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Conceptual Framework for Feasibility Evaluation of Rest and Service Area (TIP) Development Project on JORR II Toll Road Based on Value Engineering

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Abstract

Infrastructure development, particularly toll roads, requires substantial investment and involves a long payback period. According to data from BPJT, Indonesia currently operates more than 2,816 km of toll roads, an increase of 197% or 1,867.7 km compared to 2014. However, this growth has not been matched by the development of Rest and Service Areas (TIP), which are essential facilities for toll road users. Government Regulation No. 17 of 2021 mandates the provision of at least one TIP for every 50 km of toll road. In the case of the 110.74 km JORR II Toll Road, a TIP was planned as part of the Cengkareng–Batuceper–Kunciran section. However, the BUJT has been unable to construct the TIP due to delays in land acquisition and the absence of a defined investment cost by the government. This delay contributes to a prolonged deficit cash flow period for the toll road section. This study aims to provide a conceptual framework to improve the financial feasibility of TIP projects by examining the financial viability of toll road and TIP developments and identifying potential improvement strategies. Literature reviews indicate that a value engineering approach can enhance financial feasibility by optimizing construction costs and creating new revenue streams. Therefore, this study will adopt the value engineering concept as the main strategy to improve the financial feasibility of the TIP project.

Introduction

The JORR II Toll Road has a total length of 110.74 km from Cengkareng (west area) to Cilincing (east area). According to Government Regulation Number 17 of 2021 concerning the Fourth Amendment to Government Regulation Number 15 of 2005 concerning Toll Roads, urban toll roads can provide rest areas and services for the benefit of toll road users. According to these provisions, rest areas and services are provided at least 1 (one) for every 50 (fifty) kilometers in each direction. Therefore, a minimum of 4 (four) rest areas and services (TIP) are needed on the JORR II toll road, consisting of 2 (two) TIPs (1 west area and 1 east area) on the JORR II Toll Road Route leading to Cengkareng, and 2 (two) TIPs (1 west area and 1 east area) on the JORR II Toll Road Route leading to Cilincing. This is in line with research. The need for TIPs is important in inter-city and inter-provincial toll roads. (Makmur & Rajagukguk, 2015) identified that one of the substances of the minimum service standards (SPM) of toll roads that were not fulfilled by the management was the safety service facilities or TIP. A study related to the importance of TIP was conducted by (Setyabudi, 2011), who concluded that toll roads that have TIP facilities have succeeded in minimizing the

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accident rate. With TIP, drivers can rest and check their vehicles to avoid unwanted incidents (Setyabudi, 2011).

The JORR II Toll Road is managed by at least 6 (six) Toll Road Business Entities (BUJT), one of which is PT Jasamarga Kunciran Cengkareng Locks as BUJT Cengkareng-Batuceper-Kunciran Toll Road. Government regulations state that every toll road that is more than 50 km long must provide at least 1 (one) Rest and Service Area (TIP). In its policy, the Government plans to build a TIP that serves JORR II Toll Road users close to the Soekarno-Hatta Airport area, more precisely located on the Cengkareng-Batuceper-Kunciran Toll Road. In terms of planning, the Rest and Service Area (TIP) of the JORR II Toll Road has been included in the Final Technical Plan (RTA) for the management of the Cengkareng - Batuceper - Kunciran toll road. This will certainly be the scope and obligation that must be borne by PT Jasamarga Kunciran Cengkareng (JKC). However, the construction and investment costs for the construction of the TIP have not been agreed upon by the Government (Boukari & Long, 2022; Sovacool et al., 2023; Cheng et al., 2022). The current tariff and concession period do not include investment in the TIP.

The construction of TIP does not necessarily have a positive impact in terms of financial feasibility, especially the construction of TIP which is an additional investment in the management of existing toll roads (Wraharjo et al., 2022; Kochanek et al., 2024; Jeerangsuwan et al., 2014; Mbara et al., 2010; Greiman, 2013). As is known, investment in infrastructure development, especially toll roads, will experience a Cash Flow Deficit in the early stages of its investment period. This is no exception for the Toll Road Business Entity (BUJT) which operates the Cengkareng - Batuceper - Kunciran toll road. Additional investment for the construction of the JORR II Toll Road TIP has the potential to reduce the feasibility of the Cengkareng-Batuceper-Kunciran toll road business. In addition, (Rasyid, 2011) in their research on the Bali-Mandara Toll Road TIP found that the construction of the TIP was not feasible and burdened the toll road business.

Based on the above, the TIP Development on the JORR II Toll Road has the potential to impact the financial feasibility of the CBK toll road. This condition will also extend the cash flow deficit period experienced by the CBK toll road due to the additional TIP investment. Therefore, the TIP development must be financially feasible so as not to impact the financial feasibility of the toll road. This study will conduct a literature review on the financial feasibility of the project, especially for the development of toll road infrastructure and TIP. The study can provide a conceptual framework that can be used in calculating the financial feasibility of this TIP project. In addition, a literature review is also conducted to produce project cost optimization options and additional new sources of income. This aims to improve the financial feasibility of the TIP project.

Methods

This research has been designed as a conceptual investigation based on literature-based investigation aimed to determine the viability of the Rest and Service Area (Tempat Istirahat dan Pelayanan/TIP) project on JORR II Toll Road. The main goal is to develop a framework of enhancing the TIP financial viability through incorporating the value engineering concepts into the existing toll road investment assessment. Since the TIP is not already constructed and there is no concluded investment commitment on the project, the research will be completely based on the secondary data obtained through scientific research works, feasibility project reports, regulatory policies, and financial analysis criteria of toll infrastructure.

The methodological outline entails the determination of significant variables and indicators that have frequently been deployed in feasibility studies of projects, especially in the area of infrastructure where vast sums of money are involved in constructing a project, long life-cycle and regulatory and supervisory knots. In that regard, the research gathers and compiles a wide

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variety of cases, research, and scholarly reviews, as well as frameworks of policies regarding the development of toll roads, the partnership between the public and the private sectors in such projects, the functionality of TIPs, and the optimization of costs in regards to investment. The research imparts an orderly dissection of these sources to derive applicable parameters including Net Present Value (NPV), Internal Rate of Return (IRR), Payback Period (PBP) and other sources of revenue generation. This makes it possible to create a holistic conceptual framework of TIP evaluation that would suit the engineering-economic viability and match it to the requirements of the regulation..

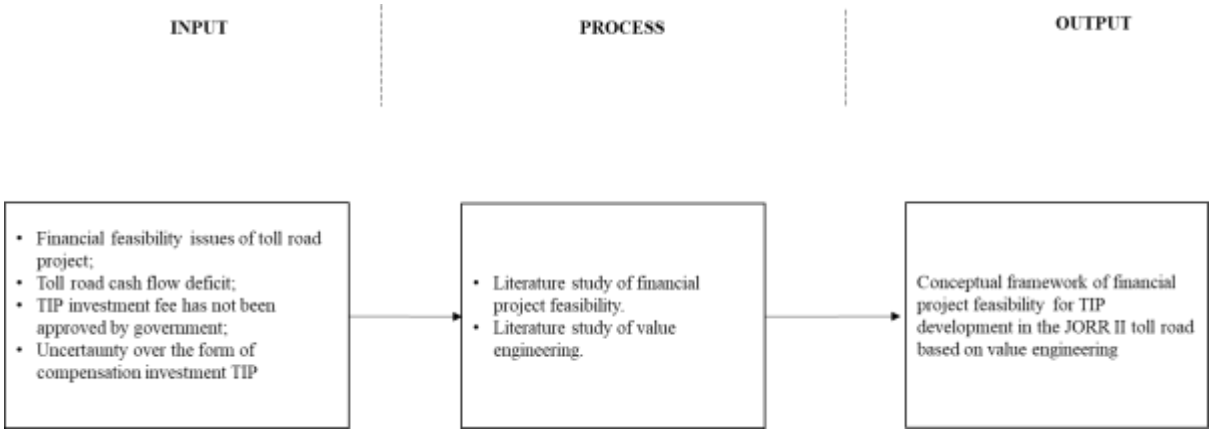

Figure 1. Research methodology

The theoretical analysis starts with the identification of the existing investment and regulatory problems in the TIP development on the CBK segment of JORR II. The government requirements are that all toll roads must have TIP integration every 50 kilometer and the time lag on land acquisition costs, as well as not making allocations on TIP investments has exposed the Toll Road Business Entity (BUJT) to a big financial risk. It is against this background that, the research takes the position to examine feasibility evaluation models that will consider such contingencies, through a triangulation of documented evidence, to outline baseline investment indicators, and appraise the potential fiscal burden TIP construction may demand.

In the second methodological layer, the analysis is conducted to cost optimization strategy and non toll income possibilities with the use of value engineering (VE). This stage reviews developing empirical research that establishes quantitative advantages of VE in infrastructure and public-private partnership (PPP) undertakings. The ways in which VE processes, e.g. Function Analysis, Creativity, and Development can be applied to ensure the elimination of fruitless spending on capex in addition to the introduction of new functions that can earn project income, is specially given. The choice of VE as a fundamental approach is determined by its satisfying performance in terms of optimization of infrastructure projects, its compatibility with multi-disciplinary approach to engineering and its applicability to long-run financial assessments.

The Quality and the Acceptance level of the integration of VE into the methodological design is also addressed to the Functional Analysis System Technique (FAST), where it helps in identification of core functions and secondary ones of the projects. What is sought is to design the TIP functions in a manner that minimized construction costs and increased auxiliary revenues are achieved together. This set of methodological elements are combined together in order to formulate one whole conceptualization which gives the research direction to the rest of the paper leading to an evaluative model that toll road planners and investors can apply in evaluating TIP project viability in cases of limited fiscal resource availability.

Results and Discussion

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Project Financial Feasibility

A feasibility study is required in a project development plan. This aims to ensure optimal allocation of company resources in order to achieve maximum results. A feasibility study of a project also aims to measure the profitability of resource use in a business operation. Gunawan (2023) in his research has identified stakeholders related to the feasibility of a project, namely: 1) Investors are parties who allocate funds to a project with the main focus being the level of profitability of the project; 2) Creditors/Banks are the parties that provide funds and will control the security of the funds. The creditors will evaluate the business prospects of a project; 3) The government has an interest in projects that provide benefits to the public interest and the national economy.

The feasibility calculation of the Cengkareng-Batuceper-Kunciran toll road construction project is carried out referring to the Toll Road Business Agreement (PPJT) between the Toll Road Business Entity (BUJT) and the Government in this case represented by the Toll Road Regulatory Agency (BPJT). Based on this document, the feasibility of the toll road construction project is assessed through several indicators, namely *Internal Rate of Return* (IRR), *Net Present Value* (NPV), and *Payback Period* (PP). (Truong et al., 2020) conducted a comprehensive study on the success factors of toll road project investment. This study was conducted on 7 (seven) toll road projects in China. The results of the study explain 5 (five) success factors that need to be considered in toll road project investment, namely: 1) The government must provide certainty in land acquisition; 2) The government must provide an appropriate toll tariff structure and provide certainty in adjusting toll tariffs; 3) Implementation of fines on vehicles with excess loads; 4) Selection of investment timing from Toll Road Business Entities (BUJT); 5) Proper use of resources for project implementation.

Several criteria can be used to measure the present value of the costs and benefits of a project, including the following: a) Gross Benefit / Cost Ratio; b) Profitability Ratio; c) Net Present Value; d) Internal Rate of Return; e) Payback Period.

Literature review was also conducted to see the factors that affect the financial feasibility of the project. Some factors that affect the financial feasibility of the project can be seen in the table below.

Table 1. Factor that influence project feasibility

No	Reference	Results (Factors Affecting Project Feasibility)
1	(Zala & Vel, 2019)	Net Present Value (NPV)
2	(de Albornoz et al., 2021)	Discounted Cash Flow (DCF)
		Internal Rate of Return (IRR)
		Payback Period (PBP)
3	(Chou & Pramudawardhani, 2015)	Profit Potential to attract investors and creditors
		Good feasibility study
4	(Almarri & Boussabaine, 2017)	Business diversification
5	(Jayasena et al., 2021)	Justification economy
6	(Yescombe & Farquharson, 2018)	Affordability
		Financing Cost
		Debt Profile
7	(Liu et al., 2020)	Control of cash flow

Important aspects that determine the financial feasibility of a project in general are revenue and expenses. If the expenses increase, then a new source of income is needed to produce a

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good level of feasibility. Based on the literature review that has been conducted, there are several alternative sources of new income that can be a solution, explained in the table below.

Table 2. Alternative new revenue sources for toll road infrastructure projects

No	Reference	Alternative Sources of Income
1	(Czajkowski et al., 2022)	Commercialization of assets for advertising
2	(Hoeflich K., 2019)	Land rental, advertising, logo sales, toll gate naming rights, communication towers, 5G network antenna rental, electric fuel stations, etc.
3	(Perkasa et al., 2023)	Advertising and land rental
4	(Susanti et al., 2023)	Land rental for advertising and rest and service business (TIP)

The financial feasibility of the project is the main component that needs to be known in this TIP Development project. In this study, the project feasibility is seen through the indicators *Net Present Value* (NPV), *Internal Rate of Return* (IRR), and *Payback Period* (PBP). These indicators are the references used in determining the feasibility of the Cengkareng-Batuceper-Kunciran toll road project as agreed in the Toll Road Business Agreement (PPJT) between the Toll Road Business Entity (BPJT) and the Government represented by the Toll Road Regulatory Agency (BPJT).

JORR II Rest Area and Service Area (TIP)

Rest and Service Areas (TIP) are places used by toll road users to rest in order to reduce the number of accidents caused by fatigue and improve safety (Darmawan, et al. 2021). TIPs, commonly known as rest areas, provide road users with the opportunity to rest for a certain period of time. The presence of road users utilizing TIP necessitates that TIP meet several aspects, including design, parking areas, facility size, water supply, and wastewater disposal. A TIP can be considered safe if it provides comfort facilities, a natural environment, and information needs for road users (Darmawan et al., 2021). Therefore, TIPs must be equipped with facilities that support road users' needs, ensuring that TIP provision can be carried out sustainably. The provision of facilities at TIPs must consider the costs involved, including construction costs, operational costs, and maintenance costs (Darmawan et al., 2021). TIP facilities have a positive impact on road users. Based on a literature review conducted by Hamdani and Hadisumarto (2023), the positive impacts of TIP facilities on toll roads include the following: a) Reducing fatigue and improving driving safety; b) Improving toll road efficiency with fuel filling facilities and vehicle maintenance services; c) Providing a positive experience for road users.

Based on the Ministerial Regulation (Permen) of Public Works and Public Housing (PUPR) No. 28 of 2021 concerning Rest Areas and Services on Toll Roads, a Rest Area and Service on a Toll Road is a rest area equipped with various public facilities for toll road users, so that drivers, passengers, and their vehicles can rest temporarily. TIPs are divided into two categories: Urban TIPs and Intercity TIPs.

The management of TIP and its facilities is included in the minimum service standards (SPM) that must be met by Toll Road Business Entities (BUJT). This aligns with Article 82 of the Minister of Public Works and Housing Regulation No. 28 of 2021 on Rest Areas and Services on Toll Roads, which states that BUJT must oversee and ensure compliance with the minimum service standards for toll roads at TIP, whether managed by BUJT or its partners. The inspection of compliance with the SPM is conducted and evaluated on a regular basis every 6 (six) months by the Toll Road Regulatory Agency (BPJT).

Based on the Regulation of the Minister of Public Works and Public Housing No. 16/PRT/M/2014 concerning Minimum Service Standards for Toll Roads, the term “Minimum

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Service Standards for Toll Roads" refers to the type and quality of basic services that must be achieved in the implementation of toll road operations. The Minimum Service Standards for Toll Roads cover several service components, consisting of: a) Toll road conditions; b) Average travel speed; c) Accessibility; d) Mobility; e) Safety; f) Rescue/emergency units and service assistance; g) Environment; and) Rest areas (TI) and rest and service areas (TIP).

Referring to the provisions mentioned above, the construction and management of TIP must consider public facilities and their achievement of SPM Toll Road standards. This will certainly require significant costs and long-term investment. Therefore, financial feasibility must first be assessed in the TIP construction plan.

The planned location for the Rest Area and Service Facility (TIP) is at KM 4+600 on both sides, namely on the side heading toward Soekarno-Hatta Airport (Route B) and on the side heading toward Tangerang (Route A). The construction of the TIP utilizes the right of way (RoW) of the Cengkareng-Batuceper-Kunciran Toll Road. The construction of the TIP is carried out through the Government-Private Partnership (GPP) concept, with PT JKC as the private partner in this collaboration. The scope of PT JKC's operations includes the construction of TIP facilities, both infrastructure and commercial, as well as the operation of the TIP. As an additional note, the Cengkareng-Batuceper-Kunciran Toll Road is a National Strategic Project (NSP), so the costs associated with land acquisition for the TIP project are fully the responsibility of the Government.

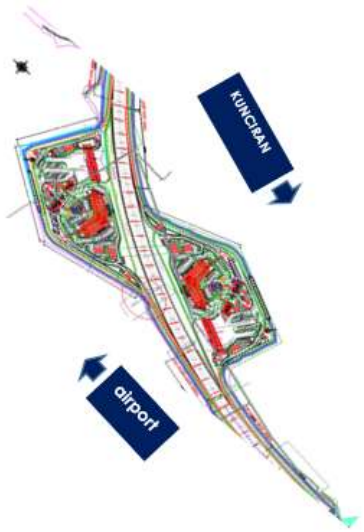

Figure 1. Area Layout Plan for the Airport Corridor – Kunciran Direction

This TIP Development Project is planned to have several basic facilities in accordance with the provisions of the Minister of Public Works and Housing (PUPR) Regulation No. 28 of 2021 on Rest Areas and Services on Toll Roads. The TIP includes facilities such as SMEs, gas stations, mosques, restrooms, commercial areas, and parking lots capable of accommodating both small and large vehicles. The total area for the TIP development is approximately 53,515 m² for TIP Route A and approximately 63,509 m² for TIP Route B. The detailed layout of the TIP is as follows.

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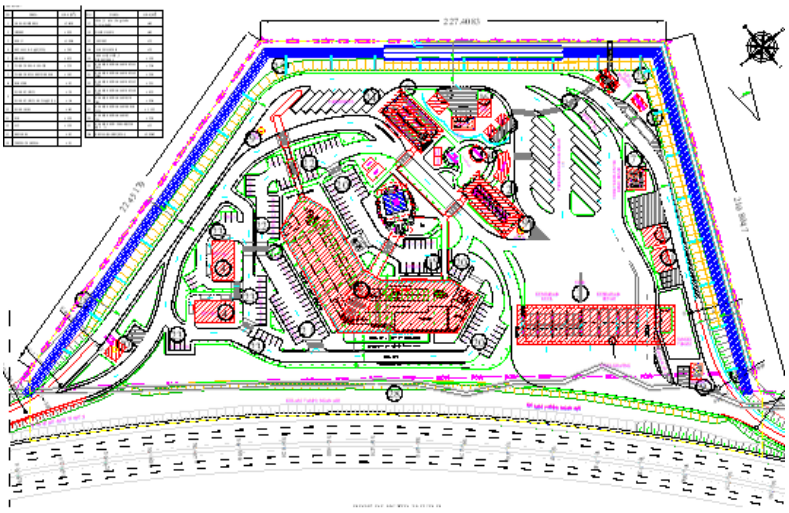

Figure 2. Layout of the JORR II Toll Road Development Plan

Value Engineering

One method that can be used to optimize costs or even reduce costs in a project is through value engineering value *engineering* (VE) (Rozi et al., 2022). The concept of value engineering is defined as a method applied through a systematic and multidisciplinary process with the aim of obtaining optimal value from a project, one of which is through function analysis (SAVE International Value Standard, 2007). Through the application of VE, it is expected to result in a reduction in unnecessary costs in a project so that the total costs incurred in a project can be reduced. In a study conducted by (Rozi et al., 2022), the application of VE has been proven to reduce costs incurred, especially for Road Construction projects, by up to 3.32%.

Studies on the application of VE for cost optimization and feasibility levels have been widely conducted. Based on the results of literature studies that have been conducted in several studies, it is concluded that the application of VE effectively results in cost reduction or increased value of a project. The literature studies conducted are as follows: 1) (Khademi & Beheshti, 2014), in a study entitled "*Value Engineering Approach in the Underpass Projects in Iran: A Case Study in Gachsaran Underpass Project*" concluded that project costs can be saved up to 21% by implementing VE. This can be done by proposing changes to the project that reduce costs and time while still improving product quality. This study uses an original VE approach with stages of information, function analysis, creativity, evaluation, development, and presentation;

Selim et al. (2017), in a study entitled "*Value Engineering (VE) Application in Infrastructure Projects by Public-Private Partnerships (PPPs)*" concluded that by implementing VE, KPBU projects can generate cost savings and also increase the value and quality of the project. VE can also reduce project completion time. Based on the studies that have been conducted, VE can be applied in KPBU projects. This study uses an original VE approach with stages of information, function analysis, creativity, evaluation, development, and presentation;

Adnan et al. (2018) in a study entitled "*An Analytical Way to Reduce Cost of a Product Through Value Engineering Employment (Case Study: Walton)*"found that based on the study and application of value engineering in this case study, there are several alternatives that can be done to generate cost savings, namely changing the body mount material, coating, and compression base plate and reducing the thickness of the side cabinet. This study uses an original VE approach with stages of information, function analysis, creativity, evaluation, development, and presentation;

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Husin et al. (2020). In a study entitled "*Box Girder Construction on Toll Road Project use Manual Program Evaluation and Review Technique (M-PERT) and Value Engineering (VE) to Performance Cost and Time Improvement*"found that the percentage of M-PERT on project scheduling was 1.13% with an accuracy level of 98.87% and with the application of VE obtained contribution other income of 9.83% outside of toll road income. This study uses FAST Diagram as a development technique to optimize functions, classification and evaluation using how-*why formula*;

Imron & Husin (2021) in a study entitled "*Value Engineering and Lifecycle Cost Analysis to Improve Cost Performance in Green Hospital Project*" found that by applying VE to conventional materials, it can generate savings of up to 2.62%. Furthermore, VE on Solar Panels results in an increase in BEP to 9.64 years. This study uses an original VE approach with stages of information, function analysis, creativity, evaluation, development, and presentation;

Rozi et al. (2022) in a study entitled "*Implementation of Value Engineering to Optimize the Designing of the Southern Java Road Project*" found that the use of VE has resulted in cost savings of 11.13% for asphalt pavement shoulder work and reached a percentage of 3.32% for the overall project value. This study uses the VE Index approach to produce a value and cost ratio;

Rani et al. (2024) in a study entitled "*Cost Saving Analysis through Value Engineering Implementation in Hermina Aceh Hospital Building Project*" found that some work items that can be value engineered are wall work, doors and windows, floors, and exteriors. The total cost savings obtained were 0.97% of the total initial project cost. This study uses the original VE approach with stages of information, function analysis, creativity, evaluation, development, and presentation;

Vansya et al. (2024) in a study entitled "*Cost Optimization of Formwork Using Value Engineering Techniques in Building Projects*" found that the application of VE in the selection of formwork types has resulted in significant cost savings compared to conventional formwork. This study uses an original VE approach with stages of information, function analysis, creativity, evaluation, development, and presentation.

Value engineering (VE) is an effort that can be done to increase the value, especially the feasibility of the TIP development project. The VE method used in this study is through the approach original *VE.* There are several stages that will be applied, namely the information stage, function analysis, creativity, evaluation, development, and presentation. This study also uses the FAST (Functional Analysis System Technique) technique to conduct a function analysis on the JORR II Toll Road TIP project. Based on previous studies, there are several VE efforts that can be done, namely VE on TIP construction costs and VE by adding new functions to increase TIP revenue. These steps will be taken in this study to produce a more optimal TIP project feasibility value.

Conceptual Framework

A feasibility study is needed in initiating a project. Research conducted by Georgen (2017) explains that a project feasibility study activity is needed to determine whether a project is feasible or not and how much value will be generated from the project. This was done on the Cengkareng-Batuceper-Kunciran Toll Road Development project. Based on the PPJT agreed between BUJT and BPJT, the project feasibility of this Toll Road was generated through calculations *Net Present Value* (NPV), *Internal Rate of Return* (IRR), and *Payback Period* (PP). The value of the three indicators has the potential to change if there is additional investment for the TIP Development project on the JORR II Toll Road.

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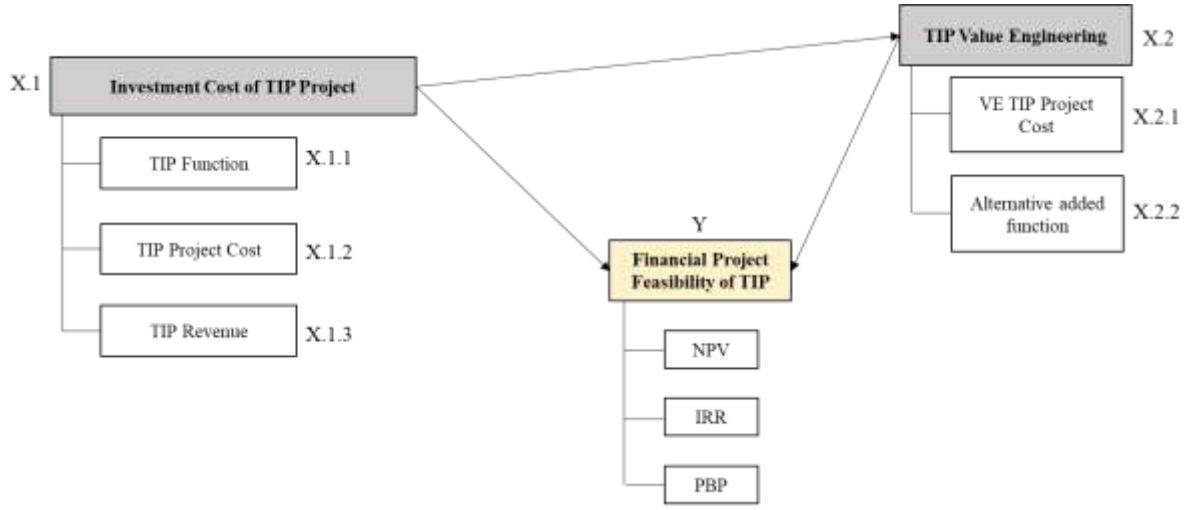

Figure 3. Conceptual Framework

Based on previous research, there are efforts that can be made to save project costs to increase the project's feasibility value, namely through the application of value engineering value *engineering* (VE). In the TIP Development on the JORR II Toll Road, VE is possible to be applied and is expected to increase the feasibility of the project. This study will examine the VE options that will be applied to the TIP development project and see their influence on the project's feasibility value. The conceptual framework in this study can be seen in the following figure.

Conclusion

Research on financial feasibility evaluation has been widely conducted, especially for toll road and TIP infrastructure projects. Based on the literature review, the options taken to improve the financial feasibility of the project are to optimize costs and add new sources of income. The method used is through value engineering by adding new alternative functions. Based on this, it can be concluded that the concept that can be done to improve the financial feasibility of the project in this study is through the application of value engineering. The value engineering is applied to investment costs and new alternative functions to obtain other sources of income. This concept is expected to help further research to produce better project financial feasibility values. This research was conducted on the TIP Development object on the JORR II Toll Road by reviewing the literature to produce a conceptual framework that can be used to increase the financial feasibility value of the project. Further research is needed to see the project feasibility value that can be produced through the application of the conceptual framework in this study. This research is limited to the financial feasibility of the project.

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