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Table Of Contents

Indonesian Journal of Innovation Studies
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Risk Breakdown Structure Framework for Fast-Track Method Implementation in Traditional Market Revitalization Projects

Kerangka Struktur Perincian Risiko untuk Penerapan Metode Jalur Cepat pada Proyek Revitalisasi Pasar Tradisional

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Abstract

Fast-track project scheduling provides a mechanism to reduce construction durations by overlapping activities, yet it introduces significant uncertainties. **General Background** Fast-track project scheduling provides a mechanism to reduce construction durations by overlapping activities, yet it introduces significant uncertainties. **Specific Background** Public construction initiatives such as the Bogor traditional market revitalization project face severe time compression demands, reducing execution periods by half. **Knowledge Gap** Comprehensive risk evaluations connecting schedule, cost, and quality categories via structured mapping remain limited for accelerated public infrastructure initiatives. **Aims** This study investigates and evaluates implementation hazards, dominant risk variables, hierarchical classifications, and corresponding mitigation strategies within an accelerated market project. **Results** Findings revealed 15 relevant variables where material delivery delay, owner payment delays, and design modification schedule shifts emerged as top critical threats. **Novelty** The application of a Risk Breakdown Structure combined with congruency patterns systematically maps interdependencies among schedule, cost, and quality risks under compressed timelines. **Implications** Successful schedule compression requires integrated risk management protocols alongside duration reduction to safeguard overall project performance.

Highlights

- The Risk Breakdown Structure mapped dominant vulnerabilities into schedule, cost, quality, and external risk categories.
- Material delivery delays and owner payment issues represented the most critical threats during schedule compression.
- Integrated risk mitigation frameworks are essential to prevent cascading failures across time, budget, and technical specifications.

Keywords

Fast-Track Project Delivery; Risk Management; Risk Breakdown Structure; Construction Risk; Market Revitalization

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INTRODUCTION

The development of public infrastructure is a key priority of the government to support economic growth and improve the welfare of the community. Traditional markets are strategic centers of local economic activity, social interaction and distribution of goods and services among public facilities. When considering regional development, traditional markets are not just commercial spaces, but also representations of the social and cultural identity of local communities. Therefore, it is important to revitalise the infrastructure of traditional markets to strengthen local economies, improve the service quality and enhance the competitiveness of traditional markets in the face of continued growth of modern retail. Public construction projects are often difficult to complete on time although they are strategically important. Delays to the project schedule may result in delays to the use of the public facilities, increased construction cost, impact on the allocation of resources and possibly the quality of work performed. Construction project management usually includes planning, scheduling, execution, monitoring and control. However, even well-prepared schedules can face various constraints during execution. As Mokalu et al. (2022) mentioned, the use of project scheduling and control mechanisms has not been able to prevent delays from being an ongoing challenge in construction projects. This situation implies the need for project delivery strategies capable of shortening construction durations while maintaining cost, quality and performance at acceptable levels.

The Fast-Track Project Delivery method is a method that is being used more and more to meet tight project completion deadlines. Fast-track refers to a project scheduling and delivery strategy undertaken to reduce the overall duration of a project compared to the conventional sequential implementation (Perwitasari et al., 2021). The fundamental principle is that activities which would normally be undertaken in sequence are overlapped so that design, procurement and construction can take place concurrently. Therefore, activities can be initiated before the preceding activities are entirely completed, thus presenting opportunities for significantly reducing the overall project duration. However, the overlap of activities to accelerate the project increases the uncertainty and makes the project execution more complex. Wiharti et al. (2020) indicated that overlapping activities should be carefully planned by considering the relationships between activities and the critical paths subject to the acceleration. If overlap is not well planned, it can create dependencies and coordination problems that ultimately defeat the expected benefits of schedule compression. Fast-track implementation, while offering significant benefits in terms of time efficiency, can also expose projects to higher levels of technical, managerial, procurement and coordination risks.

This condition can be seen in Bogor Traditional Market Revitalisation Project which is a case study in this research. The project was originally scheduled to be completed in eight months. However, the construction period was significantly reduced to four months at the request of the project owner, which meant a 50% cut down on the original duration. In an effort to achieve this fast track target the contractor adopted a fast track strategy by overlapping several construction activities which would normally be performed in sequence. Given this compressed schedule, risk management plays a particularly important role. This is because any disruption to interdependent activities may have a direct impact on the project's critical path and jeopardise the target completion date. Although fast-track implementation is expected to achieve earlier project completion, there are several risks associated with overlapping activities such as changes in design during construction, delays in procurement of materials, poor coordination among project stakeholders, rework, disputes over resources and incorrect sequencing of construction activities. These risks can affect the critical path activities, decrease productivity, increase uncertainty in the schedule and eventually cause deviations from the planned completion target. Hence, the success of fast-track implementation should not be assessed by how much the project duration can be reduced, but by the project’s ability to systematically identify, assess, respond, and control the risks of accelerated implementation.

The complexity of risk management is increased by the multiplicity of stakeholders involved in traditional market revitalisation projects, which range from local governments, project owners, consultants, contractors and suppliers to traders as the ultimate users of the facility. The involvement of several parties involves complex technical and managerial interfaces requiring intensive coordination. In fast track conditions, where concurrent activities are performed within a highly compressed schedule, delays in decision-making, design approval, material delivery, information exchange or stakeholder coordination can quickly cascade through connected activities. Previous studies have shown that financial factors, such as investment costs, interest rates, availability of funding, and suitability of financing mechanisms, also influence project feasibility and performance (Amin et al., (2025); Suwandari et al., 2025; Suwandari & Suratkon, 2026). These studies were mainly focused on financing toll-road and PPP infrastructure but their findings are supportive of the fact that financial uncertainty is an important source of project risk that should be taken into account in conjunction with technical and managerial risks. Therefore, a systematic risk identification framework is required to classify, assess and prioritise potential sources of risk. With this background, this study analyses the risks of the fast-track method implementation in a traditional market revitalisation project in Bogor using the Risk Breakdown Structure (RBS) approach. The RBS provides a systematic approach for classification of potential project risks into a hierarchy of categories and sub-categories of risks, based on their sources and nature. This allows a more thorough risk identification and assessment process. The identified risks are then evaluated in terms of their probability of occurrence and their impact on the project performance for the identification of dominant risks that may affect the achievement of the accelerated schedule. These results then serve as a basis for the development of suitable mitigation plans to reduce the probability and the consequences of critical risks.

The novelty of this study is the use of Risk Breakdown Structure (RBS) to assess the risk caused by fast-track implementation in the revitalisation of a government owned traditional market with a significant schedule compression from eight months to four months . As opposed to fast-track scheduling that only considers the potential time saving, this study systematically incorporates risk identification, probability-impact assessment, dominant-risk prioritisation, and risk mitigation. However, research that incorporates these aspects within the framework of revitalising traditional markets in

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Indonesia is still limited. The aim of this study is therefore to identify and classify fast-track implementation risks, to analyse their probability and impact on the project schedule performance, to determine the dominant risks and to develop appropriate mitigation plans. The results are expected to contribute to the body of knowledge in construction project management, especially in terms of risk-based fast-track implementation in public infrastructure projects. In practice, the results can be used as a reference for local governments, project owners, consultants, and contractors to manage accelerated construction projects systematically, thereby achieving schedule compression without compromising the overall project performance.

METHOD

This study used a mixed method, combining quantitative and qualitative analysis to comprehensively explore the risks of implementation of the Fast Track Project Delivery method in a traditional market revitalisation project in Bogor. Primary data were collected thru questionnaires and semi-structured interviews while secondary data were obtained from project documents including the time schedule, progress reports, Work Breakdown Structure (WBS), working drawings and other relevant project records. The risk factors were initially identified by a literature review and then validated by three experts who had at least a bachelor's degree, at least 10 years of professional experience and were in managerial-level positions in construction projects. The identified risks were grouped into six major categories: schedule, cost, resource, quality, coordination and external risks. The quantitative phase evaluated each risk factor based on the probability of occurrence and impact using a five-point Likert scale. The questionnaire was distributed to construction practitioners involved in the project, such as project managers, site managers, engineers, consultants, supervisors and contractors. After determining each risk level by multiplying frequency / probability score by impact score $F \times R$, the risks were categorised into low, medium and high categories using a risk matrix. High risk classified risks were identified as dominant risk and subjected for further analysis. In the qualitative stage, the main risks were categorised in a structured way by source and category according to the Risk Breakdown Structure (RBS). The RBS approach was used to develop a hierarchical and structured representation of project risks and to facilitate the identification of their causes, consequences, preventive measures and corrective actions. Additionally, a congruency pattern analysis was performed to explore inter-relationships among high-level risks, particularly risks with common causes or impacts or those that could trigger and reinforce each other. The experts then finally validated the resultant risk structure and the proposed mitigating strategies to ensure their relevance to the actual project conditions and to develop appropriate risk responses for fast-track implementation.

RESULT AND DISCUSSION

Risk Factor Identification and Stage 1 Expert Validation

The first stage of the analysis was to identify the risk factors associated with the application of the Fast-Track Project Delivery method in the market revitalisation project in Bogor. Literature reviews of scientific journals, reference books and previous studies on fast-track implementation and construction risk management were used to identify the first risk factors. The risks identified were grouped into six main categories, Schedule, Cost, Resource, Quality, Coordination and External risks. These initial risk factors formed the basis for further expert validation and risk assessment processes. Then, a pilot test and first-stage expert validation were conducted to evaluate the relevance of the identified risk factors to actual project conditions. The three experts directly involved in the market revitalisation project were selected on the basis of their educational background, professional experience, managerial position and their understanding of fast track implementation. The experts involved were a Construction Manager (master's degree, 18 years' experience), a Commercial Manager (bachelor's degree, 10 years' experience) and a Site Manager (master's degree, 25 years' experience). Their assessments were used to fine-tune the preliminary risk factors and to confirm that the factors included in the subsequent analysis were relevant to the project characteristics and practical implementation scenarios.

Item	Risk Category	Indicator	Risk Factor	E1	E2	E3	Result
X1	Schedule Risk	X1.1	Schedule changes due to design changes	R	R	NR	Analyzed
		X1.2	Delay in material delivery to the project site	R	NR	R	Analyzed
		X1.3	Poor coordination of overlapping activities	R	R	R	Analyzed
		X1.4	Work delays due to weather conditions	NR	NR	NR	Not Analyzed
X2	Cost Risk	X2.1	Delayed payment from the project owner	R	R	R	Analyzed
		X2.2	Errors in initial cost estimation	R	R	NR	Analyzed
		X2.3	Cost increases due to project acceleration	R	R	R	Analyzed
		X2.4	Project cash flow imbalance	NR	R	R	Analyzed
X3	Resource Risk	X3.1	Shortage of workers on site	NR	NR	NR	Not Analyzed
		X3.2	Limited competence and expertise of project human resources	NR	NR	NR	Not Analyzed
		X3.3	Heavy equipment breakdown or delay	NR	R	NR	Not Analyzed
		X3.4	Low labor productivity	NR	NR	NR	Not Analyzed

Vol. 27 No. 4 (2026): October
DOI: 10.21070/ijins.v27i4.2311

X4	Quality Risk	X4.1	Material quality does not meet specifications	R	NR	R	Analyzed
		X4.2	Work results do not comply with technical specifications	R	R	R	Analyzed
		X4.3	Rework due to non-compliance with quality requirements	NR	NR	R	Not Analyzed
		X4.4	Errors in construction methods	NR	NR	NR	Not Analyzed
X5	Coordination Risk	X5.1	Lack of communication among project parties	R	R	R	Analyzed
		X5.2	Overlapping work among project parties	R	NR	R	Analyzed
		X5.3	Delays in management decision-making	R	R	NR	Analyzed
		X5.4	Ineffective communication among project teams	NR	R	R	Analyzed
X6	External Risk	X6.1	Extreme weather conditions	R	R	R	Analyzed
		X6.2	Changes in government regulations and policies	NR	R	NR	Not Analyzed
		X6.3	Social disturbances and resistance from the surrounding community	R	R	R	Analyzed
		X6.4	Natural disasters that disrupt project implementation	NR	NR	NR	Not Analyzed

Table 1. *Tabulation of Expert Validation Stage 1*

Note: E1 = Expert 1; E2 = Expert 2; E3 = Expert 3; R = Relevant; NR = Not Relevant.

Source: Author's Analysis.

At the first stage of expert validation, 14 of the 24 initially identified risk factors were considered relevant for further analysis, while 10 factors were excluded based on the assessments of the experts. In the Schedule Risk category, three factors were retained including schedule changes due to design modifications (X1.1), delays in the delivery of materials (X1.2) and poor coordination of overlapping activities (X1.3). The four factors of Cost Risk were all kept, suggesting that financial issues are of particular importance for fast-track implementation. In contrast, all factors under Resource Risk were excluded from further analysis as they did not reach sufficient agreement on their relevance. For Quality Risk, two factors were kept: material quality not meeting specifications (X4.1) and work results not complying with technical specifications (X4.2). Also, all the four factors under Coordination Risk were kept for further investigation, and they were lack of communication among project parties (X5.1), overlapping work among project parties (X5.2), delays in management decision-making (X5.3) and ineffective communication among project teams (X5.4). This result emphasises the necessity of coordination in fast-track projects, where several activities are performed in parallel and therefore require intensive exchange of information and timely decision-making. Meanwhile, two External Risk factors, i.e. extreme weather conditions (X6.1) and social disturbances or resistance from the surrounding community (X6.3) were considered. In general, the expert validation helped to narrow down the initial risk indicators to those that were most relevant to the real conditions of the Bogor market revitalisation project. These validated indicators then served as the basis for the probability-impact assessment and identification of dominant risks in the next stage of the analysis.

Stage 2 Data Collection and Risk Assessment

The second stage, after the pilot test and initial expert validation, aimed at identifying high-level risks thru a probability and impact assessment (F × R). Data were collected thru distribution of questionnaires to 31 respondents who were directly involved in the Bogor Market Revitalisation Project. Respondents were asked to assess the probability of each risk factor retained from the previous validation step to occur and its possible impact. The respondents came from a variety of project functions including site management, construction management, commercial management, engineering, quantity surveying, estimating, project ownership, administration and management consulting. Most of their educational backgrounds were bachelor's degrees (S1), with a few respondents having a master's degree (S2). Their professional experience ranged from less than five years to over 20 years. The diversity gave evaluation from different functional and professional perspectives in the project organization. The respondents' distribution shows that engineering personnel had the largest proportion, about 63% of respondents, which indicates that the risk assessment was mainly informed by professionals directly involved in the technical implementation and coordination of project activities. But the respondents were drawn from managerial, commercial, estimating, quantity surveying, ownership, administrative and consulting functions and thus had broader perspectives on the risks of fast-track implementation. The questionnaire was distributed to the personnel involved in Project X and the responses collected can provide an empirical basis for risk probability and risk impact assessment under the actual conditions of the market revitalisation project in Bogor. The resulting probability and impact scores were finally used to calculate the risk level (F × R) and to identify the dominant risks to be further analysed thru the Risk Breakdown Structure (RBS).

The results of the risk data collection depicted in Table 3 indicate the distribution of the respondents' evaluation of the frequency (probability) and impact of 15 risk variables linked with the implementation of the Fast-Track Project Delivery method. The risk variables were each measured on a five-point scale ranging from 1 (very low) to 5 (very high). In the frequency assessment responses of the respondents were mostly centred around the 3 and 4 scores. This implies that most of the risks identified have a moderate to relatively high chance of occurrence during project implementation. With several variables i.e. X1, X2, X4, X9, X11 and X14 at these levels, a relatively high number of responses were achieved. This is

Indonesian Journal of Innovation Studies
Vol. 27 No. 4 (2026): October
DOI: 10.21070/ijins.v27i4.2311

indicative of the fact that these risks are seen to be sufficiently likely to occur under accelerated construction conditions. The respondents' assessment of impact was mostly concentrated in scores 4 and 5 indicating that the occurrence of the identified risks could have a significant effect on the performance of the project. This pattern suggests that even if some risks do not happen frequently, their consequences can still considerably affect the achievement of the fast-track project objectives, especially when the construction schedule is very tight. Thus, the values of frequency and impact obtained in the questionnaire were used as a base to calculate the level of risk (F × R) of each variable. The obtained values were then used to classify the risks into different levels of severity and identify the dominant high risk factors that require priority treatment, further analysis using Risk Breakdown Structure (RBS) and appropriate mitigation techniques.

Probability	Very Low (0.05)	Low (0.10)	Moderate (0.20)	High (0.40)	Very High (0.80)
0.90	0.05	0.09	0.18	0.36	0.72
0.70	0.04	0.07	0.14	0.28	0.56
0.50	0.03	0.05	0.10	0.20	0.40
0.30	0.02	0.03	0.06	0.12	0.24
0.10	0.01	0.01	0.02	0.04	0.08

Table 2. *Probability–Impact Risk Matrix for Threats*

The risk level was divided into three groups depending on the probability and impact scores obtained from the Probability–Impact Matrix shown in Table 2: low risk (0.01–0.05), moderate risk (0.06–0.14), and high risk (0.18–0.72). This classification was used to rank the priority of each risk associated with implementing the Fast-Track Project Delivery method. Low risks were considered less likely to affect project performance while moderate risks had to be monitored closely and appropriate control measures had to be taken. By contrast, high risks were considered as priority risks due to their relatively high probability and/or significant impacts on project implementation. Then, the average frequency and average impact scores for each risk event were computed for the respondents and plotted on the probability-impact matrix to establish its risk level and to identify the dominant risks for additional analysis and mitigation.

The results of the questionnaire were analysed to determine the level of risk related to the adoption of the Fast-Track Project Delivery method, in terms of the frequency and impact of each risk event. Average frequency scores were calculated using probability weights ranging from 0.10 to 0.90. Average impact scores were calculated using impact weights ranging from 0.05 to 0.80. The findings reveal differences in the probability and impact of the 15 risk variables identified. The frequency scores indicate that some risks had a relatively high probability of happening, in particular X2, X1, X4, X3 and X6. In the meantime, the impact assessment reveals that several risk events could have serious consequences on the project's performance, notably in terms of schedule, cost, quality and external conditions. Next, the average frequency and impact values were multiplied to get the risk score (F x R) for each variable. Risk scores were categorised as low risk (0.01–0.05), medium risk (0.06–0.14) and high risk (0.18–0.72) according to the Probability–Impact Matrix. The analysis showed that 9 of 15 risk variables are high risk events which are X1, X2, X3, X4, X5, X6, X7, X9 and X14. The other six variables X8, X10, X11, X12, X13 and X15 were identified as variables with moderate risk. No variable was classified as low risk. The results show that the fast-track method application in the studied project was associated with a high concentration of risks, which required active management and control.

The results of the ranking also indicate that X2 was the most critical risk with the highest F × R score of 0.308 which is related to delays in material delivery to the project site. Then X4 (0.294) was followed by X1 (0.289) represents schedule changes because of design changes and delay in payment from the project owner. Other high-risk variables were X5 (0.245) associated with errors in initial cost estimation, X3 and X6 (0.221 each) associated respectively with poorly coordinated overlapping activities and increased costs due to acceleration, X14 (0.220) representing extreme weather, X9 (0.206) representing construction work that does not comply with technical specifications, and X7 (0.193) representing project cash-flow imbalance. The results indicate that the prevailing risks are not only schedule-related but also financial, quality and external risks. In terms of project management, the prevalence of schedule and cost risks is strongly related to the features of fast-track implementation, in which many activities are carried out simultaneously on an accelerated schedule. Delay in material delivery may directly disrupt current and subsequent activities especially when the work affected is on the critical path. Likewise, changes to the design during construction can lead to changes to the schedule and possibly rework, and poor coordination of overlapping activities can lead to interference between work packages. On the financial side, delayed owner payments, inaccurate initial cost estimates, increased acceleration costs, and cash flow imbalances can restrict the contractor's ability to mobilise labour, acquire materials and sustain the necessary rate of project progress. The presence of quality and external risks further demonstrates that fast-tracked project delivery necessitates a trade-off between satisfying schedule requirements and complying with technical specifications and the ability to respond to circumstances beyond direct managerial control. The nine high-risk events were then prioritised to be validated by additional experts. This validation process was performed to determine and clarify root causes, potential effects, preventive measures and corrective actions for each dominant risk. This expert judgement was particularly important because the numerical F R scores show the relative level of risk but do not fully explain how individual risks arise, interact or impact project activities under actual field conditions. Thus, expert validation provides a qualitative appreciation of the quantitative risk assessment and ensures that the suggested risk responses are relevant to the operational characteristics of the Bogor market revitalisation project.

Overall, the findings show that risks of fast track implementation are spread across several major areas, especially schedule, cost, quality and external risks. In the previous validation process, irrelevant or insufficiently significant risk factors were excluded, the relevant factors were retained as research indicators and were quantitatively assessed by the questionnaire. To facilitate a systematic analysis of the sources and inter-relationships of the nine major high risk events identified in the probability-impact assessment, the risk breakdown structure (RBS) was used to analyse those events. Based on the results of this process, preventive and corrective measures will be developed and, in consequence, recommendations for the

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Vol. 27 No. 4 (2026): October
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improvement of risk-control procedures and support to establishing more effective Standard Operating Procedures (SOPs) for future construction projects that use the fast-track method.

Stage 3: Risk Classification Using the Risk Breakdown Structure (RBS)

The quantitative risk assessment resulted in the identification of nine high level risks, which were further validated by experts as part of the Risk Breakdown Structure (RBS) analysis. The validation was carried out thru structured interviews to validate the relevance of the dominant risks and to identify their root causes, possible impacts, preventive measures and corrective actions. Three experts were chosen based on a minimum of a bachelor's degree, substantial experience in construction and fast-track projects, and a minimum of 10 years of professional experience. The experts were a Project Site Manager with a master's degree and 20 years experience, a Project General Manager with a master's degree and 30 years experience, and a Division Head with a bachelor's degree and 17 years experience. In this stage, experts validated whether the nine major risk events were consistent with the true project state, which was generated from the previous F × R analysis. The responses were then used to validate the risk events and to serve as a basis for classifying their causes and consequences within the RBS framework and for formulating appropriate preventive and corrective risk-response strategies.

No.	Var.	Risk Event	Business Process	Risk Category	Risk Level	E1	E2	E3	Conclusion
1	R1	Delay in the completion of the construction project from the planned schedule	X1	Schedule Risk	High	Yes	Yes	Yes	Further Analysis
2	R2	Delay in the completion of the construction project from the planned schedule	X1	Schedule Risk	High	Yes	Yes	Yes	Further Analysis
3	R3	Delay in the completion of the construction project from the planned schedule	X1	Schedule Risk	High	Yes	Yes	Yes	Further Analysis
4	R4	Deviation or increase in project costs from the established budget	X2	Cost Risk	High	Yes	Yes	Yes	Further Analysis
5	R5	Deviation or increase in project costs from the established budget	X2	Cost Risk	High	Yes	Yes	Yes	Further Analysis
6	R6	Deviation or increase in project costs from the established budget	X2	Cost Risk	High	Yes	Yes	Yes	Further Analysis
7	R7	Deviation or increase in project costs from the established budget	X2	Cost Risk	High	Yes	Yes	Yes	Further Analysis
8	R9	Non-conformity of construction work with technical specifications, quality standards, and contractual requirements	X4	Quality Risk	High	Yes	Yes	Yes	Further Analysis
9	R14	Factors beyond the direct control of project management	X6	External Risk	High	Yes	Yes	Yes	Further Analysis

Table 3. *Expert Validation of Risk Responses*

The results show that the nine high-level risk events identified in the previous stage were all agreed to be relevant to the actual conditions of fast-track implementation and therefore should be further analysed by all three of the experts. The next step was to gather detailed information on the causes, preventive actions, possible impacts, and corrective actions for each dominant risk. These results were then used as a basis for risk classification with the Risk Breakdown Structure (RBS) and appropriate risk mitigation techniques.

The expert validation results provide a more detailed interpretation of the causes, preventions, impacts and corrective actions of the nine dominant risks identified in the previous stage. The results show that the main risks are from a number of inter-related sources such as weaknesses in project communication and coordination, mismatch between technical planning and real site conditions, limited production and distribution capacity of suppliers, poor activity planning, unclear responsibilities, long payment administration, inaccurate initial cost estimation, additional resource requirements due to acceleration, high initial funding requirements, poor quality supervision and unpredictable weather conditions. This can cause delay in projects, interruption in work, rescheduling, technical errors, disruption of cash flow, cost overruns, delayed payments to suppliers and workers, reduced quality performance and lower productivity of labour. The results confirm that the risks in fast-track implementation are interconnected and can cascade thru schedule, cost, quality and operational performance. To facilitate the subsequent RBS analysis, each identified cause, preventive action, impact and corrective action was coded systematically as P, TP, D and TK respectively. Preventive measures include preparing a sufficiently detailed preliminary design, conducting regular coordination, implementing early procurement, keeping buffer stocks of critical materials, developing a detailed Work Breakdown Structure (WBS), establishing clear responsibility for each activity, strengthening payment and cash-flow planning, controlling acceleration costs, implementing strict QA/QC procedures, and preparing alternative working methods for adverse weather conditions. Meanwhile, corrective actions include making partial schedule changes, reordering activities without affecting the critical path, substituting vendors, reassigning resources, modifying internal cash flow and budgets, conducting controlled rework, and speeding up activities when weather permits. The coding system provides a systematic way of mapping the interrelationships between risk sources, risk events, consequences and response strategies and provides an analytical basis for the development of an integrated risk mitigation framework for fast-track implementation.

Cause / Impact	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13
P1	X												
P2	X												
P3			X	X									
P4					X								
P5					X								
P6						X	X						
P7							X						
P8								X	X				
P9										X	X		
P10												X	
P11													X

Table 4. *Cause–Impact Matrix*

Note: P = Cause; D = Impact; X = identified relationship between a cause and its corresponding impact.

Source: Author's Analysis.

The Risk Breakdown Structure (RBS) analysis classified the dominant risks into four main categories, namely schedule risk, cost risk, quality risk and external risk. Schedule risk (X1) covers risks relating to design changes, late delivery of materials, and poorly coordinated overlapping activities. It is mainly due to poor communication and coordination systems, mismatch between technical planning and actual site conditions, limited supplier capacity, poor activity planning and unclear allocation of responsibilities. These risks can result in rework, delays in construction, rescheduling and increase in technical errors. Cost risk (X2) includes late owner payments, inaccurate initial cost estimates, increased acceleration costs and cash-flow imbalances. Impacts include disruption to cash flow of contractor, work stoppages, cost overrun and delay in payments to suppliers and workers. In the meantime, quality risk (X4) is related to construction work that does not meet technical specifications because of the lack of quality supervision, which may reduce owner satisfaction . External risk (X6) is represented by extreme weather conditions that are difficult to predict, which may reduce labour productivity and project execution efficiency . Overall, the RBS mapping uncovers the dominant risks in fast-track implementation to be linked thru their causes and consequences, thus providing a structured basis for identifying risk-control priorities and developing more tailored mitigation plans.

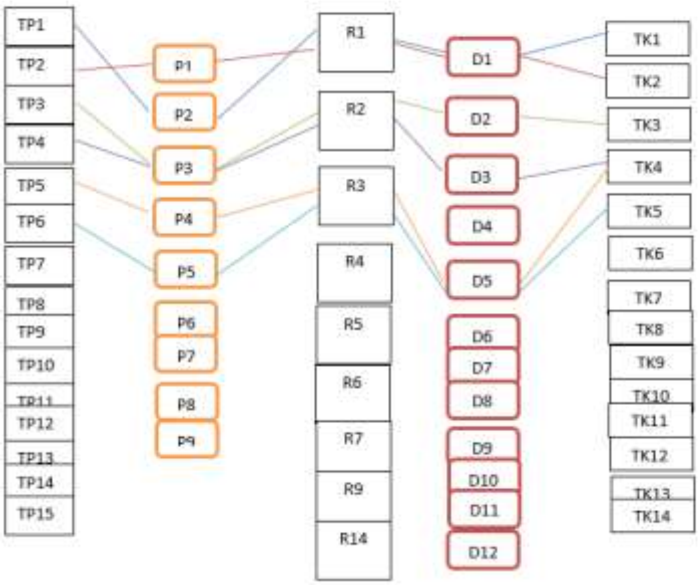

Figure 1. *Recognition Pattern RBS X1*

The Schedule Risk (X1) category includes three main risks: schedule changes due to design changes (R1), delays in material delivery (R2) and poorly coordinated overlapping activities (R3). These risks can be prevented thru detailed preliminary design, effective change management, early procurement, adequate stocks of critical materials, a clear Work Breakdown Structure (WBS) and well defined responsibilities. Potential impacts include rework, construction delays, rescheduling, and technical errors due to overlapping activities. When these impacts occur they are mitigated by partial schedule adjustments, re-sequencing, alternate suppliers, changes to fieldwork methods, and additional labour or equipment to maintain the accelerated project schedule.

Vol. 27 No. 4 (2026): October
DOI: 10.21070/ijins.v27i4.2311

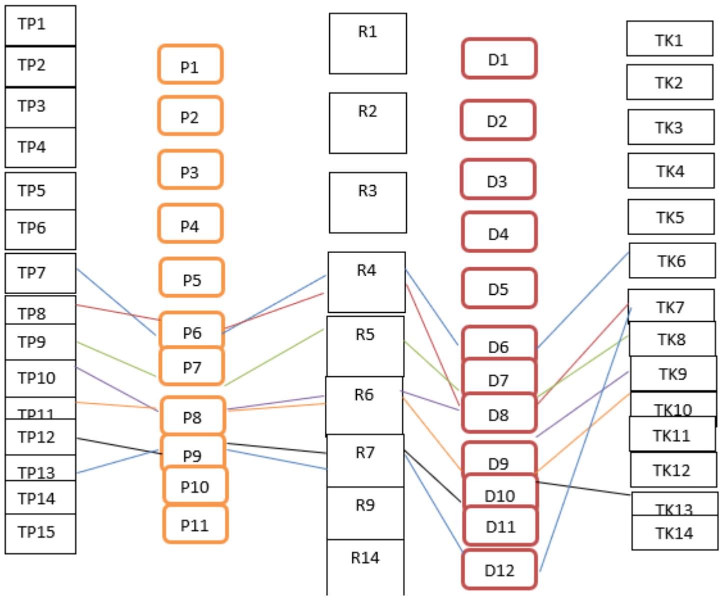

Figure 2. *Recognition Pattern RBS X2*

The Cost Risk (X2) category includes three main risks: R4 - delay in payment by the project owner, R5 - errors in the initial cost estimate, R6 - increased costs due to acceleration. These risks can be reduced by having clear payment mechanisms, contingency costs, periodic review of cost estimates, cost benefit analyses and control of overtime and additional utilisation of resources. Potential impacts include interrupted cash flow for contractors, temporary shutdowns of work, cost overruns, and increased labour and equipment costs. When these impacts occur corrective measures include temporary bridging funds, internal project cash flow adjustments, project budget revision, reduction of non-critical activities and re-adjustment of the acceleration schedule for better cost efficiency.

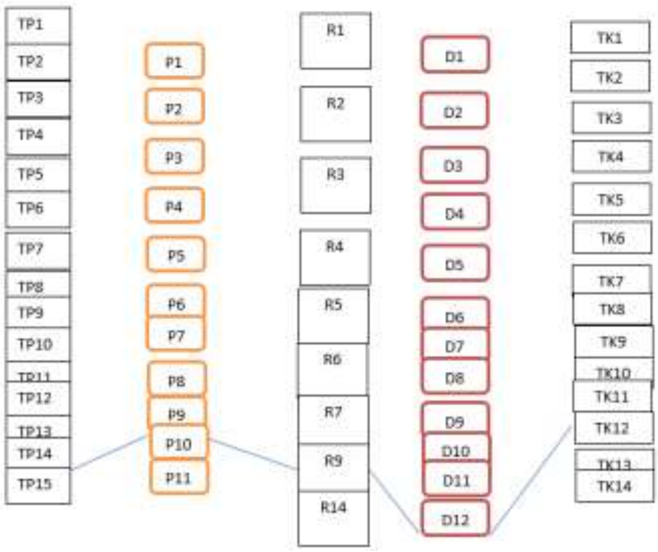

Figure 3. *Recognition Pattern RBS X4*

he Quality Risk (X4) category includes R9 which is construction work that does not comply with technical specifications, quality standards and contractual requirements. This risk can be encountered due to the lack of quality supervision (P10) and can be avoided thru the establishment of a rigorous Quality Assurance/Quality Control (QA/QC) system (TP14). The possible consequence is a decrease in the satisfaction of the project owner with the quality of the completed works (D12). In the event of the impact, corrective action should be taken thru controlled rework (TK12) so that the final construction output meets the required technical and quality standards.

Indonesian Journal of Innovation Studies
Vol. 27 No. 4 (2026): October
DOI: 10.21070/ijins.v27i4.2311

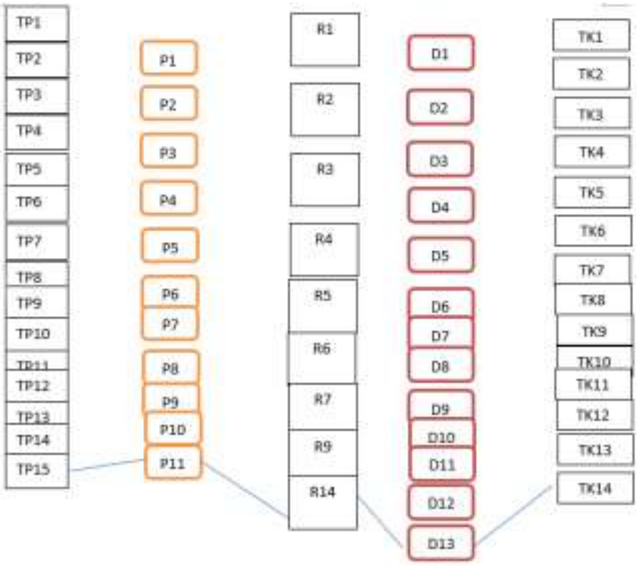

Figure 4. *Recognition Pattern RBS X6*

R14 (included in the External Risk (X6) category) - Adverse weather conditions that could impact the construction schedule as planned. This risk is linked to unpredictable weather conditions (P11), and can be mitigated by preparing alternative work methods adapted to weather conditions (TP15). The possible effect is lower labour productivity and project execution efficiency (D13). If the impact happens, the construction activities can be expedited when favourable weather conditions are available (TK14) to minimise the schedule delays by implementing the corrective actions. The last expert validation was conducted by 3 experts from educational and professional backgrounds which are considered to be able to assess the risk analysis of fast-track implementation on Bogor Market Revitalisation Project. Experts were selected based on having at least a bachelor's degree, more than five years of professional experience and adequate knowledge of the Fast-Track Project Delivery method. The panel included an Expert/Professional Specialist with a master's degree and 10 years of experience, an Academic with a bachelor's degree and 22 years of experience and an Academic and Practitioner with a master's degree and 25 years of experience. The diversity of academic and practical expertise was to provide a comprehensive assessment of the research findings, especially to validate the identified dominant risks, their causes and impacts and the proposed preventive and corrective measures prior to the formulation of the final risk mitigation recommendations.

Research Question	Validation Statement	Expert Assessment	Remarks
RQ1	Appropriateness of the identified risk factors	Agree (√)	The identified risk factors adequately represent actual project conditions
RQ2	Determination of high-category risks based on the frequency–impact (F × R) assessment	Agree (√)	The dominant risks are consistent with actual project conditions
RQ3	Risk classification using the *Risk Breakdown Structure* (RBS)	Agree (√)	The RBS structure is systematic and relevant
RQ4	Analysis of risk interrelationships (*congruency pattern*)	Agree (√)	The relationships among risks have been appropriately represented
R5	Deviation or increase in project costs from the established budget	X2	Cost Risk
R6	Deviation or increase in project costs from the established budget	X2	Cost Risk
R7	Deviation or increase in project costs from the established budget	X2	Cost Risk
R9	Non-conformity of construction work with technical specifications, quality standards, and contractual requirements	X4	Quality Risk
R14	Factors beyond the direct control of project management	X6	External Risk

Table 5. *Final Expert Validation Results*

The results of the expert validation show the final results of the expert's agreement with the four main components in the research results. The identified risk factors (RQ1) were considered representative of actual project conditions and the determination of dominant risks based on the frequency-impact (F × R) assessment (RQ2) was considered appropriate. Moreover, the experts verified that the risk classification with the Risk Breakdown Structure (RBS) (RQ3) was systematic and relevant and that the congruency pattern analysis (RQ4) correctly depicted the interrelationships among the identified risks . These results support the overall risk analysis validity and support the use of the proposed risk mitigation measures for fast-track implementation in the Bogor Market Revitalisation Project.

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Vol. 27 No. 4 (2026): October
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Table 6. Summary of Final Expert Validation and Follow-Up Actions

The final expert review confirmed that the risk identification, high level risk determination, RBS structure and risk interrelationship analysis were valid and generally consistent with actual project conditions. However, the experts made a number of recommendations to improve the findings, such as keeping labour shortages (X3.1) as an extra consideration, highlighting material delivery delays and cash-flow problems as the most important issues, extending weather-related impacts to include occupational safety and material damage, and including bureaucratic approval processes in the risk analysis. More detailed preventive measures for risks associated with weather were also recommended by the experts. In the final analysis, these suggestions were adopted to improve the completeness and practical applicability of the suggested risk mitigation framework for the fast-track project implementation.

CONCLUSION

This study concludes that the implementation of the Fast-Track Project Delivery method on the Bogor Market Revitalisation Project has the risks of schedule, cost, resources, quality, coordination, and external factors that are interrelated. The frequency–impact (F × R) analysis highlighted the dominant high-level risks, such as delays in material delivery, cash flow management, design changes, and project coordination. The Risk Breakdown Structure (RBS) offered a systematic framework to map risk sources, events and impacts, and the congruency pattern analysis showed that individual risks may interact and cause cascading effects on project time, cost and quality performance. The expert validation confirmed the relevance of the performed risk analysis to the real project conditions. Therefore, successful fast-track requires not only a shortening of the project duration, but also the implementation of an integrated and systematic risk management system throughout the life cycle of the project. "Integrated and prioritised risk management from planning thru to project completion should be used on fast-track projects. Contractors need to improve their preliminary design readiness, adopt early procurement, maintain strict cash-flow management and ensure availability of adequate competent resources. Consultants should improve their multidisciplinary coordination and strengthen QA/QC procedures. Project owners should facilitate prompt decision-making and payment processes and support flexible but accountable contractual arrangements. RBS, a system for early warning, and integrated project management technologies such as BIM or PMIS are also recommended to improve risk monitoring and coordination. For public construction projects, the acceleration of projects should also consider specific risk-based fast-track implementation guidelines, stronger contractual frameworks, professional capacity development and digitalisation of project management to ensure that project acceleration can be achieved without compromising cost, quality, accountability and overall project performance.

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