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Article

Initial study of the Palu-Parigi By-pass road policy in Central Sulawesi Province, Indonesia

Mohamad Ahlis Djirimu[1,*], Yunus Sading[1], Muhtar Lutfi[1], Vera Cicilia[1], Andi Darmawati Tombolotutu[2]

[1] Department of Economics & Development Studies, Faculty of Economics & Business, Tadulako University, Palu 94118, Indonesia
[2] Faculty of Economics, Abdul Azis Lamadjido University, Palu 94111, Indonesia
*** Corresponding author:** Mohamad Ahlis Djirimu, mohahlis@untad.ac.id

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Abstract: This research aims to do the assessing the feasibility of the Public-Private Partnership project in investing in the construction of the Palu-Parigi By-pass road through a PPP financing scheme, thereby providing opportunities for the private sector to participate in the provision of special road infrastructure. In this context, experimental criteria for determining Value for Money (VFM) are applied using the PPP model, to evaluate projects. The main objective also emphasizes the provision of greater VFM Goods through private financing, through conventional methods that are economical, efficient and effective. Furthermore, financial performance measurement reports apply several methods, including Payback Period (PP), Net Present Value (NPV), and Internal Rate of Return (IRR) which determine the feasibility and time required for returns on invested capital. The previous Economic Feasibility Study of the Palu-Parigi By-pass Road Construction project also showed an EIRR value of 20.1% in 2014, illustrating the economic development of this work. In connection with the limitations currently faced by the Regional Budget Agency of Central Sulawesi Province, the next PPP scheme is recommended for road construction by prioritizing infrastructure completion after the 28 September 2018 earthquake and the COVID-19 pandemic. The DBFMT (Design–Build–Finance–Maintenance–Transfer) model was also applied to the project, with GCA responsible for design, construction, financing, periodic maintenance and transfer at the end of the collaboration agreement.

Keywords: benefit value of money; internat rate of return; net present value; Palu-Parigi By-pass road; public-private partnership

1. Introduction

In road management, the challenges faced in Central Sulawesi are relatively the same as the challenges faced in other regions in Indonesia. From this context, the challenges indicate a small population with limited direct impact on the economy, despite having the largest area on the island. This condition can be seen in 2020 with an infrastructure development allocation of USD19,49 million. At the district and city level, the lowest realization of infrastructure spending also occurred in Parigi Moutong Regency, which reached USD1,27 million or represent 0.06% of the Central Sulawesi Province Revenue and Expenditure Budget, or represent 0.0043% of the Indonesia's annual budget. Spending continues to focus on a combination of various sectors, including roads, bridges, irrigation, etc. (Central Sulawesi Provincial Office of Directorate General of Treasury Ministry of Finance, 2021). In addition, the lack of funds to finance roads and bridges causes high transportation and logistics costs.

The ratio of road lengths in good condition also currently reaches 0.3 points or 30% of all route distances in Central Sulawesi, with the proportion of infrastructure

stability monitored at 0.62 points or 62%. In this context, the percentage of roads that are in good condition is a big challenge because it allows vehicles to pass at a speed of 40 km/h.

The low of Locally-Generated Revenue (LGR) in Central Sulawesi can be further seen from its contribution to regional income of 29.64%. Followed by Morowali Regency and Palu City with 24.17% and 21.10% respectively. However, LGR's contribution to income is lowest in Banggai Sea Regency, reaching 4.08%. This situation causes the need for innovative and alternative funding for road construction and management. One suitable financing scheme is the Government Business Entity Cooperation (KPBU) model which is legally valid to be implemented in Indonesia. This scheme is regulated by existing policies, including Presidential Regulations (Perpres) and Ministerial Regulations, especially the Ministry of Finance and Ministry of Public Works and Public Housing, as well as the National Planning and Development Agency (Bappenas). **Table 1** presents several achievements of Public Works and Spatial Planning performance indicators in Central Sulawesi Province in 2016–2020. Based on **Table 1**, there are several important things related to the performance of Public Housing in Central Sulawesi Province which are priorities. First, the ratio of road lengths in good condition remained stable and experienced significant improvement, especially the quality of infrastructure which achieved an excellent score of 0.618 points. Second, there has been a significant increase in the percentage of roads that are well maintained, with a significant achievement reaching 22.48% in 2020. Third, the ratio of the length of roads in good condition compared to the population has decreased over the previous five years, falling from 0.006 to 0.005 between 2016 and 2020.

Table 1. Performance indicators and achievements in the field of public works and spatial planning in Central Sulawesi for the 2016–2020 period.

No.	Information	Performance achievements this year				
		2016	**2017**	**2018**	**2019**	**2020**
1.	Road length ratio in good condition	0.37	0.36	0.27	0.26	0.30
2.	Road stability ratio	0.59	0.61	0.61	0.61	0.62
3.	Ratio of road length to population	0.01	0.01	0.01	0.01	0.01
4.	Percentage of provincial roads in good condition (> 40 km/hour)	16.70	23.49	16.43	27.52	22.48

Source: Central Statistical Agency of Central Sulawesi Province 2017–2020, Central Sulawesi Province Public Housing Employment Service Main Performance Index 2020.

Research question could be analyzed as follows: does the construction of the Palu-Parigi By-Pass Road have feasibility and encourage private interest in collaboration with the Government? Does the construction of the Palu-Parigi By-Pass Road have financing feasibility in managing road transportation through the PPP scheme? Is there a transfer of technology and managerial skills in the provision of road infrastructure services in the project area?

Therefore, this research aims to achieve the following objectives, (1) evaluating the feasibility of the Public-Private Partnership (PPP) project and attracting private investment for the development of the Palu-Parigi By-pass Road, (2) assessing the

feasibility of implementing financing and managing road construction. through the PPP scheme, and (3) facilitating the transfer of technology and managerial expertise for the provision of services in the project area. The Palu-Parigi By-pass Road is also expected to pass through six sub-districts, namely South Palu, as well as Sigi Biromaru, South Parigi, Central Parigi and Parigi sub-districts. In this case, the results obtained are expected to demonstrate effective project performance using the PPP scheme.

Wu et al. (2021) said that in economic theory, the relationship between infrastructure development and economic growth is generally associated with the multiplier effect, namely government investment which depends on strengthening the investment multiplier which is able to encourage growth. In the industrial sector, it can accelerate economic growth in a region. Transportation infrastructure development can influence economic growth through influencing production behavior. Through the economic growth created, it will also influence the performance of economic development in a region. Usually infrastructure improvements in an area are managed by the local government. Therefore, a good region can be assessed through the performance of local government in managing and optimizing infrastructure procurement as a locomotive for development (De Almeida and De Mendoza, 2019). In order to increase and create economic activities that can be a means of meeting community needs, adequate infrastructure is needed. Not only that, the existence of infrastructure is also seen as optimizing the development process in an area. As a driving force for economic growth, infrastructure can be a locomotive for development, both national and regional. Infrastructure is a basic physical structure that is important to facilitate society in terms of providing the basic framework necessary for economic output (Sharif and Tauqir, 2021). Banerjee et al. (2020) aid that, infrastructure can be the main key in the process of accelerating equitable development which can ultimately reduce poverty and unemployment levels in a region. Lin (2020) defines transportation infrastructure as the key to driving economic growth. This is due to the availability of access to markets as a medium for economic activity. The better the transportation infrastructure and the better the accessibility, the more economic activity between regions or areas will increase. Pradhan et al. (2021) summarize three ways that can prove the relationship between transportation infrastructure and economic growth. First, this type of transportation infrastructure plays a role in the production process as a direct input, and in many cases transportation infrastructure plays a role as an unpaid production factor. Second, transportation infrastructure can trigger the creation of inputs in other fields so that they become more productive. Third, the existence of transportation infrastructure can become a magnet for agglomerative economic growth in a region.

In their research, Pradhan and Bagchi (2013) concluded that good transportation infrastructure can expand a country's productivity capacity, both through increasing the mobilization of existing resources and increasing the productivity of the resources they own. The influence that transportation infrastructure has on economic growth by changing aggregate demand. An example is the development of transportation infrastructure which can produce input from other sectors so that it can become a multiplier effect stimulus in economic activities.

Several previous empirical studies provide justification that the development and provision of transportation infrastructure encourages economic growth and opens up

regional isolation and optimizes the role of regions in encouraging equitable national development and logistics distribution. However, transportation infrastructure is a public good, its provision is only the responsibility of the regional government, especially in the province of Central Sulawesi. Therefore, this research provides an analysis of the feasibility of financing development by involving the private sector in investing in transportation infrastructure development. Thus, the involvement of the private sector in collaboration with local governments through the PPP scheme is an alternative in accelerating the provision of road infrastructure which is expected to encourage economic activity in the community, especially Palu-Parigi.

2. Materials and methods

This needs study is expected to formally describe and ensure the existence of sustainable infrastructure needs for system development, road construction and management. This systematic discussion is prioritized through the following description.

2.1. Materials

2.1.1. General description

In the Technical Rational, several elements and components are explained. First, managing transportation needs in Central Sulawesi Province, the population of which is monitored according to the Central Statistics Agency, in the 2020 census program is 2,983,000 people (Central Statistical Agency of Central Sulawesi Province, 2021). The population increases every year by 35,000 people, with the number of men and women respectively 1,534,710 people and 1,451,030 people. The majority of the population is also dominated by the Millennial generation and Generation Z (Gen Z) at 25.89% and 31.25% respectively. Based on 2014 BPS statistical data, the number of vehicles monitored in Central Sulawesi was 12,395 vehicles, 7638 units and 2209 units respectively in the form of goods cars and pickup cars.

Second, road conditions in the area are expected to be well improved. This is because the Provincial Roads Service only succeeded in maintaining 1567.04 km of lanes suitable for four-wheeled vehicles at the end of 2018, as stated in the 2016 Central Sulawesi Governor's Decree. Road construction is still behind the target set at 30 km, so completion is only 12 km. This inconsistency causes the budget allocation to be smaller than the initial plan in the Regional Medium Term Development Planning (RPJMD).

Third, regarding technical operations, the target of provincial road stability falls within the authority of the regional government, in terms of technical operational implementation. This target is a type of service that emphasizes Minimum Service Standards (SPM) in the field of General Planning and Spatial Planning. The achievements are also taken into account through the stability of all provincial roads in Central Sulawesi as stated in the Regional Governor's Decree Number 620/932/DINAS BINA MARGA-G.ST/2016 and the conversion of the Public Works and Public Housing Ministerial Decree with Good Conditions, and Medium to Total Length. During the completion of the 2-year strategic plan at the end of 2018, the realization of stability reached 60.46%, exceeding the second year target of 59.74%.

This achievement was prioritized in improving 63.4 km of roads in regions 1 and 2, accompanied by routine maintenance activities on various routes and bridges. Apart from determining stability based on road conditions, several environmental factors are also very influential. This description explains that the stability of provincial roads is a key indicator in the SPM in the field of General Planning and Spatial Planning. This also ensures that areas that meet the requirements are able to meet the minimum needs of each resident, as regulated in the Minister of Public Works and Public Housing Regulation Number 01/PRT/M/2014 concerning Minimum Field Service Standards in the Public Sector and Spatial Planning. These achievements are then calculated using all the stability of provincial roads in Central Sulawesi, as outlined in Regional Governor Decree Number 620/299/DIS.BMPR-G.ST/2017. This decision determines the status of the road section as provincial infrastructure by considering the total length condition is good or moderate.

As the result of demographic and economic agglomeration, cities become the centers of carbon emission. In general, industrial production, building construction, and transportation are three largest sectors that contribute to the carbon emission of cities. So far many studies have been conducted to raise planning and management solutions to the transportation emissions. The impact of spatial structure of cities, traffic modes, and the service level of public transportation are widely accepted as critical factors to be considered. The environmental impacts of transportation emissions have been evaluated by many at a regional or national scale to examine related planning issues (Gao et al., 2013).

2.1.2. Policy review

The following elements and components are analyzed appropriately regarding secondary data. First, it is hoped that economic connectivity in Central Sulawesi can be improved so that it will have an impact on improving transportation infrastructure. This improvement step aims to connect industrial centers on the West Coast with rapidly developing coastal production centers in the East, especially in Parigi Moutong Regency. In this context, the construction of a new road, the Palu-Parigi By-pass, is expected to reduce transportation costs and thus have an impact on domestic and foreign commodity prices.

Second, it emphasizes the significant social benefits to society, leading to increased transport efficiency, through faster travel times and reduced travel costs. Health services, education and various social services are also strengthened, resulting in increased community welfare. It is hoped that this service improvement will collaborate with increased accessibility in affected areas, thereby improving the overall quality of life of local residents.

2.1.3. Stakeholder support

Stakeholder support analysis was carried out to ensure that the Bypass Road project, the Palu–Parigi route plan, received support from the various parties involved. From this context, the Provincial Government aims to connect Central Sulawesi with more developed provinces in the Eastern Region of Indonesia. This is in line with the provisions in the Government Vision 2011–2016 and Province 2021–2026, concerning “Accelerating Progress and Prosperity of Central Sulawesi”. This situation requires accelerated economic growth, which is difficult to achieve without

infrastructure development, especially in the road and bridge sector. Based on Presidential Decree Number 167 of 1998, Central Sulawesi has now established an Integrated Economic Development Zone (KAPET), including the Palu Industrial Zone (KIP) which is recommended to become a KEK (Special Economic Zone) and the main driver for accelerating regional economic growth. The plan to develop the Pantoloan-Palu section as a freeway also increases connectivity between industrial areas on the West Coast and coastal production centers that are developing rapidly on the East Coast, especially in Parigi Moutong Regency. This road construction project was designated as a priority for Master Plan for the Acceleration and Expansion of Indonesian Economic Development (MP3EI) in Central Sulawesi.

Based on the suitability analysis, 95% of participants knew about the road construction plans which came from various sources, including the mass media and local officials at the sub-district and village levels. Around 86% also said they agreed with the construction of the road. Various reasons were given by the participants supporting the project, such as reducing distances and encouraging the economy of the local community. Meanwhile, there were no specific reasons given by those who did not agree with the development of this infrastructure. The Palu-Sigi-Parigi By-pass Road must also consider the Grand Forest Park (Tahura) in Palu City, specifically in South Palu District and Sigi Regency in Sigi Biromaru District. These requirements are in line with Decree of the Minister of Environment and Forestry Number 8113 of 2018 and Government Regulation Number 13 of 2017 which amends Government Regulation Number 26 of 2008 concerning National Regional Spatial Planning. In this context, the regulation stipulates that the Tahura area is allocated for 2842.70 ha in Sigi Biromaru District.

2.2. Methods

2.2.1. Criteria for analysis of factors that influence the value of money

Analytical criteria for factors influencing value for money (VFM) are applied to determine the effectiveness of a project, using the Public-Private Partnership (PPP) model. This analysis emphasizes economic efficiency and effectiveness and at the same time evaluates superior VFM provision through private financing, compared to conventional methods. In this analytical context, only qualitative aspects are considered, and the results form an important basis for procurement decisions. **Table 2** prioritizes comparative analysis of goods procurement using traditional and PPP methods. This comparison helps the Person in Charge of the Cooperation Project (PJPK) in deciding whether or not to apply the PPP method. Additionally, higher values in the analysis emphasize preferences for the selected option. This analysis process then applies four categories, where the values 3, 2, 1, and 0 represent high, medium, low monetary benefits, and no monetary benefits, respectively.

Table 2. VFM analysis.

NO	Determinants of value	Score		Information
		Conventional	PPP	
1	Construction of the Palu–Parigi By-pass Road.	1	2	The results of the PPP model include maintenance programs and road management costs periodically during the service period. Meanwhile, conventional output only builds roads without routine and periodic maintenance programs.
2	Innovations in design and/or construction practices provide long-term value, in terms of better product structures, or lower operational and maintenance costs.	1	2	Bidders/business entities are encouraged to identify innovative methods to achieve the required results at the lowest total cost. This emphasizes the increase in VFM in PPP. Meanwhile, conventional schemes closely follow existing designs, and any innovations are handled in separate projects.
3	Flexibility over changes to contract specifications.	2	2	Changes in specifications in PPP transactions and conventional schemes have become more flexible.
4	Ability to raise funds/ease of obtaining financing.	1	2	Conventional schemes depend on the capabilities of the Provincial Budget Revenue and Expenditure (APBD), which often emphasizes long time periods and poses relatively significant challenges for accommodation in anticipating National Budget Revenue and Expenditure (APBN) funds. In contrast, the PPP scheme provides a more secure alternative source of funding.
5	Total project completion time.	1	3	Project completion by PPP is generally on time to avoid losses due to delays. However, completion of conventional projects is slower depending on regional budgeting mechanisms and APBD capabilities.
6	Method of all costs during the project implementation period.	1	2	PPP option bidders are encouraged to apply the whole-of-life method to project costs, using an effective competition mechanism. Meanwhile, conventional procurement options do not support whole-life methods due to mismatches between facility design and construction, as well as ongoing maintenance and operations. This emphasizes GCA's responsibility to consider the impact of design on future operational and maintenance costs.
7	Product life cycle calculations to reduce costs.	0	1	Business Entities optimize construction, maintenance and operational costs throughout the Collaboration period.
8	Risk Allocation—Construction and design—Delays in erection and design.	1	2	The risk of structural damage is borne by parties who have efficient management capabilities. Project completion calculations also take into account preparation and construction time. For conventional projects, implementing simple costs facilitates efficient and rapid completion. However, more complex and expensive PPP projects with a higher risk of construction delays are better suited to be managed by the private sector, due to their thoroughness in preventing setbacks.
9	Speed of project realization.	1	1	The conventional APBD and PPP/KPS procurement options are the same.
10	Output specifications.	1	2	The potential for meeting minimum standard output specifications is better in the PPP model compared to conventional schemes. For example, PPP financing for highways covers maintenance costs.
11	Ease of earning income.	1	2	When income is not conventionally observed, services improve societal performance. Meanwhile, potential income opportunities emphasize optimizing land along road construction corridors when the potential for money in the PPP is large, starting from levies to other elements.

Table 2. (*Continued*).

NO	Determinants of value	Score		Information
		Conventional	**PPP**	
12	Sectors related to long term contracts.	1	2	This long-term contract does not provide a significant positive impact. This shows that long-term PPP contracts allow Person in Charge of Collaboration Project Government Business Entity Cooperation (GBEC) to allocate budgets with Availability Payment (AP) in a clear and measurable manner. Meanwhile, the very long contract period is holding GBEC hostage.
13	Life cycle cost method.	2	1	Construction and operational costs during the concession period in the PPP model are greater than those in the conventional scheme.
14	Budget, management and revenue sustainability.	1	2	In terms of budget, management and revenue sustainability, the use of the PPP scheme is appropriate.
15	Opportunities for sectoral collaboration.	1	2	The PPP model is broader and allows collaboration with external parties than conventional schemes.
16	Market interest in related sectors.	2	2	In the construction of the Palu–Parigi By-pass Road using a conventional scheme, market interest is quite high because the procurement process is not complicated and takes a long time. However, market interest in using the PPP scheme is not necessarily high because the construction of supporting roads is limited and takes a long time, from a business perspective.
	Total score	18	30	

Based on **Table 2**, a total score of 30 indicates that potential PPP procurement provides better VFM compared to conventional methods. In this context, the PPP was implemented to secure the funding necessary to complete the Palu–Parigi By-pass Road Development project, emphasizing its status as a more profitable option.

2.2.2. Financial aspect

Financial analysis is responsible for evaluating investment calculations, preparing reports, and measuring performance in monetary reporting. In this context, initial steps include examining the income statement during a particular analysis. The report represents the financial profitability of a company in a certain time, detailing details and cash flow information that describes the funds available for operational activities. Financial performance measurement also uses various methods, including Payback Period (PP), Net Present Value (NPV), and Internal Rate of Return (IRR). These methods are used to determine the feasibility and time required for return of invested capital.

a. Repayment period (PP)

The payback period is used to evaluate the time required to recover investments in a particular project. This provides insight into the timeframe required for a new working group to recoup its investment during a feasibility analysis. This is also calculated by determining the time required for the total cash inflow to equal all outflows. Therefore, the presence or absence of several alternative options is usually presented with a shorter payback period. PP analysis is also especially recommended to obtain additional information about the speed with which an investment returns the invested capital. The following formula is applied to calculate the Payback Period.

1) When annual cash flows vary, the following equation is used to calculate PP:

$$\text{Payback Period (PP)} = n + \frac{(a-b)}{(c-b)} \times 1 \text{ year}$$

Information:

n = Last year, where the amount of cash flow has not covered the initial investment.

a = Initial investment amount

b = Cumulative cash flow value in the n the year

c = Total cumulative cash flow in year n + 1

2) If annual cash flows are consistent, the following formula is used to calculate PP:

$$\text{Payback Period (PP)} = \frac{\text{Initial Investment Amount} - \text{Cumulative Cash Flow Value in the n year}}{\text{Total Cumulative Cash Flow} - \text{Cumulative Cash Flow Value in the n year}} \times 1 \text{ year}$$

The following criteria should also be considered during decision making:

i. Shorter payback periods are analytically appropriate;

ii. Long payback periods are not experimentally appropriate.

b. Net Present Value (NPV)

NPV is the current income generated by investment capital, emphasizing discounted cost reduction. This method is useful for evaluating investments while considering currency fluctuations and showing the difference between current profits and costs. The following formula is used to calculate NPV:

$$NPV = \sum_{t=1}^{n} \frac{Cft}{(1+i)^t} - I_0$$

Information:

NPV = Net Present Value (Rp),

Cft = Cash flow per year in period *t*,

K = Interest rate (discount rate),

I_0 = Investment begins,

t = year *t*,

n = number of years,

The following indicators are applied to assess the suitability of the NPV calculation results:

i. If NPV > 0, then the business is profitable and worth running.

ii. The business is detrimental and cannot be carried out when NPV < 0.

iii. If NPV = 0, then the business is able to return the invested capital.

c. Break Event Point (BEP)

This method is used to determine the sales volume required for a product to exceed the break-even point. This point is reached in business when sales cover costs, ensuring the absence of profits or losses during a certain period.

c.1. BEP Units

The following formula is used in calculating BEP to determine the number of units.

$$\text{BEP} = \frac{\text{FC}}{\text{P} - \text{C}}$$

Information:

BEP = Upper Break Event Point the basis of product units produced,

FC = Fixed costs (Rp),

P = Selling Price (Rp),

V = Variable costs (Rp).

c.2. BEP Revenue

The following expression is applied in calculating BEP to derive revenue:

$$\text{BEP} = \frac{\text{FC}}{1 - \frac{\text{TVC}}{\text{S}}}$$

Information:

BEP = Break Event Point,

FC = Fixed Costs,

TVC = Total Variable Costs,

S = Sales Volume.

d. Internal Rate of Return (IRR)

IRR is a metric that reflects the actual return on investment. This metric is similar to NPV in assessing the feasibility of an investment. The following formula is used in calculating IRR:

$$IRR = i1 + \frac{NPV1}{NPV1 - NPV2} \times (i2 - i1)$$

Information:

IRR = Interest value in question,

I1 = The interest rate value used for the final positive NPV,

I2 = The interest rate used for the final NPV is negative,

NPV1 = positive final NPV,

NPV2 = negative final NPV.

e. Depreciation

Depreciation is the reduction in the value of an asset over time due to its use. In this context, depreciation of an asset is generally caused by the following factors:

i. Physical damage due to use of tools;
ii. The need for new production or more services;
iii. Reducing production or service requirements;
iv. Assets that are obsolete due to technological developments;
v. The invention of advanced facilities allows the production of more products at lower costs and higher levels of safety.

The following necessary conditions must be met for an asset to be depreciated:

i. The assets must be used for business needs or to generate income;
ii. Calculation of economic life;
iii. The asset must be used, is susceptible to wear and tear, or declines in value due to natural causes.

The following applies to depreciation calculations.

f. Straight Line Depreciation (SLD)

The SLD method is the simplest and most commonly applied method for calculating asset depreciation. This method ensures consistent depreciation values each year throughout the asset's useful life, resulting in a linear devaluation graph. Important parameters in calculating SLD include the initial investment, as well as the age and value of productive assets at the end of their useful life. The following formula is used to calculate depreciation:

$$Dt = \frac{I - S}{N}$$

Information:

D_t = Amount of depreciation per period,

I = Investment (initial asset value),

S = the final life of the productive residual value asset,

N = Duration of the asset being depreciated.

i. Total Year Digit Depreciation (SOYD);
ii. Depreciation of Decreasing Balance (DBD);
iii. Double Declining Balance Depreciation (DDBD);
iv. Balance Depreciation Declines to Conversion Depreciation;
v. Production Unit Depreciation.

g. Interest rate

Minimum Attractive Rate of Return (MARR) is the minimum return value obtained and received by investors. The following formula is used to calculate MARR:

$$Ic = Ir + If + (Ir)(If)$$

Information:

Ic = Interest rate used to influence inflation,

Ir = Applicable annual interest rate,

If = Inflation rate.

h. Profitability Index (PI)

PI is a method used to analyze the feasibility of an investment effort. This method is commonly known as the B/C Ratio (Net Benefit Cost Ratio) and is calculated by comparing the net cash inflow generated by the investment with the initial funding costs. The following formula is used to calculate PI:

$$PI = \frac{NPV + I0}{I0}$$

Information:

PI = Profitability Index Value,

NPV = Net Present Value (NPV),

I_0 = Investment Value.

The eligibility criteria for calculating PI are presented as follows:

1) If PI > 1, the business is supported for execution.
2) If PI < 1, the business is not supported for execution.

2.2.3. Sensitivity analysis

Sensitivity analysis is used to assess patterns of change in various factors that influence the profits of a business. This analysis focuses on evaluating the impact of changes in sensitive variables, such as MARR, NPV, PP, BEP, IRR, and PI. These changes can also be influenced by increases in production costs, decreases in product selling prices, or fluctuations in income.

2.3. Analysis of economic and financial benefits

The study of Zhang et al. (2017) is to find out the interaction rules between three systems, the economic, land use and traffic systems, in order to establish relevant integrated models with which to study the macro rules across these three urban sub

systems through quantitative analysis and the study of micro individual behaviors under the conditions of a market economy. Based on the feasibility assessment of infrastructure development, including roads, there are two important components to consider, namely costs and benefits. This assessment is also accompanied by consideration of the Rate of Return (ROR) which includes various suitability indicators, such as BCR (Benefit-Cost Ratio), NPV, and IRR. The construction of the new Palu-Parigi By-pass road is also considered to be an important component of regional transportation infrastructure, thereby contributing to the region's macroeconomic growth. In this context, the method used to assess feasibility is economic analysis. This shows that not carrying out a financial feasibility analysis emphasizes the lack of capability due to the indirect benefit of the road, thereby leading to services for broader economic purposes.

Several subsequent calculations show that road and bridge construction is beneficial if it considers various factors such as direct user traffic, high volume in developing areas, reduced vehicle operating costs (BOK), time assessment, and taking into account differences in accidents with and without the project. In this case, the use of this method can only be applied when sufficient and significant normal traffic is observed, thus depicting a reduction of 80 km as a reliable and acceptable size. In addition to evaluating components directly related to transportation infrastructure, various calculations also focus on the benefits felt by consumers and communities in the hinterland areas served by the proposed road. This benefit calculation is generally categorized as the consumer surplus method.

In low-volume pedestrian areas or in underdeveloped/upcoming areas, conventional methods must be modified to accommodate existing benefits and road improvements. From this context, consideration is often made of indirect benefits for road users, such as increased natural or industrial production in hinterland areas served by the infrastructure being built. This calculation method is categorized as Producer Surplus and is applied for planning the new Palu-Parigi By-pass road. This is also relevant where there is potential for increased production and economic dependence on route networks, including agricultural plantations and fish manufacturing. Producer Surplus is further suitable for areas experiencing significant development, especially areas connecting tourist destinations. Therefore, this method provides a basis for evaluating the benefits for road users, thereby enabling improvements in the agricultural sector in certain commodities, including cocoa, sea grass, rattan, etc. For the consumer surplus method, the benefits associated with a reduction in the price of consumer goods are considered, accompanied by a reduction in transportation costs.

A review study of the Multiplier Effect method was also carried out to evaluate the benefits of building the new Palu-Parigi By-pass road. This shows that infrastructure development has a minimum impact on three strategic sectors, namely production, users and local government organizations. In addition, the primary data obtained includes a number of previous cross-classification information, as well as interview parameters that emphasize the origin-destination of private and public vehicles, goods transportation, and road conditions. This implementation data provides a comprehensive picture of route characteristics, conditions and alternative locations for infrastructure development. Similar to freight transportation analysis, this data serves as a basis for assessing significant needs for road infrastructure and

passenger turnover. This is illustrated by the volume of commodities transported at each location. In this context, economic aspects are assessed through three main components, namely NPV, BCR and IRR which have specific criteria for determining project profitability. In addition, economic analysis was carried out over a certain period of 30 years, with details of each aspect presented as follows:

1) Income;
2) Cost Investment without Land Acquisition;
3) Feasibility, including NPV, B/C Ratio, and IRR Indicators.

3. Results and discussion

3.1. Results

3.1.1. Net present value (NPV)

Analysis of financial calculation methods is significant in assessing the positive and negative NPV proposals. It emphasizes determining the difference between the marked income and the investment earned in a project. Based on these results, the income obtained from Palu's Gross Domestic Regional Product (GDRP) follows a leap pattern that emphasizes Gross Domestic Product (GDP) growth due to the presence of Special Economic Zones (KEK). This pattern includes a multiplier effect that is common in certain cities in Indonesia, especially Jakarta. Savings obtained from reduced traffic congestion and the development of employment opportunities are also determined through various operational stages within the KEK area. In this case, an increased investment scenario is assumed, with only 10% of the total 1500 ha of land initially put into operation. This initial operation is gradually increased periodically according to the expected life of the road plan. Therefore, the calculated data shows a positive NPV, which confirms the feasibility of the project for implementation.

3.1.2. Benefit cost ratio (BCR)

Representation of financial calculation analysis methods is important in determining BCR > 1, comparing the profit sharing which is characterized by the investment obtained in a project. The following formula is used to calculate BCR.

$$\mathrm{BCR} = \frac{\mathrm{Revenue}}{\mathrm{Cost}}$$

Based on the results, the BCR is greater than 1, which confirms the feasibility of the project.

3.1.3. IRR (Internal Rate of Return)

The discount rate represents an acceptable investment, because it equates a project's NPV to zero and sets the BCR to one. This shows that investments are profitable and unprofitable when the IRR is higher or lower than the discount rate, respectively. Achieving a higher IRR also generally requires various methods, including trial & error and estimating the initial interest rate (i) as an estimate. In addition, high levels are considered unfavorable for the IRR when negative values are obtained, thereby causing interpolation performance when certain conditions are met. This performance is focused on determining the zero point of NPV by operating between the highest and lowest discounts with positive and negative Net Present Value respectively using the following formula:

$$\mathrm{IRR} = \mathrm{il} + \frac{\mathrm{NPV1}}{\mathrm{NPV1} - \mathrm{NPV2}} \times (\mathrm{i2} - \mathrm{i1})$$

Information:

NPVI = NPV value with the first interest rate,

NPV2 = NPV value with second interest rate,

I1 = First Interest Rate,

I2 = Second Interest Rate.

Based on the IRR value analysis, this project is financially feasible to operate at the level of each ethnic group of interest.

In **Table 3**, Central Sulawesi's Gross Domestic Regional Product (GDRP) shows a quite significant increase. GDRP is used as a basis for calculating the feasibility of building the Palu-Parigi Bypass Road, waiting time and economic growth. In 2020, the GDRP value of Central Sulawesi will also be IDR36,467,013,549 when the freeway is implemented, accompanied by a prediction of IDR5,317,627,770,637,130 in 2048. Furthermore, the observed time savings value due to better road implementation, emphasizing an increase of IDR4,843,058,912 respectively to IDR1,824,936,419,877 from 2020 to 2048. This shows that cost savings and economic value are greater due to reduced transportation costs.

Table 3. Gross domestic regional product + time savings + economic growth.

RMS Rp	**1,350,000**			
Year	**Income (GDRP) IDR**	**Savings from Congestion + Vehicle Operating Costs**	**Growth/Influence of Special Economic Zones**	**Total income**
2012	14,686,401,511			
2013	16,454,644,253			
2014	18,435,783,421			
2015	20,655,451,745			
2016	23,142,368,135			
2017	25,928,709,258			
2018	29,050,525,853	4,843,058,912		3,389,358,476,429
2019	32,548,209,165	4,843,058,912		3,739,126,807,695
2020	36,467,013,549	4,843,058,912	135,000,000,000	17,631,007,246,046
2021	40,857,641,980	4,843,058,912	297,000,000,000	34,270,070,089,175
2022	45,776,902,075	4,843,058,912	324,000,000,000	37,461,996,098,616
2023	51,288,441,084	5,327,364,803	526,500,000,000	58,311,580,588,710
2024	64,110,551,355	5,860,101,283	567,000,000,000	63,697,065,263,846
2025	80,138,189,194	6,446,111,411	810,000,000,000	89,658,430,060,563
2026	100,172,736,493	7,090,722,552	864,000,000,000	97,126,345,904,533
2027	125,215,920,616	7,799,794,808	1,147,500,000,000	128,051,571,542,380
2028	156,519,900,770	8,579,774,288	1,147,500,000,000	138,009,967,505,860
2029	195,649,875,963	10,295,729,146	1,215,000,000,000	174,494,560,510,882
2030	283,692,320,146	12,354,874,975	1,539,000,000,000	191,604,719,512,126
2031	411,353,864,212	14,825,849,970	1,620,000,000,000	241,067,971,418,198
2032	596,463,103,107	17,791,019,965	1,984,500,000,000	269,325,412,307,125

Table 3. (*Continued*).

RMS Rp	**1,350,000**			
Year	**Income (GDRP) IDR**	**Savings from Congestion + Vehicle Operating Costs**	**Growth/Influence of Special Economic Zones**	**Total income**
2033	864,871,499,505	21,349,223,957	2,079,000,000,000	305,972,072,346,217
2034	1,254,063,674,282	25,619,068,749	2,173,500,000,000	354,768,274,303,079
2035	2,069,205,062,565	33,304,789,374	2,268,000,000,000	480,250,985,193,866
2036	3,414,188,353,232	43,296,226,186	2,700,000,000,000	626,548,457,941,802
2037	5,633,410,782,833	56,285,094,041	2,808,000,000,000	897,019,587,687,473
2038	9,295,127,791,675	73,170,622,254	3,280,500,000,000	1,277,029,841,392,880
2039	15,336,960,856,264	95,121,808,930	3,402,000,000,000	1,934,708,266,519,370
2040	28,373,377,584,088	123,658,351,609	3,915,000,000,000	2,890,203,593,569,670
2041	52,490,748,530,562	173,121,692,253	4,050,000,000,000	5,789,512,022,281,490
2042	97,107,884,781,540	242,370,369,154	5,231,250,000,000	10,275,025,515,069,400
2043	179,649,586,845,849	339,318,516,815	5,400,000,000,000	18,667,140,536,266,400
2044	332,351,735,664,821	475,045,923,541	6,682,500,000,000	33,971,178,158,836,200
2045	664,703,471,329,642	665,064,292,958	6,885,000,000,000	67,245,603,562,260,000
2046	1,329,406,942,659,280	931,090,010,141	7,087,500,000,000	133,762,803,266,942,000
2047	2,658,813,885,318,570	1,303,526,014,198	9,990,000,000,000	267,010,741,133,276,000
2048	5,317,627,770,637,130	1,824,936,419,877	10,260,000,000,000	532,971,270,705,701,000

Source: Study results; RMS means Regional Minimum Salary.

The research results also prove that economic growth increases along with the addition of GDRP value, with an emphasis on an increase of IDR135,000,000,000 to IDR10,260,000,000,000 from 2020 to 2048. The same thing also happens to total regional income. which continues to increase from IDR17,631,007,246,046 to IDR532,971,270,705,701,000 respectively in 2020 to 2048.

i. Investment costs (excluding land)

Based on **Table 4**, the investment costs used for construction projects are observed to be a total value of IDR350,137,073,048,400. These costs are consistent with land acquisition financing, where local governments along the road route provide compensation costs for local communities affected by construction procedures.

Table 4. Recapitulation of job price estimates.

Projects/Projects section:		
Contract package number:		
Package name: Palu-Parigi Arterial Road		
Province/Regency/City: Central Sulawesi/Donggala-Parigi Moutong/Palu City		
Number of divisions	Information	Total Job Price (Rp)
1	General	345,000,000,000
2	Drainage	2,545,000,000,000
3	Earthworks	253,867,930,044,000
4	Road widening, pavement, road shoulders	0
5	Non-Asphalt pavement	26,198,000,000,000

Table 4. (*Continued*).

Projects/Projects section:		
6	Asphalt pavement	16,081,000,000,000
7	Structure	19,040,000,000,000
8	Return conditions and minor work	229,500,000,000
9	Daily job	0
10	Routine maintenance work	0
(A)	Total Job Price (including general costs and profit)	318,306,430,044,000
(B)	Value Added Tax (VAT) = 10% × (A)	31,830,643,004,400
(C) Total Job Price = (A) + (B)		350,137,073,048,400
(D) Round		350,137,073,048,400

Source: Study results.

ii. Cash flow: NPV, IRR and BC Ratio

In **Tables 5** and **6**, the results of cash flow calculations which include NPV, IRR and B/C Ratio are observed. By calculating the investment value and the applicable interest rate, the total income at the end of the investment loan repayment period will be IDR1,080,007,615,162,920,000 in 2048, a very significant value for Central Sulawesi.

Table 5. Cash flow: NPV, IRR and BC ratio.

Year	**DF 10**	**DF 12**	**Cost**	**Cost (Discount/PV)**	
				10	**12**
0	1	1	150,000,000,000	150,000,000,000	1,500,000,000
1	0.909091	0.892857	20,000,000,000	18,181,818,182	178,571,429
2	0.82446	0.797194	225,000,000,000,000	185,950,413,223,140	1,793,686,224,490
3	0.751315	0.71178	125,000,000,000,000	93,914,350,112,697	889,725,309,767
4	0.683013	0.635518	0	0	0
5	0.620921	0.567427	0	0	0
6	0.564474	0.506631	0	0	0
7	0.513158	0.452349	100,000,000,000	51,315,811,823	452,349,215
8	0.466507	0.403883	0	0	0
9	0.424098	0.36061	0	0	0
10	0.385543	0.321973	110,000,000,000	42,409,761,837	354,170,560
11	0.350494	0.287476	0	0	0
12	0.318631	0.256675	0	0	0
13	0.289664	0.229174	121,000,000,000	35,049,389,948	277,300,770
14	0.263331	0.20462	0	0	0
15	0.239392	0.182696	0	0	0
16	0.217629	0.163122	133,100,000,000	28,966,437,974	217,114,932
17	0.197845	0.145644	0	0	0
18	0.179859	0.13004	0	0	0
19	0.163508	0.116107	146,410,000,000	23,939,204,937	169,991,932

Table 5. (*Continued*).

Year	DF 10	DF 12	Cost	Cost (Discount/PV)	
				10	12
20	0.148644	0.103667	0	0	0
21	0.135131	0.09256	0	0	0
22	0.122846	0.082643	161,051,000,000	19,784,466,890	133,096,589
23	0.111678	0.073788	0	0	0
24	0.101526	0.065882	0	0	0
25	0.092296	0.058823	177,156,100,000	16,350,799,083	104,209,076
26	0.083905	0.052521	0	0	0
27	0.076278	0.046894	0	0	0
28	0.069343	0.041869	194,871,710,000	13,513,057,093	815,913,578
29	0.063039	0.037383	0	0	0
30	0.057309	0.033378	0	0	0
31	0.052099	0.029802	214,358,881,000	11,167,815,779	50,017,433
32	0.047362	0.026609	0	0	0
33	0.043057	0.023758	0	0	0
34	0.039143	0.021212	235,794,769,100	9,229,599,818	50,017,433
Total			351,763,742,460,100	280,284,671,499,201	2,686,993,830,179

Source: Study results.

Table 6. Cash flow: NPV, IRR and BC Ratio (Continued).

Year	DF 10	DF 12	Income	NPV	NPV	
			12		10%	12%
0	1	1	1,500,000,000	0	(1,500,000,000)	−1,500,000,000
1	0.909091	0.892857	178,571,429	0	(181,818,182)	−178,571,429
2	0.82446	0.797194	1,793,686,224,490	0	(1,859,504,132,231)	−1,793,686,224,490
3	0.751315	0.71178	889,725,309,767	0	(939,143,501,127)	−889,725,309,767
4	0.683013	0.635518	0	33,891,584,764	33,893,584,764	33,893,584,764
5	0.620921	0.567427	0	37,391,268,077	33,992,061,888	33,385,060,783
6	0.564474	0.506631	0	176,310,072,460	145,710,803,686	140,553,310,316
7	0.513158	0.452349	452,349,215	342,700,700,892	257,476,108,859	243,927,589,807
8	0.466507	0.403883	0	374,619,960,986	255,870,474,002	238,077,757,738
9	0.424098	0.36061	0	583,115,805,887	362,069,037,688	330,875,568,254
10	0.385543	0.321973	354,170,560	636,970,652,638	359,553,327,624	322,709,155,903
11	0.350494	0.287476	0	896,584,300,606	460,089,512,534	405,569,204,862
12	0.318631	0.256675	0	971,263,459,045	453,101,571,773	392,277,021,058
13	0.289664	0.229174	277,300,770	1,280,515,715,424	543,063,665,200	461,766,804,128
14	0.263331	0.20462	0	1,380,099,675,059	532,088,168,463	444,355,159,196
15	0.239392	0.182696	0	1,744,945,605,109	611,592,789,518	501,630,164,421
16	0.217629	0.163122	217,114,932	1,916,047,195,121	610,511,684,553	491,801,591,896
17	0.197845	0.145644	0	2,410,679,714,182	698,288,044,152	552,465,571,160
18	0.179859	0.13004	0	2,693,254,123,071	709,217,986,393	551,093,153,990

Table 6. (*Continued*).

Year	DF 10	DF 12	Income 12	NPV	NPV 10%	12%
19	0.163508	0.116107	169,991,932	3,059,720,723,462	732,472,814,487	558,999,536,689
20	0.148644	0.103667	0	3,547,682,743,031	772,079,129,423	578,703,904,735
21	0.135131	0.09256	0	4,802,509,851,939	950,150,971,546	639,458,382,202
22	0.122846	0.082643	133,096,589	6,265,484,579,418	1,126,902,474,649	814,761,045,593
23	0.111678	0.073788	0	8,970,195,876,875	1,466,698,705,148	1,041,500,531,339
24	0.101526	0.065882	0	1,770,298,413,929	1,898,223,487,197	1,323,855,525,687
25	0.092296	0.058823	104,209.076	19,347,082,665,194	2,614,382,326,397	1,790,758,458,615
26	0.083905	0.052521	0	28,902,035,697	3,550,498,742,782	2,388,536,806,202
27	0.076278	0.046894	0	57,895,120,222,815	6,465,620,371,750	4,271,962,568,514
28	0.069343	0.041869	81,591,358	102,750,255,150,694	10,431,781,098,289	5,799,402,927,898
29	0.063039	0.037383	0	186,671,405,362,664	17,229,023,689,062	10,980,629,302,188
30	0.057309	0.033378	0	339,711,781,588,362	28,503,670,885,642	17,841,937,739,093
31	0.052099	0.029802	50,017,433	672,456,035,622,600	51,293,389,287,586	32,533,870,795,872
32	0.047362	0.026609	0	1,337,628,032,669,420	92,755,608,162,920	56,005,506,202,881
33	0.043057	0.023758	0	2,670,107,411,332,760	168,321,992,192,428	99,817,358,957,866
34	0.039143	0.021212	50,017,433	5,329,712,707,057,010	305,438,124,752,289	177,854,745,037,973
Total			2,686,993,830,179	10,800,076,151,629,200	696,816,808,461,168	416,771,278,316,938

Source: Study results.

Based on **Table 7**, the output of investment feasibility in construction projects is observed which presents calculations via B/C Ratio, NPV and IRR. This calculation shows that the investment is worth making because it provides a higher profit or rate of return compared to the output obtained after the loan repayment period.

Table 7. B/C Ratio, NPV & IRR.

BCR at 10%	249
NPV at 10%	694,012,362,900,609
EIRR	21.95%
BCR at 10%	155
NPV at 10%	414,083,320,569,290
EIRR	20.16%

Source: Study results.

3.2. Discussions

In every trip or move, costs are specifically incurred during the implementation of the activity. These costs of traffic congestion are not directly integrated into the calculation of social or economic benefits, although they focus on various specific aspects presented as follows:

1) The Value of Time calculation is carried out by assessing each individual's monthly income based on their working hours. In Palu City, 8 hours is the standard daily time, which leads to numerical determination of income;

2) Congestion Cost Calculation focuses on several components required, as follows:

3.2.1. Calculation of average travel speed (average speed)

Average Travel Speed is calculated using the following formula, and the results are presented in full in **Table 8** (Roth, 1996).

$$AV.Speed = V\ max - (axq)$$

Table 8. Average speed calculation (AV. Speed).

No.	Road Section Name	Daily Traffic Average-Average	Travel Speed (V Max) Km/h	Constant (a)	Average Congestion Volume (q) Vehicles/Hour	Average Travel Speed (A.VS)
1	Taweli-Toboli Road	4938	39.1	0.01091	357	35.2
2	Palu-Parigi (New Road)	2469	70	0.01091	357	66.1

Source: Study results.

Based on **Table 8**, the Average Daily Traffic Value (LHR) for the Palu-Parigi route is obtained from the assumption that half of the vehicles using Taweli-Toboli road use the New Road. In this context, average volume becomes congested when certain conditions are met, causing significant travel delays or challenges. This shows that vehicles on new road are moving slower than the planned speed.

3.2.2. Calculation of congestion time (Delay)

The time needed to predict traffic jams is determined by analyzing previous volume data, where traffic jams generally occur during peak hours, as explained in the Traffic Counting analysis. However, the report on the suitability of the new Palu-Parigi road proves that the unusual traffic obstacles are caused by certain factors, such as the natural conditions in the area. In this case, the Average Travel Speed is calculated using the following formula, with the results presented in full in **Table 9** (Roth, 1996).

$$\text{Delay}\left(\frac{\text{Vmax} - \text{AV.Speed}}{\text{V max}\hat{}2} \times 60\right)$$

Table 9. Calculation of congestion time (delay).

No.	Road Section Name	Daily Traffic Average-Average	Travel Speed (V max) km/h	Average Travel Speed (A.VS)	Average Jam volume^2 (V Max)^2	Congestion Time
1	Taweli-Toboli Road	4938	35.1	34.8	1232.01	0.015
2	Palu-Parigi (New Road)	2469	70	66.1	4900	0.048

Source: Study results

3.2.3. Congestion cost calculation

Estimates of average speed and delay are required in calculating congestion costs, which then become multipliers.

The calculation of the average number of passengers per vehicle during a traffic jam is determined by observing the number of cars in the field and the occupancy rate of each vehicle. This information helps knowledge about the number of passengers affected by vehicle congestion. Additionally, congestion charges prioritize the monetary value of traffic congestion, and are calculated annually to determine the actual financial burden on vehicle users due to traffic-related changes. In this case, the plans for the existing Tawaeli-Toboli road and the new Palu-Parigi road show annual

cost congestion of IDR9,686,117,823 and IDR4,843,058,912 respectively.

Based on these results, the construction of the new Palu-Parigi road was declared feasible for business by prioritizing improving infrastructure performance. This declaration is further supported by the positive values of IRR, NPV, and BCR, presented in **Table 10**.

Table 10. Calculation of congestion costs (delay).

No.	Road Section Name	Number of Passengers (people)	Delay (hours/km)	Voting (rp/hour)	Road Length (km)	Congestion Fee (rp/hour)	Congestion Fee (rp/year)
1	Taweli-Toboli Road	12522	0.06	119.1	45.3	4,386,829	9,686,117,823
2	Palu-Parigi (New Road)	6261	0.06	110.7	48.74	2,193,414	4,843,058,912

Source: Study results.

3.2.4. Estimated impact of spatial development on the economy and road network system

The "cost-benefit analysis" method is often used to determine the economic and financial feasibility of road construction. This method puts forward the principle of comparing the benefits obtained from building a new road with the costs required. The construction of new roads and the relocation of their routes also show various positive and potentially very negative impacts. From this context, the positive impact leads to improving the welfare of the surrounding community. This was accompanied by an increase in land prices and a significant multiplier effect, thereby increasing community welfare and the overall economic impact, as can be seen in **Figure 1**.

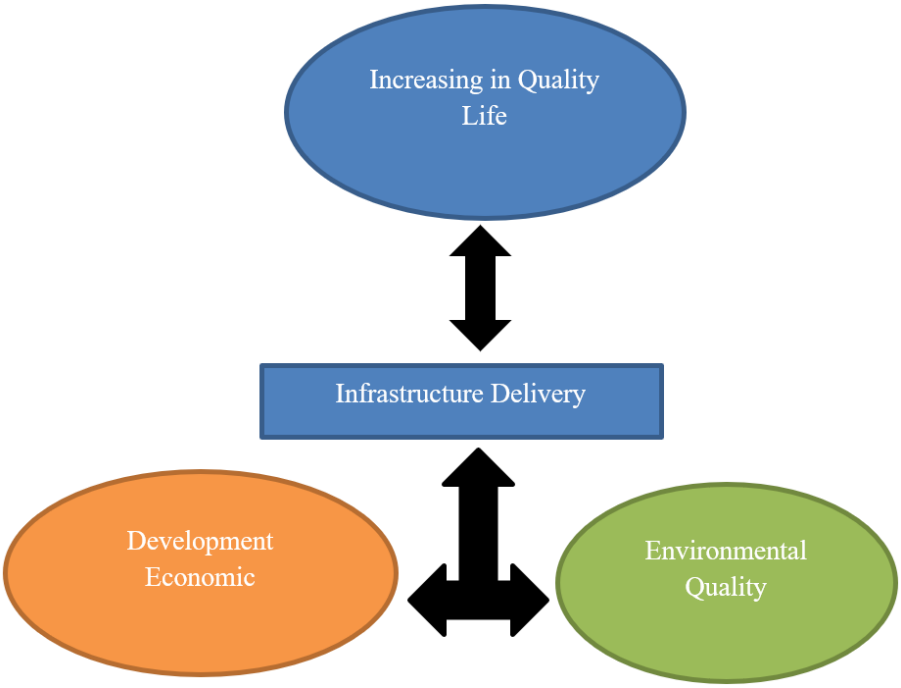

Figure 1. Economic suitability.

Economic suitability is defined as suitability for all parties who benefit directly or indirectly from road construction activities. Based on economic analysis, the expected benefits are greater than the costs incurred. The benefits of building this road are divided into the following categories:

a. Measurable benefits contribute greatly to the overall assessment of economic feasibility. These benefits are calculated quantitatively and used as input in assessing economic feasibility, including:

b. Improved road performance

Improved road performance is expected to lead to an expansion of the route network, including improvements and improvements to supply infrastructure. This condition has an impact on improving the performance of road users, especially in reducing travel time.

c. Increase the rate of economic growth

The growth rate of production of certain commodities increased due to improved transportation. This is because the benefits of road construction are calculated based on producer surplus.

d. Decrease in prices of consumer goods

With a significant reduction in transportation costs due to improvements to existing roads, the prices of goods consumed by the people of Palu are expected to decrease. This is because the benefits of road construction are taken into account by the reduction in prices felt by the public, especially in the consumption of daily goods.

Producer surplus analysis is also a parameter for assessing project feasibility. In this criterion, the benefits considered include the entire surplus enjoyed by producers of goods and services within the project's area of influence.

According to the economic analysis, the experimental performance was carried out over a period of 30 years. **Table 11** presents an economic feasibility analysis at a discount rate of 12%.

Table 11. Economic feasibility analysis.

BCR at 10%	249
NPV at 10%	694,012,362,900,609
EIRR	21.95%
BCR at 12%	155
NPV at 12%	414,083,320,569,290
EIRR	20.16%

Source: Study results.

4. Conclusion

4.1. Conclusion

In conclusion, previous research and the Economic Feasibility Analysis of the Palu-Parigi Bypass Road Development show an EIRR value of 20.1% (2014), which confirms the fiscal feasibility of the project. However, priority is given to recovering from the COVID-19 pandemic after the earthquake (28 September 2018), taking into account the fiscal challenges currently facing Central Sulawesi Province. In this case, a Public-Private Partnership (PPP) scheme is recommended for the construction of the Palu-Parigi By-pass Road using the Design-Build-Finance-Maintenance-Transfer (DBFMT) model. The Government Contracting Authority (GCA) also delegates DBFMT responsibilities at the end of the cooperation agreement.

Based on the Palu-Parigi By-pass Road Construction Project, the Governor of Central Sulawesi who acts as PJPK is responsible for the PPP cooperation agreement with the Implementing Business Entity (BUP). This BUP obtains capital financing through bank credit or assistance from stakeholders, while also having the right to obtain Viability Gap Funding of a maximum of 49% of the capital cost. The payment structure provided by the GCA (Government Cooperation Agreement) also applies an AP (Availability Payment) scheme which is supported by a guarantee from Public Entreprise PT. Penjaminan Infrastruktur Indonesia (PT. PII).

4.2. Recommendation

In line with the PPP scheme recommended for the Palu-Parigi By-pass Road construction project, the model chosen is Design-Build-Finance-Maintenance-Transfer (DBFMT). Therefore, the qualification criteria for private companies interested in participating in the PPP auction have been determined as follows:

1) Business Entities/Companies must have adequate and experienced cash flow, strong financial reserves, and a healthy balance sheet in order to be said to be financially healthy;
2) Business Entities/Companies are expected to have net worth above IDR200,000,000,000 (Two Hundred Billion Rupiah) with attached proof of financial reports from a Public Accountant;
3) Stakeholders must have a minimum cumulative experience of IDR16,660,000,000 (Sixteen Billion Six Hundred and Sixty Million Rupiah) in a 10 years period for each subclassification;
4) Companies are also expected to have certified expertise with Main Expert qualifications, as Persons Responsible for Engineering (PJT) and PJK (Persons Responsible for Classification).

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