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Article

Schematic risk management in solicited and unsolicited project

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Abstract: The Indonesian government is currently carrying out massive infrastructure development, with a budget exceeding 10. Risk mapping based on good risk management is crucial for stakeholders in organizing construction projects. Projects financed by government, whether solicited or unsolicited schemes, should also include risk mapping to add value and foster partnerships. Therefore, this study aimed to develop a risk management model for solicited and unsolicited projects, focusing on the collaborative management system among stakeholders in government-financed projects. Risk review was conducted from various stakeholders' perspectives, examining the impacts and potential losses to manage uncertainty and reduce losses for relevant parties. Furthermore, qualitative analysis was conducted using Focus Group Discussion (FGD) and in-depth interviews. The results showed that partnering-based risk management with risk sharing in solicited and unsolicited projects had similarities with Integrated Project Delivery (IPD). This approach provided benefits and value by developing various innovations in the project life cycle.

Keywords: project risk management; project partnering; project risk sharing; solicited; unsolicited; project sustainability; integrated project delivery

1. Introduction

Risk is an unpredictable consequence of uncertain conditions and requires appropriate management to mitigate the potential impacts (Uher and Toakley, 1999). Project risk can be defined as the unfavorable consequence affecting finances or structure due to decision-making or environmental conditions at a project location (Nurdiana et al., 2015). Moreover, construction projects are unique, specific, dynamic, and have different levels of risk. The risk requires different responses to minimize the impacts on project performance (Andi, 2006; Patil and Molenaar, 2011). Risk categories in construction project include external, economic and financial, technical and contractual, as well as managerial risk (Wiguna and Scott, 2006).

The global construction industry has been experiencing continuous growth, and the Indonesian government has allocated a minimum of 10% of its budget for infrastructure development. In 2021, the Ministry of Finance set the infrastructure budget at IDR 417 trillion, a 48% increase from 2020, which was the highest in Asia. However, this growth contrasts with the construction industry performance in Indonesia and globally, characterized by low productivity and high waste (Elizar et al., 2017). Due to global economic growth, technological advancements, massive changes in the economic structure, and increasingly fierce market competition, construction projects could face more uncertainty and higher risk in the future (Andi, 2006; Andi and Darmawan, 2006; Rafindadi et al., 2014; Ramanathan and Narayanan, 2012), leading to higher losses (Andi and Darmawan, 2006). From an economic perspective, asymmetrical information can lead to opportunistic behaviour, such as adverse selection and moral hazard, which undermines trust in the construction market and creates risk in construction project (Lui et al., 2004). Project risk is becoming more significant in the construction industry, showing the importance of implementing information theory for management (Azhar et al., 2000; Ma et al., 2022; Patil and Molenaar, 2011; Rafindadi et al., 2014).

Government project should ensure certainty due to the involvement in public interests. Given the government's limited budget, meeting the demands for accelerating infrastructure development can be challenging. Therefore, long-term cooperation with private business entities is essential to accelerate infrastructure in Indonesia. One of the collaborations being developed is Public Private Partnerships (PPP) in both solicited and unsolicited forms. Previous studies have shown that in several developed countries such as the US and Europe, PPP cooperation can enhance and address gaps in government infrastructure projects. The study showed the importance of partnering in government projects from the outset through solicited and unsolicited PPP. The development of these PPPs includes joint risk management between the government and business entities. Effective risk management in PPPs can lead to improved project performance. It can also foster the growth and development of PPP implementation in Indonesia, as the government relies on the support of Private Business Entities to collaborate on infrastructure project.

1.1. Risk management

Risk management has been evolving from individual to partnership management (Castelblanco and Guevara, 2020; Mhetre et al., 2016; Rafindadi et al., 2014). Risk is classified at the project initiation, and the future impact is predicted collaboratively by sharing resources, strengthening interactions, and distributing among stakeholders (Abednego and Ogunlana, 2006; Andi and Darmawan, 2006; Jin, 2010; Kim et al., 2005).

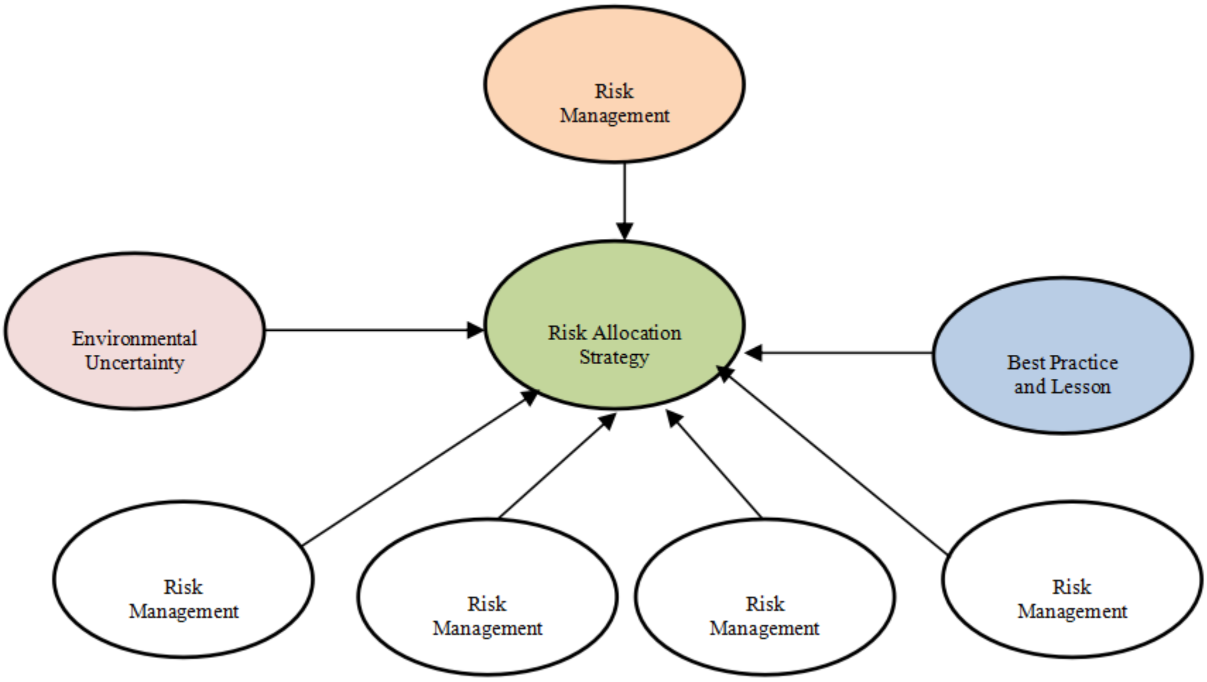

Figure 1. Framework shared risk management (Jin, 2010).

Based on **Figure 1**, Jin (2010) stated that sharing risk management into multiple clusters helps determine the "partner" responsible for handling the respective clusters. In construction project, there is a special relationship between owners and supervisors, as well as between owners and contractors, to ensure mutual interest in successful project completion. The attempt of a participant to maximize personal interest can harm the interests of others. Several effective steps to reduce project risk have been identified when exploring the incentive mechanism for project success (Andi, 2006; Andi and Darmawan, 2006). These studies showed the key feature of motivation and contract incentives, as incentive arrangements should correspond with the needs of clients and contractors, properly allocate risk, and allow an appropriate level of client engagement (Adnan et al., 2012; Bellini et al., 2016; Crowley and Karim, 1995; Lahdenperä, 2012; Spang and Riemann, 2014), rational risk allocation between parties in construction contracts is crucial for project success. Lam et al. (2007) developed a decision model using fuzzy logic to transform linguistic principles and expert knowledge into a more beneficial and systematic quantitative analysis (Gao et al., 2008; Lam et al., 2007). Xu et al. (2010) explored risk allocation in public-private partnership project, prioritizing risk allocation principles and setting a framework for PPP project. Risk allocation between participants is closely related to their behaviour (Xu et al., 2010). The relationship between contractors' risk perception, behavioral risk, and risky behavior can be understood by investigating potential changes in pattern from perception to attitude and to behavior (Andi and Darmawan, 2006; Rafindadi et al., 2014). The importance of risk-setting behavior can be optimally measured by examining risk perception and shared attitude with other situational variables that affect behavioral expression. Bahamid et al. (2019) found that risk in construction project is classified based on stakeholders. Similarly, Uher and Toakley (1999) mentioned that project risk is classified based on levels and area. Nurdiana et al. (2015) also found that risk classification was based on the perspectives of each stakeholder.

According to Thompson et al. (1998), shifting the paradigm of risk sharing to partnering can improve organizational achievements when partnering reaches levels of cooperation, collaboration and coalition (Sari et al., 2023a; Sari et al., 2023b). Crane et al. (1999) stated that aspects of risk in project involving cost, schedule, quality, safety and litigation could be managed effectively through partnering. This partnering is characterized by internal communication, external communication, and effective meetings between stakeholders.

1.2. Solicited and unsolicited project

Solicited and unsolicited projects are collaborative infrastructure projects between the government and business entities. In these projects, the government partners with business entities through a cooperation agreement contract, which includes a government agency as the responsible party and a business entity (Castelblanco and Guevara, 2020). The entity can be responsible for the design, construction, financing, and operation of the project. These cooperation agreements typically have a long-time frame (more than 10 years) to allow for the return on investment by the business entities (Nahdi et al., 2024). The basis of the cooperation agreement is the allocation of risk sharing between the government and the business entity. Solicited project is initiated by the government, while unsolicited project is initiated by business entities (Fulghieri et al., 2014; Poon and Chan, 2010; Yun et al., 2015) and should meet the following criteria:

1) Technically integrated with the master plan in the relevant sectors;
2) Financially and economically feasible;
3) The proposing business entities should have the financial capability to finance the infrastructure provision.

Proper management is required by law for both solicited and unsolicited projects financed by APBN/APBD. Construction law No. 2 year 2017 governs partner selection in the implementation of construction services. Objective partner selection promotes professionalism in hosting projects. Various risk management analyses should also be conducted from the beginning of the project with owners (Castelblanco and Guevara, 2020).

Sari et al. (2021, 2023a, 2023b) found that deep partnering can generate value and innovation by establishing partnerships before a project begins. One limitation of a project financed by APBN/APBD is that during the initiation phase, the main contractor cannot intervene due to the deep partnering in the project. This cooperative project offers an opportunity for improved risk management by providing more detailed identification, allocation, and transfer.

Both solicited and unsolicited project models face risk during construction, operations, and maintenance phases (Yun et al., 2015). During the construction phase, risk includes technical, political, social, as well as increases in interest rates. In the maintenance phase, risk in PPP projects (solicited or unsolicited) varies based on the cooperation scheme between the Government and Business Entities. These schemes, explained in the following figure are usually categorized as user charges or availability payment (Castelblanco and Guevara, 2020; Fulghieri et al., 2014; Yun et al., 2015).

Figure 2 shows that after the completion of PPP project in the construction phase, tariffs were imposed on users based on government tariff provisions. The associated risk includes ensuring the suitability of rates and accuracy of the services provided. In addition, the occurrence of natural disasters causes significant risk for PPP project managers.

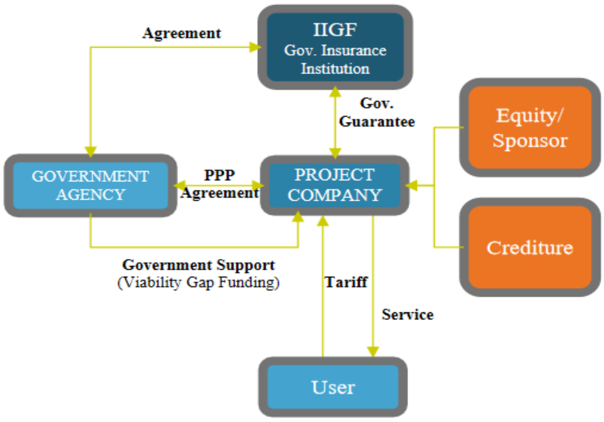

Figure 2. User charge model

Figure 3 shows PPP services using the Availability Payment model, where the PPP Manager bills the government for services at a consistent value throughout the contract period, such as 15 years. The risk faced by managers includes the certainty of bank interest rates and maintaining the level of service provided, as the value of the bills to the government remains constant each year.

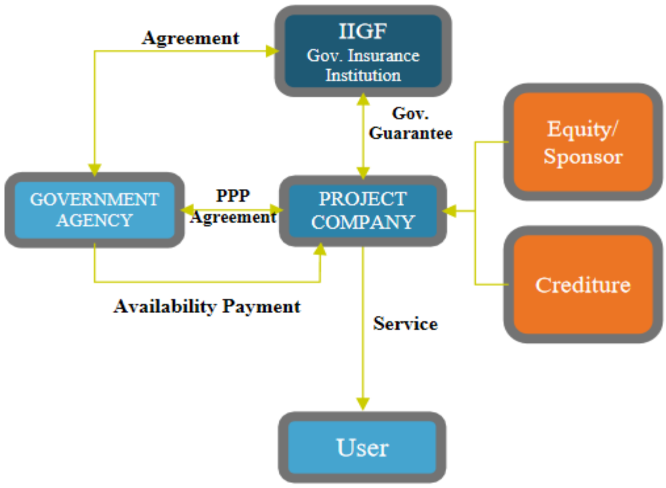

Figure 3. Availability payment model

1.3. Integrated Project Delivery (IPD)

Integrated Project Delivery (IPD) enables owners to foster partnerships and collaboration with various stakeholders from project inception to completion (Ashcraft and Bridgett, 2011; Ghassemi and Gerber-Becerik, 2011; Leicht and Harty, 2017). This collaborative approach considers several crucial factors contributing to effective collaboration in each phase of the project. During the initiation phase, it is essential to consider the credibility of the planning consultant (Ashcraft and Bridgett, 2011; Dossick et al., 2013; Guan, 2018; Rached and Hamzeh, 2014). Building security hinges on the credibility of the planning consultant, ensuring the consultant has the appropriate competence to plan the project (Glick and Guggemos, 2009). Adaptability, dependence, accountability, responsibility, and interaction are crucial factors to be developed in order to achieve mutual orientation in the partnering process between owners and the planning consultants (Glick and Guggemos, 2009). Most IPD contracts include elements designed to foster teamwork and promote project success among specific team members (Ashcraft, 2022; Ashcraft and Bridgett, 2010; Ghassemi and Gerber-Becerik, 2011; Sari et al., 2023b). Unlike traditional project where each party typically minimize personal risk, IPD contracts integrate risk and reward from all team members, compelling collaboration toward achieving the project's objectives (Ghassemi and Gerber-Becerik, 2011). These objectives often revolve around costs, schedule, and quality, which are generally used to measure project success (Ashcraft and Bridgett, 2011).

In the bidding phase, determining the partnering that can increase value added from contractors requires considering several factors, namely fairness, credibility, comfort, commitment, investment, loyalty, dependence, longevity, trust, interaction, shared value, rescue, and support (Baiden et al., 2006; Eriksson, 2015; Larsson and Larsson, 2020; Mesa et al., 2020; Prajogo et al., 2016; Sari et al., 2023a). Contractors and subcontractors/suppliers play a crucial role in executing construction work, making this phase essential in controlling the design to ensure it is implemented according to realistic schedules, meeting deadlines, and achieving project quality in terms of time, cost, quality, and safety & environment (Xiang et al., 2012; Zhou et al., 2010).

During construction execution, effective communication and collaboration between owners, contractors, and consultants are essential in the design engineering process. This collaboration ensures that the conceptualized design can be successfully implemented in construction project execution. Several essential factors in this process include effectiveness, efficiency, adaptability, availability of alternatives, realism, reliability, and communication (Gadde and Dubois, 2010). Asmar et al. (2013) stated that in IPD, design readiness, even at 0% completion, could be achieved through partnering due to the trust between stakeholders. Design planning can also be conducted collaboratively between owners and planners (Asmar et al., 2013).

1.4. Delphi method

Delphi Method has proven to be an acceptable approach in construction management research. It entails a collective assessment from experts, gathering subjective opinions to generate more reliable and objective results compared to individual statements. This method typically entails the selection of qualified experts, the development of appropriate questions, and the analysis of responses. Previous studies utilizing Delphi Method typically included 5–20 experts (Gordon, 1994; Humphrey-Murto et al., 2020; Thangaratinam and Redman, 2005) and were conducted over two rounds to reach a decision. These experts were professionals with heterogeneous knowledge (Chan et al., 2001; Humphrey-Murto et al., 2020) who were involved in decision-making processes related to their fields, typically having a minimum of five years of work experience. An important aspect of every Delphi Method case study is ensuring that the results are based on consensus between research experts participating in each round. Hallowell and Gambatese (2010) defined consensus as an absolute deviation of 5% from the appropriate median expert response. The use of absolute deviation and media instead of standard deviation and mean helps to mitigate bias in results.

2. Materials and methods

This study used quantitative and qualitative methods to produce output formulated through three RQ (Research Questions) as follows:

Table 1 explains that results were sequentially analyzed in three steps using RQ1, RQ2, and RQ3. Subsequently, the elements and indicators from risk management affecting solicited and unsolicited projects were identified.

Table 1. Research methodology scheme.

RQ	Problem	Input	Proses	Output
RQ1	How does potential risk in unsolicited and solicited projects manifest during the project life cycle phase?	Variable from literature review	Literature study	Risk mapping on solicited and unsolicited projects
RQ2	How does partnering in risk management occur in solicited and unsolicited projects?	Variable from literature review, Output RQ1	Empirical field, In-Depth Interview, validation from experts in FGD	Risk management mapping by partnering in solicited and unsolicited projects
RQ3	What are the elements and indicators in each phase in the project life cycle for solicited and unsolicited projects for developing risk management model?	Variable from literature review, Output RQ2	Empirical field and In-Depth Interview	Elements and indicators mapping that affect risk management on solicited and unsolicited projects

The following were considered in conducting FGD and deriving results through Delphi Method:

1) Nine experts with specialized and heterogeneous knowledge were selected.
2) The process was repeated three times to reach a conclusion with consensus.
3) Experts were chosen based on their heterogeneous skills in risk management, each with a minimum of five years of work experience.

Based on these considerations, nine experts were selected as shown in the table as follows:

Based on **Table 2**, FGD was conducted using Delphi Method. The sequential steps taken to obtain the results are as follows:

Table 2. Profile of respondent for FGD (Ashcraft, 2022; Calahorra-Jimenez et al., 2020; Cheng et al., 2003; Huemann et al., 2007; Ilin et al., 2016; Katar, 2019; O' Connor, 2009).

Actor	Resp.	Position/Role
Owner	1	Member of Kementerian PUPR

Table 2. (*Continued*).

Actor	Resp.	Position/Role
	2	Head Of Section
Operator PPP	3 4	Senior Manager Senior Manager
Contractor	5	Chief Executive Officer
	6	Project Manager
	7	Operational Director
Academic	8	Professor of Construction Management
	9	Professor of Construction Management

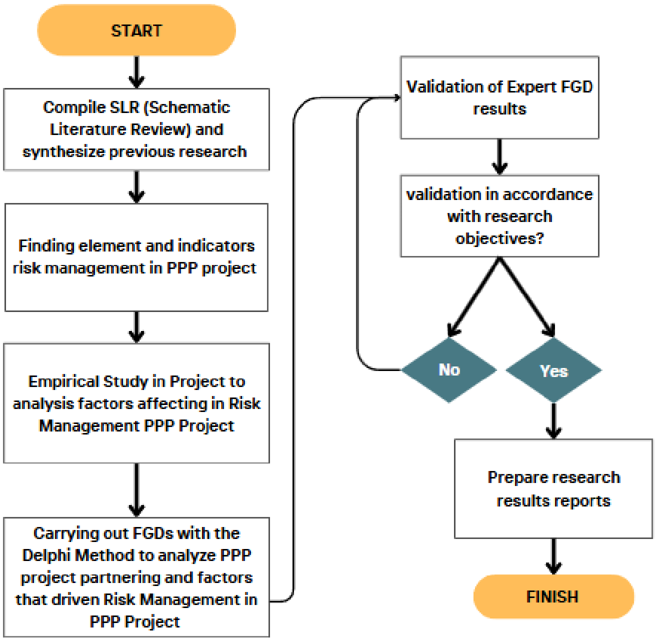

Figure 4. Step-by-step research.

Figure 4 is a sequential step taken to achieve research output, specifically mapping factors influencing risk management in PPP projects. This is detailed as follows:

Step 1: Conduct a schematic literature review to analyze the factors and variables influencing risk management in PPP projects.

Step 2: Find factors and variables synthesized from previous studies.

Step 3. Conduct an empirical study in the field of PPP Project to analyze the factors and variables influencing various types of risk.

Step 4: Conduct an FGD to validate the factors and variables obtained from Steps 1 and 3 to reach a consensus regarding the factors and variables influencing PPP project risk management. A research report is prepared when validation is met.

3. Results

3.1. Schematic literature review: Risk management

Risk identification starts with project analysis, risk analysis, risk response/simulation (Tepeli et al., 2021), described as follows:

Figure 5 shows the analysis phase in risk management in PPP projects, starting from identifying risk, conducting assessments, responding, effectively addressing, and monitoring risk implementation. These processes were a unified cycle crucial for managing risk management in PPP project.

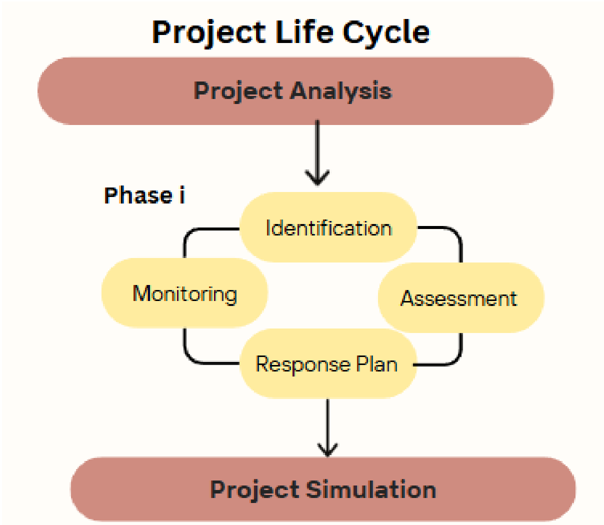

Figure 5. Project analysis, risk analysis, and project simulation in a dynamic structure (Tepeli et al., 2019).

Table 3 is a risk mapping based on the categorizations from various literature review. These results were subsequently used as reference for experts in Delphi Method round 1.

Table 3. SLR risk categories.

No	Risk Categories	Risk Name	Reference
1	Technical/Construction Risk	• Lack of clarity and misalignment of goals • Ambiguity in scope • Strict quality requirements • Ambiguity in technical methods • Conflicting norms and standards • Use of innovative technology • Lack of experience with technology • Defective design/quality problems • Engineering changes/design variations • Delays in design and regulatory approvals • Equipment shortage	(Qazi et al., 2016) (Rehacek, 2017) (Perera et al., 2014) (Lehtiranta, 2011)
2	Organizational	• Lack of experience with parties involved Organisational • Multiple contracts • Poor labour productivity • Poor labour availability/shortage of skilled labour • Delays in obtaining required raw materials quantity • Supplier/subcontractors' default	(Qazi et al., 2016) (Rehacek, 2017) (Perera et al., 2014) (Lehtiranta, 2011)

Table 3. (*Continued*).

No	Risk Categories	Risk Name	Reference
3	Environment	• Unwillingness to share information/lack of visibility • Misalignment of interests/conflicts with stakeholders • Occurrence of dispute • Environment damage • Accident related loss	(Qazi et al., 2016) (Rehacek, 2017) (Lehtiranta, 2011)
4	Political risk	Change of law	(Rehacek, 2017)
5	Economic risk	• Increase materials cost • Difficulty of financing	(Rehacek, 2017)
6	Social risk	• Language/cultural barrier • Rigid bureaucracy • Lobby (legal/illegal) • Labor union	(Rehacek, 2017)
7	Weather risk	• Earthquake • Fire • Rainfall	(Rehacek, 2017) (Lehtiranta, 2011)

3.2. Delphi method round 1: Risk management perspective

In Delphi Method round, respondents were provided with questionnaires addressing risk management from the perspectives of owners, designers, contractors, and suppliers/subcontractors. The questionnaire covered various risk criteria divided into seven categories accordingly. Experts were given five days to respond to each category and the stakeholders involved. The literature mapping results were attached for reference, without restricting the experts from responding based on field experience. The conceptualization for risk mapping is expected to describe the scheme as follows:

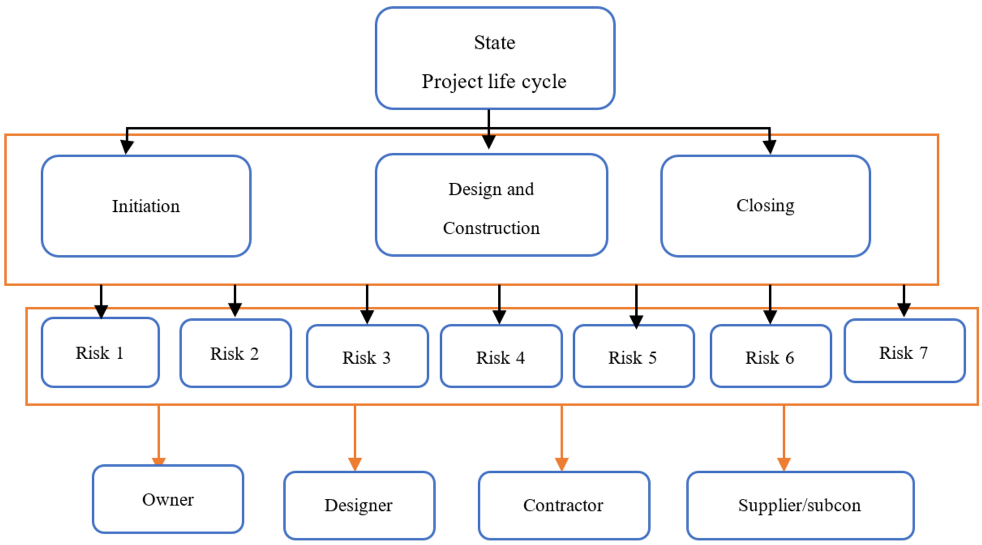

Figure 6. Risk mapping scheme on project life cycle.

Using the mapping according to **Figure 6** for Delphi round 1, a new mapping was created as shown in **Table 4**:

From **Table 4**, project risk is grouped based on the project life cycle and relevant stakeholders, and categorized into seven types.

Table 4. Results of Delphi round 1.

PLC	Owner	Designer	Contractor	Supplier/Subcontractor
Initiation	Multiple contracts	Lack of clarity and misalignment of goals	Multiple contracts	Use of innovative technology
	Unwillingness to share information/lack of visibility	Ambiguity in scope	Supplier/subcontractors' default	
	Lack of clarity and misalignment of objectives	Conflicting norms and standards	Unwillingness to share information/lack of visibility	
	Ambiguity in scope		Lack of clarity and misalignment of objectives	
	Conflicting norms and standards		Ambiguity in scope	
			Conflicting norms and standards	
			Use of innovative technology	
Design		Defective design/quality problems	Defective design/quality problems	
		Engineering changes/design variations	Engineering changes/design variations	
		Delays in design and regulatory approvals	Delays in design and regulatory approvals	
Construction	Lack of experience with relevant organizational parties		Poor labour productivity	Lack of experience with technology
			Lack of experience with technology	
			Equipment shortage	Equipment shortage
			Lack of experience with relevant organizational parties	
			Poor labor availability/shortage of skilled labor	Delays in obtaining required raw materials quantity
			Escalation in raw material price	Escalation in raw material price
	Misalignment of interests/conflicts with stakeholders	Misalignment of interests/conflicts with stakeholders	Misalignment of interests/conflicts with stakeholders	Misalignment of interests/conflicts with stakeholders
	Contract disputes	Contract disputes	Contract disputes	Contract disputes
			Increase in labour cost	
	Environment damage		Environment damage	
			Accident related loss	Accident related loss
	Change of law	Change of law	Change of law	
			Increase materials cost	Increase materials cost
			Difficulty of financing	Difficulty of financing
			Language/cultural barrier	

Table 4. (*Continued*).

PLC	Owner	Designer	Contractor	Supplier/Subcontractor
			Rigid bureaucracy	
			Lobby (legal/illegal)	
			Labor union	
	Earthquake		Earthquake	Earthquake
	Fire		Fire	Fire
	Rainfall		Rainfall	Rainfall
Closing	permit regulation		permit regulation	

3.3. Delphi method round 2: Refining risk management

In Delphi Method round 2, questionnaires were provided to experts with the following explanation:

Table 5. Results of Delphi method 2.

	% expert who stated very often and often	Very Often	Often	Never
Initiation				
Owner				
Multiple contracts	44%	11%	33%	56%
Unwillingness to share information/lack of visibility	100%	11%	89%	0%
Lack of clarity and misalignment of objectives	100%	11%	89%	0%
Ambiguity in scope	78%	0%	78%	22%
Conflicting norms and standards	56%	0%	56%	44%
Designer				
Lack of clarity and misalignment of goals	67%	0%	67%	33%
Ambiguity in scope	67%	0%	67%	33%
Conflicting norms and standards	44%	0%	44%	56%
Contractor				
Multiple contracts	44%	0%	44%	56%
Supplier/subcontractors' default	100%	0%	100%	0%
Unwillingness to share information/lack of visibility	100%	0%	100%	0%
Lack of clarity and misalignment of objectives	100%	0%	100%	0%
Ambiguity in scope	100%	0%	100%	0%
Conflicting norms and standards	67%	0%	67%	33%
Use of innovative technology	89%	0%	89%	11%
Supplier/Subcontractor				
Use of innovative technology	67%	0%	67%	33%
Design				
Designer				
Defective design/quality problems	100%	0%	100%	0%
Engineering changes/design variations	100%	56%	0%	0%
Delays in design and regulatory approvals	100%	44%	56%	0%

Table 5. (*Continued*).

	% expert who stated very often and often	Very Often	Often	Never
Contractor				
Defective design/quality problems	100%		100%	0%
Engineering changes/design variations	100%	44%	56%	0%
Delays in design and regulatory approvals	100%	44%	56%	0%
Construction				
Owner				
Lack of experience with relevant organizational parties	89%	0%	89%	11%
Misalignment of interests/conflicts with stakeholders	89%	11%	78%	11%
Contract disputes	67%			33%
Environment damage	44%	0%	44%	56%
Change of law	44%	0%	44%	56%
Earthquake	22%	0%	22%	78%
Fire	22%	0%	22%	78%
Rainfall	100%	0%	100%	0%
Designer				
Misalignment of interests/conflicts with stakeholders	78%	0%	78%	22%
Contractor				
Poor labour productivity	100%	33%	67%	0%
Lack of experience with technology	89%	11%	78%	11%
Equipment shortage	56%		56%	44%
Lack of experience with relevant organizational parties	100%	0%	100%	0%
Poor availability/shortage of skilled labour	100%	33%	67%	0%
Misalignment of interests/conflicts with stakeholders	100%	0%	100%	0%
Increase in labour cost	100%	44%	56%	
Rigid bureaucracy	44%	0%	44%	56%
Lobby (legal/illegal)	33%	0%	33%	67%
Labor union	22%	0%	22%	78%
Earthquake	22%	0%	22%	78%
Fire	33%	0%	33%	67%
Rainfall	100%	0%	100%	
Supplier/subkon				
Lack of experience with technology	78%	0%	78%	22%
Equipment shortage	44%	0%	44%	56%
Delays in obtaining required raw materials quantity	89%	0%	89%	11%
Misalignment of interests/conflicts with stakeholders	100%	0%	100%	
Earthquake	22%	0%	22%	78%
Fire	33%	0%	33%	67%
Rainfall	100%	0%	100%	0%
Closing				
Owner				
permit regulation	100%	0%	100%	0%

Table 5. (*Continued*).

	% expert who stated very often and often	Very Often	Often	Never
Contractor				
permit regulation	100%	0%	100%	0%

Table 6. Risk probability result of Delphi Round 2.

	INITIATION	DESIGN	CONSTRUCTION	CLOSING
OWNER	Multiple contracts	-	Lack of experience with parties involved Organisational	permit regulation
	Unwillingness to share information/lack of visibility		Misalignment of interests/conflicts with stakeholders	
	Lack of clarity and misalignment of goals		Contract disputes	
	Ambiguity in scope		Environment damage	
			Change of law	
	Conflicting norms and standards		Earthquake	
			Fire	
			Rainfall	
DESIGNER	Lack of clarity and misalignment of goals	Defective design/quality problems	Misalignment of interests/conflicts with stakeholders	-
	Ambiguity in scope			
	Conflicting norms and standards	Engineering changes/design variations		
CONTRACTOR	Multiple contracts	Delays in design and regulatory approvals	Poor labour productivity	permit regulation
	Supplier/subcontractors' default	Defective design/quality problems	Lack of experience with technology	
	Unwillingness to share information/lack of visibility	Engineering changes/design variations	Equipment shortage	
	Lack of clarity and misalignment of goals		Lack of experience with parties involved Organisational	
	Ambiguity in scope		Poor labour availability/shortage of skilled labour	
	Conflicting norms and standards		Misalignment of interests/conflicts with stakeholders	
		Delays in design and regulatory approvals	Increase in labour cost	
			Rigid bureaucracy	
			Lobby (legal/illegal)	
	Use of innovative technology		Labor union	
			Earthquake	
			Fire	
			Rainfall	

Table 6. (*Continued*).

	INITIATION	DESIGN	CONSTRUCTION	CLOSING
SUPPLIER/SUBCONTRACTOR	Use of innovative technology		Lack of experience with technology Equipment shortage Delays in obtaining required raw materials quantity Misalignment of interests/conflicts with stakeholders Earthquake Fire Rainfall	-

Part 1: Questionnaire for severity level calculation throughout every project life cycle. Experts were also requested to provide new responses to show the level of frequency a risk might occur and its impact.

Part 2: Questionnaire for allocating risk among relevant parties after one section had been analyzed. **Table 5** presents Delphi Method Round 2:

Table 5 shows that not all risk always occurs, with some not even occurring throughout the project life cycle phase. Below is the risk mapping and the probability of risk to occur in a project, which are differentiated in color levels. Mapping is created as shown in **Table 4**.

Based on **Table 6**, legends were represented as "Green" 100% probability, "Blue" 75%–99% probability, "Orange" 50%–74% probability and "Red" < 50% probability.

3.4. Delphi method round 3: Risk impact and allocation

In the third round of Delphi Method, experts were presented with questions regarding risk impact and allocation that occurred, with the options "avoid", "transfer", "mitigate" "accept", and "sharing risk". Three categories were identified for impact assessment, namely "high", "medium", and "low". The results of Delphi Method round 3 mappings are as follows:

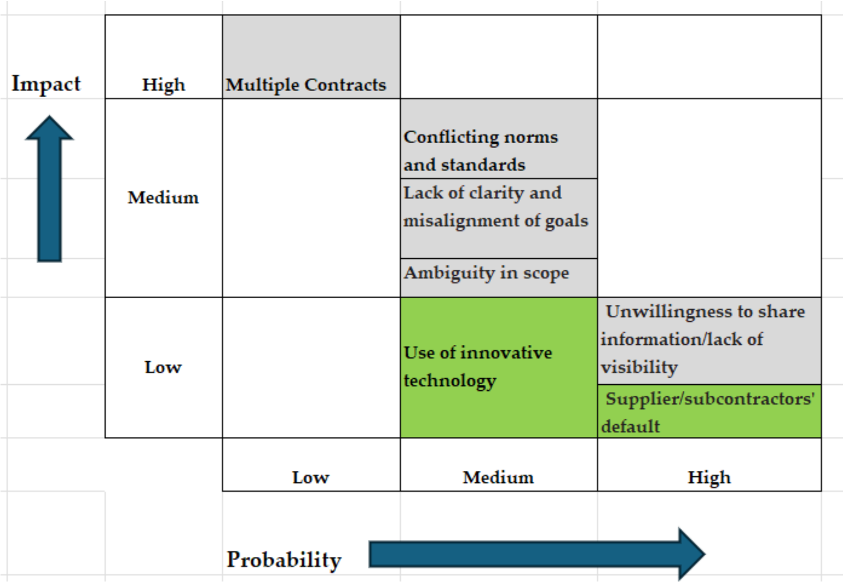

Figure 7. Impact and allocation risk in initiation phase.

Based on **Figure 7**, the probability and impact of risk in the initiation phase were represented with legends as "Grey = avoid", "Green = mitigate", "Yellow = accepted", "Purple = Risk Sharing", and "Orange = risk transfer". Avoidance entails changing project plans to nullify identified risk, while mitigation entails finding ways to reduce the probability and/or impact (Klemetti, 2006). The following are the impact and risk allocation in the design, construction, and closing phases:

Based on **Figure 8**, several mitigations should be implemented in the design phase, specifically addressing design changes and errors as well as delays in design changes.

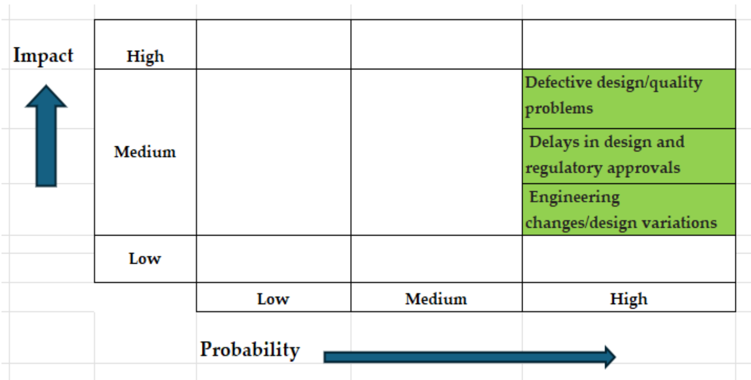

Figure 8. Impact and allocation risk in design phase.

Based on **Figure 9**, various mitigation responses needed to be implemented, specifically addressing subcontractor inexperience and unfamiliarity with technology. In addition, the risk of rain should be accepted by PPP operator.

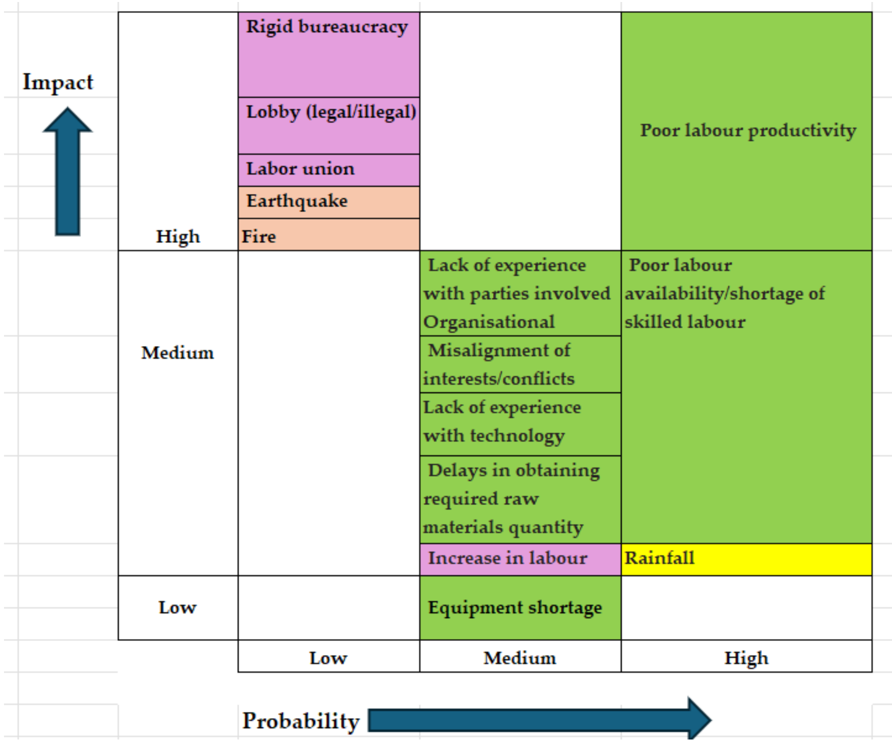

Figure 9. Impact and allocation risk in construction phase.

Based on **Figure 10**, the risk that should be shared relates to permit regulations.

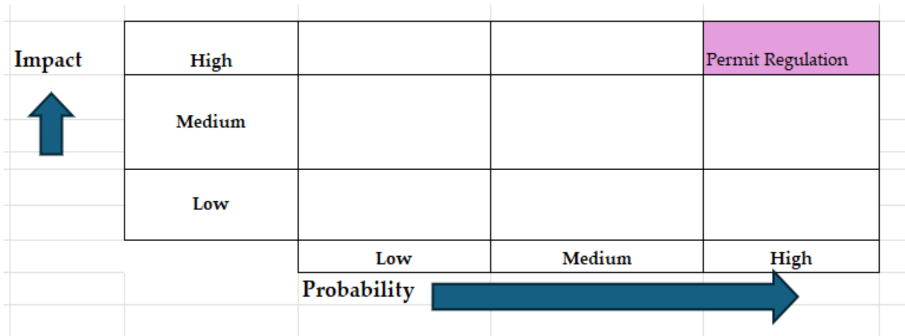

Figure 10. Impact and allocation risk in closing phase.

4. Discussion

Based on the results, the risk of solicited and unsolicited projects in the field was similar. In projects that had not been executed, the initiation phase tended to dominate the risk. Meanwhile, in executed projects, risk during construction work and related to government regulation was more pronounced. Solicited and unsolicited projects typically had long-term operational characteristics. Therefore, after the closing phase, risk might occur in relation to economy and environment, such as:

1) The risk of setting toll road tariffs, given the prevalence of solicited and unsolicited toll road projects in Indonesia.
2) Company of Traffic volume risk: when the actual average daily traffic volume on toll roads is lower than predicted, it may have an effect on the income of project owners.

3) Land acquisition risk: solicited and unsolicited projects may face delays when all sections do not experience land acquisition troubles, which can hinder project execution.
4) Risk of riots: anticipating and preventing riots is crucial to avoid problems related to land acquisition risk and ensure that affected communities receive appropriate development programs.
5) Risk of termination of government business permits ensures every permit fulfills the requirements set by the government.
6) Economic risk relates to the gross domestic product affecting the economy of an area. Positive economic growth is necessary to support the utilization of developed infrastructure.
7) Fund interest rates: construction projects typically funded by banks face risk associated with floating interest rates.
8) Government regulation risk on companies should comply with government regulations, as non-compliance can hinder business activities.
9) Additional risk: based on expert recommendations, additional risk from solicited and unsolicited projects have been mapped, as shown in the table as follows:

Figure 11 shows that potential risk outside the project life cycle phase was managed through sharing, due to being unpredictable and comprised uncontrollable factors, such as the government and society. However, mitigation measures could be implemented to prevent risk related to pricing and land acquisition, which was directly controllable by owners and contractors. This showed the handling of solicited and unsolicited projects was the same as Integrated Project Delivery (IPD) principles where sharing could be used to manage risk collectively.

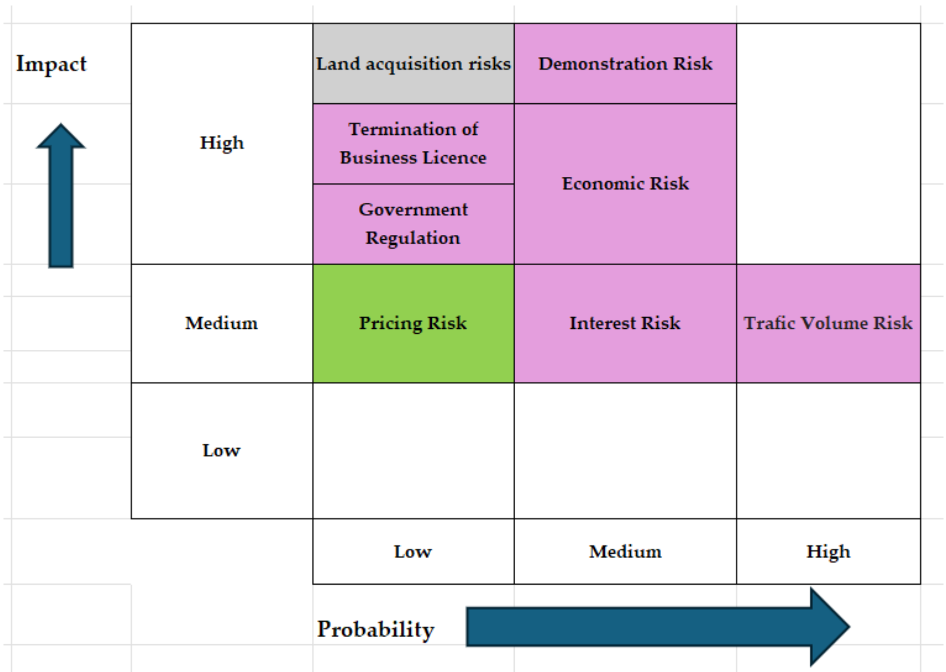

Figure 11. Impact and allocation risk.

5. Conclusion

In conclusion, cooperation project between the government and business entities (public private partnerships-PPP) entailed a long-term investment typically initiated either by the government or contractor, acting as project implementers. Solicited and unsolicited projects required distinct risk management for both project and non-project life cycle phases due to differing characteristics:

1) Risk occurring during the project life cycle could be managed by owners, contractors, and suppliers through avoidance, mitigation, transfer, acceptance, and sharing among stakeholders in accordance with the ongoing projects phase.
2) Risk outside the project life cycle, which were related to tripartite entities (Society and other stakeholders) could be managed through sharing as part of a collaborative effort. This necessitated partnering and effective governmental engagement in reaching mutual agreements.
3) Risk management in solicited and unsolicited projects corresponded with the philosophy of Integrated Project Delivery (IPD), showing the importance of risk sharing among relevant stakeholders.

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