Improving Feasibility of Mega Infrastructure Project Development Using Value Engineering Method

by Herawati Zetha Rahman

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Abstract

According to RPJMN 2010 – 2014, the Government of Indonesia stated that the priority of infrastructure development was an increase of 10 – 14 percent in transportation sector. Railway transportation provides a significant role in national economic development with investment required about 41.20% from the total investment in transportation sector. Soekarno- Hatta International Airport Railway Link (SHIARL), as one of mega infrastructure projects, is expected to provide accessibility and mobility for people and goods from and to the airport. Currently, the project realization by using PPP scheme is not able to attract private investors. Incomplete PPP project proposal preparations are argued to be the major obstacles which causes lack of quality in the feasibility study.

Therefore, it is required an alternative approach to obtain values added to the project feasibility using value engineering (VE) method. VE is used to identify additional functions, to provide creative and innovative ideas and to produce the best options for the project development. This research is aimed to improve the quality of SHIARL feasibility study by implementing value engineering method in the planning stage.

The research methodology is conducted by a combination of qualitative and quantitative approaches through questionnaire surveys, action researches and focus group discussions. The result of VE study indicates that Soekarno-Hatta International Airport Rail Link (SHIARL) is an innovative conceptual design to overcome congestion and flood through the integration of airport rail link and MRT line in one tunnel called Public Railway and Stormwater Infrastructure (PRASTI) Tunnel.

Keywords

Innovation; Mega Infrastructure; Airport Railway; Mass Transportation; Value Engineering

1. Introduction

Priority of the infrastructure development in Indonesia is an increase in transportation sector of 10–14 percent with investment projection up to US$64 billion or 44.8 percent of the total infrastructure investment in 2010 – 2014. Railway infrastructure will play a significant role in national economic development by contributing 41.20 percent from the transportation sector investment (Dikun, 2010). Private sector is expected to contribute about 51.20 percent from the total railway project financial.

Soekarno – Hatta Airport Rail Link (SHIARL) is one of mega infrastructures in Indonesia railway transportation. As one of the busiest airport in the world, Soekarno – Hatta airport has significant growth of passengers around 14% per year and serves 44 million passengers per year. Access to the airport depends mainly on the intercity roads and Sediyatmo highways, which naturally causes congestion and travel time uncertainty while in peak hours. On the other hand, flooded highways near the airport duringrainy season are worsening the accessibility and potentially reducing the transportation sector performance. In such condition, alternative mode of transportation through railway construction is required in order to provide high mobility of passengers and goods from and to the airport. Therefore, SHIARL project is expected to increase punctuality and to provide a better mass transportation for the public.

SHIARL feasibility project was first employed in 2002 by PT.RAILINK and offered to the investors in Infrastructure Summit in the period of 2005 and 2006. Due to failure in its financial feasibility, the project was re-developed to attract private investors. Currently, SHIARL project downgrades its status from ready-to-offer project into priority project. Major gap between the initial cost and the return on investment to the private investors is argued to be the main reason why SHIARL is lacking of interest from the private investors. Therefore, alternative approaches are required by creating added values to improve the feasibility study of the project.

This paper aims to improve the quality of the feasibility study of Soekarno Hatta International Airport Railway Links (SHIARL) by applying value engineering (VE).VE has been applied in various projects, particularly in mega infrastructure projects. VE is a proven systematical method in analyzing functions of a system in order to provide optimum outcome for a project in term of quality (Sik-wah Fong and Shen, 2000; Woodhead and Berawi, 2007), technology breakthrough (Berawi,2013; Yang, et al., 2012), efficiency (Berawi andWoodhead,2005; Abdul-Rahman, et al., 2008) and innovation (Berawi and Woodhead, 2008; Chen, et al., 2010) Application of VE at the initial and conceptual stages of an infrastructure project will increase efficiency and effectiveness of the project. VE approach in SHIARL project is started by seeking additional functions that can be integrated into the project. The result is expected to provide an innovative conceptual design to address problems in Jakarta.

2. Methodology

This research employed a combination of quantitative and qualitative approaches (Green & Caracelli, 1997). Quantitative approaches are characterized by the use of control variables and objectivity that are conducted through questionnaire survey and Life Cycle Cost (LCC) analysis. Qualitative approaches (Creswell, 1998) are conducted by using a participatory action research (participative action) which criticizing the assumptions and allowing for the learning process (Carr & Kemmis, 1986) and "grounded theory" (Strauss & Corbin, 1998) through focus group discussions.

The questionnaires were distributed by way of online (soft copy) and offline (mail/hard copy) surveys and aimed to identify the stakeholders' perception on the ideas generation produced by value engineering process. The respondents for offline questionnaires were government and private companies related to infrastructure development, including PT Kereta Api Indonesia (KAI), PT Railink, PT INKA, Ministry of Transportation, Ministry of Public Works, PT Jasa Marga, PT Wijaya Karya, Bappenas, PT IIGF (Indonesia Infrastructure Guarantee Fund), PT Sarana Multi Infrastructure (SMI), Special Committee for the Acceleration of Infrastructure Indonesia, and the Investment Coordinating Board. While online survey questionnaires were sent to the respondents via e-mail to six mailing groups of construction industries and value engineering practitioners in Indonesia. The data collected from the questionnaire surveys was then analyzed by using inferential statistics, Croncbach's Alpha and one sample T-test to determine the respondents' proportion and the reliability of the responses to the questionnaires based on a 95 percent confidence level.

3. Results and Discussion

The process of questionnaire surveys took a month (30 days) from August 1st, 2012, to August 30th, 2012, with 32 returned questionnaires. Once the analysis of questionnaire survey was completed, the next stage, focus group discussions (FGDs) commenced. FGDs were conducted as a validation and verification in order to gain more inputs from various stakeholders of SHIARL project on the findings.

3.1. Questionnaire Survey

Most of the respondents work for private companies with a coefficient of 43 percent and the second largest part of the respondents work for government agencies. Meanwhile, more than 50 percent of the respondents are post graduate holders and 26 percent of them hold managerial and general director positions.

According to the respondents' answers, most of them agreed that punctuality was the major factor in selecting public transportation, particularly when using railway transport. Additional functions that could be integrated into SHIARL project were residential, business centers and city check–in. Extra cost from these additional functions to SHIARL project can be tolerate up to 30 percent from the previous SHIARL total investment. Questionnaire results also showed that private sectors were expected to be much more involved in financial support with proportion of 40 percent government and 60 percent private sectors. Focus group discussions (FGDs) also confirmed that the questionnaire results on flood mitigation, fiber optic and transit-oriented development (TOD) as potential additional functions to the project.

3.2. Value Creation

Valuable data gained from the questionnaire surveys and focus group discussions was used to create ideas by seeking additional functions that can be integrated into the project through a FAST diagram. Innovative ideas for SHIARL project are generated from various problems found in Jakarta region, targeted development set by the government in a period

Table 1. Innovative Ideas for SHIARL

Reference	Innovative Ideas
Limited land	Underground infrastructure
Lack of public transportation	Mass rapid transit (MRT) integration
Flood	Flood tunnel integration
Needs in communication	Fiber optic integration
Renewable energy	Utilizing natural resources (solar, kinetic energies)
Increase regional economy	Developing commercial areas (residences, business centers)

of 20 years and potential transportation development to be integrated in the project.

One of the problems in Jakarta is devastating annual flood in rainy season and periodically disturbed accessibility of users to the airport which depends largely on the intercity roads and Sediyatmo high-

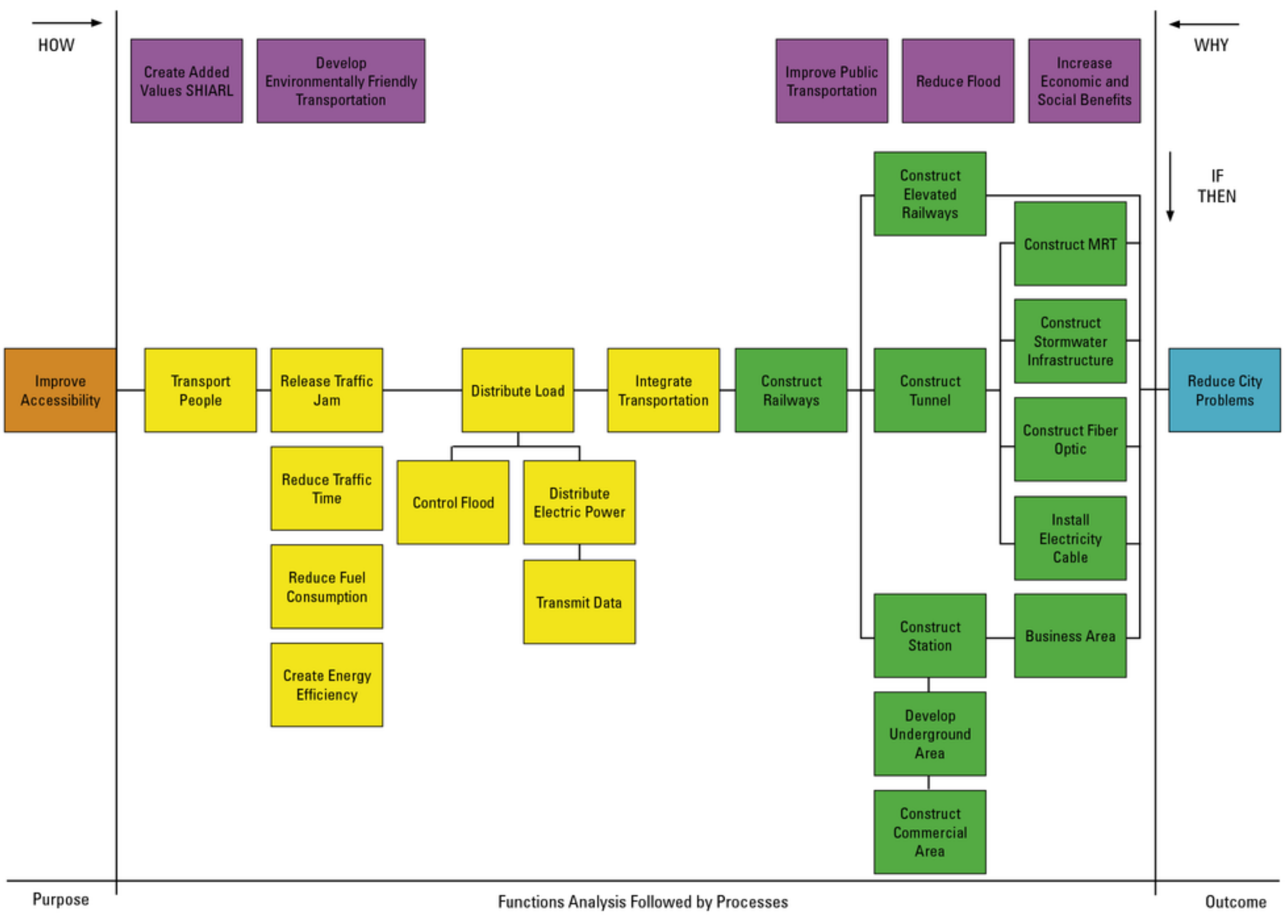

Figure 1. FAST Diagram for Kereta API Bandara (Soekarno Hatta Airport Railway Link [SHIAARL])

Figure 2. Route of PRASTI Tunnel

ways. This dependency also leads to congestion and travel time uncertainty during peak hours while commuters struggling to access or leave their office. The increasing number of commuters using their private vehicles is considered as a result of the poor public transportation and the limited land availability in Jakarta to serve the city functions and people activities makes the people moves to the city perimeters. On the other hand, the development of roads which are used for the commuter's vehicles accessibility is nearly below 1 percent per year and compared to over 1,000 new vehicles sold every day, the roads are predicted to be stuck in 2020. Rail–based project development is argued as the best solution to solve the transportation problems in Jakarta region. Potential railway project, particularly for urban development, is mass rapid transit (MRT) Jakarta planned along 110.8 km line, which is divided into north and south corridors. (See Table 1, previous page, top.)

Various problems that occurred in Jakarta and the potency of development provoke innovative ideas for the project. Underground infrastructure is proposed as a solution for the limited land in Jakarta by integrating MRT line and flood tunnel that will be used to solve Jakarta's lack of public transportation and annual flood. Economic aspect is also considered by proposing commercial area and fiber optic integration to generate regional income. In the meantime, the application of natural resources to the project is expected to increase efficiency and quality of the environment. These ideas lead to the development of FAST diagram as shown in Figure 1 (previous page, bottom).

3.3. Public Railway and Stormwater Infrastructure (PRASTI) Tunnel

Public Railway and Stormwater Infrastructure (PRASTI) Tunnel is a conceptual design of multi–function tunnel generated from function analysis stage of value engineering method. It is aimed to overcome congestion, reduce flood in Jabodetabek area and increase accessibility from and to Soekarno – Hatta airport by integrating three main functions, namely MRT, airport railway, and flood control, in one tunnel development. The proposed diameter of the tunnel is 19 meter, about25 – 40 meter underground and span along 9 kilometer from Dukuh Atas station to Pluit. (See Figure 2, above.)

The tunnel is divided into three (3) levels; the first level is served as flood control, the second level is

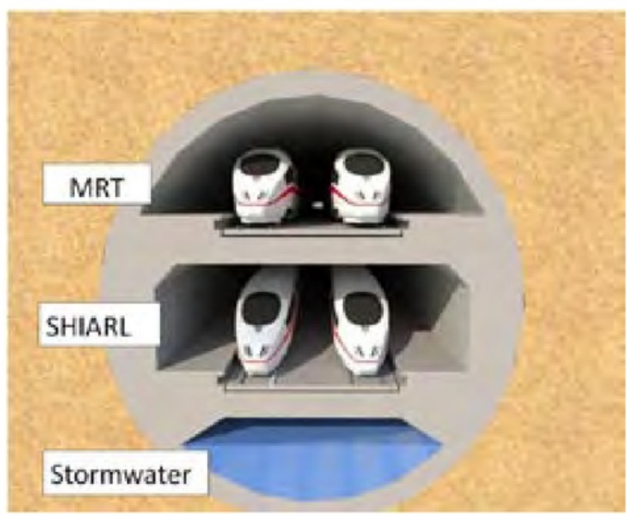

Figure 3. Cross-Section View of PRASTI Tunnel

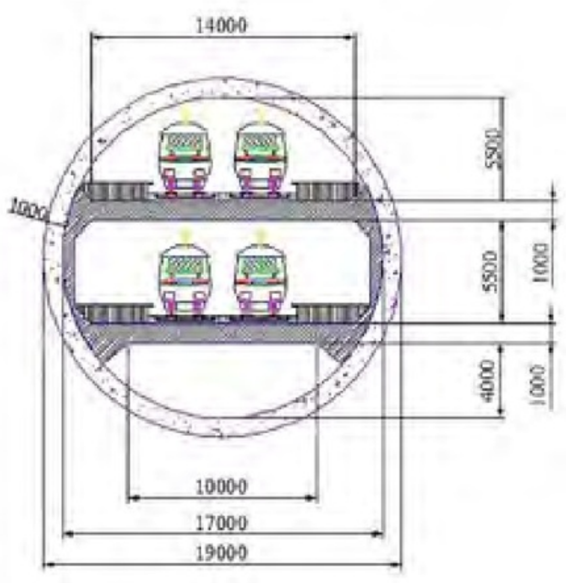

Figure 4. Diameter Analysis of PRASTI Tunnel

served as airport accessibility through SHIARL and the third level is expected to increase public transport through MRT line. The cross-section visualization of PRASTI Tunnel concept is shown in Figures 3 (previous page, bottom) and Figure 4 (above).

As the result, a total route of about 38.5 kilometers connects Halim airport in Eastern Jakarta with Soekarno – Hatta airport in Western Jakarta by using median road of the 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 kilometers, the second section is from Dukuh Atas to Sedyatmo Toll Road near Pluit, which will be built by using PRASTI Tunnel along nine kilometers, and the third section from Sedyatmo Toll Road near Pluit to Soekarno – Hatta airport with elevated lane along 17.5 kilometers.

3.4. Construction, Operational and Maintenance Cost of PRASTI Tunnel

The construction cost for PRASTI tunnel will be divided into four functions, namely Flood, Transportation which consists of airport train and MRT, telecommunication, and commercial area development. Although the construction cost for tunnel around the world vary depends on numerous factors, the initial cost for PRASTI Tunnel will be determined through benchmarking tunnel projects with similar diameter and functions. Comparisons for unit prices for the tunnel projects were gathered from benchmarking various tunnels in the world, from SMART Tunnel in Malaysia to Channel Tunnel in UK. Since PRASTI Tunnel diameter (19 m) is much larger compared to SMART Tunnel (13.2 m), interpolation approach is then used for calculating PRASTI Tunnel's initial cost. On the other hand, operational and maintenance costs for the tunnel are assumed 0.5 percent from the initial cost (Baumgartner, 2001) or equals to US$78,554,192.63 increasing with annual inflation per year.

Initial cost for the function of transportation comprises of airport train and MRT. Both have similar components consisting of tracks, electricity for 18 km as well as signal and telecommunication for 9 km, and additional two units of sub-stations are added for the airport train. Therefore, the initial cost for transportation function is estimated about US$93,217,500.00 with US$622,575.00 per year for operational and maintenance cost in airport train section and US$720,450.00 per year for operational and maintenance cost in MRT section.

Considering the fiber optic construction cost proposed by PT Telkom, an Indonesia's state owned enterprise for telecommunication, which is about US$15,933.33/km, the 9 km-long fiber optic construction in PRASTI Tunnel will cost about US$143,400.00. Meanwhile, operational and maintenance cost for fiber optic of PRASTI Tunnel will require about US$10,687.50 and increasing with annual inflation every year. Furthermore, there is a 5,600 square meters, commercial area located underground and divided into six MRT underground stations and Du-

Table 2. Summary of PRASTI Tunnel Cost

PRASTI Tunnel Function	Initial Cost	Annual Operational and Maintenance Cost
Flood Function	1,636,545,679.70	78,554,192.63
Transportation Function		
a. Airport Train	44,161,875.00	622,575.00
b. MRT	49,055,625.00	720,450.00
Telecommunication Function	143,400.00	10,687.50
Commercial Area Development Function	382,678,365.83	7,653,567.32
Total Initial Cost	2,112,584,945.53	87,561,472.45

kuh Atas station. Construction cost for the commercial area is estimated about US$14,000,000.00. While six MRT and Dukuh Atas stations will cost about US$368,678,365.80. On the other hand, operations and maintenance costs are assumed 2 percent from the initial cost, which will cost about US$7,653,567.32. The overall calculation for the identified functions is summarized in Table 2 (previous page, bottom).

Currently, separate projects of related functions in PRASTI Tunnel have been proposed to be developed in Jakarta area. Firstly, the MRT project proposed by the Indonesian government to reduce congestion in Jakarta requires about US$3,388.8 million for 23.3 km from Lebak Bulus in South Jakarta to Kampung Banda in North Jakarta. Meanwhile, according to the Ministry of Development Planning (2013), airport train construction from Halim airport in Eastern Jakarta to Soekarno – Hatta airport in Western Jakarta along 38.5 km requires about US$2,580 million and will be built with three main stations. Lastly, a flood control system is proposed with a cost of about US$1,700 million to reduce annual heavy flooding that caused a loss of about US$2,000 in 2013. Compared to US$7,668.8 million of separate projects that have been proposed before, US$2,112.58 million of PRASTI Tunnel investment, which integrates all the functions, is an effective way to overcome various problems in Jakarta and an innovative solution to obtain financial feasibility of the project.

On top of that, the revenue estimation generated from transportation, commercial areas, utilities and benefits from flood control have shown that the feasibility of PRASTI Tunnel is increased with Public Private Partnership (PPP) financial scheme.

4. Conclusion

Value engineering (VE) has been widely applied to produce optimum result for projects development through the fulfillment of the required quality, application of advanced technology and achievement of innovative ideas. VE application for mega infrastructure, particularly in SHIARL, has produced added value to the project. This method improves the existing conceptual design of SHIARL project by creating innovation through the development of Public Railway and Stormwater Infrastructure (PRASTI) Tunnel that combined the following functions: 1) transportation function through airport train and MRT; 2); flood function 3) telecommunication tunction, and 4) commercial area development function. Initial cost for multi–function tunnel is US$2,112,584,945.53 with operational and maintenance costs about US$87,561,472.45, increasing with annual inflation every year.

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