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Project Risk Management and Success of Greywater Recycling System in Hospitality Industry: A Case Study of Radisson Blu Hotel & Convention Centre, Kigali, Rwanda

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Abstract: Project risk management is critical to the success of sustainability-oriented projects, particularly in the hospitality sector where water conservation initiatives involve technical, financial, operational, and regulatory uncertainties. This study examined the effect of project risk management on the success of the greywater recycling system at Radisson Blu Hotel & Convention Centre, Kigali, Rwanda. Specifically, the study assessed the effects of risk identification, risk assessment, risk mitigation, and risk monitoring on project success. A case study design supported by a mixed-methods approach was adopted. Quantitative data were collected using structured questionnaires from 60 employees and professionals involved in the system, while qualitative data were obtained through semi-structured interviews. Data were analyzed using descriptive statistics, Pearson correlation, multiple linear regression, and thematic analysis. The findings revealed that risk identification, risk assessment, risk mitigation, and risk monitoring were positively and significantly correlated with project success ($r = 0.687–0.827$, $p < 0.001$). The regression model explained 72.6% of the variance in project success ($R^2 = 0.726$; Adjusted $R^2 = 0.706$; $F = 36.483$, $p < 0.001$). Risk monitoring emerged as the strongest and only statistically significant individual predictor ($\beta = 0.529$, $p < 0.001$). The study concluded that effective project risk management significantly contributed to successful greywater recycling, with continuous risk monitoring playing the most decisive role. The study recommends strengthening continuous monitoring, financial risk documentation, staff training, and regulatory compliance mechanisms to enhance the sustainability and performance of greywater recycling initiatives in the hospitality sector.

Keywords: *Project Risk Management, Risk Identification, Risk Assessment, Risk Mitigation, Risk Monitoring, Greywater Recycling, Project Success.*

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I. INTRODUCTION

Sustainable water management has become increasingly important as population growth, urbanization, and climate variability continue to intensify pressure on freshwater resources. The hospitality industry is among the sectors with substantial water requirements due to accommodation services, laundry, food preparation, sanitation, cleaning, and landscaping. Consequently, hotels are increasingly required to maintain high service standards while adopting environmentally sustainable practices that reduce resource consumption and operational costs (Zhang et al., 2020; Borah & Gongutri, 2025).

Globally, greywater recycling has emerged as an important strategy for improving water-use efficiency. Greywater generated from showers, wash basins, and laundry can be treated and reused for non-potable purposes such as toilet flushing, irrigation, and cleaning. When properly implemented, greywater recycling systems can reduce freshwater consumption, lower operational costs, and improve environmental performance. However, their implementation and long-term success remain constrained by technical, financial, regulatory, and operational risks, particularly in developing countries (Filali et al., 2022; Kholijah & Siti, 2024).

In sustainability-oriented projects, project risk management provides a systematic approach for addressing uncertainties that may affect project objectives. It involves identifying potential risks, assessing their likelihood and impact, implementing appropriate mitigation strategies, and continuously monitoring emerging and existing risks throughout the project lifecycle. Effective application of these practices supports informed decision-making, efficient resource allocation, cost control, system reliability, and

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regulatory compliance (Rane et al., 2021). In greywater recycling projects, risk management is particularly important because technical system failures, high investment and maintenance costs, regulatory requirements, and inadequate operational capacity may compromise both implementation and long-term performance (Giri & Om Prakash, 2025).

In developing countries, the adoption of sustainable water technologies continues to face challenges associated with limited financial resources, technical capacity, regulatory frameworks, and maintenance systems. Hospitality facilities operating within these environments must balance increasing water demand with the need to maintain service quality and control operating costs. Although greywater recycling offers an opportunity to address these challenges, inadequate identification and management of project risks can result in delays, cost overruns, system underperformance, regulatory non-compliance, and failure to achieve expected sustainability outcomes (Ndungutse et al., 2021).

In Rwanda, environmental conservation and sustainable resource management remain important development priorities, while rapid urbanization continues to increase pressure on water resources, particularly in Kigali. The hospitality sector faces growing expectations to improve resource efficiency while maintaining internationally competitive service standards. Despite the potential contribution of greywater recycling to sustainable hotel operations, uncertainties surrounding technical performance, financial viability, regulatory compliance, and long-term operation may affect successful implementation. Evidence on how structured project risk management can address these uncertainties within Rwanda's hospitality sector remains limited (Twizerimana et al., 2025).

The Radisson Blu Hotel & Convention Centre in Kigali represents a large-scale hospitality environment characterized by substantial water demand, high service requirements, and increasing sustainability expectations. The implementation and operation of a greywater recycling system within such an environment require effective management of technical, financial, operational, and regulatory risks. However, limited documentation exists on how project risk management practices influence the success of greywater recycling systems in large hospitality facilities in Rwanda. This lack of context-specific evidence limits the ability of hotel managers, project practitioners, engineers, and policymakers to make evidence-based decisions regarding sustainable water management initiatives (Filimonau et al., 2020).

Previous studies have examined project risk management, water infrastructure, and environmental sustainability separately, but limited empirical attention has been given to the relationship between specific project risk management practices and the success of greywater recycling systems within Rwanda's hospitality industry. In particular, there is insufficient evidence showing how risk identification, risk assessment, risk mitigation, and risk monitoring individually contribute to technical performance, cost efficiency, operational sustainability, and regulatory compliance. This study addressed this gap by examining the effect of project risk management on the success of the greywater recycling system at Radisson Blu Hotel & Convention Centre, Kigali, Rwanda.

➢ *The Study was Guided by the Following Specific Objectives:*

- To assess the effect of risk identification on the success of greywater recycling at Radisson Blu Hotel & Convention Centre.
- To examine the effect of risk assessment on the success of the greywater recycling system at Radisson Blu Hotel & Convention Centre, Kigali.
- To evaluate the effect of risk mitigation on the success of the greywater recycling system at Radisson Blu Hotel & Convention Centre, Kigali.
- To evaluate the contribution of risk monitoring to the success of the greywater recycling system at Radisson Blu Hotel & Convention Centre.

➢ *The Study Tested the Following Null Hypotheses:*

- H_{01}: Risk identification has no statistically significant effect on the success of the greywater recycling system at Radisson Blu Hotel & Convention Centre, Kigali.
- H_{02}: Risk assessment has no statistically significant effect on the success of the greywater recycling system at Radisson Blu Hotel & Convention Centre, Kigali.
- H_{03}: Risk mitigation has no statistically significant effect on the success of the greywater recycling system at Radisson Blu Hotel & Convention Centre, Kigali.
- H_{04}: Risk monitoring has no statistically significant effect on the success of the greywater recycling system at Radisson Blu Hotel & Convention Centre, Kigali.

II. LITERATURE REVIEW

The literature review examines the concepts, theories, and empirical evidence underlying the relationship between project risk management and the success of greywater recycling systems. It focuses on risk identification, risk assessment, risk mitigation, and risk monitoring as the major project risk management practices and considers their contribution to successful and sustainable greywater recycling in hospitality projects.

➢ *Conceptual Review*

- *Risk Identification*

Risk identification is the systematic process of recognizing uncertainties that may affect the achievement of project objectives. It enables project teams to identify potential threats before they develop into significant technical, financial, regulatory, or operational problems. Common approaches include expert consultation, document review, stakeholder engagement, previous project experience, and risk registers (Okiye et al., 2022). In greywater recycling projects, risk identification is

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particularly important because challenges may arise from system design, integration with existing infrastructure, treatment efficiency, equipment failure, financial constraints, regulatory requirements, and staff capacity. Early identification enables managers to establish appropriate responses and allocate responsibilities before identified threats adversely affect project performance. Consequently, comprehensive risk identification can contribute to improved system reliability, cost control, regulatory compliance, and operational sustainability.

- *Risk Assessment*

Risk assessment involves evaluating identified risks according to their likelihood of occurrence and potential impact on project objectives. It allows project managers to distinguish between minor uncertainties and risks requiring immediate management attention. Risk assessment may involve qualitative approaches, such as probability-impact matrices and expert judgement, as well as quantitative techniques for estimating possible financial, schedule, or operational consequences (Mutua & Augustus, 2020). Within greywater recycling systems, assessment is necessary for prioritizing risks associated with treatment performance, equipment reliability, investment costs, maintenance, water-quality requirements, and operational continuity. Effective assessment supports evidence-based decision-making and ensures that limited project resources are directed toward the most significant threats. Appropriate risk assessment therefore strengthens project preparedness and contributes to successful implementation and operation.

- *Risk Mitigation*

Risk mitigation refers to the development and implementation of measures intended to reduce the likelihood or consequences of identified project risks. Depending on the nature of a risk, project teams may avoid, reduce, transfer, or accept it while establishing appropriate contingency measures (Cooper & Mason, 2024). In greywater recycling projects, mitigation measures may include preventive equipment maintenance, technical quality controls, staff training, financial contingency planning, regulatory compliance procedures, and clearly assigned responsibilities. Effective mitigation is particularly important because unmanaged technical or operational problems can affect water quality, increase maintenance costs, interrupt system operations, and undermine expected sustainability benefits. Integrating mitigation measures into project planning and routine operations therefore improves resilience and supports reliable long-term system performance.

- *Risk Monitoring*

Risk monitoring is the continuous process of tracking identified risks, evaluating the effectiveness of implemented responses, and detecting new or changing uncertainties throughout the project lifecycle. It may involve regular review of risk registers, performance reports, compliance records, system indicators, and stakeholder feedback (Nnaji et al., 2020). Continuous monitoring is essential in greywater recycling because technical performance, maintenance requirements, operating costs, and regulatory conditions may change over time. Effective monitoring enables project teams to identify deviations early and undertake corrective action before problems significantly affect system performance. It also supports continuous improvement by providing evidence on whether risk responses are producing the intended outcomes. Therefore, consistent monitoring can enhance system reliability, regulatory compliance, cost efficiency, and operational sustainability.

- *Success of Greywater Recycling Systems*

Project success in sustainability-oriented hospitality projects extends beyond traditional measures of completion within time and budget. It also encompasses technical performance, cost efficiency, regulatory compliance, operational sustainability, and environmental benefits (Spanaki & Maria Zoi, 2025). Greywater recycling systems are intended to treat wastewater from showers, sinks, and laundry for reuse in non-potable applications, thereby reducing freshwater consumption and associated operational costs (Prakash et al., 2024). Their success therefore depends on the ability of the system to operate reliably, achieve intended water savings, comply with applicable requirements, control operating costs, and maintain benefits over time. Effective project risk management supports these outcomes by anticipating potential difficulties and establishing appropriate responses before risks compromise technical and sustainability objectives.

➢ *Theoretical Review*

- *Project Risk Management Theory*

Project Risk Management Theory explains how uncertainty can be systematically managed throughout the project lifecycle through risk identification, assessment, response, and continuous monitoring. The theory proposes that projects are more likely to achieve their objectives when potential uncertainties are recognized early, evaluated according to their significance, and addressed through appropriate response strategies (Raydugin & Yuri, 2025). It emphasizes that risk management should be continuous rather than a one-time activity because both existing and emerging risks may change as a project progresses. The theory was particularly relevant to this study because greywater recycling involves technical, financial, regulatory, and operational uncertainties. It provided the principal theoretical foundation for examining how risk identification, assessment, mitigation, and monitoring influenced the success of the greywater recycling system at Radisson Blu Hotel & Convention Centre.

- *Sustainability Theory*

Sustainability Theory emphasizes meeting present needs while preserving resources and opportunities for future generations. It promotes a balance among environmental protection, economic viability, and social responsibility and therefore encourages organizations to move beyond short-term economic benefits toward responsible long-term resource management (Emina & Kemi Anthony, 2021). Sustainable water management is particularly relevant to this perspective because efficient use, treatment, and reuse of water contribute to environmental conservation and operational efficiency. Greywater recycling reflects

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sustainability principles by reducing freshwater demand, lowering costs, and reducing pressure on conventional water supplies (Arora et al., 2022). In this study, Sustainability Theory helped explain why successful risk management is necessary to protect sustainability investments and ensure that greywater recycling continues to generate environmental and operational benefits over time.

- *Systems Theory*

Systems Theory views a project as a collection of interconnected and interdependent components whose combined functioning determines overall performance (Jafari Songhori & Nasiry, 2020). A greywater recycling system consists of several related components, including wastewater collection, treatment, storage, distribution, maintenance, monitoring, and compliance processes. A failure or inefficiency in one component may consequently affect the performance of the entire system. For example, inadequate maintenance of treatment equipment can affect water quality, increase operational costs, and create regulatory compliance problems (Adepoju et al., 2022). Systems Theory was therefore relevant to this study because it emphasized the need for integrated risk management across the technical and operational components of greywater recycling rather than managing individual risks in isolation.

➢ *Empirical Review*

- *Risk Identification and Project Success*

Empirical evidence indicates that early and systematic identification of project risks contributes to improved project performance by enabling potential threats to be addressed before they escalate. Projects applying formal identification practices tend to demonstrate improved preparedness, decision-making, and control over uncertainties affecting project objectives (Goswami & Vishwa, 2024). In water and sustainability projects, early recognition of technical, financial, environmental, and regulatory risks is particularly important because failures may create significant operational and financial consequences. However, limited empirical evidence exists regarding how risk identification specifically affects the performance of greywater recycling systems in Rwanda's hospitality sector. This study addressed this limitation by assessing the effect of risk identification on the success of the greywater recycling system at Radisson Blu Hotel & Convention Centre.

- *Risk Assessment and Project Success*

Risk assessment enables project teams to prioritize uncertainties according to their likelihood and potential consequences and has been associated with improved resource allocation and project control. Systematic assessment allows management to focus resources on risks with the greatest potential to affect cost, technical performance, operational continuity, and sustainability. Research on greywater systems indicates that high capital requirements, technical complexity, regulatory uncertainty, and maintenance requirements remain significant challenges to successful implementation (Raja et al., 2026). Nevertheless, limited evidence has examined whether structured assessment of these risks translates into improved project success within hospitality facilities in Rwanda. The present study therefore evaluated the relationship between risk assessment and greywater recycling system success.

- *Risk Mitigation and Project Success*

Risk mitigation contributes to project performance by translating identified and assessed risks into practical preventive and corrective actions. Effective mitigation measures may include technical controls, contingency planning, preventive maintenance, training, financial safeguards, and compliance procedures. Previous studies have indicated that projects employing structured mitigation practices experience improved operational efficiency and greater resilience to uncertainty (Goswami & Vishwa, 2024). Greywater recycling projects particularly require appropriate responses to equipment failures, treatment inefficiencies, maintenance costs, and regulatory requirements. However, empirical evidence concerning the contribution of mitigation practices to greywater recycling success in Rwanda remains limited. This study consequently examined whether risk mitigation influenced the success of the system within the selected hospitality facility.

- *Risk Monitoring and Project Success*

Continuous risk monitoring allows project teams to evaluate changes in existing risks, identify emerging threats, and assess whether implemented responses remain effective. Regular monitoring has been associated with stronger project control because it enables timely corrective actions and adaptation to changing project conditions. This is particularly relevant to greywater recycling systems, where treatment performance, equipment condition, operating expenses, and compliance requirements require continuous attention. Existing research recognizes the importance of operational monitoring in sustainable infrastructure but provides limited evidence on its independent contribution to greywater recycling project success in Rwanda's hospitality industry (Tukamuhabwa et al., 2023). The current study addressed this gap by examining the contribution of risk monitoring to system success.

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➢ *Conceptual Framework*

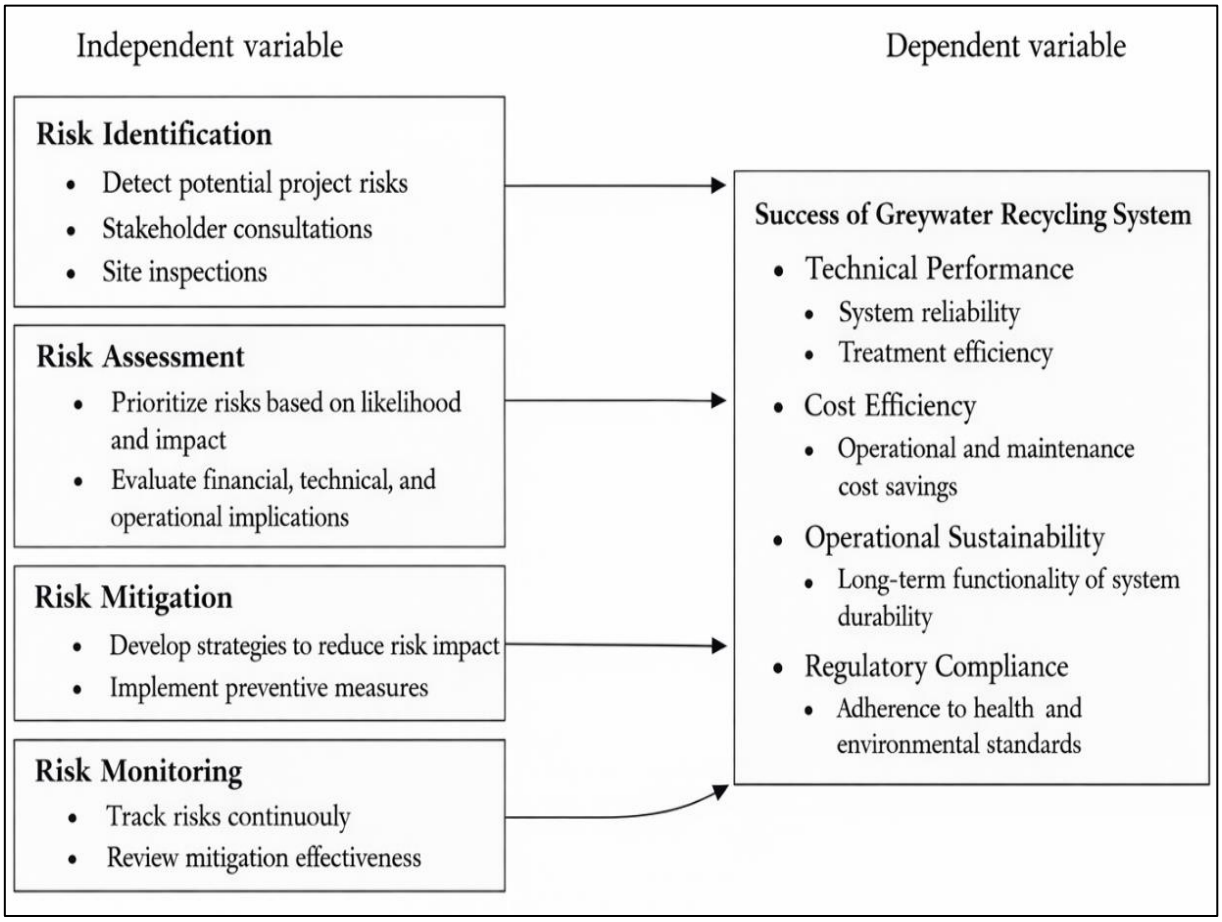

Fig 1 Conceptual Framework

➢ *Research Gap*

Although existing literature recognizes the contribution of project risk management to project performance and the environmental and economic benefits of greywater recycling, the two areas have largely been examined separately. Studies on project risk management generally focus on conventional infrastructure, construction, financial, or public-sector projects, while greywater studies predominantly emphasize technical design, treatment efficiency, water conservation, and environmental performance. Consequently, limited empirical evidence demonstrates how structured risk management practices influence the successful implementation and operation of greywater recycling systems (Yoonus et al., 2020).

The gap is particularly evident in Rwanda's hospitality sector, where limited research has examined the individual contribution of risk identification, risk assessment, risk mitigation, and risk monitoring to the success of sustainable water-reuse initiatives. Existing studies on water and sanitation infrastructure have largely focused on public infrastructure and broader sustainability concerns rather than privately operated hospitality facilities (Tukamuhabwa et al., 2023). This study addressed this contextual and empirical gap by examining how the four project risk management practices influenced the technical performance, cost efficiency, regulatory compliance, and operational sustainability of the greywater recycling system at Radisson Blu Hotel & Convention Centre in Kigali, Rwanda.

III. METHODOLOGY

➢ *Research Design:*

The study adopted a case study research design supported by a mixed-methods approach to examine the effect of project risk management on the success of the greywater recycling system at Radisson Blu Hotel & Convention Centre, Kigali, Rwanda. The case study design enabled an in-depth investigation of project risk management within its actual operational setting, while the mixed-methods approach combined quantitative and qualitative evidence. The quantitative component examined the relationships between risk identification, risk assessment, risk mitigation, risk monitoring, and project success, while qualitative evidence provided contextual explanations of the risk management practices and operational experiences.

➢ *Population and Sample:*

The target population consisted of 70 employees and professionals involved in the implementation, operation, monitoring, and management of the greywater recycling system. These comprised project managers and coordinators, engineers and technical specialists, sustainability and environmental officers, maintenance personnel, and

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operational staff. A sample of 60 respondents was determined using Slovin's formula at a 5% margin of error. Stratified sampling was used to categorize respondents according to their professional groups, followed by simple random sampling within the respective strata to ensure adequate representation.

➢ *Data Collection Tools:*

Primary data were collected using structured questionnaires and semi-structured interviews. The questionnaire consisted mainly of closed-ended items measured on a five-point Likert scale and covered risk identification, risk assessment, risk mitigation, risk monitoring, and project success. Semi-structured interviews were conducted with selected key informants, including managers, engineers, facility personnel, and sustainability officers, to obtain detailed information regarding risks encountered, mitigation measures, operational challenges, and system performance. Content validity was established through expert review to ensure that the instruments were relevant and aligned with the study objectives.

➢ *Reliability:*

The internal consistency of the questionnaire was assessed using Cronbach's Alpha. All study constructs recorded coefficients above the recommended threshold of 0.70, with values ranging from 0.917 to 0.939, demonstrating excellent internal consistency of the research instrument.

Table 1 Reliability Statistics

Variable	Cronbach's Alpha
Risk Identification	0.917
Risk Assessment	0.928
Risk Mitigation	0.939
Risk Monitoring	0.934
Project Success	0.925

Source: Research Findings, 2026

➢ *Data Analysis:*

Quantitative data were checked, coded, cleaned, and analyzed using SPSS. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarize the data. Pearson correlation analysis was applied to establish the strength and direction of relationships between project risk management practices and project success, while multiple linear regression was used to determine the individual and combined effects of risk identification, risk assessment, risk mitigation, and risk monitoring on project success. Hypotheses were tested at a 5% significance level ($p < 0.05$). Qualitative data from the interviews were analyzed thematically and used to complement the quantitative findings.

➢ *Ethical Considerations:*

Authorization was obtained from the University of Kigali and the management of Radisson Blu Hotel & Convention Centre before data collection. Respondents were informed about the purpose of the study, participation was voluntary, and informed consent was obtained. Confidentiality and anonymity were maintained, and the collected information was used strictly for academic purposes.

IV. FINDINGS AND DISCUSSIONS

Data were obtained from all 60 respondents who participated in the study, representing a 100% response rate and providing a complete dataset for analysis. The analysis focused on establishing the relationships between risk identification, risk assessment, risk mitigation, risk monitoring, and the success of the greywater recycling system.

➢ *Correlation between Project Risk Management and Project Success*

Pearson correlation analysis was conducted to establish the strength and direction of the relationships between the four dimensions of project risk management and the success of the greywater recycling system.

Table 2 Pearson Correlation between Project Risk Management Practices and Project Success

Project Risk Management Practice	Project Success (r)	p-value	Interpretation
Risk Identification	0.687	<0.001	Strong positive
Risk Assessment	0.767	<0.001	Strong positive
Risk Mitigation	0.783	<0.001	Strong positive
Risk Monitoring	0.827	<0.001	Very strong positive

Source: Primary Data (2026)

The results indicate that all four project risk management practices were positively and statistically significantly associated with project success ($p < 0.001$). Risk monitoring recorded the strongest relationship with project success ($r = 0.827$), followed by risk mitigation ($r = 0.783$), risk assessment ($r = 0.767$), and risk identification ($r = 0.687$). These findings demonstrate that stronger application of project risk management practices was associated with better technical performance, cost efficiency, operational sustainability, and overall performance of the greywater recycling system.

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➢ *Multiple Regression Analysis*

Multiple linear regression analysis was conducted to determine the combined explanatory contribution of risk identification, risk assessment, risk mitigation, and risk monitoring to the success of the greywater recycling system.

Table 3 Multiple Regression Model Summary

R	R^2	Adjusted R^2	F-statistic	p-value
0.852	0.726	0.706	36.483	<0.001

Source: Primary Data (2026)

The model produced an R value of 0.852 and an R^2 of 0.726, indicating that the four project risk management dimensions jointly explained 72.6% of the variance in project success, while 27.4% was attributable to factors outside the model. The adjusted R^2 of 0.706 further indicated substantial explanatory power after adjustment for the number of predictors. The overall regression model was statistically significant ($F = 36.483$, $p < 0.001$), demonstrating that project risk management practices collectively contributed significantly to explaining variations in the success of the greywater recycling system.

➢ *Regression Coefficients and Hypothesis Testing*

The regression coefficients were examined to determine the unique contribution of each project risk management dimension when the other predictors were held constant.

Table 4 Regression Coefficients and Hypothesis Decisions

Predictor	B	β	t	p-value	Decision
Risk Identification	0.043	0.041	0.265	0.792	H_{01} not rejected
Risk Assessment	0.135	0.140	0.665	0.509	H_{02} not rejected
Risk Mitigation	0.192	0.195	1.170	0.247	H_{03} not rejected
Risk Monitoring	0.545	0.529	4.217	<0.001	H_{04} rejected

Dependent Variable: Project Success. Source: Primary Data (2026)

Risk monitoring emerged as the strongest and only statistically significant independent predictor of project success ($B = 0.545$, $\beta = 0.529$, $t = 4.217$, $p < 0.001$). Holding the other variables constant, a one-unit increase in risk monitoring was associated with a 0.545-unit increase in project success. Risk identification ($\beta = 0.041$, $p = 0.792$), risk assessment ($\beta = 0.140$, $p = 0.509$), and risk mitigation ($\beta = 0.195$, $p = 0.247$) showed positive but statistically non-significant independent effects.

Accordingly, H_{01}, H_{02}, and H_{03} were not rejected, while H_{04} was rejected. This interpretation is more statistically appropriate for hypotheses framed in terms of the *effect* of each predictor because the multiple regression estimates each variable's unique contribution while controlling for the others. The strong bivariate correlations nevertheless indicate that risk identification, risk assessment, and risk mitigation remain important components of the broader risk management process.

➢ *Discussion of Findings*

The findings showed a strong positive association between risk identification and project success ($r = 0.687$, $p < 0.001$). Respondents also reported a high level of risk identification practice (composite mean = 3.921), with environmental risk identification receiving particularly strong assessment. This indicates that identifying technical, environmental, operational, and financial risks early is associated with successful system operation. The finding supports Okiye et al. (2023), who emphasized that early identification enables project teams to anticipate disruptions and establish appropriate responses before risks escalate. However, risk identification was not statistically significant when considered simultaneously with the other risk management dimensions ($\beta = 0.041$, $p = 0.792$), suggesting that identification alone may not independently determine project success.

Risk assessment was also strongly and positively correlated with project success ($r = 0.767$, $p < 0.001$). Risk impact analysis was particularly highly rated (M = 4.233), indicating that systematic evaluation of risk consequences supported decision-making within the greywater recycling system. This finding is consistent with Mutua and Augustus (2020), who associated structured risk assessment and prioritization with improved project outcomes. Nevertheless, its regression coefficient was not statistically significant ($\beta = 0.140$, $p = 0.509$), indicating that its unique effect was limited after accounting for the other risk management practices.

Similarly, risk mitigation demonstrated a strong positive relationship with project success ($r = 0.783$, $p < 0.001$). Staff training was the highest-rated mitigation practice (M = 4.283), highlighting the importance of employee competence in preventing and responding to technical and operational risks. The result supports Rane et al. (2021), who emphasized preventive measures, capacity development, and structured risk responses as important elements of project resilience. Although risk mitigation showed a positive regression coefficient, its independent effect was not statistically significant ($\beta = 0.195$, $p = 0.247$).

Most importantly, risk monitoring emerged as the dominant determinant of project success. It had the strongest bivariate relationship with project success ($r = 0.827$, $p < 0.001$) and remained statistically significant in the multiple regression model ($\beta = 0.529$, $p < 0.001$). Continuous monitoring of risks during system operation was also highly

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rated by respondents (M = 4.200). This finding supports Nnaji et al. (2020), who emphasized continuous monitoring as essential for early detection of emerging problems and maintenance of operational reliability. In the context of greywater recycling, continuous monitoring enables technical faults, compliance concerns, maintenance requirements, and performance deviations to be detected and addressed before they compromise system performance.

Overall, the findings demonstrate that the four project risk management practices function as an interconnected management process rather than isolated activities. Their strong inter-correlations, including correlations as high as r = 0.893 between risk identification and risk assessment, indicate substantial overlap among the dimensions. This helps explain why risk identification, risk assessment, and risk mitigation showed strong individual associations with project success but did not remain statistically significant when entered simultaneously in the regression model. Risk monitoring, however, retained a substantial independent effect, demonstrating that continuous oversight, early detection of operational challenges, compliance monitoring, and performance review were particularly important for sustaining the success of the greywater recycling system.

V. CONCLUSION

The study concluded that project risk management contributed significantly to the success of the greywater recycling system at Radisson Blu Hotel & Convention Centre, Kigali. Risk identification, risk assessment, risk mitigation, and risk monitoring were all positively and significantly associated with project success. Collectively, these practices explained 72.6% of the variation in project success ($R^2 = 0.726$, $p < 0.001$). However, risk monitoring was the strongest and only statistically significant independent predictor ($\beta = 0.529$, $p < 0.001$). The study therefore concludes that integrated risk management, particularly continuous monitoring, is essential for enhancing the technical performance, cost efficiency, operational sustainability, and regulatory compliance of greywater recycling systems in the hospitality sector.

RECOMMENDATIONS

Based on the findings, hotel management should prioritize continuous risk monitoring by strengthening digital monitoring systems for water quality, treatment efficiency, system performance, and maintenance requirements. Regular updating of risk registers should also be undertaken to improve the identification of technical, operational, environmental, and particularly financial risks. In addition, continuous staff training in preventive maintenance, emergency response, water-quality control, and system troubleshooting should be institutionalized to strengthen risk mitigation and sustain system performance.

Policymakers and relevant environmental and water authorities should develop clear technical and regulatory guidelines for greywater recycling in hospitality facilities. Appropriate incentives should also be considered to encourage wider adoption of sustainable water-reuse technologies. Furthermore, collaboration between policymakers, hospitality establishments, and academic institutions should be strengthened to generate evidence on greywater recycling performance and support sustainable water management practices in Rwanda.

- *Recommendations for Future Research*

Future studies should extend this research beyond a single hospitality facility by conducting comparative studies across hotels in Rwanda and the wider East African region to improve the generalizability of the findings. Longitudinal studies are also recommended to examine how risk management practices and greywater recycling system performance evolve over time. Further research could investigate the influence of organizational factors, including management commitment, organizational culture, and technological capacity, on the relationship between project risk management and system success. Finally, future studies should assess the economic returns of risk management practices through cost-benefit analysis to determine their financial value in greywater recycling investments.

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