



Effect of Leadership Practices on the Success of Engineering Projects: A Case of Gihira Water Treatment Plant Upgrade Project in Rubavu District, Rwanda

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Abstract: The study assessed the effect of leadership practices on the success of engineering projects, using the Gihira Water Treatment Plant Upgrade Project in Rubavu District, Rwanda, as the case study. Four leadership dimensions were examined: transformational leadership style, communication practices, conflict resolution strategies, and negotiation practices. A descriptive-correlational design was applied within a mixed-methods study, while the manuscript reports the quantitative strand. The target population comprised 2,147 project stakeholders and a sample of 326 was determined using the Krejcie and Morgan formula. The instrument attained a Content Validity Index of 0.895 and an overall Cronbach's Alpha of 0.862 for 34 measurement items. The regression model explained 82.6% of the variation in project success ($R = 0.909$, $R^2 = 0.826$, adjusted $R^2 = 0.824$). Transformational leadership had a positive significant effect ($B = 0.243$, $t = 7.839$, $p = 0.000$), communication practices produced the strongest effect ($B = 0.457$, $t = 11.718$, $p = 0.000$), conflict resolution strategies were significant ($B = 0.140$, $t = 4.375$, $p = 0.000$), and negotiation practices also contributed significantly ($B = 0.127$, $t = 3.098$, $p = 0.002$). The study concluded that engineering project success depends not only on technical execution but also on leadership that sustains a shared direction, reliable information flows, constructive dispute management, and fair stakeholder agreements. It recommends systematic leadership development, stronger project communication systems, formal conflict-resolution mechanisms, and integrative negotiation procedures in major public infrastructure projects.

Keywords: Leadership Practices, Transformational Leadership, Communication Practices, Conflict Resolution, Negotiation Practices, Project Success

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1. Introduction

Leadership has become a decisive management concern in engineering projects because technical plans must be translated into coordinated human action before infrastructure can deliver its intended value. Complex projects bring together managers, engineers, contractors, public agencies, consultants, suppliers, and communities whose interests do not always move in the same

direction. In such settings, project leadership is expressed through the ability to establish a compelling direction, communicate expectations, manage disagreement, and negotiate workable commitments. Turner and Müller (2005) argued that leadership style deserves attention as a project success factor because project managers influence both team behaviour and the conditions under which work is executed. The relevance of leadership becomes even more pronounced when

projects are technically demanding, socially visible, and exposed to multiple stakeholder interfaces.

Transformational leadership is particularly important where teams need motivation, adaptability, and a shared understanding of why the project matters. Rather than relying solely on formal authority, transformational leaders seek to generate commitment around common objectives and encourage team members to contribute ideas beyond routine task execution. Aga et al. (2016) found that transformational leadership was positively associated with project success and that team-building partly explained this relationship. Müller and Turner (2010) further showed that successful project managers display combinations of intellectual, managerial, and emotional competencies that vary with project type. These observations are relevant to civil engineering projects because effective delivery often depends on how leaders mobilise specialised teams around demanding schedules, quality standards, and stakeholder expectations.

Communication practices form another central element of leadership in infrastructure delivery. Engineering work requires information to move accurately between designers, supervisors, contractors, procurement teams, government officers, and end users. A technically correct decision can still fail operationally when the message reaches the wrong person, arrives late, or is interpreted differently across project teams. Zulch (2014) demonstrated that communication functions as a foundation of project management because it integrates scope, cost, time, and quality considerations. In construction settings, formal communication has also been associated with project success, while weak communication can intensify process and relationship conflict among project teams (Wu et al., 2017). For a water-treatment upgrade, where design changes, safety requirements, supply arrangements, commissioning activities, and community expectations intersect, the quality of communication can therefore affect the pace and reliability of implementation.

Conflict management is equally significant because disagreement is an ordinary feature of multi-stakeholder projects. Conflicts may originate from resource competition, contract interpretation, technical preferences, responsibilities, changes in scope, or competing stakeholder priorities. The problem is not simply the existence of disagreement but the way it is handled. Prieto-Remón et al. (2015) showed that project actors adopt different conflict-resolution strategies depending on the nature of the dispute and their responsibility within the project. Evidence from the construction sector also indicates that integrating and cooperative approaches can strengthen relationship quality and improve the effectiveness of conflict management under appropriate project conditions (Kwofie et al., 2024). This makes conflict resolution a

practical leadership responsibility rather than a secondary administrative activity.

Negotiation adds a further dimension to leadership because engineering projects are built through continuing agreements. Initial contracts do not remove the need for later negotiation; projects frequently require adjustments involving variations, claims, responsibilities, schedules, resources, and stakeholder commitments. Murtoaro and Kujala (2007) describe project activity as a continuum of recurring negotiations in which parties repeatedly seek workable agreements under changing conditions. Within construction, integrative negotiation of subcontract conditions has been associated with opportunities to improve project value, cost performance, quality, and time management (Chi & Mackay, 2015). Lu and Liu (2014) likewise demonstrated that project progress and quality performance can shape dispute-negotiation outcomes. Negotiation is therefore closely connected to both relationship management and the continuity of project execution.

Rwanda continues to place infrastructure at the centre of its long-term development agenda. Vision 2050 identifies reliable infrastructure and improved public services as part of the wider transformation required to support high living standards and sustained economic development (Republic of Rwanda, 2020). Water infrastructure is especially important because access to reliable treatment and distribution systems directly affects public health, economic activity, and community wellbeing. The Gihira Water Treatment Plant Upgrade Project in Rubavu District provides an appropriate setting for examining leadership practices because its implementation required coordination across technical teams, public institutions, contractors, and community stakeholders while maintaining attention to quality, time, operational continuity, and long-term service benefits.

The study was motivated by the need to understand the human and managerial dimensions of engineering project success within the Rwandan context. Technical competence and financial resources remain essential, but they do not automatically generate coordinated implementation. Difficulties in stakeholder alignment, delayed decisions, communication gaps, unresolved disputes, or poorly negotiated commitments can weaken otherwise sound project plans. The dissertation therefore examined four leadership practices, transformational leadership style, communication practices, conflict resolution strategies, and negotiation practices, and related them to project success as reflected in efficiency, effectiveness, sustainability, and project impact. By focusing on the Gihira Water Treatment Plant Upgrade Project, the research provided empirical evidence on the leadership behaviours that accompanied successful delivery in a major public water infrastructure setting.

Project success in engineering is also broader than completion of physical works. A technically operational facility may still underperform if it is delivered with persistent disputes, weak stakeholder acceptance, poor coordination, or insufficient arrangements for sustainable operation. Turner and Müller (2005) emphasised that project success cannot be separated from the managerial context in which teams are led. This broader view is consistent with the present study, which treated project success through efficiency, effectiveness, sustainability, and impact rather than relying on a single completion indicator. The four leadership practices were therefore examined as mechanisms through which project actors could protect both implementation performance and the longer-term value of the upgraded facility.

The interaction among the four leadership dimensions is equally important. Transformational leadership can create commitment, but commitment becomes difficult to sustain when information is delayed or contradictory. Communication may be clear, yet unresolved disputes can still weaken cooperation. Conflict can be settled temporarily, but poor negotiation may recreate the same disagreement when responsibilities or resources remain unclear. For this reason, the study did not treat leadership as a single behaviour. Instead, it examined a package of practices that operate at different points in the project-management process. This approach makes it possible to identify whether one practice remains statistically important after the contribution of the others is considered.

Infrastructure leadership in Rwanda also operates within an institutional environment where public agencies, contractors, technical professionals, district authorities, and communities are expected to work toward common development objectives. Vision 2050 places strong emphasis on effective institutions and quality infrastructure as foundations for higher living standards (Republic of Rwanda, 2020). Public engineering projects therefore carry a dual responsibility: they must meet technical specifications and they must deliver services that are trusted and valued by the population. Leadership practices influence both responsibilities because they shape coordination within the project organisation and the quality of relationships with external stakeholders.

The case of Gihira is particularly useful because water-treatment infrastructure combines continuous public-service expectations with complex engineering requirements. Upgrading an operating water facility can involve technical interfaces, procurement dependencies, quality controls, safety obligations, stakeholder complaints, and pressures to minimise service disruption. These conditions create a management environment in which leadership decisions are immediately consequential. The study therefore responds to a practical question of direct importance to project management in Rwanda: which leadership

practices most strongly accompany successful delivery when several practices are considered together rather than discussed separately?

1.1 General Objective

The general objective was to assess the effect of leadership practices on the success of engineering projects, using the Gihira Water Treatment Plant Upgrade Project in Rubavu District, Rwanda, as the case study.

1.2 Specific Objectives

The study was guided by four specific objectives that reflected the principal leadership practices investigated in relation to project success.

- i. To evaluate the effect of transformational leadership style on the success of Gihira Water Treatment Plant Upgrade Project in Rubavu District.
- ii. To assess the effect of communication practices on the success of Gihira Water Treatment Plant Upgrade Project in Rubavu District.
- iii. To examine the effect of conflict resolution strategies on the success of Gihira Water Treatment Plant Upgrade Project in Rubavu District.
- iv. To analyse the effect of negotiation practices on the success and successful delivery of Gihira Water Treatment Plant Upgrade Project in Rubavu District.

2. Literature Review

The literature review develops the theoretical and empirical basis for examining how leadership practices relate to engineering project success. It first presents the theories used to interpret leadership behaviour and then reviews evidence concerning transformational leadership, communication, conflict resolution, and negotiation in project environments.

2.1 Theoretical Review

Three complementary perspectives guided the study: Trait Theory, Behavioural Theory, and Transformational Leadership Theory. Together, they explain why leader characteristics matter, how observable leadership behaviour shapes project processes, and how inspirational leadership can mobilise project teams toward demanding objectives.

2.1.1 Trait Theory

Trait Theory provides a starting point for considering the personal attributes that enable leaders to influence teams and manage demanding project environments.

Trait-based approaches focus on relatively enduring characteristics associated with effective leadership, including confidence, integrity, emotional stability, judgement, adaptability, and interpersonal capability. Northouse (2016) explains that trait perspectives seek to identify qualities that distinguish effective leaders and help explain why individuals respond differently to comparable leadership demands. In project settings, these characteristics can influence how a manager interprets risk, communicates under pressure, handles disagreement, and maintains credibility among technically specialised stakeholders.

The theory is relevant to the Gihira Water Treatment Plant Upgrade Project because transformational behaviour does not emerge in isolation from the leader's personal capacity. A project manager who demonstrates resilience, ethical consistency, confidence, and social awareness is better positioned to articulate a convincing project direction, sustain trust, and encourage constructive responses when implementation becomes difficult. Trait Theory therefore supports the first objective by clarifying the personal foundation from which transformational leadership behaviours may develop.

2.1.2 Behavioural Theory

Behavioural Theory shifts attention from who a leader is to what a leader does, making it especially relevant to the communication, conflict-resolution, and negotiation practices examined in the study.

Behavioural perspectives treat leadership as a pattern of observable actions that can be learned, practised, evaluated, and improved. Rather than assuming that effective leadership depends entirely on innate characteristics, the theory considers how leaders structure tasks, exchange information, involve followers, solve problems, and manage relationships. Northouse (2016) notes that behavioural approaches opened the possibility of developing leaders through deliberate improvement of specific leadership actions.

Communication practices are readily understood through this lens because clarity, feedback, responsiveness, and choice of communication channels are observable leadership behaviours. Conflict management also reflects behaviour: leaders may confront, collaborate, compromise, avoid, or mediate when disagreements arise. Negotiation similarly involves deliberate choices about information sharing, fairness, consensus, concessions, and mutual gain. Behavioural Theory therefore provides a practical link between leadership

actions and the project processes investigated under the second, third, and fourth objectives.

For the Gihira project, the theory implies that leadership effectiveness can be strengthened by changing what project leaders routinely do. Clearer briefings can reduce ambiguity; structured mediation can prevent disagreements from escalating; transparent bargaining can improve acceptance of project decisions. Because these practices are observable and repeatable, they can be embedded in project procedures rather than treated as individual personality preferences.

2.1.3 Transformational Leadership Theory

Transformational Leadership Theory explains how leaders move beyond routine supervision by creating commitment to a shared vision and encouraging followers to contribute at a higher level.

Transformational leadership emphasises idealised influence, inspirational motivation, intellectual stimulation, and individualised consideration. Bass and Riggio (2006) describe transformational leaders as individuals who encourage followers to transcend immediate self-interest, develop confidence, and pursue collective goals with greater commitment. The approach is particularly useful in complex projects where teams must adapt, solve non-routine problems, and sustain motivation through periods of uncertainty.

Empirical project research provides support for this theoretical position. Aga et al. (2016) found that transformational leadership contributed to project success and that team-building served as an important mechanism through which the effect occurred. Müller and Turner (2010) also showed that successful project managers require leadership competencies that vary with project characteristics, with more complex environments demanding stronger interpersonal and transformational capabilities. These findings reinforce the relevance of the theory to infrastructure projects that require sustained coordination among diverse professional groups.

Within the Gihira Water Treatment Plant Upgrade Project, transformational leadership was represented through vision, inspiration, innovation, motivation, and team commitment. The theory therefore directly underpinned the first objective and provided a basis for interpreting whether stronger transformational practices were associated with better efficiency, effectiveness, sustainability, and project impact.

2.2 Empirical Review

Empirical evidence was reviewed in the order of the four specific objectives. The emphasis is placed on how comparable studies measured leadership practices, the project settings they examined, and the conclusions they reached regarding performance or success.

2.2.1 Transformational Leadership Style and Project Success

Research on project leadership consistently identifies transformational behaviour as an important mechanism for building commitment and enabling teams to respond to complex project demands.

Aga et al. (2016) examined development projects and tested the relationship between transformational leadership and project success while considering team-building as a mediating mechanism. Their findings showed a positive contribution of transformational leadership to project success and demonstrated that part of this contribution operated through stronger team-building. The study is relevant to engineering projects because multidisciplinary teams require both technical coordination and a common motivational direction.

Turner and Müller (2005), in a review centred on leadership as a project success factor, highlighted the gap between general management research, which has long treated leadership as critical, and traditional project success literature, which historically paid less attention to the project manager's leadership style. Their work strengthened the case for analysing leadership characteristics alongside conventional success measures such as time, cost, and quality.

Müller and Turner (2010) extended this line of inquiry by profiling the leadership competencies of managers associated with successful projects. Using responses from project managers across several project types, they found that successful managers displayed combinations of intellectual, managerial, and emotional competencies, with some competencies differing according to project complexity and application. For a technically demanding water infrastructure project, this supports the expectation that project success is partly connected to the quality of leadership exercised by those coordinating specialised teams.

The present study builds on this evidence by testing transformational leadership directly against project success in a Rwandan public water project. Unlike broad multi-industry investigations, the Gihira case provides a specific infrastructure context in which leadership had to operate across engineering, public administration, contracting, and community interfaces.

Aga et al. (2016) also demonstrated that the pathway from transformational leadership to project success is partly relational. Team-building mediated part of the observed effect, which suggests that leadership contributes to performance by shaping how people work together rather than by influencing outcomes directly in isolation. This is highly relevant to engineering projects because task interdependence is extensive: design, construction, quality control, procurement, and

commissioning teams depend on one another's timely performance.

The competency evidence reported by Müller and Turner (2010) further cautions against assuming that one leadership style is universally sufficient. Their findings showed that successful leadership profiles vary with project type and complexity. Engineering and construction projects frequently combine high technical uncertainty with contractual and stakeholder complexity. A transformational orientation may therefore need to be accompanied by practical competence in coordination, decision-making, and relationship management.

Taken together, the literature supports a testable expectation that stronger transformational leadership should be associated with better project outcomes, but it also leaves room for other leadership practices to explain additional variance. The Gihira study addressed this by entering transformational leadership into a multivariable model rather than testing it as the only leadership predictor.

2.2.2 Communication Practices and Project Success

Communication research in project environments shows that information flow is not merely a support activity; it shapes coordination, conflict, decision speed, and the ability of teams to act on shared priorities.

Zulch (2014) investigated communication within project management and found that communication performs a foundational role by integrating the central project management areas. The study surveyed construction-related professionals and concluded that the project manager's communication ability affects the effective coordination of cost, scope, time, and quality. This is closely aligned with the Gihira study, where communication was measured through clarity of information, feedback flow, and the suitability of channels used to reach stakeholders.

Wu et al. (2017) analysed communication-conflict interaction among construction project teams and modelled its relationship with project success. Their results showed that communication willingness and formal communication were positively associated with project success, while process and relationship conflict could undermine performance. Importantly, enhanced communication strengthened the constructive effect of task conflict and reduced the damaging consequences of dysfunctional conflict. This evidence illustrates how communication influences project outcomes both directly and through its interaction with team relationships.

The empirical literature therefore suggests that communication quality matters most where work is interdependent and errors in information transmission can affect several parties at once. Water-treatment

upgrades involve design details, safety procedures, procurement requirements, commissioning sequences, and community service expectations. A communication system that carries accurate information and closes feedback loops can reduce coordination failures and support timely corrective action.

The current study adds evidence from Rubavu District by estimating the independent contribution of communication practices while transformational leadership, conflict resolution, and negotiation were controlled statistically. This allows the effect of communication to be distinguished from the broader leadership environment in which it operates.

The communication literature also indicates that the quality of formal channels matters, not only the amount of information exchanged. Wu et al. (2017) found that formal communication was positively associated with project success, whereas some forms of informal communication were not beneficial. This distinction is important because complex engineering projects require traceable technical decisions. Verbal exchanges may support coordination, but formal records are often necessary for design instructions, approvals, changes, and accountability.

Zulch (2014) approached the issue from the perspective of project integration and concluded that communication connects the principal project-management areas. In practice, this means that communication can influence performance through several routes at once: it clarifies scope, coordinates time, supports cost control, and enables quality expectations to be understood. A single communication weakness can therefore produce consequences across multiple success dimensions.

For the Gihira study, the evidence justified measuring communication through clarity, feedback flow, and the channels used. These indicators capture both the content and the process of communication. Their inclusion also allowed the regression analysis to establish whether communication made an independent contribution after transformational leadership and the two relationship-management variables were taken into account.

2.2.3 Conflict Resolution Strategies and Project Success

Conflict-management studies show that the outcome of disagreement depends heavily on how project actors respond to it, particularly in construction environments where organisational boundaries and stakeholder interests overlap.

Prieto-Remón et al. (2015) examined conflict-resolution approaches in project settings using evidence from project managers and team members. The study found meaningful differences in the strategies used to address disagreement and showed that project responsibility and

conflict sources shape the way disputes are handled. Confronting and compromising approaches were frequently selected, illustrating that constructive resolution requires deliberate managerial choice rather than passive avoidance.

Wu et al. (2017) further demonstrated that the relationship between conflict and project success is complex. Task conflict may contribute positively under conditions of stronger communication, whereas process and relationship conflicts tend to undermine project success. Their findings imply that project leaders should distinguish between disagreements that stimulate useful technical debate and conflicts that damage coordination or relationships.

Evidence from the Ghanaian construction sector provides additional relevance to African project environments. Kwofie et al. (2024) identified different relationship clusters among project teams and found that the effectiveness of conflict-management strategies varied across those relationship conditions. Integrating approaches performed well in several collaborative and partnering configurations, suggesting that conflict-resolution strategies should be fitted to the quality and structure of project relationships.

Against this background, the Gihira study evaluated mediation, collaboration, and structured problem solving as practical mechanisms for resolving project disputes. The analysis therefore contributes evidence on whether conflict-resolution behaviour remained statistically important after other leadership practices were taken into account.

Conflict research also shows that the same disagreement can have different consequences depending on how it is managed. Prieto-Remón et al. (2015) observed that project actors choose among several resolution strategies and that responsibility within the project influences those choices. The implication is that project leaders need diagnostic judgement: a collaborative response may be appropriate in one situation, whereas a direct confronting approach may be required when safety, quality, or contractual obligations are at risk.

Kwofie et al. (2024) provide further evidence from the construction environment by showing that relationship conditions shape the effectiveness of conflict-management strategies. Their findings suggest that conflict-resolution procedures cannot be separated from trust, role clarity, and the broader quality of project relationships. A technically correct solution may still fail if the parties do not accept the process used to reach it.

The present study therefore focused on mediation, collaboration, and problem-solving rather than treating conflict resolution as a single undifferentiated activity. These practices are especially relevant in public infrastructure projects where disputes can involve both

internal project teams and external stakeholders, and where unresolved conflict can delay activities that depend on coordinated access, approvals, or resource commitments.

2.2.4 Negotiation Practices and Project Success

Negotiation is embedded throughout project delivery because contractual agreements, changes, resource allocations, claims, and stakeholder commitments require repeated adjustment as implementation proceeds.

Murtoaro and Kujala (2007) developed a project negotiation framework that treats major projects as a continuum of recurring negotiations between parties with different interests. Their empirical inquiry into negotiations surrounding a major construction project showed that project negotiation involves both efficiency and fairness considerations. This perspective is relevant to the Gihira study because consensus building, fairness, and mutual benefit were central indicators of negotiation practice.

Lu and Liu (2014) investigated dispute negotiation in construction and found that project progress and quality performance affected bargaining conditions and negotiation outcomes. Their results indicated that better progress and quality can support successful dispute settlement by strengthening the contractor's bargaining position and facilitating agreement. The study demonstrates that negotiation is connected to wider project performance rather than being an isolated contractual event.

Chi and Mackay (2015) examined subcontract negotiation in the Australian construction industry using survey evidence from contractors and subcontractors. Both groups identified opportunities for integrative negotiation to improve project value and performance, even where perceptions of fairness differed. Their findings support the use of negotiation strategies that seek mutual gains rather than relying exclusively on competitive bargaining.

The present research applied these ideas to a public water infrastructure project by testing whether consensus building, transparent bargaining, fairness, and mutually beneficial outcomes were associated with project success. In doing so, the study provided evidence from a Rwandan engineering context where negotiations can influence procurement, resource distribution, community relations, and implementation continuity.

Negotiation literature similarly demonstrates that project bargaining is not restricted to procurement. Murtoaro and Kujala (2007) found that negotiations recur throughout implementation as project conditions, information, and stakeholder interests evolve. This perspective is useful for infrastructure projects because technical changes, claims, work sequencing, compensation, and community

concerns may require new agreements after the original contract has been signed.

Lu and Liu (2014) connected negotiation outcomes to project performance by showing that progress and quality conditions can alter bargaining power and the ability of parties to settle disputes. The finding suggests a two-way relationship: negotiation influences delivery, but project performance can also affect the negotiating position of stakeholders. Leaders therefore need to protect both the fairness of the process and the operational conditions that make agreements credible.

Chi and Mackay (2015) provide evidence that integrative bargaining can create opportunities for improved project value. Their construction-industry survey showed that contractors and subcontractors recognised the potential for negotiation to improve cost, quality, and time outcomes even when the parties did not hold identical views on contractual fairness. This is especially relevant to the Gihira context, where negotiation had to support continued cooperation among parties with different organisational interests.

Across the four empirical strands, a common pattern emerges: project success depends on

3. Methodology

The methodology describes how the study population was defined, how respondents were selected, how the questionnaire was assessed for measurement quality, and how the quantitative evidence was analysed. Although the dissertation adopted a mixed-methods approach, the manuscript reports the questionnaire-based quantitative strand used for inferential testing.

3.1 Research Design

A descriptive and correlational design was employed within the wider mixed-methods study. The descriptive component captured prevailing leadership practices and project conditions, while the correlational component examined the direction and strength of statistical relationships among the variables. This combination was appropriate because the study sought both to characterise the project environment and to test whether leadership practices predicted project success. Creswell and Creswell (2018) note that quantitative designs are suitable where variables are measured systematically and hypotheses are examined using numerical evidence.

3.2 Study Population

The study targeted 2,147 stakeholders connected with the Gihira Water Treatment Plant Upgrade Project. The population consisted of 3 project managers, 6 project team members drawn from WASAC, contractors, supervisors and engineers, 2 district officials, and 2,136

community representatives. These categories were included because they represented the principal groups exposed to project leadership decisions, implementation processes, and project outcomes.

3.3 Sampling Design

The sample size was determined using the Krejcie and Morgan approach for a finite population at a 95% confidence level and a 5% margin of error. Krejcie and Morgan (1970) provide a formula that incorporates population size, the chi-square value, the assumed population proportion, and the desired degree of precision.

$$s = \chi^2 NP(1 - P) / [d^2(N - 1) + \chi^2 P(1 - P)]$$

Using $N = 2,147$, $\chi^2 = 3.841$, $P = 0.50$ and $d = 0.05$ produced a sample of approximately 326 respondents.

Proportional allocation yielded 2 project managers, 4 project team members, 1 district official, and 319 community representatives. Stratified random sampling was applied so that each stakeholder category was represented, after which respondents were selected within the relevant strata.

3.4 Data Collection Instruments

Data were collected using a structured questionnaire, interview guide, and documentary review. The questionnaire generated quantitative data on leadership practices and project success, while interviews provided qualitative insights from key informants. Documentary review examined project reports, progress records, feasibility studies, meeting minutes, policy documents, and monitoring reports for triangulation purposes.

3.5 Pilot Study, Validity and Reliability

Before the main analysis, the research instrument was reviewed and tested to establish whether its items adequately represented the intended constructs and produced internally consistent measurements. Content validity and Cronbach's Alpha were therefore used as the principal quality checks.

Content validity was evaluated through expert judgement using the Content Validity Index. Of the 38 questionnaire items reviewed, 34 substantive items were judged directly relevant to the study constructs, producing a CVI of 0.895. The value exceeded the accepted benchmark applied in the dissertation and indicated that the questionnaire adequately covered transformational leadership, communication practices, conflict resolution, negotiation, and project success.

Reliability was assessed using Cronbach's Alpha. Transformational leadership recorded $\alpha = 0.812$, communication practices $\alpha = 0.786$, conflict resolution strategies $\alpha = 0.804$, negotiation practices $\alpha = 0.791$, and project success $\alpha = 0.887$. The overall coefficient was $\alpha = 0.862$ for 34 measurement items. Because every scale exceeded 0.70, the instrument demonstrated satisfactory internal consistency.

3.6 Data Analysis

Quantitative data from complete questionnaires were processed using IBM SPSS Statistics Version 26. Pearson correlation analysis assessed the direction and strength of bivariate relationships, whereas multiple linear regression estimated the independent contribution of each leadership practice to project success. Field (2018) explains that regression permits the effect of one predictor to be interpreted while the remaining predictors are statistically held constant.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon$$

In the model, Y represented project success; X_1 represented transformational leadership style; X_2 represented communication practices; X_3 represented conflict resolution strategies; X_4 represented negotiation practices; β_0 was the constant; β_1 – β_4 were the regression coefficients; and ε represented unexplained variation.

3.7 Ethical Considerations

Ethical safeguards were applied throughout data collection and analysis. Participation was voluntary, respondents were informed about the academic purpose of the study, and no names were required on the questionnaire. Authorization was obtained through the relevant institutional and project channels before data collection. Confidentiality was maintained during data handling, and findings were reported in aggregate form so that individual participants could not be identified.

4. Results and Discussions

The results are organised to show the adequacy of the quantitative dataset and then to test the four leadership practices against project success. The presentation moves from response rate to correlation, regression, decisions on the null hypotheses, and an objective-based discussion linked to empirical literature.

4.1 Response Rate

Response status was reviewed before inferential analysis so that only complete questionnaires were used in the statistical model.

Table 1: Response Rate

Questionnaires	Frequency	Percentage (%)
Returned Complete	316	96.93
Returned Incomplete	7	2.15
Unreturned	3	0.92
Total	326	100.00

Source: Field Data, 2026

Table 1 shows the response position for the entire sample of 326 respondents. A total of 316 questionnaires were returned complete, equivalent to 96.93% of the sample, while 7 questionnaires (2.15%) were returned incomplete and 3 questionnaires (0.92%) were not returned. The 316 complete responses therefore constituted the valid dataset used for the subsequent correlation and regression analyses. The distribution also indicates that missing or unusable responses represented only a small proportion of the intended sample, allowing the inferential results to reflect nearly all sampled stakeholder categories.

4.2 Inferential Statistics

Inferential analysis was used to move beyond descriptive perceptions and establish whether transformational leadership, communication, conflict resolution, and negotiation were statistically associated with project success and whether each variable retained an independent predictive effect in the combined model.

4.2.1 Correlation Analysis

Pearson correlation coefficients were computed for the four leadership variables and project success. The coefficients show both the direction and the strength of the bivariate relationships before the effects of other predictors are controlled.

Table 2: Correlations

		Transformational Leadership Style	Communication practices	Conflict resolution strategies	Negotiation practices	Project success
Transformational Leadership Style	Pearson	1	.645**	.678**	.726**	.786**
	Correlation Sig. (2-tailed)		.000	.000	.000	.000
Communication practices	N	316	316	316	316	316
	Pearson Correlation Sig. (2-tailed)	.645**	1	.594**	.777**	.836**
Conflict resolution strategies	N	316	316	316	316	316
	Pearson Correlation Sig. (2-tailed)	.678**	.594**	1	.704**	.717**
Negotiation practices	N	316	316	316	316	316
	Pearson Correlation Sig. (2-tailed)	.726**	.777**	.704**	1	.808**
Project success	N	316	316	316	316	316
	Pearson Correlation	.786**	.836**	.717**	.808**	1

Sig. (2-tailed)	.000	.000	.000	.000	
N	316	316	316	316	316

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

Field Data, 2026

Table 2 indicates that all four leadership practices had positive and statistically significant relationships with project success. Communication practices recorded the strongest bivariate relationship ($r = 0.836$, $p = 0.000$), followed by negotiation practices ($r = 0.808$, $p = 0.000$), transformational leadership style ($r = 0.786$, $p = 0.000$), and conflict resolution strategies ($r = 0.717$, $p = 0.000$). The results show that better leadership practices were consistently associated with stronger project-success ratings. Because several predictors were also correlated with one another, however, the regression analysis was

necessary to determine their unique contributions when assessed simultaneously.

4.2.2 Regression Analysis

Multiple linear regression was applied to determine how much of the observed variation in project success could be explained jointly by the four leadership practices and to identify the contribution of each predictor within the same statistical model.

Table 3: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.909 ^a	.826	.824	.15947	1.736

a. Predictors: (Constant), Negotiation practices, Conflict resolution strategies, Transformational Leadership Style, Communication practices
b. Dependent Variable: Project success

Source: Field Data, 2026

Table 3 presents a multiple correlation coefficient of $R = 0.909$, showing a very strong combined relationship between the leadership predictors and project success. The R^2 value of 0.826 means that transformational leadership, communication, conflict resolution, and negotiation jointly explained 82.6% of the observed variation in project success. After adjustment for the

number of predictors, the explanatory power remained almost unchanged at 82.4%. The standard error of estimate was 0.15947, while the Durbin-Watson statistic of 1.736 was sufficiently close to 2.0 to indicate no evident problem of residual autocorrelation in the fitted model.

Table 4: Analysis of Variance (ANOVA)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	37.671	4	9.418	376.720	.000 ^b
	Residual	7.909	311	.025		
	Total	45.580	315			

a. Dependent Variable: Project success
b. Predictors: (Constant), Negotiation practices, Conflict resolution strategies, Transformational Leadership Style, Communication practices

Source: Field Data, 2026

Table 4 confirms that the regression model was statistically significant, $F(4, 311) = 376.720$, $p = 0.000$. Since the probability value was below the 0.05 significance level, the four leadership practices, considered together, provided a meaningful statistical explanation of project success. The regression sum of squares of 37.671 was substantially larger than the

residual sum of squares of 7.909, which is consistent with the high R^2 reported in the model summary. The ANOVA result therefore justified proceeding to the individual regression coefficients to determine which leadership practices contributed significantly while the other predictors were controlled.

Table 5: Coefficients

Model	Unstandardized Coefficients	Standardized Coefficients		t	Sig.	Collinearity Statistics	
	B	Error Std.	Beta			Tolerance	VIF
1 (Constant)	.156	.111		1.405	.159		
Transformational Leadership Style	.243	.031	.290	7.839	.000	.407	2.456
Communication practices	.457	.039	.447	11.718	.000	.382	2.618
Conflict resolution strategies	.140	.032	.155	4.375	.000	.444	2.251
Negotiation practices	.127	.041	.141	3.098	.002	.277	3.615

a. Dependent Variable: Project success

Source: Field Data, 2026

Table 5 shows that every leadership variable made a statistically significant positive contribution to project success. Communication practices had the largest standardized effect ($B = 0.457$, $\beta = 0.447$, $t = 11.718$, $p = 0.000$), followed by transformational leadership style ($B = 0.243$, $\beta = 0.290$, $t = 7.839$, $p = 0.000$). Conflict resolution strategies remained significant ($B = 0.140$, $\beta = 0.155$, $t = 4.375$, $p = 0.000$), and negotiation practices also contributed positively ($B = 0.127$, $\beta = 0.141$, $t = 3.098$, $p = 0.002$). All VIF values were below 10, ranging from 2.251 to 3.615, indicating that harmful multicollinearity was not evident in the model.

Based on the unstandardized coefficients, the estimated regression equation was: Project Success = $0.156 + 0.243(\text{Transformational Leadership Style}) +$

$0.457(\text{Communication Practices}) + 0.140(\text{Conflict Resolution Strategies}) + 0.127(\text{Negotiation Practices}) + \varepsilon$. Holding the other predictors constant, the positive coefficients indicate that stronger application of each leadership practice was associated with higher predicted project success.

4.3 Decision on Null Hypotheses

The null hypotheses were assessed using the p-values from the multiple regression model. The decision rule was to reject a null hypothesis when $p < 0.05$ and retain it when $p \geq 0.05$.

Table 6: Decision on Null Hypotheses

Null Hypothesis	p-value	Decision
H01: Transformational leadership style has no significant effect on the success of Gihira Water Treatment Plant Upgrade Project.	.000	Rejected
H02: Communication practices have no significant effect on the success of Gihira Water Treatment Plant Upgrade Project.	.000	Rejected
H03: Conflict resolution strategies do not significantly contribute to the success of Gihira Water Treatment Plant Upgrade Project.	.000	Rejected
H04: Negotiation practices have no significant effect on the performance and successful delivery of Gihira Water Treatment Plant Upgrade Project.	.002	Rejected

Source: Field Data, 2026

Table 6 shows that all four null hypotheses were rejected. Transformational leadership style, communication practices, and conflict resolution strategies each produced $p = 0.000$, while negotiation practices produced $p = 0.002$. Every value was below the 0.05 decision threshold, providing statistical evidence that the four leadership practices each contributed significantly to project success when entered together in the regression model. The decisions also show that the study's four specific objectives were answered consistently: no

leadership variable became statistically redundant after the effects of the other variables were taken into account.

4.4 Discussion of Research Findings

The discussion considers the findings in the same sequence as the specific objectives. Each result is interpreted in relation to the statistical evidence from the Gihira project and then compared with relevant project-management and construction research.

4.4.1 Transformational Leadership Style and Project Success

The first objective examined whether transformational leadership affected project success. The regression evidence established a positive and statistically significant contribution after communication, conflict resolution, and negotiation had been controlled.

The finding suggests that a project leader's ability to provide direction, inspire commitment, encourage innovation, and motivate team members contributed materially to the success of the Gihira Water Treatment Plant Upgrade Project. In engineering work, this effect is plausible because implementation problems rarely have purely routine solutions. Teams must often interpret design information, respond to unexpected conditions, and maintain commitment despite schedule or resource pressure. Transformational leadership can create the shared purpose required for specialists to coordinate their separate responsibilities rather than operate as disconnected technical units.

The result is consistent with Aga et al. (2016), who found that transformational leadership contributed positively to project success and that team-building partly mediated this relationship. It also aligns with Turner and Müller (2005), whose review positioned leadership style as an important project success consideration rather than a peripheral managerial issue. The Gihira evidence extends these conclusions to a Rwandan public water project and demonstrates that transformational leadership retained its significance even when other interpersonal leadership practices were included in the same model.

Müller and Turner (2010) further observed that successful project managers display combinations of leadership competencies that depend partly on the type and complexity of the project. The Gihira project involved technical upgrading, public-service expectations, contractors, government stakeholders, and community representatives. A leadership approach capable of maintaining motivation while adapting to this complexity would therefore be expected to support project efficiency, effectiveness, sustainability, and impact.

The standardized coefficient also shows that transformational leadership retained a meaningful effect even after communication practices were entered into the model. This matters because vision and communication are related but not identical. Communication concerns the movement and clarity of information, whereas transformational leadership concerns the motivational quality and direction attached to that information. The regression result indicates that inspirational leadership contributed something beyond simple message transmission.

From a project-management perspective, the finding supports leadership development that combines technical competence with the capacity to influence people. Engineering organisations often promote managers because of strong professional expertise, yet successful project leadership also requires the ability to build commitment across teams that may have different priorities or contractual relationships. The Gihira evidence therefore reinforces the argument that leadership preparation should be treated as part of project capability development rather than as an optional soft-skill activity.

4.4.2 Communication Practices and Project Success

The second objective produced the largest standardized regression effect in the model, establishing communication practices as the strongest independent predictor of project success.

The magnitude of the communication coefficient indicates that the success of the project was closely associated with how clearly information was exchanged, whether feedback moved in both directions, and whether the selected communication channels reached the appropriate stakeholders. Engineering projects depend on tightly connected activities: an instruction misunderstood by one team can affect procurement, site execution, safety, quality inspection, or commissioning. Effective communication reduces these coordination losses by making responsibilities and expectations visible before errors become expensive.

This result supports Zulch (2014), who found that communication performs a foundational function in project management because it helps integrate scope, cost, time, and quality. The result is also consistent with Wu et al. (2017), who showed that formal communication and communication willingness were positively related to construction project success and could shape the way conflict affected project outcomes. In the Gihira setting, these mechanisms help explain why communication exerted more predictive weight than the other leadership variables.

The finding further suggests that two-way communication deserves particular attention. A project can distribute instructions efficiently and still fail to learn from field conditions if feedback does not travel upward. The Gihira result supports communication arrangements in which site teams, communities, and other stakeholders can report problems, obtain responses, and verify that decisions have been understood. This closes the loop between information provision and implementation.

4.4.3 Conflict Resolution Strategies and Project Success

The third objective established that conflict-resolution strategies had a positive and statistically significant

effect on project success, even though their standardized coefficient was smaller than those for communication and transformational leadership.

The finding indicates that mediation, collaboration, and structured problem solving helped protect project implementation from the negative effects of unresolved disagreement. Construction and engineering projects naturally create points of tension because parties work under different contracts, professional obligations, technical interpretations, and resource constraints. When disagreement is addressed early and fairly, attention can return to the work itself; when it is allowed to persist, time and managerial effort are diverted away from project objectives.

Prieto-Remón et al. (2015) similarly found that project participants rely on distinct conflict-resolution strategies depending on the source and context of disagreement. Their work highlights the role of confronting and compromising approaches in dealing with project conflict. Kwofie et al. (2024), working in the Ghanaian construction industry, also demonstrated that the effectiveness of conflict-management strategies changes across different relationship clusters and that integrating approaches can perform well in several collaborative project relationships.

The Gihira result also complements Wu et al. (2017), who distinguished between forms of conflict that may support useful task debate and those that damage project relationships or processes. This distinction is important for engineering management: leaders should not suppress every disagreement, but they must prevent technical debate from becoming relationship conflict or implementation obstruction. The significant coefficient suggests that the project benefited when disputes were converted into manageable problems rather than allowed to become persistent barriers.

The smaller standardized coefficient for conflict resolution should not be interpreted as evidence that conflict management is unimportant. Regression coefficients show relative contribution within a combined model, not the practical cost of ignoring a variable. A single unresolved dispute can disrupt access, delay approvals, or damage cooperation between parties. The significant coefficient demonstrates that, across the sample, better conflict-resolution practices still predicted improved project success after the stronger effects of communication and transformational leadership were considered.

4.4.4 Negotiation Practices and Project Success

The fourth objective showed that negotiation practices had a positive and statistically significant effect on project success, confirming that fair consensus building and mutually beneficial agreements supported delivery.

Although the standardized effect was the smallest among the four predictors, the result remained significant after the other leadership variables were held constant. This indicates that negotiation added a distinct contribution to project success. In practice, water infrastructure projects require agreement on resources, sequencing, responsibilities, changes, claims, community concerns, and the distribution of obligations. A negotiation process that is perceived as fair can reduce resistance and help parties preserve working relationships even when their initial interests differ.

Murtoaro and Kujala (2007) argue that project delivery can be understood as a recurring series of negotiations rather than a single contract-setting event. Their framework is consistent with the Gihira result because agreements must often be revisited as project conditions change. Lu and Liu (2014) also showed that progress and quality performance can improve dispute-negotiation outcomes, linking bargaining processes to wider project success conditions.

Evidence from construction subcontracting points in the same direction. Chi and Mackay (2015) found that contractors and subcontractors recognised opportunities to improve project performance and value through integrative negotiation, despite differences in how the fairness of contractual conditions was perceived. The positive Gihira coefficient therefore supports negotiation practices that seek workable mutual gains, transparent decisions, and durable agreements rather than short-term positional victories.

Negotiation's independent significance is also noteworthy because the model already included communication and conflict resolution. This indicates that negotiation was not merely another form of communication or dispute management. It contributed through the specific work of aligning interests, allocating resources, and converting competing positions into agreed commitments. The positive coefficient therefore supports treating negotiation capability as a distinct project-management competence.

5. Conclusions and Recommendations

The final section draws together the evidence from the four objectives and translates the findings into practical recommendations for the management of major engineering and public infrastructure projects.

5.1 Conclusion

The study concludes that leadership practices were integral to the success of the Gihira Water Treatment Plant Upgrade Project. Technical engineering capability remained essential, but the statistical evidence shows that project outcomes were also shaped by the way leaders motivated teams, exchanged information, handled

disagreement, and negotiated stakeholder commitments. The four leadership practices worked as complementary managerial mechanisms rather than isolated behaviours.

Transformational leadership supported project success by giving teams a clearer sense of direction and encouraging commitment to shared objectives. Communication practices made the strongest independent contribution, demonstrating that leadership becomes effective when accurate information, feedback, responsibilities, and decisions move reliably across the project. Conflict-resolution strategies helped preserve cooperation by addressing disagreements before they disrupted implementation. Negotiation practices contributed through consensus, fairness, and mutually acceptable agreements that supported continued delivery.

Taking it together, the findings indicate that the success of complex engineering projects cannot be secured by technical controls alone. Leadership quality becomes operational through the everyday processes that connect people to project objectives. Engineering organisations therefore need leaders who can combine vision with communication discipline, use constructive mechanisms for resolving conflict, and negotiate agreements that remain workable for the stakeholders responsible for implementation.

The combined model also reveals a hierarchy of emphasis without reducing the importance of any single practice. Communication carried the strongest statistical weight, but transformational leadership, conflict resolution, and negotiation remained significant in their own right. This pattern suggests that project managers should not search for one superior leadership technique. High-performing engineering leadership is better understood as an integrated capability in which different practices are activated according to the problem being managed.

For public infrastructure institutions, the broader implication is that leadership systems should be designed as deliberately as technical systems. Clear expectations about communication, escalation, conflict handling, negotiation authority, and leadership development can reduce dependence on individual improvisation. The Gihira case therefore provides a practical basis for embedding leadership practices into project governance, professional development, and routine management procedures.

5.2 Recommendations

The recommendations respond directly to the four leadership practices that were found to influence project success and are intended for public agencies, project managers, contractors, and other actors involved in infrastructure delivery.

1. Public infrastructure agencies should institutionalise leadership development for project directors and senior technical managers, with emphasis on vision communication, team motivation, adaptive problem solving, and recognition of innovation during project implementation.
2. Engineering projects should operate through an explicit communication architecture that defines reporting channels, decision responsibilities, feedback timelines, escalation routes, and regular cross-functional briefings so that critical technical and managerial information reaches the right stakeholders without delay.
3. Project governance arrangements should include formal conflict-resolution procedures that prioritise early identification, mediation, collaborative problem solving, and documented follow-up before disagreements develop into contractual or operational disruption.
4. Procurement and project teams should strengthen integrative negotiation practices by preparing stakeholder interests in advance, using transparent information during bargaining, documenting agreed responsibilities, and seeking solutions that protect project value while preserving long-term working relationships.

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