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Risk Management in the PPP Scheme for the East Sumatra National Ring Road Preservation Project in Riau Province

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ABSTRACT

The East Sumatra Highway, particularly the Pekanbaru–Simpang Lago section in Pelalawan Regency, is a strategic route that supports national economic growth and is part of the National Road network, which experiences congestion due to heavily loaded vehicles. As the need for road infrastructure intensifies, the government faces limitations in the State Revenue and Expenditure Budget (APBN). Therefore, alternative financing mechanisms such as State Sharia Securities (SBSN) and the Government and Business Entity Cooperation (PPP) scheme are required. This study aims to identify and assess the risks in the East Sumatra National Road Preservation PPP Project using a type-1 questionnaire-based descriptive analysis approach. The research respondents consist of representatives from the Party in Charge of the Cooperation Project (PJPK) and the Implementing Business Entity (BUP). The results indicate that PJPK faces 63 risks, with the main classifications including location, design, construction, operations, revenue, political, financial, force majeure, sponsorship, interface, asset ownership, and strategy. Meanwhile, BUP faces 60 risks under similar classifications, except that location risks fall solely under the responsibility of PJPK. These findings highlight the importance of proportional risk sharing according to the authority and responsibilities of each party. This research contributes to the development of risk mitigation strategies and supports decision-making for PPP-based infrastructure project financing. For future research, the use of the fuzzy logic method is recommended to reinforce risk weight allocation and to broaden the respondent base from both parties, thereby producing more representative results.

Keywords: Eastern Cross Road, PPP, risk management, infrastructure financing, fuzzy logic.

INTRODUCTION

The East Cross Road connects the city of Pekanbaru with Siak and Pelalawan Regencies. This route is frequently traversed by vehicles, particularly large trucks carrying heavy loads at high speeds. One of the East Sumatra Roads in the province, stretching from Simpang Kayu Ara (Pekanbaru City) to Simpang Lago (Pelalawan Regency), consists of three road sections categorized as National Roads that are closely linked to national economic growth. To support economic development, the quality and comfort of highway infrastructure must be ensured (Wibowo & Sundermeier, 2020; Yuan et al., 2022; Zhang, 2015).

Infrastructure refers to technical, physical, systemic, hardware, and software facilities necessary to provide services to the community and to support structural networks that enable sustainable economic and social growth (Presidential Decree Number 38 of 2015). Infrastructure is classified into three types: economic infrastructure, social infrastructure, and administrative infrastructure. Economic and social infrastructure comprise technical facilities that deliver tangible services to the community, whereas administrative infrastructure refers to

intangible facilities such as coordination and law enforcement mechanisms (Albalate & Bel-Piñana, 2019; Ameyaw & Chan, 2016, 2017). In essence, infrastructure encompasses the physical, technical, systemic, and technological frameworks required to deliver public services and support structural networks that foster optimal economic and social development (Mladenovic & Queiroz, 2014; Osei-Kyei & Chan, 2015; Valipour et al., 2016; Wibowo & Alfen, 2015).

The provision of infrastructure includes activities related to development, capacity building, management, and maintenance, all aimed at maximizing the functions and benefits of the infrastructure (Presidential Decree No. 38 of 2015). Cooperation between the Government and Business Entities, hereinafter referred to as PPP (Public–Private Partnership), is a form of collaboration between the government and business entities in providing infrastructure for public purposes, in accordance with specifications predetermined by the Minister, Head of Institution, Regional Head, State-Owned Enterprise, or Regional-Owned Enterprise. This cooperation partially or fully utilizes the resources of the business entity while ensuring appropriate risk sharing between the parties involved (Presidential Regulation No. 38 of 2015).

1) Meet the need for funding in a sustainable manner in the provision of infrastructure through the deployment of private funds;
2) Realizing the provision of quality, effective, efficient, on-target, and timely infrastructure;
3) Creating an investment climate that encourages the participation of business entities in the provision of infrastructure based on healthy business principles;
4) Encourage the use of the principle of users paying for the services received, or in certain cases consider the user's ability to pay; and/or
5) Providing certainty of return on investment of business entities in the provision of infrastructure through a periodic payment mechanism by the Government to business entities.

According to the Regulation of the Minister of Finance Number 260/PMK.08/2016, Availability Payment refers to a periodic payment made by Ministers, Heads of Institutions, or Regional Heads to the Implementing Business Entity for the availability of infrastructure services that meet the quality and/or criteria stipulated in the PPP Agreement. In applying this payment scheme, several criteria must be considered, as outlined below.

1) Economic and social infrastructure projects that have great benefits for the community as service users:
2) The return on investment is not sourced from the payment by the user of the service fee;
3) In the event that the PPP project receives income from payment by the user for the service fee, the PJPK does not take into account the amount of income from the payment of the service user to carry out the payment of service availability to the Implementing Business Entity; and
4) The procurement of Business Entities is carried out through fair, open, and transparent election stages, and pays attention to the principles of healthy business competition.

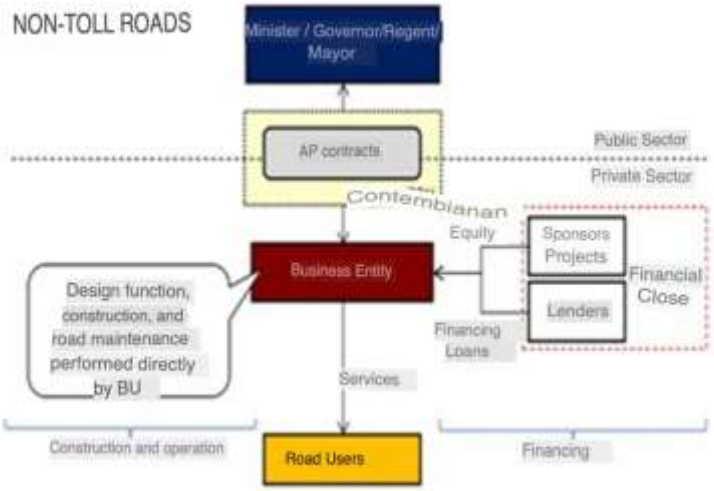

Figure 1. PPP scheme

Availability payment is a concept that balances both the affordability for the government or service users and the financial feasibility of the project. Additionally, it serves as a demand risk allocation mechanism. For instance, in a non-toll road project with no tariffs charged to users, the government plays a crucial role in providing payments to business entities that have invested in road construction (Carbonara et al., 2014; Castelblanco et al., 2020). Even though traffic volumes on the road may fluctuate, business entities still receive payments of a predetermined value from the government. However, full payment is only granted if all agreed service indicators are met by the business entity. This system, known as availability payment, is a payment scheme based on the continuous availability of infrastructure services (Li & Zou, 2011; Liu et al., 2015; Mazher, 2025).

The choice of risk analysis method depends on factors such as the type and scale of the project, the availability of information, the analysis cost, the time allocated for analysis, and the analyst's experience and expertise (Smith, 2003 in Setiawan, 2019). In general, there are two main approaches to conducting risk analysis: quantitative and qualitative. Quantitative analysis is applied to aspects that can be calculated mathematically, such as material losses caused by the project. In contrast, qualitative analysis is used for aspects that cannot be materially calculated, such as disruptions to the comfort of communities near the project. Thus, risk analysis can be conducted either qualitatively or quantitatively, depending on the nature of the risk in question (Chan et al., 2011; Cui et al., 2018; Ilbahar et al., 2021; Kumar et al., 2018; Lawther & Martin, 2015).

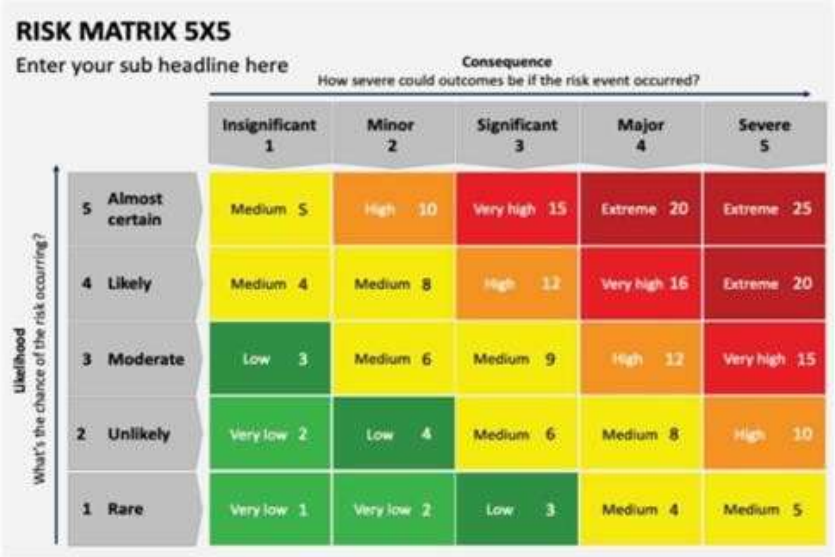

Figure 2. Risk Matrix

Several previous studies have explored the concept of risk allocation and the use of the Availability Payment (AP) mechanism in Public–Private Partnership (PPP) infrastructure projects; however, few have specifically examined high-traffic arterial roads like the East Cross Road or have integrated comprehensive risk analysis with AP feasibility modeling in the context of national highways. For example, Suwandairi (2025) analyzed financing risks in toll road PPP projects using sensitivity analysis and identified demand, cost, and revenue forecasting errors as dominant risks impacting project feasibility. Nevertheless, this study did not address how the AP mechanism could manage demand-related risks in non-toll road projects, which often experience heavy and unstable traffic volumes. Another study by Syugiarto (2024) examined PPP projects in Indonesia employing the Availability Payment scheme and concluded that AP is an effective alternative for infrastructure projects that do not generate revenue directly, as it enables periodic payments to private entities based on performance indicators.

The aim of this research is to evaluate risk factors affecting the financial and operational sustainability of the East Cross Road PPP project and to assess the appropriateness of the AP scheme for equitable risk and payment allocation between the government and the private sector. This research is expected to provide practical policy recommendations and a structured model for risk–payment balancing, which will enhance transparency, efficiency, and the long-term sustainability of PPP implementation in Indonesia's national road infrastructure.

METHOD

Research Design

This study employed a quantitative descriptive approach using a survey method. The objective was to identify, assess, and analyze various risks that could arise in the PPP project for the Preservation of the National Road Across East Sumatra in Riau Province. This method provided an empirical overview of the risks encountered by the two main parties involved in the project: the Person in Charge of the Cooperation Project (PJPK) and the Implementing

Business Entity (BUP). The analysis utilized the Severity Index, calculated from the probability and impact scores reported by respondents.

Location and Research Subject

This research focused on the East Sumatra Cross Road preservation project, particularly on the section connecting Pekanbaru City to Simpang Lago in Pelalawan Regency, Riau Province. This location was selected because it represents the first national road preservation project to implement the Government and Business Entity Cooperation (PPP) scheme using the Availability Payment method.

The research subjects consisted of two main groups, namely:

1) PJPK: includes officials or technical staff who are responsible for the planning and implementation of PPP projects from the government side.
2) BUP**:** includes personnel directly involved in the implementation of the project from the private sector, including the implementation team, risk control, and project management.

Research Instruments

The primary instrument used in this study was a Type 1 questionnaire comprising a list of risks identified through literature review and previous research. The questionnaire utilized a Likert scale to evaluate two key aspects of each risk: Probability (P), which measures the likelihood of occurrence, and Impact (I), which assesses the potential consequences if the risk materializes. Each respondent provided scores for both P and I for each risk, and these scores were then processed using the formula Severity Index (SI) = P × I.

Data Collection Techniques

The data for this study was collected using two techniques. Primary data was obtained through the distribution of questionnaires to respondents from PJPK and BUP. Additionally, interviews were conducted with key informants from both parties to gain deeper insight into the context and responsibilities associated with each risk. Secondary data was sourced from project documents, laws and regulations, scientific journals, and previous studies relevant to PPP projects, risk management, and availability payment schemes.

Data Analytical Techniques

The data processing and analysis in this study involved several steps. For risk assessment, severity index values were used, based on respondents' evaluations of Probability (P) and Impact (I). Respondents were asked to assign P and I scores on the provided questionnaire. Those chosen for the Severity Index assessment included representatives from the project owner and contractor who were directly involved in implementing the Availability Payment PPP in Indonesia, enabling a deterministic measurement and classification of risk levels.

RESULTS AND DISCUSSION

Early-stage Risk List

Risk management in road preservation projects consists of several main stages: risk identification, assessment, and mitigation. Through interviews with practitioners managing the East Sumatra Ring National Road Preservation Project (Pekanbaru–Simpang Lago, Pelalawan, Riau), risk mapping was performed, covering regulatory, financial, technical, operational, social, and environmental aspects. The outcomes of this identification process serve as the basis

for assessing the urgency of each risk, enabling the development of appropriate management strategies. With this approach, contractors can anticipate obstacles more quickly and enhance the effectiveness of project planning and execution.

Identification of Risks Interviews and Literature Studies

Based on the Type-1 questionnaire, initial risk identification was conducted for the East Sumatra Ring National Road Preservation Project (Pekanbaru–Simpang Lago, Pelalawan, Riau). The findings highlighted various factors that could disrupt the smooth progress of the project. This identification serves as the first step in understanding potential issues before performing probability and impact analyses. The questionnaire results provide the foundation for assessing risk severity and developing appropriate mitigation strategies to ensure the project proceeds as planned.

Table 1. Risk Severity

Yes	Risk
1	Complicated Resettlement Process
2	Damage to artifacts and ancient items on site
3	It depends on the comfort of the people around the location area
4	Obstruction of access to public transportation
5	Soil status risks
6	Construction workspace delays
7	Difficulties in unpredictable location conditions
8	Contamination/pollution to the project environment
9	Location security
10	Detail design errors
11	Unclear output specifications
12	Changes in scope of work after signing the contract
13	Rising construction costs
14	Late completion of construction
15	*Default* contractor/sub-contractor
16	Failure to maintain on-site security and safety
17	Operational test risks (*testing & commissioning*)
18	Failure to Comply with Contracts and Contracts
19	Failure to meet construction specifications & standards
20	Poor performance of contractors/sub-contractors
21	Disputes between *Professional Teams* (Relationship Risk)
22	Project control and monitoring failures
23	Project management failures
24	Availability of facilities
25	Poor or unavailability of service
26	Increased O&M costs (due to *overloading*)
27	Misestimation of *life cycle costs*
28	Rising energy costs-due to unit inefficiency
29	Irregular availability of utilities
30	Traffic accidents or safety issues

List of Risks Faced by PJPK and BPU

After compiling a list of potential risks for the South Sumatra Jalintim Preservation PPP Project, a risk assessment was conducted for both the PJPK and the BUP. The results of this assessment, detailing the specific risks faced by the PJPK, are presented in Table 1, while the risks identified for the BUP are shown in Table 2.

Table 2. List of Risks Faced by PJPK

Yes	Risk	Risk Description	Risk Code
A. Location Risk			
1	Land cannot be freed	The failure of the project land location is due to the difficult land acquisition process, such as waqf land, Village Cash Hold (TKD), forestry that takes a long time.	A1
2	Land cannot be used after the exemption	The existence of difficulties in accessing land due to social disturbances	A2
3	Delays and rising costs of land acquisition	Delays and costs due to the prolonged land acquisition process	A3
4	Complicated resettlement process	Delays and increased costs due to the complexity of the resettlement process	A4
5	Damage to artifacts and ancient items on site	Damage to artifacts and ancient items found at the site during the construction of the project	A6
6	Disruption of the comfort of the community around the project area	Projects can cause health and comfort disturbances, for example people's homes are damaged due to construction activities	A7

Table 3. List of Risks Faced by BUP

Yes	Risk	Risk Description	Risk Code
A. Location Risk			
1	Complicated resettlement process	Delays and rising costs due to the complexity of re-lockdown	A4
2	Damage to artifacts and ancient items on site	Damage to artifacts and ancient items found at the site during the construction of the project	A6
3	It depends on the comfort of the community around the project area	Projects can cause health and comfort disturbances, for example people's homes are damaged due to construction activities	A7
4	Obstruction of access to public transportation	Projects that cut off residential areas can have an impact on disrupting people's access to communication and economy	A8
5	Soil status risks	Dual land certificate ownership was discovered when the project was underway	A9
6	Construction workspace delays	Related to the provision of land for workspace during the construction period	A11
7	Difficulties in unpredictable location conditions	The unidentification of the utility and the difficulty of the utility relocation process, resulting in delays and possible rerouting	A12
8	Contamination/pollution to the environment of the site	Contamination/pollution in the site environment that interferes with the implementation of the project	A13
9	Location security	Maintaining site security from intervention/disturbance	A14
B. Design, Construction and Test Operation Risks			
1	Detail design errors	Cause extras/design revisions requested by operators	B1
2	Unclear output specifications	Delays and increases Costs due to unclear output specifications	B2
3	Changes in the work environment after signing the contract	Changes in CAPEX and/or OPEX due to changes in the scope of work at the request of the Government and/or BU proposals	B3
4	Rising construction costs	Increase due to changes in the volume of work or the price of the property	B4
5	Construction completion delays	This can include due to poor quality of human resources, limited availability of materials and equipment, delays Return of location access	B5

Yes	Risk	Risk Description	Risk Code
6	Default contractor/subcontractor	Failure of contract completion by contractors/sub-contractors due to internal & financial management	B6
7	Failure to maintain on-site security and safety	Accident rate during construction work is high	B7
8	Operational test risks (testing & commissioning)	Time/cost estimation errors in technical operation tests	B8
9	Failure to achieve quality assurance and quality control	Quality assurance and quality control that are not suitable after checking so that the work is late	B9
10	Failure to meet construction specifications & standards	Delays and cost increases due to project specifications not being achieved and work not up to standard	B10
11	Poor performance of contractors/sub-contractors	The contractor/sub-contractor is unable to perform the work according to the contract	B11
12	Disputes between Professional Teams (Relationship Risk)	There is a dispute between the BU, the owner, or other stakeholders that causes problems in the construction	B12
C. Operational Risk			
1	Control failures and *Project Monitoring*	The occurrence of undetected contamination due to failure of control and monitoring by Business Entities or PJPK	C1

Risk Assessment on the Jalitim Preservation PPP Project in Riau province Persepri and BUP Perception

A risk assessment based on the probability and impact of each event was conducted by respondents from both parties. The results of the risk assessment from the perspective of the South Jalintim PPP Preservation Project's PJPK are presented in Table IV.3, while the risk assessment from the BUP's perspective is shown in Table IV.4.

Table 4. Risk Assessment on the South Sumatra Jalitim Preservation PPP Project PJPK Conservation

No	Code Risk	Risk	Probability (P)	Impact (I)	*Severity Index* (P*I)	Category Risk
1	A1	Settlement Process Complicated return	3	2	6	Tolerable
2	A2	Damage to artifacts and ancient items on site	2	2	4	*Negligible*
3	A3	It depends on the comfort of he people who are in the Around the location area	3	2	6	Tolerable
4	A4	Obstruction of transportation access community	1	1	1	*Negligible*
5	A6	Soil status risks	3	4	12	Unwanted
6	A7	Construction workspace delays	4	2	8	Tolerable

Table 5. Risk Assessment on the South Sumatra Jalitim Preservation PPP Project BUP Conservation

No	Risk Code	Risk	Probability (P)	Impact (I)	*Severity Index* (P*I)	Category Risk
1	A4	Complicated Resettlement Process	4	1	4	*Negligible*
2	A6	Damage to artifacts and ancient items on site	5	3	15	Unwanted

No	Risk Code	Risk	Probability (P)	Impact (I)	*Severity Index* (P*I)	Category Risk
3	A7	It depends on the comfort of the people around the location area	4	1	4	*Negligible*
4	A8	Obstruction of access to public transportation	4	1	4	*Negligible*
5	A9	Soil status risks	4	1	4	*Negligible*
6	A11	Construction workspace delays	4	1	4	*Negligible*
7	A12	Difficulties in Unpredictable location conditions	5	2	10	Unwanted
8	A13	Contamination/pollution to the project environment	4	1	4	*Negligible*
9	A14	Location security	5	1	5	*Negligible*
10	B1	Detail design errors	4	2	8	Tolerable
11	B2	Unclear output specifications	4	1	4	*Negligible*
12	B3	Changes in scope of work after signing the contract	5	2	10	Unwanted
13	B4	Rising construction costs	4	1	4	*Negligible*
14	B5	Late completion of construction	4	2	8	Tolerable
15	B6	*Default* contractor/subcontractor	5	3	15	Unwanted
16	B7	Failure to maintain on-site security and safety	5	1	5	*Negligible*
17	B8	Operational test risks (*testing & commissioning*)	4	1	4	*Negligible*
18	B9	Failure to Comply with Contracts and Contracts	4	2	8	Tolerable
19	B10	Failure to meet construction specifications & standards	5	3	15	Unwanted
20	B11	Poor performance of contractors/sub-contractors	5	5	25	*Intolerable*
21	B12	Disputes between *Professional Teams* (Relationship Risk)	3	1	3	*Negligible*
22	C1	Project control and monitoring failures	3	1	3	*Negligible*

Identify Dominant Risks Using Risk Matrix

A comprehensive list of risks, as assessed by the respondents, was then refined based on the Severity Index score to identify the dominant risks. The Probability and Impact values were entered into a 5x5 Risk Matrix, resulting in categories such as Negligible risk, Tolerable risk, Undesirable/Unwanted risk, and Intolerable risk.

Table 6. Identification of Dominant Risks

Probability		Risk. Map			
Almost certain	5		**A12, A14, E1**	**C9, C10, E6SS**	**C5**	**B4, F2, F4**

Probability		Risk. Map				
Likely	4		**A7, A11, A13, C11, C12, C13**	**B7, C1, C6,C7,C8, F3,F5**	**B6, B9, C2, D1, E2, H2, I2, J1,**	**B11, H1, I1**
Possibele	3		**A1, A3**	**B12, C3, D2**	**A6, B2, B3, B10, C4**	**B1, B5, F1, G1, G2, G3, G4, H3**
Unlikely	2		**A2, A8, A9**		**B8, J2**	
Rare	1	**A4**		**E3, E4, E5**		**D3**
Impact		1	2	3	4	5
		Insignificant	*Minor*	*Moderate*	*Major*	*Catastrophic*

The results of the risk matrix on BUP perception can be seen in Figure 4.

Table 7. Identification of Dominant Risks

Probability		Risk. Map				
Almost certain	5	**A14, B7, C4, C5, C7, C8, C9, C10, C13, E1, E2, F3, F4, F5, G4,J1**	**A12, B3, D1, D3, F2, G1**	**A6, B6, B10**		**B11, G2, G3**
Likely	4	**A4, A7, A8, A9, A11, A13, B2, B4, B8, C11, E3, E4, E5**	**B1, B5, B9, C2, C3, C6**			**D2**
Possibele	3	**B12, C1, C12, I1, I2**	**E6**			**F1**
Unlikely	2		**Day 2**			
Rare	1			**H2**		**H1, H3, K2**
Impact		1	2	3	4	5
		Insignificant	*Minor*	*Moderate*	*Major*	*Catastrophic*

The results indicate that the Availability Payment (AP) model provides a balanced risk-sharing framework ideally suited for non-toll or low-revenue road projects like the East Cross Road. Within this scheme, demand risk is retained by the government, while performance and operation & maintenance (O&M) risks are transferred to the private sector, establishing a mutually advantageous arrangement. This approach is consistent with recommendations from the OECD (2012) and World Bank (2018), which found that AP models enhance service reliability and lower the frequency of renegotiations when compared to traditional PPPs dependent on user-fee revenues. Furthermore, these findings support Suwandairi (2025) and Syugiarto (2024), who highlighted the effectiveness of AP mechanisms in fostering private sector participation in infrastructure projects with uncertain demand patterns. By guaranteeing periodic payments linked to service availability, the government can attract investors while upholding quality standards.

This mechanism also embodies Public Sector Comparator (PSC) principles, ensuring the project delivers value for money through efficient risk allocation and predictable fiscal responsibility. From a policy standpoint, adopting the AP model for the East Cross Road project can promote financial sustainability, enable transparent performance monitoring, and

minimize the fiscal impact of cost overruns. However, successful implementation relies on a robust legal framework, transparent procurement processes, and the existence of a real-time monitoring system for performance indicators.

The risk analysis revealed that traffic demand and construction cost risks are the most significant challenges for the East Cross Road PPP project. Implementing the Availability Payment scheme can help mitigate these risks by providing consistent returns to private investors based on performance, rather than volatile traffic revenue. This study corroborates previous theoretical foundations on PPP risk management and offers empirical evidence supporting the effectiveness of AP models in non-toll infrastructure. Future research should expand this analysis through simulation modeling or case comparisons in various regions to refine AP design parameters for Indonesia's national road networks.

CONCLUSION

Based on the data obtained, as well as the analysis and discussion carried out, it can be concluded that the Party in Charge of the Cooperation Project (PJPK) faced 63 risks. These included 12 Location Risks, 12 Design, Construction, and Operation Test Risks, 13 Operational Risks, 3 Revenue Risks, 6 Political Risks, 5 Financial Risks, 4 Force Majeure Risks, 3 Sponsor Risks, 2 Interface Risks, 2 Asset Ownership Risks, and 1 Strategic Risk. Meanwhile, the Implementing Business Entity (BUP) faced 60 risks in the PPP Scheme Project for the Preservation of the National Road Across East Sumatra in South Sumatra Province, with a risk classification similar to that of the PJPK except for Location Risk. On the BUP side, there are three differences in Location Risk, namely the Risk of Land Not Being Exempt (A1), the Risk of Land Not Being Usable After Acquisition (A2), and the Risk of Delay and Increase in Land Acquisition Costs (A3). These three risks are only faced by the PJPK because responsibility for location falls under the PJPK's authority.

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