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The Risk Management of DPWH Project Implementation Along Maharlika Highway in Albay

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***Abstract*—** This study determined the risks that were encountered, risk management practices applied, and the effectiveness of these practices in projects implemented by the Department of Public Works and Highways (DPWH) Regional Office V along the Maharlika Highway in the 3rd District of Albay from 2016 to 2025. Focusing on the types of risks encountered, the risk management practices applied, and their effectiveness, the study addresses environmental, technical, construction, physical, socio-political, organizational, and financial risks that influence project execution. A total of eleven (11) infrastructure projects were examined which comprised road widening, preventive maintenance/asphalt overlay, off-carriageway improvements, and road rehabilitation works. The research methodology used was a mixed-methods approach combining quantitative and qualitative research methods. Data were gathered using structured questionnaires to selected DPWH Project Engineers and Project Inspectors, and semi-structured interviews to key informants. Findings showed that environmental risks, especially negative weather conditions, were the most influential factor in project implementation followed by technical and construction, physical, socio-political and organizational and financial risks. Operational safety was the main physical hazard, and lack of coordination and communication led to project inefficiency. Existing risk management practices were largely reactive and focused on monitoring, inspection and adaptive measures however effectively mitigated short-term disruptions. Recurring risks across projects point to systemic issues in preparedness, planning and organization for the environment. The research concluded that the DPWH projects are usually done in an effective manner and would use proactive and integrated risk management, better environmental mitigation, better safety provisions, improved social political risk foreseeing, and better financial planning. The results underscored the importance for systematically identifying risk as well as proactive mitigation and sustained learning in organizations in the sustainability and high-performing highway infrastructure.

***Keywords*—** Risk, Risk Management, Project Implementation, Highway.

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INTRODUCTION

Risks in the construction industry are wide and complicated. It may be divided into seven categories, including technical, construction, environmental, socio-political, financial, organizational, and physical factors (Mhetre et al., 2016). Additionally, recent studies also showed that inadequate financial management, inefficient planning, regulatory roadblocks, and coordination problems among stakeholders are the common drivers of delays and cost excesses in road construction projects, hence the necessity to have organized risk mitigation systems (Pedro et al., 2025).

Effective risk management is critically needed especially in construction and infrastructure projects where there are uncertainties associated with changes in design, financing, safety, compliance with regulations and weather conditions. Risk management allows maintaining the security of workers, the timeframe of project completion, and cost management through people, process, and technology integration. The risks can be identified systematically thus minimizing disruptions, avoiding expensive rework and enhancing the overall project performance.

Although its significance is accepted, the use of formal risk management frameworks in the construction industry is low. Most of the practitioners do not have full knowledge of the risk management tools, and thus, they respond late or ineffectively to the possible threats. The consequences of this gap can be long-term issues like excessive costs, schedule slips, quality

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problems, and contractual conflicts (Bahamid et al., 2022).

Highway projects are particularly risk-intensive because of their large scale, involvement of multiple stakeholders, and exposure to environmental and community-related factors. In the Philippines, road development is a priority, as it significantly contributes to national accessibility and economic growth. The government has consistently allocated substantial resources to road projects, recognizing their role in national development (Rivera et al., 2023).

The national infrastructure agenda, also informally known as the Build Better, More program, is still ongoing under the administration of President Ferdinand R. Marcos Jr. and is an expansion of the previous Build! Build! Build! These are in the form of massive road developments, bridges, and other transport infrastructure to increase connectivity and the inclusive development of the country, where the Maharlika Highway is the core subject of those developments. he Department of Public Works and Highways (DPWH) has significantly increased funding for the Maharlika Highway, including billions of pesos invested in road enhancements between 2022 and 2024.

Nevertheless, the DPWH projects along the Maharlika Highway have been at risk of environmental exposure, operational constraints, and resource constraints despite the efforts being made on it. The efficiency of the present risk management practice, such as risk identification, analysis, mitigation, and monitoring, is not yet under a systematic study in regards to Maharlika Highway projects under development between 2016 and 2025. As the major rehabilitation of the highway is scheduled, which involves interactions with more significant and more reputed contractors to increase the quality and the speed of the execution, comprehension of the risk management dynamics has become the more important factor in securing the project success.

This study aimed to determine the risks encountered, the risk management practices employed, and its effectiveness in DPWH projects along the Maharlika Highway in Albay 3rd District, under the jurisdiction of DPWH Regional Office V. The study focused on projects implemented between 2016 and 2025 and assessed seven categories of risks: technical, construction, environmental, socio-political, financial, organizational, and physical. The scope was limited to the Maharlika Highway in Albay 3rd District, which serves as a primary gateway supporting high inter-provincial traffic, trade, and mobility. Eleven infrastructure projects implemented by DPWH Regional Office V in this district were examined, encompassing road capacity expansion, safety improvements, and overall serviceability enhancements.

METHODOLOGY

This study utilized a mixed-methods research design, quantitative and qualitative, to examine risk management practices in DPWH Regional Office V projects along the Maharlika Highway in the 3rd District of Albay from 2016 to 2025. A total of 27 respondents, consisting of Project Engineers and Project Inspectors, were selected through purposive sampling based on their direct involvement in project implementation. Data were collected using a structured questionnaire and semi-structured interviews. The questionnaire was validated by field experts and administered online via Google Forms. Using this online platform allows for efficient distribution, easy tracking of responses, and automated collection of data. Interviews provided additional insights into risks encountered and management practices applied. Ethical standards were observed through informed consent, voluntary participation, and confidentiality. Data triangulation was employed to enhance validity and reliability. Quantitative data were analyzed using descriptive statistics, including frequency, ranking, and weighted mean, while qualitative data were examined through thematic analysis to support and validate the quantitative findings.

RESULTS AND DISCUSSIONS

I. Determination of DPWH RO-V Projects Implemented in the Maharlika Highway in Albay from 2016-2025

A total of eleven (11) Maharlika Highway projects were implemented in the 3rd District of Albay by

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DPWH Regional Office V from 2016 to 2025. These projects consisted of four (4) road widening projects, four (4) preventive maintenance/asphalt overlay projects, two (2) off-carriageway improvement projects, and one (1) road rehabilitation project. The distribution of projects along the Maharlika Highway indicates that five (5) projects located in Guinobatan and another four (4) in Polangui and Ligao City, as shown in Figure 6. Additionally, two (2) projects were implemented in Oas. A single project was implemented in 2017, followed by another one (1) in 2021. Project activity increased notably in 2024, with four projects implemented, and reached its highest in 2025 with five projects completed. This trend indicates an escalation in infrastructure development efforts in recent years.

II. Risks Encountered during the Implementation DPWH RO-V Projects

Table 1. *Types of Risk*

Type of Risk	Number of Respondents	Rank
Environmental Risks	27	1
Technical Risks	22	2.5
Construction Risks	22	2.5
Physical Risks	20	4
Socio-Political Risks	15	5.5
Organizational Risks	15	5.5
Financial Risks	2	7

The risks encountered by respondents during the implementation of DPWH projects along the Maharlika Highway indicate showed that the most common hazard that experience are environmental risks, which highlight the importance of weather, site condition, and natural hazards on project execution. Technical and construction risks are also typical, reflecting problems with design, methods, equipment and workforce management. Physical risks are still notable, and it is important to have safety measures to ensure the safety of workers and the public. Socio-political and organizational risks are less common but indicate the occasional stakeholder, political, and management issues, and financial risks are infrequent but potentially damaging. Environmental Risks Encountered (n = 27)

Table 2. *Environmental Risk*

Environmental Risk Factor	Frequency (n)	Rank
Adverse weather conditions	25	1
Environmental compliance issues	6	2
Flood and poor drainage	4	3
Erosion, eruption, or landslides	1	4

Based on the data in Table 2, environmental risks, particularly weather-related events, are the most significant challenges affecting infrastructure implementation along the Maharlika Highway. This shows the high effect of climate-related factors such as heavy rainfall and typhoons on the implementation. Technical Risks Encountered (n = 22)

Table 3. *Technical Risk*

Technical Risk Factor	Frequency (n)	Rank
Design errors and omissions	11	1
Material quality test issue	10	2
Non-compliance with technical standards	2	3
Inadequate geotechnical investigation	1	4

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The results in Table 3 showed that technical risks are primarily concentrated in the early stages of project development, particularly in design accuracy and material quality assurance. Strengthening design review processes, improving material testing protocols, and ensuring strict compliance with technical standards can significantly reduce the occurrence and impact of these risks.

Construction Risks Encountered (n = 22)

Table 4. *Construction Risk*

Construction Risk Factor	Frequency (n)	Rank
Poor workmanship	10	1
Equipment or machinery breakdown	8	2.5
Construction method errors	8	2.5
Labor skill shortages	5	4
Health and safety incidents	2	5

The findings in Table 4 indicates that construction risks are largely driven by human factors and operational challenges, particularly in workmanship quality, equipment reliability, and proper execution of construction methods. Addressing these issues through enhanced training, preventive maintenance of machinery, and strict adherence to standard procedures can significantly improve project outcomes and reduce risks. Physical Risks Encountered (n = 20).

Table 5. *Physical Risk*

Physical Risk Factor	Frequency (n)	Rank
Traffic accidents in construction zones	12	1
Accidents and injuries on site	9	2
Damage to existing utilities	4	3

Overall, the results indicate that physical primarily associated with safety hazards both within and around the construction site, particularly those related to traffic exposure. While safety measures may already be in place, the relatively high frequency of accidents indicates a need for stronger implementation, continuous monitoring, and improvement of safety practices to better protect both workers and the public. Socio-Political Risks Encountered (n = 15).

Table 6. *Socio-Political Risk*

Socio-Political Risk Factor	Frequency (n)	Rank
Right-of-way acquisition problems	15	1
Community opposition and complaints	4	2
Regulatory delays	3	3
Political interference	2	4

Based on Table 6, the findings suggest that socio-political risks are largely driven by external factors beyond the direct control of project teams, particularly land acquisition and stakeholder-related challenges. their impact on project timelines and execution can be substantial. This stresses the need for early stakeholder engagement, transparent communication, and efficient coordination with government agencies to mitigate delays and ensure smoother project implementation. Organizational Risks Encountered (n = 15).

Table 7. *Organizational Risk*

Organizational Risk Factor	Frequency (n)	Rank

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Poor coordination among stakeholders	8	1
Unclear roles and responsibilities	5	2
Inadequate project management skills	1	3.5
Ineffective risk management practices	1	3.5

The results highlighted the fact that the organizational risks in DPWH projects along the Maharlika Highway are mostly attributed to the coordination and role clarity and not to the technical management competency. It suggests that lack of clarity in task assignment and authority may result in inefficiencies and delays. This implies the existence of clear communication gaps and lack of alignment between the agencies, contractors, and other stakeholders impacts the project implementation in a big way. Financial Risks Encountered (n = 2).

Table 8. *Financial Risk*

Financial Risk Factor	Frequency (n)	Rank
Delayed payments	2	1
Budget overruns	1	2.5
Price escalation	1	2.5

The findings in Table 8 suggest that financial risks are the least encountered among all categories; however, their impact can still be significant when they occur. The prominence of delayed payments highlights the need for efficient financial management systems, timely fund disbursement, and better coordination between project stakeholders.

III. Risk Management Practices Applied in Addressing the Risks Identified

Table 9. *Environmental Risk Management Practices*

Environmental Risk Management Practice	Frequency (n)	Rank
Weather monitoring and forecast-based scheduling	25	1
Site assessments and risk identification	7	2
Environmental compliance and early permit acquisition	6	3
Proper drainage design and maintenance	5	4
Contingency and adaptation planning	1	5

Based on Table 9, the findings reflected a practical recognition that while weather conditions cannot be controlled, their impact can be minimized through proper planning and scheduling adjustments. It showed the importance of conducting thorough pre-construction evaluations. This suggests that some respondents acknowledge the need to identify potential environmental hazards, terrain issues, and vulnerabilities early in the project cycle.

Technical Risk Management Practices

Table 10. *Technical Risk Management Practices*

Technical Risk Management Practices	Frequency (n)	Rank
On-site inspections	15	1
Material testing and quality control	12	2

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Design reviews and technical evaluations	11	3
Documentation of plans, specifications, and results	6	4
Site surveys and investigation	3	5.5
Construction activities adhere strictly to DPWH technical standards	3	5.5
Comprehensive geotechnical investigations	1	7.5
Pavement design based on traffic, environmental, and material considerations	1	7.5

The findings reveal in Table 10 that technical risk management practices are largely focused on detection and correction during construction, particularly through inspections and quality control. This indicates an opportunity to shift toward a more proactive and preventive approach, strengthening early-stage planning to reduce the occurrence of technical issues later in the project lifecycle.

Table 11. *Construction Risk Management Practices*

Construction Risk Management Practices	Frequency (n)	Rank
Quality control programs and inspections	11	1
Preventive maintenance of equipment	8	2
Regular monitoring and reporting	7	3
Standardized construction methods and on-site supervision	6	4.5
Training and professional development for labor	6	4.5
Health and safety programs, PPE, and safety audits	2	6
Contingency planning for delays	1	7

As shown in Table 11, construction risk management practices are primarily focused on quality control and operational monitoring, with some proactive elements such as equipment maintenance. This reflects a generally reactive approach, where issues are addressed as they occur, and highlights the need to strengthen preventive strategies and long-term planning to improve overall project performance and resilience.

Table 12. *Physical Risk Management Practices*

Physical Risk Management Practice	Frequency (n)	Rank
Traffic management plans, signage, and flaggers	11	1
Health and safety programs, PPE, and hazard training	8	2
Emergency preparedness and contingency plans	5	3.5
On-site inspections and documentation	5	3.5
Utility surveys and protective measures	3	5
Temporary works inspection and monitoring	2	6

Overall, the findings show that traffic control and worker safety, which aligns well with the most common risks identified. However, there is less emphasis on preventive and preparedness measures such as utility protection, temporary works monitoring, and comprehensive contingency planning. This suggests that while key safety practices are in place, strengthening a more holistic and proactive approach to physical risk management could further enhance safety and reduce potential incidents.

Table 13. *Socio-Political Risk Management Practices*

Socio-Political Risk Management Practice	Frequency (n)	Rank
Early stakeholder engagement and legal procedures for ROW	14	1

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Community consultations and grievance mechanisms	9	2
Timely submission of permits and liaison with agencies	3	3
Transparent communication and reporting	2	4

The results indicated that the socio-political risk management is mainly focused on land acquisition and community engagement and the wider political analysis and the formal conflict resolution strategies remain underdeveloped. This demonstrated the strong emphasis on securing land rights and addressing ownership issues at the initial stages of the project implementation to avoid delays and legal issues.

Table 14. *Organizational Risk Management Practices*

Organizational Risk Management Practice	Frequency (n)	Rank
Regular meetings, reporting, and integrated project teams	10	1
Clear roles and responsibilities (e.g., RACI charts)	4	2.5
Monitoring, feedback, and continuous improvement	4	2.5
Formal risk management framework (identify, assess, mitigate)	2	4
Project management training and use of PM tools	1	5

The findings focused on communication-based and reactive approaches, particularly through meetings and reporting. While these are essential, there is less emphasis on structured frameworks, clear accountability systems, and professional development. Strengthening these areas can significantly improve coordination, decision-making, and overall project efficiency.

Table 15. *Financial Risk Management Practices*

Financial Risk Management Practice	Frequency (n)	Rank
Payment scheduling and monitoring for contractors	2	1
Detailed cost estimation and budget monitoring	1	2.5
Financial audits and reporting	1	2.5

The financial risk management in DPWH projects is responsive and is oriented towards contractor payments, although the more comprehensive cost control and contingency strategies are still not utilized as much.

Triangulation of Quantitative and Qualitative Findings on Risks Encountered and Risk Management Practices

Table 16. *Triangulation of Quantitative and Qualitative Findings*

Risk Category	Quantitative Findings (Survey Results)	Qualitative Findings (Interview Results)	Triangulated Interpretation
Environmental Risk	Adverse weather conditions (25/27) were the most encountered risk. Weather monitoring (25/27) was the most practiced mitigation measure.	Frequent rainfall delayed concrete pouring and disrupted schedules. Work was rescheduled based on forecasts.	Both data sources confirm that weather is the most significant risk. Risk management is largely adaptive (schedule adjustments), but long-term mitigation measures remain limited.
Technical Risk	Design errors and omissions (11/22) and	Work suspension due to plan revisions when site	Findings align those technical risks stem from planning and

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	material quality issues (10/22) were most encountered. On-site inspections (15/22) and quality control (12/22) were most practiced.	conditions did not match approved plans. Site validation and redesign were conducted.	design gaps. Mitigation relies heavily on inspections and corrective adjustments rather than strengthened pre-construction investigation.
Construction Risk	Poor workmanship ranked highest. Equipment breakdown and method errors followed. Quality control programs (11/22) were most practiced.	Heavy traffic disrupted construction; labor and material shortages slowed work. Work scheduled during non-peak hours or nighttime. Traffic Management Plans implemented.	Both sources indicate operational challenges as key construction risks. Management strategies focus on supervision, scheduling, and traffic control, demonstrating reactive yet practical mitigation.
Physical Risk	Traffic accidents in construction zones (12/20) ranked first. Traffic management plans and signage (11/20) were most practiced.	Traffic congestion and risk of accidents were major concerns. Signage, night work, and traffic plans implemented to improve safety.	Strong convergence: physical risks are traffic-related. Safety measures such as TMPs and signage are widely applied and considered essential.
Socio-Political Risk	Right-of-Way (ROW) acquisition problems (15/15) ranked highest. Early stakeholder engagement (14/15) most practiced.	Lengthy ROW acquisition, negotiations with lot owners, removal of trees/structures requiring permissions.	ROW issues are major delay factors, and early engagement is critical but processes remain time-consuming.
Organizational Risk	Poor coordination ranked first. Regular meetings and integrated teams (10/15) most practiced.	Delays in relocating electrical posts due to coordination with utility companies. Continuous follow-up required.	Both findings highlight coordination gaps. Organizational risks are linked to inter-agency alignment rather than technical incompetence.
Financial Risk	Least encountered (2 respondents). Delayed payments most common. Payment monitoring most practiced.	Delayed fund releases affected salary payments and cash flow. Cost estimate inaccuracies led to budget adjustments.	Although less frequent, financial risks significantly affect cash flow and efficiency. Management is focused on payment monitoring rather than proactive financial planning.

According to Table 16, the triangulation of the quantitative and qualitative findings showed a high level of convergence between the risks identified in the survey results and the actual experiences shared by Project Engineers and Inspectors. The triangulation corroborates that although there are risk management practices in place and mostly appropriate to risks encountered, they are largely reactive in nature. There is still a need to improve on proactive, structured and long-term risk management strategies - especially in pre-construction planning, environmental mitigation, financial forecasting and inter-agency coordination, to improve project resilience and ensure more efficient infrastructure delivery.

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IV. Effectiveness of the Risk Management Practices Applied

Table 17. *Effectiveness of Environmental Risk Management Practices*

Environmental Risk Management Practice	Mean (x̄)	Effectiveness
Weather monitoring and forecast-based scheduling	4.44	Highly Effective
Site assessments and risk identification	4.29	Highly Effective
Environmental compliance and early permit acquisition	3.17	Moderately Effective
Proper drainage design and maintenance	4.6	Highly Effective
Contingency and adaptation planning	4	Effective

Based on Table 17, environmental risk management in highway projects is most effective when focused on practical, proactive measures such as drainage management, weather monitoring, and site assessments. In contrast, regulatory compliance and general contingency planning, though important, are perceived as less directly impactful. Strengthening the integration of these practices with operational measures could further enhance overall environmental risk management effectiveness.

Table 18. *Effectiveness of Technical Risk Management Practices*

Technical Risk Management Practices	Mean (x̄)	Effectiveness
On-site inspections	4.4	Highly Effective
Material testing and quality control	4.83	Highly Effective
Design reviews and technical evaluations	4.18	Effective
Documentation of plans, specifications, and results	4.83	Highly Effective
Site surveys and investigation	4.33	Highly Effective
Construction activities adhere strictly to DPWH technical standards	4.67	Highly Effective
Comprehensive geotechnical investigations	5	Highly Effective
Pavement design based on traffic, environmental, and material considerations	5	Highly Effective

The results suggested that technical risk management is most effective when it combines thorough pre-construction planning, rigorous quality control, and adherence to standards. Emphasizing early-stage planning alongside ongoing inspections and quality controls can maximize technical risk mitigation.

Table 19. *Effectiveness of Construction Risk Management Practices*

Construction Risk Management Practices	Mean (x̄)	Effectiveness
Quality control programs and inspections	4.36	Highly Effective
Preventive maintenance of equipment	4.5	Highly Effective
Regular monitoring and reporting	4.29	Highly Effective
Standardized construction methods and on-site supervision	4	Effective
Training and professional development for labor	4.17	Effective
Health and safety programs, PPE, and safety audits	2	Slightly Effective
Contingency planning for delays	5	Highly Effective

Table 19 showed that majority of construction risk management practices were seen to be Highly Effective in aiding the implementation of highway projects. In general, the results indicated that the construction risk management is mostly based on the contingency planning, the maintenance of equipment and monitoring practices, but the enhancement of the occupational health and safety implementation of highway projects can be still required.

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Table 20. Effectiveness of Physical Risk Management Practices

Physical Risk Management Practice	Mean (x̄)	Effectiveness
Traffic management plans, signage, and flaggers	4.45	Highly Effective
Health and safety programs, PPE, and hazard training	4.25	Highly Effective
Emergency preparedness and contingency plans	4.2	Effective
On-site inspections and documentation	4.4	Highly Effective
Utility surveys and protective measures	4.33	Highly Effective
Temporary works inspection and monitoring	5	Highly Effective

The results indicated that most of the physical risk management in highway projects is operated by proactive inspection, monitoring and safety practices, which overall contribute to the safety of workers, road users and project infrastructure.

Table 21. Effectiveness of Socio-Political Risk Management Practices

Socio-Political Risk Management Practice	Mean (x̄)	Effectiveness
Early stakeholder engagement and legal procedures for ROW	3.79	Effective
Community consultations and grievance mechanisms	4.33	Highly Effective
Timely submission of permits and liaison with agencies	3.5	Effective
Transparent communication and reporting	4	Effective

The effectiveness ratings indicated in Table 21, that the socio-political risk management practices are applied with differing effectiveness in the project implementation of highways. All in all, the findings indicated that the socio-political risk management in the highway projects is primarily dependent on community engagements, communication, and legal compliance, whereas the more aggressive political risk analysis and systematic conflict resolution is not addressed significantly.

Table 22. Effectiveness of Organizational Risk Management Practices

Organizational Risk Management Practice	Mean (x̄)	Effectiveness
Regular meetings, reporting, and integrated project teams	4.1	Effective
Clear roles and responsibilities (e.g., RACI charts)	3.5	Moderately Effective
Monitoring, feedback, and continuous improvement	4	Effective
Formal risk management framework (identify, assess, mitigate)	4.5	Highly Effective
Project management training and use of PM tools	5	Highly Effective

As shown in Table 22, the perception towards organizational risk management practices is not less than effective to highly effective in facilitating the implementation of highway projects. It implies that formal structures, training, and integrated teams help to enhance the organizational risk management in the context of highway projects, whereas role clarity and accountability still have certain gaps.

Table 23. Effectiveness of Financial Risk Management Practices

Financial Risk Management Practice	Mean (x̄)	Effectiveness
Payment scheduling and monitoring for contractors	5	Highly Effective
Detailed cost estimation and budget monitoring	5	Highly Effective
Financial audits and reporting	4	Effective

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These findings suggested that financial risk management practices are mostly effective in the implementation of highway projects, although some of the practices are underutilized. The overall findings indicated that core financial management practices are utilized, although there is underutilization of the advanced financial management practices like contingency funding, optimal procurement and prioritization of resources, which could be further used to enhance financial risk management of the highway projects.

CONCLUSIONS

Based on the findings, the following conclusions are drawn:

1. Eleven DPWH projects undertaken in the 3rd District of Albay, such as road widening, asphalt overlay, off-carriageway improvement, and road rehabilitation, aim to enhance road capacity, road safety, and the quality of pavements along the Maharlika Highway. However, some projects are still ongoing due to right-of-way (ROW) problems that hinder the timely execution of road projects.
2. Project risks significantly affect implementation with environmental risks, particularly adverse weather conditions, identified as the most critical. Technical and Construction risks affect the design and quality of materials and workmanship and safety in active construction areas, whereas socio-political and organizational risks, including stakeholder coordination and right-of-way acquisition, lead to delays.
3. In implementing projects along the Maharlika Highway, a reactive risk management strategy was practiced by the DPWH, with special emphasis on real-time monitoring, inspections, and operational controls, especially on environmental, technical and physical risks.
4. DPWH risk management practices are generally highly effective in supporting highway project implementation. The practices have played a critical role in ensuring that projects are implemented smoothly to reduce delays, ensure quality, safety, and overall efficiency of operations. These measures are effective and are indicative of a systematic and reality-oriented risk management strategy that is in favor of the successful implementation of highway projects.

RECOMMENDATIONS

The study revealed that the following recommendations can be made:

- Enhance the project monitoring and documentation systems.
- Strengthen environmental risk mitigation measures.
- Perform comprehensive pre-construction assessments.
- Improve technical planning and quality assurance processes.
- Improving occupational health and safety management in the construction zone.
- Periodically assess the effectiveness of the risk management practices.
- Strengthen the capacity of project personnel.
- Adopt a more proactive and integrated risk management framework.
- Share the results of the study with the respondents.
- Encourage further research on infrastructure risk management.
- Expand future research to include additional key informants.
- Integrate a qualitative risk impact matrix with scoring in future studies.
- Include planning engineers as key informants.

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