Enhancing Risk Management in the SPALD Project

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ABSTRACT

The SPALD Project is currently undergoing a survey phase to gather data on perceptions and experiences related to risks. Data analysis has been conducted using statistical methods to explore the relationship between risk identification and risk management effectiveness in the context of the SPALD project. The analysis results indicate a significant positive correlation between risk identification and risk management effectiveness, with a correlation coefficient of 0.75 ($p < 0.01$). Regression analysis indicates that the risk identification variable significantly predicts risk management effectiveness ($F(1, 123) = 64.32$, $p < 0.001$), with a coefficient of determination (R squared) of 0.52. These findings affirm that enhancing the risk identification process meticulously and comprehensively can enhance risk management effectiveness in the SPALD project in DKI Jakarta. Recommendations for this project include initial risk identification, the use of adaptive risk management systems, implementation of analysis-based mitigation strategies, and team awareness enhancement. These recommendations aim to enhance risk management effectiveness, achieve project objectives, and mitigate potential negative impacts.

Keywords: SPALD Project; risk; identification; management; effectiveness; correlation; regression analysis.

INTRODUCTION

The development project of the domestic wastewater treatment system (DWTS), known as SPALD, in DKI Jakarta, faces a plethora of significant risks, ranging from technical to financial, as well as social and environmental concerns. Technical risks primarily stem from the alignment of chosen technology with the characteristics of domestic wastewater, with potential disruptions to system performance if not met. Financial risks impact project sustainability and the quality of SPALD infrastructure. Social and environmental risks, such as land acquisition issues and community resistance, also have the potential to affect project acceptance and continuity. Effective risk management is paramount in addressing these risks, necessitating thorough identification, analysis, development of mitigation strategies, and implementation of appropriate risk control measures to ensure smooth project execution and minimize negative impacts on society and the environment. Consequently, it is hoped that the SPALD development project will proceed more smoothly, reduce the likelihood of project failures, and minimize adverse effects on communities and the environment.

The identification of problems within the SPALD development project in DKI Jakarta highlights potential risks such as planning errors, technological mismatches, and construction challenges. Effective risk management through meticulous identification, analysis, and management of risks, along with appropriate mitigation strategies, is imperative to address these challenges.

This study aims to delve into the intricacies of risk management within the SPALD project in DKI Jakarta. By analyzing project risks, developing the Risk Breakdown System (RBS) approach, and studying risk management practices, it seeks to enhance project effectiveness and contribute significantly to the field. Through a comprehensive understanding of the project's risk landscape, effective strategies for risk mitigation and improved project efficiency can be devised, ultimately ensuring the achievement of SPALD project objectives and operational standards.

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RESEARCH METHODS

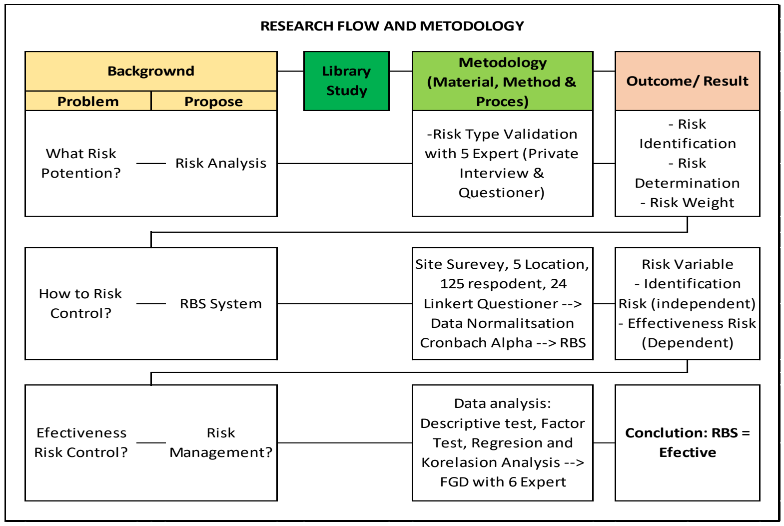

Figure 1. Researh methods

Material

Based on the research flow provided, the materials used in the study include:

1. Library Study: This involves gathering information, literature, and existing studies related to the SPALD project, risk analysis, risk management, and methodologies like the Risk Breakdown System (RBS).
2. Private Interviews and Questionnaires: The researchers conduct interviews and distribute questionnaires to five experts to validate the types of risks identified in the SPALD project.
3. Site Surveys: Field surveys are conducted at five locations related to the SPALD project. This involves collecting data from 125 respondents using 24 Likert questionnaires.
4. Statistical analyses, including normalization, Cronbach Alpha test, descriptive analysis, factor test, regression, and correlation analysis, were performed on collected data.
5. Focused Group Discussions (FGD): FGDs are conducted with six experts to evaluate the results and draw conclusions regarding the effectiveness of the Risk Breakdown System (RBS) in controlling risks in the SPALD project.

These materials are essential components used throughout the research process to analyze, develop, and implement risk management strategies in the SPALD project.

Research Flow

The research begins by identifying potential risks in the SPALD project, followed by conducting risk analysis to understand their types and validate them through interviews and questionnaires with five experts. This phase involves identifying, determining, and weighting risks. Subsequently, the Risk Breakdown System (RBS) is utilized for risk control, involving field surveys at five locations with 125 respondents using 24 Likert questionnaires. The collected data is then normalized, tested using Cronbach's Alpha, and used to construct the RBS, identifying risk variables and measuring the effectiveness of risk control. Finally, the effectiveness of risk control is evaluated through various statistical tests and focused group discussions with six experts, concluding that the use of RBS is effective in managing risks.

Data Analysist

The research employs a structured approach to data analysis, commencing with risk analysis to identify, determine, and weight potential risks associated with the SPALD project. These identified risks are subsequently validated through interviews and questionnaires with five experts. Following this, the Risk Breakdown System (RBS) is utilized for risk control, utilizing field surveys and Likert questionnaires across five locations to collect relevant data. The collected data is then subjected to statistical analysis, including normalization and tests such as Cronbach's Alpha, descriptive, factor, regression, and correlation analyses. Finally, the effectiveness of risk control strategies, particularly the RBS, is evaluated through statistical tests and focused group discussions with six experts, providing comprehensive insights into the management of risks within the SPALD project.

RESULT & DISCUSSION

Risk Weight

No.	Risk Category	Risk	Impact (1-5)	Probability (1-5)	Risk Weight (Impact x
1	Technical Risk	Delay in Land Acquisition	4	3	12
		Incompatibility of Waste Processing Technology	5	2	10
		Changes in Geological Conditions	4	3	12
		Design Incompatibility with Field Conditions	4	3	12
		Soil Instability	5	2	10
		Incompatibility of Technology with Local Environment	4	3	12
2	Policy and Regulation Risk	Changes in Central Government Policy	4	3	12
		Changes in Environmental Policy	4	3	12
		Difficulty in Obtaining Environmental Permits	5	2	10
		Violations of Construction Regulations	4	3	12
3	Health and Safety Risk	Budget Limitations	4	3	12
		Increase in Building Material Costs	4	3	12
		Economic Loss Due to Property Damage	4	3	12
4	Project Management Risk	Project Completion Delay	4	3	12
		Delay in Construction Work	4	3	12
5	Environmental Risk	Unexpected Environmental Impact	5	2	10
6	Social and Communication Risk	Traffic Disruptions and Accessibility Issues	4	3	12
		Lack of Community Participation	4	3	12
		Project Disapproval	4	3	12
7	Health and Safety Risk	Uncertainty of Health Impacts	4	3	12
		Violations of Workplace Safety Procedures	4	3	12

Figure 2. Risk category and probablity

The table summarizes various project risks across technical, policy, financial, project management, environmental, social, and health and safety domains. Risks are assessed based on their impact and probability, with a risk weight calculated accordingly. This evaluation helps prioritize risk mitigation strategies for effective project management.

Reliability Test

Reliability testing using statistical methods like Cronbach's Alpha coefficient is crucial for ensuring the trustworthiness of gathered information. A high Cronbach's Alpha value, such as 0.96 in this case, indicates good consistency among questionnaire items, affirming data reliability. Consequently, the questionnaire results can be relied upon for further analysis and interpretation, ensuring accuracy and reliability for subsequent research stages.

Survey Results

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No	Risk Type	Score Risk	Risk Classification
1	Technical Risk	1223	Low
2	Financial Risk	507	Moderate to Low
3	Waste Control Risk	524.5	Low
4	Social Risk	510.75	Low
5	Environmental Risk	528.25	Low
6	Stakeholder Risk	418	Moderate to Low
	Total	**520**	**Low**

Figure 3. Survey and results risk type

The table presents an overview of different types of risks, their respective risk scores, and their classification. Technical risk has the highest score of 1223, indicating a low level of risk. Financial risk follows with a score of 507, classified as moderate to low. Waste control, social, and environmental risks have scores ranging from 510.75 to 528.25, all classified as low. Stakeholder risk, with a score of 418, falls into the moderate to low category. Overall, the total risk score is 520, signifying a low level of risk across all categories.

Correlation Analysist

Correlations

		R.Teknis	R.Keuangan	R.Peng. Limbah	R.Sosial	R.Lingkungan	R. Kepentingan
R.Teknis	Pearson Correlation	1	.613**	.783**	.695**	.710**	.523**
	Sig. (2-tailed)		.000	.000	.000	.000	.000
	N	125	125	125	125	125	125
R.Keuangan	Pearson Correlation	.613**	1	.693**	.601**	.544**	.811**
	Sig. (2-tailed)	.000		.000	.000	.000	.000
	N	125	125	125	125	125	125
R.Peng.Limbah	Pearson Correlation	.783**	.693**	1	.826**	.786**	.649**
	Sig. (2-tailed)	.000	.000		.000	.000	.000
	N	125	125	125	125	125	125
R.Sosial	Pearson Correlation	.695**	.601**	.826**	1	.849**	.485**
	Sig. (2-tailed)	.000	.000	.000		.000	.000
	N	125	125	125	125	125	125
R.Lingkungan	Pearson Correlation	.710**	.544**	.786**	.849**	1	.479**
	Sig. (2-tailed)	.000	.000	.000	.000		.000
	N	125	125	125	125	125	125
R.Kepentingan	Pearson Correlation	.523**	.811**	.649**	.485**	.479**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	
	N	125	125	125	125	125	125

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 4. Correlation analysist

The Pearson correlation analysis highlights significant positive correlations among various risk types in the SPALD project. For instance, Technical Risk strongly correlates with Waste Management, Social, Environmental, and Stakeholder Risks (0.783, 0.695, 0.710, and 0.523, respectively), indicating higher technical risk is linked to increased possibilities of these risks. Similarly, Financial Risk correlates notably with Waste Management, Social, Environmental, and Stakeholder Risks (0.693, 0.601, 0.544, and 0.811, respectively), emphasizing the close association between financial risks and other project dimensions. These strong correlations underscore the need for an integrated risk management approach to effectively address interconnected aspects in project management

Descriptive Test

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
R.Teknis	125	3.50	5.00	4.3640	.54115
R.Keuangan	125	3.00	5.00	4.0560	.62610
R.Peng.Limbah	125	3.00	5.00	4.1960	.52612
R.Sosial	125	3.00	5.00	4.0860	.66532
R.Lingkungan	125	3.00	5.00	4.2260	.56478
R.Kepentingan	125	2.75	5.00	4.0340	.73736
Valid N (listwise)	125				

Figure 5. Descriptive test

The descriptive analysis provides a comprehensive overview of risk distribution in the SPALD project in DKI Jakarta, covering six types of risks: Technical, Financial, Waste Management, Social, Environmental, and Stakeholder. Overall, risk values range from 4.034 to 4.364, indicating significant risk levels. The relatively low standard deviations (0.526 to 0.737) suggest consistency in risk assessments. While all risk types have minimum values above three, indicating moderate to high-risk assessments, variations exist across different aspects. Despite the high-risk tendency, attention to identifying suitable mitigation strategies is crucial for project success.

Factor Test

Communalities

	Initial	Extraction
R.Teknis	1.000	.721
R.Keuangan	1.000	.683
R.Peng.Limbah	1.000	.868
R.Sosial	1.000	.772
R.Lingkungan	1.000	.741
R.Kepentingan	1.000	.578

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component 1
R.Teknis	.849
R.Keuangan	.826
R.Peng.Limbah	.932
R.Sosial	.879
R.Lingkungan	.861
R.Kepentingan	.761

Extraction Method: Principal Component Analysis.
a. 1 components extracted.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.363	72.725	72.725	4.363	72.725	72.725
2	.819	13.654	86.379			
3	.334	5.570	91.950			
4	.197	3.282	95.232			
5	.174	2.898	98.130			
6	.112	1.870	100.000			

Extraction Method: Principal Component Analysis.

Figure 6. Factor test

The PCA results on risk variables in the SPALD project indicate important findings. Communalities reflect variance explained by factors, with financial risk having the highest (.683) and stakeholder risk the lowest (.578). One factor explains 72.725% of variance, increasing to 86.379% with an additional factor. The Component Matrix shows significant correlations, suggesting a common factor associated with all risks. Overall, the analysis suggests a single factor significantly related to all risk types, possibly reflecting shared dimensions or management patterns. Further research is needed to confirm these interpretations and explore uncovered aspects.

RBS Analysist

The utilization of Risk Breakdown Structure (RBS) analysis in the research on project risk management in SPALD within DKI Jakarta has proven to be highly effective in categorizing and organizing infrastructure-related risks. As highlighted by Hillson (2010), employing RBS aids researchers in systematically organizing these risks into a hierarchical structure, thereby enhancing their comprehension of the project's risk complexity. A study by Ahsan and Gunawan (2014) underscores the pivotal role of RBS in project risk management, particularly in identifying critical risks and devising more effective risk mitigation strategies. The primary objective of integrating RBS into this research is to furnish a structured framework for identifying, evaluating, and managing risks throughout the SPALD project's execution. Kerzner (2013) emphasizes that RBS facilitates a comprehensive risk assessment and aids in the selection of suitable mitigation strategies, thereby increasing the project's likelihood of

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success. Additionally, as outlined by Söderlund et al. (2014), leveraging RBS enables researchers to gain a more detailed understanding of risk hierarchies and enhances risk management by providing structured and detailed information. Given these scholarly contributions, the incorporation of Risk Breakdown Structure (RBS) analysis in this research is anticipated to significantly enhance the understanding and management of risks inherent in the SPALD project in DKI Jakarta. Consequently, RBS will serve as a valuable tool for informed decision-making and the development of more effective risk management strategies in the realm of public infrastructure projects within the region.

MATRIKS RISK BREAKDOWN STRUCTURE

Risk Type	Sub-Risk	Priority	Mitigation Strategy
Technical Risk	Workplace Safety	High impact on workers, communities, environment	Better safety equipment, worker training, safer waste management.
	Public Safety	Impact on surrounding communities	Noise management, air pollution control, wastewater handling.
	Environmental Safety	Risks to natural ecosystems	Environmentally friendly tech, monitoring, ecosystem restoration.
Environmental Risk	Impact on Ecosystems	Potential long-term damage to ecosystems	Ecosystem monitoring, robust recovery programs.
	Greenhouse Gas Emissions	Contributes to climate change	Emission reduction, eco-tech, energy efficiency.
	Resource Utilization	Threatens natural resources	Efficient tech, sustainable practices, wise resource use.
	Waste Management	Inadequate waste processing	Improved waste management, active monitoring.
Financial Risk	Infrastructure Factors	Supports project technology and needs	Infrastructure management, system reliability.
	Cost Estimation	Uncertain cost projections	Cost sensitivity, financial planning, strict control.
	Budget Management	Efficient fund allocation	Tight expenditure control, budget monitoring, careful planning.
	Project Financing	Required financial resources	Funding monitoring, appropriate financing.
Waste Handling Risk	Financial Evaluation	Difficulty in cost estimation	Efficient waste strategies, careful finance planning, cost monitoring
	Infrastructure Availability	Existing system capacity	Infrastructure improvement, adaptation to waste.
	Cost Estimate Uncertainty	Uncertain cost planning	Risk analysis, regular cost monitoring, adjustments.
	Compliance with Standards	Environmental regulations	Regulation understanding, compliant systems.
Social Risk	Community Engagement	Community involvement and support	Effective communication, increased participation.
	Effective Communication	Quality communication	Improved communication, proactive approach.
	Public Acceptance	Community support	Education, collaboration, transparent implementation.
Interest Risk	Stakeholder Expectations	Managing diverse expectations	Stakeholder identification, expectation management, communication.

Figure 7. Matriks risk breakdown structure

Implementation and FGD Outcome

The implementation of risk management based on Risk Breakdown Structure (RBS) in the SPALD project in DKI Jakarta is a strategic step enabling the systematic identification, evaluation, and management of project risks. RBS serves as a useful tool for mapping project-related risks into a hierarchical structure, facilitating a better understanding of risk sources and enabling more effective decision-making. Through RBS implementation, the project management team can identify risks at each project stage, ranging from high-level risks to more specific and detailed ones, aligning with the views of Pinto and Slevin (2019) on the importance of comprehensive risk mapping for enhancing project risk scope understanding.

Furthermore, the implementation of RBS in SPALD project risk management allows for the development of more focused and responsive risk response plans. By understanding the mapped risk hierarchy through RBS, the project management team can design specific mitigation strategies for each risk category and allocate resources more efficiently. According to Hillson and Murray-Webster (2017), utilizing RBS in developing response plans can enhance the effectiveness of preventive actions and responses to project risks, thus reducing their potential negative impacts.

Lastly, through RBS implementation, periodic risk monitoring can be conducted in a more structured and detailed manner. RBS provides a clear framework for monitoring changes in project risks over time. By updating and adjusting RBS according to project developments, the project management team can proactively identify changes in risks and take appropriate corrective actions. According to Turner (2018), continuous risk monitoring is a key component of effective risk management, and RBS implementation allows for more adaptive and responsive project risk management, thereby enhancing the likelihood of success in the SPALD project. Thus, the implementation of RBS-based risk management in the SPALD project is expected to significantly contribute to improving project success and smooth implementation of this public infrastructure project in DKI Jakarta.

CONCLUSSION

This study aimed to analyze, develop, and implement risk management in the project of constructing a Domestic Wastewater Management System (SPALD) on a residential scale in DKI Jakarta. Three main objectives have been addressed in this research: 1) the study identified 6 types of risks related to the SPALD project in DKI Jakarta, detailing potential impacts and correlations, 2) a Risk Breakdown System (RBS) approach was developed, enabling systematic evaluation of risks and deeper understanding for accurate identification and proactive mitigation, 3) implementation of detailed risk management strategies, including risk weighting and scoring, focused on critical risks, enhancing overall project effectiveness. Thus, this study successfully presents an in-depth analysis of risks associated with the SPALD project in DKI Jakarta, develops an effective RBS approach, and implements risk management strategies that can enhance project effectiveness and overall risk management.

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