000,000	14.24%

5. Conclusion

Value engineering (VE) has been widely applied to produce optimum result for projects developments through the fulfillment of the required quality, application of advanced technology and achievement of innovative ideas. VE application for mega infrastructures (i.e. Sunda Strait Bridge and PRASTI Tunnel) has produced added value to the projects.

A combination of qualitative and quantitative approaches was used to identify stakeholders' perception regarding additional functions generated from FAST diagram in Value Engineering process. Result and discussion section has shown additional functions to increase feasibility for both projects. Additional functions for the Sunda Strait Bridge development are: 1) Power plant development based on renewable energy by using tidal and wind power; 2) Integration of oil and gas as well as (3) fiber optic pipelines to the bridge; 4) Tourism Development in Sangiang Island which may be accessed by using either road bridge or hanging train; 5) Development of industrial area. While innovation for the SHIARL project are: 1) Passenger MRT; 2) Airport Passenger Train; 3) Potential Commercial Area Underground, 4) Fiber Optics, and 5) Flood control. Value for money for both proposed projects developments are achieved by conducting Life Cycle Cost analysis that produces a positive NPV and significant Internal Rate of Return (IRR).Findings of this research are expected to contribute a significant insight to the public and private sectors and can be used as a benchmark for similar case to enhance project's feasibility by using Value Engineering.

Further research on public private partnership scheme and detailed engineering design are suggested to increase the projects feasibility.

Acknowledgements

This research is fully supported by research grants from University of Indonesia and Ministry of Education of the Republic of Indonesia.

References

[1] Business Monitor International. Indonesia Economic Growth, 2012.
[2] State Ministry of National Development Planning. Public Private Partnership: Infrastructure Projects in Indonesia. Jakarta; 2011.
[3] Berawi MA. Roles, Challenges and Prospects of Construction Services in Indonesia. National Seminar of GAPEKSINDO 12 October 2010. Jakarta; 2010.
[4] Coordinating Ministry for Economic Affair. Masterplan for Acceleration and Expansion of Indonesia. Jakarta; 2011.
[5] Sik-wah Fong P, Shen Q. Is the Hong Kong construction industry ready for value management? International Journal of Project Management. 2000;18(5):317-26.
[6] Woodhead R, Berawi M. An alternative theory of idea generation. International Journal of Management Practice. 2007;3(1):1-19.
[7] Zack M, McKeen J, Singh S. Knowledge management and organizational performance: an exploratory analysis. Journal of Knowledge Management. 2009;13(6):392-409.Van der Geer J, Hanraads JAJ, Lupton RA. The art of writing a scientific article. J Sci Commun 2000;163:51-9.
[8] Berawi MA. Quality revolution: leading the innovation and competitive advantages. International Journal of Quality & Reliability Management. 2004;21(4):425-38.
[9] Berawi MA, Woodhead RM. Stimulating Innovation Using Function Models: Adding Product Value. Value World. 2008;31(2):4-7.
[10] Chen WT, Chang P-Y, Huang Y-H. Assessing the overall performance of value engineering workshops for construction projects. International Journal of Project Management. 2010;28(5):514-27.
[11] Daddow T, Skitmore M. Value Management In Practice: An Interview Survey. The Australian Journal of Construction Economics and Building. 2005;4(2):11-8.
[12] Leung MY, Kong SS. Identifying Key Competencies of VM Facilitators Based on International Standards. HKIVM 9th International Conference Proceedings, 30th and 31st Oct 2008; Hongkong2008.
[13] Robinson JL. Value Added Strategies to Sustain A Successful Value Improvement Program. Value World. 2008;31(3):19-25.
[14] Berawi MA, A Guide For Idea Generation and Creativity Using Function Analysis. Proceeding of the 51th SAVE Annual Conference; 2011; Oregon, USA.
[15] Kamal SB. No idea? Evaluating the effectiveness of creativity training. Journal of European Industrial Training. 2005;29(2):102-11.
[16] Wynand EJB. Formalization and innovation revisited. European Journal of Innovation Management. 2002;5(4):214-23.
[17] Brian SC. Innovation overview and future challenges. European Journal of Innovation Management. 1998;1(1):21-9.
[18] Baumgartner JP. Prices and costs in the railway sector: Institut des transports et de planification; 2001.
[19] Statistics Indonesia. Statistical Yearbook of Indonesia 2012. Jakarta: Statistics Indonesia, 2012.

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