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# Which Stakeholder Engagement Practices Drive Project Outcomes? A Multidimensional and Higher-Order Analysis of Industrial Projects in Jordan

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**Abstract** Grounded in instrumental stakeholder theory, this study examines how six stakeholder engagement practices—stakeholder identification, communication and information sharing, participation and consultation, collaboration and partnerships, feedback and response mechanisms, and assessment and evaluation—are individually and jointly associated with project outcomes in industrial projects. Survey data from 397 professionals involved in industrial projects in Central Jordan were analysed using partial least squares structural equation modelling (PLS-SEM), including a higher-order model, PLSpredict, and importance–performance map analysis. The results were triangulated using confirmatory factor analysis, consistent PLS, and covariance-based structural equation modelling, with additional checks for common method bias, nonlinearity, and endogeneity. All six engagement practices were positively associated with project outcomes and jointly explained 61.6% of the variance in those outcomes, while demonstrating high out-of-sample predictive power. Assessment and evaluation ( $\beta = .263$ ) and participation and consultation ( $\beta = .224$ ) were the strongest predictors, whereas communication had the smallest unique effect. As a higher-order capability, stakeholder engagement was strongly related to project outcomes ( $\beta = .785$ ). Participation and consultation combined relatively high importance with the lowest observed performance level. Managers should therefore prioritise giving stakeholders a genuine voice in project decisions, institutionalise efficient and systematic routines for evaluating engagement, and manage the six practices as an integrated system. The study distinguishes the unique and joint statistical contributions of stakeholder engagement practices, highlights the relatively under-researched evaluative component of engagement, and provides evidence subjected to multiple robustness checks from industrial projects in an Arab emerging economy.

**Index Terms** stakeholder engagement; stakeholder theory; project success; industrial projects; PLS-SEM; higher-order construct; Jordan

## 1. Introduction

Projects are temporary organisations whose successful implementation depends in substantial part on actors beyond their direct organisational control. Owners, contractors, suppliers, regulators, financiers, employees and local communities can all affect — and be affected by — a project. Their expectations frequently diverge, and their capacity to influence project decisions and implementation changes throughout the project life cycle [1], [2]. For these reasons, stakeholder management has become a central and increasingly important theme in project management research. The field has moved from managing stakeholders as constraints towards engaging with them as partners whose knowledge, resources and legitimacy shape project results [3], [4]. At the same time, the meaning of project success has broadened beyond the "iron triangle" of time, cost and quality to include stakeholder satis-

faction, benefits and sustainability [5]–[7]. Because different stakeholders increasingly shape the criteria by which success is judged, the quality of engagement with those stakeholders may be an important correlate of project outcomes.

Despite the growing scholarly consensus concerning stakeholder engagement, three important limitations continue to constrain current knowledge. First, much of the evidence is conceptual or based on case studies of construction megaprojects [2], [8], [9]. Large-sample evidence across the broader population of industrial projects remains scarce. Second, quantitative studies have usually treated stakeholder management as a single construct, as a list of critical success factors or as a moderator [10]–[12]. Consequently, comparatively little is known about which engagement practices are most strongly associated with outcomes or whether those practices operate separately or as an integrated organisational capability. In par-

ticular, the evaluative component of engagement — assessing how well engagement works and learning from it — has rarely been modelled, although organisations are known to struggle to learn from projects [13]. Third, empirical evidence from Arab emerging economies remains limited, even though projects in these settings face documented performance problems, including recurrent implementation delays [14].

Jordan offers an instructive setting for addressing these gaps. Its industrial activity is concentrated in the Central Region — Amman, Zarqa, Balqa and Madaba — and spans manufacturing, construction and infrastructure, mining and chemicals, food and pharmaceuticals, and energy and utilities. Projects in these sectors are capital-intensive, regulated and embedded in dense networks of public and private stakeholders, including neighbouring communities. Research on Jordanian projects has documented chronic delays associated with owner-initiated changes and contractors' financial difficulties [14]. Such difficulties may be associated, at least in part, with the ways in which stakeholder expectations, competing interests, and relationships are managed.

This study addresses these gaps by asking: Which stakeholder engagement practices are associated with project outcomes in industrial projects, how strongly, and do they operate as an integrated capability? Drawing on instrumental stakeholder theory [15], the study conceptualises engagement as six practices: identification, communication and information sharing, participation and consultation, collaboration and partnerships, feedback and response mechanisms, and assessment and evaluation. Using survey data from 397 professionals working on industrial projects in Central Jordan, it examines the unique and joint statistical associations of these practices with a multidimensional measure of project outcomes.

The study makes three contributions. First, it provides a fine-grained test of instrumental stakeholder theory at the project level, indicating that the observed value of engagement differs across practices and that evaluation and participation are the strongest correlates of the measured project outcomes. Second, it models engagement as a higher-order capability and examines the combined contribution of these complementary practices rather than treating each engagement activity solely in isolation. Third, it contributes evidence from an under-researched context and applies a transparent analytical protocol that combines explanatory and predictive assessment with tests of method bias, nonlinearity, endogeneity and estimator choice [16]–[18]. The remainder of the paper develops the theoretical hypotheses, describes the study methodology, presents the empirical results, and discusses their theoretical and practical implications.

## II. Theoretical Background and Hypotheses

### A. Instrumental stakeholder theory and engagement as a capability

Stakeholder theory conceptualises organisations as interconnected sets of relationships with groups that have an identifiable stake in organisational activities [19]. It has descriptive, instrumental and normative aspects [20] and has become a

central framework in management research [21]. Its instrumental branch proposes that organisations whose stakeholder relationships are grounded in mutual trust and cooperation can reduce opportunistic behaviour and contracting costs and may consequently outperform comparable organisations [15]. "Managing for stakeholders" also generates information, innovation and reciprocity that improve performance [22]. Which stakeholders deserve attention depends on their power, legitimacy and urgency [23], and this salience changes as projects evolve [1].

When applied to projects, the theory suggests that organisations engaging their stakeholders systematically can obtain more reliable information about requirements and risks, encounter less opposition and fewer disputes, and secure necessary cooperation more readily. We complement this view with the capability perspective, which locates performance differences in organisations' ability to integrate and reconfigure resources and routines [24]. From this perspective, stakeholder engagement is a bundle of complementary routines that together constitute an organisational capability. This provides a theoretical justification for examining both the distinctive statistical contribution of each engagement practice and the combined association of the complete bundle of practices with project outcomes [25], [26].

### B. Stakeholder engagement in projects

Stakeholder engagement denotes the practices an organisation undertakes to involve stakeholders in a positive manner in its activities [27]; it encompasses moral, strategic and pragmatic aspects [4]. Project research initially concentrated on identifying, analysing and mapping stakeholders [28], although practitioners find such analyses difficult to apply [29] and the stakeholder notion is used inconsistently in the literature [30]. Later work emphasised the organisation of engagement and its integration into project governance [31], [32]. Drawing together these theoretical and empirical contributions, we distinguish six complementary stakeholder engagement practices, as defined and supported by the sources summarised in Table 1.

### C. Project outcomes

Project success is widely recognised as a multidimensional phenomenon. Although time, cost, and quality remain important criteria, they are insufficient when considered in isolation [5]. Success also encompasses impact on customers, business results and preparation for the future [6], and recent work adds benefits realisation, stakeholder perceptions and sustainability [7]. Because different stakeholder groups assign different levels of importance to particular success criteria [36], success measures should reflect multiple perspectives [37]. We therefore conceptualise project outcomes as encompassing schedule and budget performance, quality, achievement of objectives, stakeholder satisfaction, health, safety and environmental (HSE) compliance, minimisation of disputes and sustainable benefits.

Table 1: Stakeholder engagement practices examined in this study

| Practice                                    | Description                                                                                                                                                     | Key sources                                           |
|---------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|
| Stakeholder identification (IS)             | Systematically identifying stakeholders, analysing their interests and influence, documenting needs and roles, and updating the register as the project evolves | Mitchell, Agle and Wood [23]; Jepsen and Eskerod [29] |
| Communication and information sharing (CIS) | Providing accurate, timely and transparent information through planned, tailored and two-way channels                                                           | Wu et al. [33]                                        |
| Participation and consultation (PC)         | Involving stakeholders, including affected communities, in defining objectives and requirements and consulting them before key decisions                        | Olander and Landin [8]; Di Maddaloni and Davis [9]    |
| Collaboration and partnerships (CP)         | Building long-term, trust-based relationships with resource sharing, joint problem-solving and fair sharing of benefits and responsibilities                    | Jones [15]; Pinto, Slevin and English [34]            |
| Feedback and response mechanisms (FRM)      | Providing formal, accessible channels for feedback and grievances, and responding to and acting on them                                                         | Lehtinen and Aaltonen [32]                            |
| Assessment and evaluation (AE)              | Evaluating engagement effectiveness with indicators, measuring stakeholder satisfaction, documenting lessons learned and involving stakeholders in evaluation   | Williams [13]; Duffield and Whitty [35]               |

#### D. Hypotheses

Figure 1 presents the proposed research model, showing the hypothesised relationships between the six stakeholder engagement practices, their higher-order construct, and project outcomes. The seven individual hypotheses are developed below.

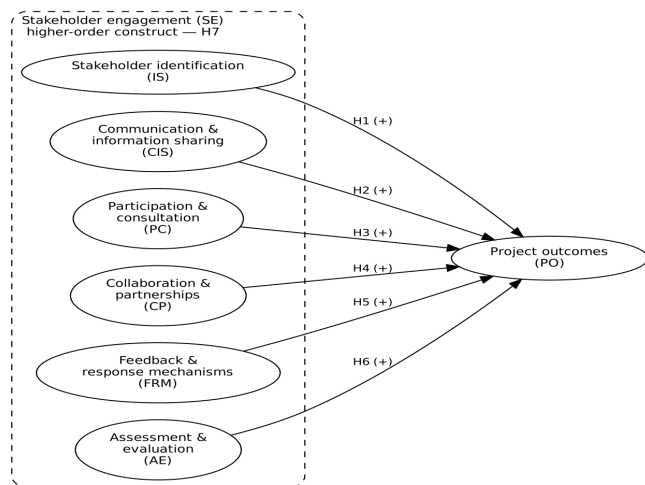


Figure 1: Research model

Note. H7 refers to the higher-order construct (dashed boundary) formed by the six practices. Controls (organisation size, experience, sector) are omitted for clarity.

**Stakeholder identification.** Stakeholders who have not been identified cannot be systematically engaged; accordingly, stakeholder identification provides the logical starting point for meaningful engagement throughout the project life cycle. The salience framework holds that managerial attention should be allocated according to stakeholders' power, legitimacy and urgency [23]. Because these attributes change as projects unfold, and stakeholders adapt their influence strategies across the life cycle [1], identification must be continu-

ous rather than confined to project initiation. Systematically documenting stakeholders' needs, expectations and roles also clarifies responsibilities and reduces the risk that influential stakeholders surface late and force costly changes. Practitioners nevertheless find stakeholder analysis difficult to perform well [29], which implies meaningful variation across projects in the quality of identification. Projects that identify their stakeholders systematically should therefore achieve better outcomes.

H1. Stakeholder identification is positively related to project outcomes.

**Communication and information sharing.** Projects frequently experience changes in scope, schedules, and risk exposure that stakeholders need to understand, assess, and respond to in a timely manner. Timely, accurate and transparent communication reduces uncertainty, aligns expectations and allows concerns to surface before they escalate into conflict. Two-way channels, in particular, signal that stakeholders' views are valued. From an instrumental perspective, information sharing reduces the information asymmetries that give rise to opportunism and mistrust [15]. Empirically, the interplay between communication and conflict has been shown to affect the success of construction project teams [33].

H2. Communication and information sharing is positively related to project outcomes.

**Participation and consultation.** Participation extends beyond providing information to stakeholders by creating meaningful opportunities for them to influence objectives, requirements, and important project decisions. This improves decision quality, because stakeholders contribute operational, technical and local knowledge that the project team may lack. It also strengthens the legitimacy of decisions and the commitment of those who must implement or accept them. Case evidence from construction shows that stakeholders whose concerns are neglected can mobilise opposition that disrupts implementation [8]. In megaprojects, local communities are often treated as peripheral, although including them more fully improves project performance [9]. Industrial projects, with their environmental and social footprint, are likely to benefit similarly.

H3. Participation and consultation is positively related to project outcomes.

**Collaboration and partnerships.** Industrial projects depend on owners, contractors, suppliers, utility providers, and regulators whose contributions and interactions cannot always be specified comprehensively in formal contracts. Instrumental stakeholder theory predicts that relationships based on trust and cooperation lower the costs of monitoring and enforcement [15]. Such relationships also generate reciprocity and information that improve performance [22]. Long-term partnerships, joint problem-solving and fair sharing of risks and benefits enable partners to absorb unforeseen problems without resorting to disputes. Trust between owners and contractors [34] and trust and collaboration within project teams [38] have been associated with project success.

H4. Collaboration and partnerships is positively related to project outcomes.

*Feedback and response mechanisms.* Stakeholder engagement becomes more credible when stakeholders have accessible opportunities to express concerns and can observe that their submissions are considered and acted upon. Formal, accessible channels for feedback and grievances, combined with systematic recording, timely responses and communication of the actions taken, institutionalise engagement in the project organisation. The way engagement is organised — through dedicated roles, structures and routines — determines whether stakeholder input is actually absorbed by projects [32]. Such mechanisms also integrate stakeholders into project governance [31]. By resolving grievances early, they should prevent escalation into disputes, delays and reputational damage.

H5. Feedback and response mechanisms are positively related to project outcomes.

*Assessment and evaluation.* Engagement arrangements are rarely optimal from the outset, and their continuing effectiveness depends on whether project organisations systematically monitor, review, and adapt their practices. Periodic evaluation with explicit indicators, measurement of stakeholder satisfaction during and after the project, documentation of lessons learned and involvement of stakeholders in performance reviews convert relational experience into organisational knowledge. Learning from projects does not occur automatically; organisations frequently fail to learn lessons despite formal procedures [13], and learning requires a deliberate, systemic process [35]. Evaluation allows projects to detect emerging dissatisfaction early and to recalibrate their engagement approach before problems affect delivery.

H6. Assessment and evaluation is positively related to project outcomes.

*Stakeholder engagement as an integrated capability.* The six stakeholder engagement practices are theoretically complementary rather than completely independent of one another. Identification informs communication and participation, collaboration depends on the trust that communication and responsiveness build, and evaluation feeds back into all other practices. Consistent with this view, critical success factors for stakeholder management have been found to be strongly interrelated [10], and engagement has been conceptualised as a multidimensional set of moral, strategic and pragmatic activities [4]. The capability perspective therefore suggests that the benefits of engagement derive from the bundle as a whole [24]. Accordingly, we specify overall stakeholder engagement as a reflective–formative higher-order construct formed by the six constituent practices [25], [26].

H7. Overall stakeholder engagement is positively related to project outcomes.

### III. Methodology

#### A. Context, sample and procedure

This study was conducted in the Central Region of Jordan, encompassing Amman, Zarqa, Balqa, and Madaba, where a substantial proportion of the country's industrial and in-

frastructure activities are concentrated. The research covered five major industrial sectors: manufacturing, construction and infrastructure, mining and chemical industries, food and pharmaceutical industries, and energy and utilities. The target population consisted of professionals with direct experience in industrial projects undertaken within the region during the preceding three years. To ensure the relevance and reliability of the responses, participants were required to have been involved in at least one industrial project during this period. Each respondent served as a key informant and assessed stakeholder engagement practices and outcomes in a recent industrial project in which that respondent had personally participated. Accordingly, the industrial project was treated as the intended unit of analysis, while the individual professional represented the unit of observation from which project-specific data were obtained.

Given the absence of a comprehensive sampling frame identifying professionals involved in industrial projects across the region, a non-probability purposive sampling strategy was adopted to target respondents with relevant project experience. The sampling strategy sought to include respondents from several industrial sectors, professional roles, experience categories, and organisational size groups, rather than to produce a statistically representative probability sample. A structured, bilingual (Arabic–English) questionnaire was used to collect information on stakeholder engagement practices and project outcomes. Following the application of the eligibility criteria and data-quality screening procedures, a final sample of 397 valid responses was retained for analysis. The respondents represented diverse professional backgrounds, including engineers and technical specialists (37.3%), project managers (31.0%), senior managers (15.1%), and administrative and support personnel (16.6%). Manufacturing accounted for 32.5% of the sample, followed by construction and infrastructure (22.2%), mining and chemical industries (16.1%), food and pharmaceutical industries (15.1%), and energy and utilities (14.1%). Moreover, 51.9% of respondents reported more than ten years of experience in industrial projects, supporting the relevance of their assessments. The final sample also exceeded the calculated minimum sample size of approximately 275 observations estimated using the inverse square root method for detecting a minimum path coefficient of 0.15 at a 5% significance level with 80% statistical power [39]. The detailed demographic and professional characteristics of all retained respondents are presented in Table 2.

#### B. Measures

The study employed a structured bilingual (Arabic–English) questionnaire to assess stakeholder engagement practices and project outcomes in industrial projects in Jordan. The measurement instrument comprised 44 items distributed across seven constructs, including six dimensions of stakeholder engagement and one multidimensional construct representing project outcomes. Each stakeholder engagement dimension was measured using six items, while project outcomes were assessed using eight items. Specifically, the stakeholder

engagement dimensions included stakeholder identification, communication and information sharing, participation and consultation, collaboration and partnerships, feedback and response mechanisms, and assessment and evaluation. The measurement framework was informed by established theoretical and empirical literature on stakeholder management, stakeholder engagement, and project success [23], [29]; [8], [27]; [13], [32]. All measurement items were assessed on a five-point Likert response scale ranging from 1 (strongly disagree) to 5 (strongly agree), and the individual items were specified as reflective indicators of their corresponding first-order constructs in the measurement model.

Table 2: Respondent profile

| Characteristic / category                | n   | %    |
|------------------------------------------|-----|------|
| <b>Gender</b>                            |     |      |
| Male                                     | 281 | 70.8 |
| Female                                   | 116 | 29.2 |
| <b>Age group</b>                         |     |      |
| Under 25                                 | 19  | 4.8  |
| 25–34                                    | 124 | 31.2 |
| 35–44                                    | 136 | 34.3 |
| 45–54                                    | 83  | 20.9 |
| 55 and above                             | 35  | 8.8  |
| <b>Educational level</b>                 |     |      |
| Diploma or below                         | 27  | 6.8  |
| Bachelor's                               | 251 | 63.2 |
| Master's                                 | 83  | 20.9 |
| Doctorate                                | 36  | 9.1  |
| <b>Industrial sector</b>                 |     |      |
| Manufacturing                            | 129 | 32.5 |
| Construction and infrastructure          | 88  | 22.2 |
| Mining and chemical industries           | 64  | 16.1 |
| Food and pharmaceutical industries       | 60  | 15.1 |
| Energy and utilities                     | 56  | 14.1 |
| <b>Job position</b>                      |     |      |
| Senior management                        | 60  | 15.1 |
| Project manager                          | 123 | 31.0 |
| Engineer / technical specialist          | 148 | 37.3 |
| Administrative / support staff           | 66  | 16.6 |
| <b>Experience in industrial projects</b> |     |      |
| Less than 5 years                        | 64  | 16.1 |
| 5–10 years                               | 127 | 32.0 |
| 11–20 years                              | 154 | 38.8 |
| More than 20 years                       | 52  | 13.1 |
| <b>Organisation size (employees)</b>     |     |      |
| Fewer than 50                            | 74  | 18.6 |
| 50–249                                   | 111 | 28.0 |
| 250–999                                  | 153 | 38.5 |
| 1,000 or more                            | 59  | 14.9 |

Note. N = 397.

Project outcomes were operationalised as a multidimensional construct encompassing project efficiency, project effectiveness, and broader stakeholder- and sustainability-related outcomes. Project efficiency was assessed through schedule adherence and budget performance, whereas project effectiveness was evaluated through compliance with quality standards and achievement of predetermined project objectives. The broader outcome indicators captured stakeholder satisfaction, compliance with health, safety and environmental requirements, minimisation of stakeholder-related disputes, and the generation of sustainable benefits for organisations and surrounding communities. This multidimensional opera-

tionalisation is consistent with established perspectives emphasising that project success extends beyond the traditional constraints of time, cost, and quality [6], [7].

Table 3: Item wording and descriptive statistics

| Item                                               | Statement                                                                                    | Mean (M) | SD   | Skewness | Kurtosis |
|----------------------------------------------------|----------------------------------------------------------------------------------------------|----------|------|----------|----------|
| <b>Stakeholder identification (IS)</b>             |                                                                                              |          |      |          |          |
| IS1                                                | The project systematically identifies all internal and external stakeholders at initiation.  | 3.83     | 1.05 | -0.92    | 0.32     |
| IS2                                                | Stakeholders are analysed according to their level of interest and influence on the project. | 3.94     | 0.93 | -0.83    | 0.44     |
| IS3                                                | A stakeholder register is maintained and updated throughout the project life cycle.          | 3.79     | 1.08 | -0.86    | 0.23     |
| IS4                                                | The needs and expectations of each stakeholder group are clearly documented.                 | 3.85     | 0.97 | -0.65    | -0.09    |
| IS5                                                | The roles and responsibilities of key stakeholders are clearly defined.                      | 3.89     | 0.98 | -0.67    | -0.18    |
| IS6                                                | New stakeholders are identified promptly as the project progresses.                          | 3.86     | 1.04 | -0.87    | 0.30     |
| <b>Communication and information sharing (CIS)</b> |                                                                                              |          |      |          |          |
| CIS1                                               | A formal communication plan guides information exchange with stakeholders.                   | 3.88     | 1.01 | -0.88    | 0.37     |
| CIS2                                               | Stakeholders receive accurate project information in a timely manner.                        | 3.82     | 1.04 | -0.78    | -0.05    |
| CIS3                                               | Communication channels are tailored to the needs of different stakeholder groups.            | 3.79     | 1.01 | -0.51    | -0.63    |
| CIS4                                               | Project progress is reported regularly to the relevant stakeholders.                         | 3.91     | 0.93 | -0.60    | -0.38    |
| CIS5                                               | Information about project risks and changes is shared transparently.                         | 3.83     | 1.00 | -0.77    | -0.12    |
| CIS6                                               | Two-way communication allows stakeholders to raise questions and concerns.                   | 3.82     | 1.01 | -0.52    | -0.63    |
| <b>Participation and consultation (PC)</b>         |                                                                                              |          |      |          |          |
| PC1                                                | Stakeholders are consulted before key project decisions are made.                            | 3.85     | 0.96 | -0.69    | 0.10     |
| PC2                                                | Stakeholders participate in defining project objectives and requirements.                    | 3.77     | 1.07 | -0.82    | 0.15     |
| PC3                                                | Consultation meetings or workshops are held at key project stages.                           | 3.84     | 1.03 | -0.87    | 0.41     |
| PC4                                                | Stakeholder opinions are seriously considered in project planning.                           | 3.80     | 1.11 | -0.79    | -0.14    |
| PC5                                                | Stakeholders have adequate opportunities to express their views.                             | 3.81     | 1.15 | -0.93    | 0.22     |
| PC6                                                | Local communities affected by the project are consulted.                                     | 3.81     | 1.08 | -1.01    | 0.66     |
| <b>Collaboration and partnerships (CP)</b>         |                                                                                              |          |      |          |          |
| CP1                                                | The project builds long-term partnerships with key stakeholders.                             | 3.93     | 1.01 | -0.88    | 0.49     |
| CP2                                                | Stakeholders and the project team share resources to achieve project goals.                  | 3.80     | 1.03 | -0.73    | 0.10     |
| CP3                                                | Joint problem-solving with stakeholders is practised when issues arise.                      | 3.86     | 1.01 | -1.02    | 0.80     |
| CP4                                                | Responsibilities and benefits are shared fairly with project partners.                       | 3.83     | 1.08 | -0.94    | 0.50     |
| CP5                                                | Trust-based relationships exist between the project team and stakeholders.                   | 3.95     | 1.02 | -1.11    | 1.08     |
| CP6                                                | Collaborative agreements with stakeholders (e.g., MoUs, contracts) are honoured.             | 3.84     | 1.09 | -0.92    | 0.26     |
| <b>Feedback and response mechanisms (FRM)</b>      |                                                                                              |          |      |          |          |
| FRM1                                               | Formal mechanisms exist for stakeholders to submit feedback or complaints.                   | 3.88     | 0.96 | -0.52    | -0.38    |
| FRM2                                               | Stakeholder feedback is recorded and tracked systematically.                                 | 3.85     | 0.96 | -0.59    | -0.21    |
| FRM3                                               | Stakeholder concerns are responded to within a reasonable time.                              | 3.83     | 1.07 | -0.81    | 0.01     |
| FRM4                                               | Stakeholders are informed of the actions taken in response to their feedback.                | 3.82     | 0.95 | -0.79    | 0.80     |
| FRM5                                               | Feedback received is used to adjust project plans and activities.                            | 3.84     | 1.06 | -0.82    | 0.10     |
| FRM6                                               | Grievance-handling procedures are accessible to all stakeholder groups.                      | 3.76     | 1.01 | -0.51    | -0.41    |
| <b>Assessment and evaluation (AE)</b>              |                                                                                              |          |      |          |          |
| AE1                                                | The effectiveness of stakeholder engagement is evaluated periodically.                       | 3.88     | 1.02 | -0.76    | 0.07     |
| AE2                                                | Clear indicators are used to measure stakeholder engagement performance.                     | 3.94     | 0.94 | -0.73    | 0.23     |
| AE3                                                | Stakeholder satisfaction is measured during and after the project.                           | 3.94     | 0.99 | -0.76    | -0.03    |
| AE4                                                | Evaluation results are used to improve engagement practices.                                 | 3.94     | 0.98 | -0.75    | -0.19    |
| AE5                                                | Lessons learned about stakeholder engagement are documented.                                 | 3.85     | 1.00 | -0.81    | 0.20     |
| AE6                                                | Stakeholders take part in evaluating project performance.                                    | 3.96     | 0.96 | -0.83    | 0.17     |
| <b>Project outcomes (PO)</b>                       |                                                                                              |          |      |          |          |
| PO1                                                | The project is completed within the planned schedule.                                        | 3.91     | 0.92 | -0.51    | -0.34    |
| PO2                                                | The project is completed within the approved budget.                                         | 3.87     | 0.97 | -0.94    | 0.91     |
| PO3                                                | Project deliverables meet the specified quality standards.                                   | 3.80     | 1.02 | -0.79    | 0.17     |
| PO4                                                | The project achieves its stated objectives.                                                  | 3.85     | 0.98 | -0.67    | -0.04    |
| PO5                                                | Key stakeholders are satisfied with the project results.                                     | 3.95     | 0.91 | -0.72    | 0.09     |
| PO6                                                | The project complies with health, safety and environmental requirements.                     | 3.90     | 1.03 | -0.68    | -0.47    |
| PO7                                                | Disputes and conflicts with stakeholders are kept to a minimum.                              | 3.90     | 0.95 | -0.68    | -0.04    |
| PO8                                                | The project delivers sustainable benefits to the organisation and the community.             | 3.91     | 0.89 | -0.70    | 0.40     |

Note. Five-point Likert scale. Items were administered in Arabic and English.

Prior to the main survey, a pilot study involving approximately 27 respondents was conducted to evaluate the preliminary reliability and practical suitability of the questionnaire. Internal consistency was assessed using Cronbach's alpha

coefficient, with an overall reliability coefficient of approximately 0.86, exceeding the commonly accepted threshold of 0.70 and indicating good preliminary internal consistency. The pilot assessment provided preliminary evidence supporting the internal consistency of the questionnaire; more comprehensive reliability and validity assessments were subsequently conducted using the full study sample of 397 respondents. The measurement model was evaluated through indicator loadings, Cronbach’s alpha, composite reliability, average variance extracted (AVE), and discriminant validity assessment, as detailed in the subsequent analytical sections.

Furthermore, organisation size, years of experience in industrial projects, and industrial sector were incorporated as control variables to account for potential contextual and professional differences in project outcomes. All measurement items, their exact wording, and their corresponding descriptive statistics are reported in Table 3.

C. Analytical approach

We employed partial least squares structural equation modelling (PLS-SEM) because the research has a substantial predictive objective, the observed data departed from multivariate normality, and the specified analysis included a higher-order construct [16]. The model was estimated in R with semr (version 2.6.0; path weighting; 5,000 bootstrap resamples). Consistent with the established two-step approach [40], we evaluated the measurement model before proceeding to estimation and assessment of the structural relationships. We then estimated a higher-order model with the disjoint two-stage approach [26], assessed predictive power with PLSpredict [17] and identified managerial priorities through importance–performance map analysis (IPMA) [41]. Because the constructs were conceptualised as common factors, we further triangulated the results with confirmatory factor analysis (CFA), consistent PLS (PLSc) [42], and covariance-based structural equation modelling (CB-SEM) estimated in lavaan [43]. Further robustness checks followed Sarstedt et al. [18] and Hult et al. [44]. Table 4 summarises the analytical procedures, decision criteria, and methodological sources used throughout the study; the associated annotated R script is described as available for replication.

IV. Results

A. Data screening and common method bias

The screened dataset contained no missing values, out-of-range codes, or apparent straight-lining responses. Six potential multivariate outliers (Mahalanobis  $D^2$ ,  $p < .001$ ) were retained because excluding them changed no path coefficient by more than .007. Skewness (–1.11 to –0.51) and kurtosis (–0.63 to 1.08) were moderate, but Mardia’s multivariate normality test [45] rejected the assumption of multivariate normality ( $p < .001$ ), supporting a bootstrap-based approach. Construct means ranged from 3.81 (PC) to 3.92 (AE) on the five-point scale, while the mean for project outcomes was 3.88. These descriptive results are presented in Table 5 and visually summarised in Figure 2.

Table 4: Analytical procedures, decision criteria and sources

| Stage                            | Procedure                                                             | Criterion                                                            | Source                                                                                                   |
|----------------------------------|-----------------------------------------------------------------------|----------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| Data screening and power         |                                                                       |                                                                      |                                                                                                          |
| Data quality                     | Missing values, out-of-range codes, straight-lining                   | No missing values or justified treatment of any missing observations | —                                                                                                        |
| Outliers                         | Mahalanobis $D^2$ with sensitivity analysis                           | $p < .001$                                                           | —                                                                                                        |
| Distribution                     | Skewness, kurtosis, Mardia’s test                                     | Informs choice of bootstrap inference                                | Mardia [45]                                                                                              |
| Power                            | Inverse square root method                                            | $n \geq (2.486 / 1/\beta_{\min})^2$                                  | Kock and Hadaya [39]                                                                                     |
| Common method bias               |                                                                       |                                                                      |                                                                                                          |
| Statistical tests                | Harman’s single-factor test; full-collinearity VIF; single-factor CFA | $< .50\%$ ; VIF $< 3.3$ ; poor single-factor fit                     | Podsakoff et al. [46]; Kock and Lynn [47]                                                                |
| Measurement model                |                                                                       |                                                                      |                                                                                                          |
| Indicator reliability            | Outer loadings                                                        | $\geq .708$                                                          | Hair et al. [16]                                                                                         |
| Internal consistency             | $\alpha$ , $\rho_A$ , $\rho_C$                                        | .70–.95                                                              | Dijkstra and Henseler [42]                                                                               |
| Convergent validity              | AVE                                                                   | $\geq .50$                                                           | Fornell and Larcker [48]                                                                                 |
| Discriminant validity            | HTMT with bootstrap CI; Fornell–Larcker                               | HTMT $< .85$                                                         | Henseler, Ringle and Sarstedt [49]                                                                       |
| Common-factor check              | CFA (robust ML)                                                       | CFI/TLI $\geq .95$ ; RMSEA $\leq .06$ ; SRMR $\leq .08$              | Hu and Bentler [50]                                                                                      |
| Structural model                 |                                                                       |                                                                      |                                                                                                          |
| Collinearity                     | Inner VIF                                                             | $< 3$                                                                | Hair et al. [16]                                                                                         |
| Significance                     | Percentile bootstrap (5,000); Holm correction                         | $p < .05$                                                            | Holm [51]                                                                                                |
| Explanatory power                | $R^2$ , $f^2$                                                         | .25/.50/.75; .02/.15/.35                                             | Hair et al. [16]; Cohen [52]                                                                             |
| Predictive power                 | PLSpredict (10 $\times$ 10)                                           | $Q^2_{\text{predict}} > 0$ ; RMSE/MAE vs. LM                         | Shmueli et al. [17]                                                                                      |
| Advanced analyses and robustness |                                                                       |                                                                      |                                                                                                          |
| Higher-order construct           | Reflective–formative, disjoint two-stage                              | Significant weights; VIF $< 3$                                       | Becker, Klein and Wetzel [25]; Sarstedt et al. [26]                                                      |
| IPMA                             | Importance vs. performance (0–100)                                    | —                                                                    | Ringle and Sarstedt [41]                                                                                 |
| Robustness                       | Controls; RESET; quadratic terms; Gaussian copulas; PLSc; CB-SEM      | Stability of core results                                            | Ramsey [53]; Park and Gupta [54]; Hult et al. [44]; Sarstedt et al. [18]; Becker, Prosch and Ringle [55] |

Table 5: Construct descriptive statistics and correlations

| Construct | M    | SD   | 1    | 2    | 3    | 4    | 5    | 6    | 7 |
|-----------|------|------|------|------|------|------|------|------|---|
| 1. IS     | 3.86 | 0.86 | —    |      |      |      |      |      |   |
| 2. CIS    | 3.84 | 0.84 | .442 | —    |      |      |      |      |   |
| 3. PC     | 3.81 | 0.90 | .461 | .498 | —    |      |      |      |   |
| 4. CP     | 3.87 | 0.86 | .365 | .443 | .559 | —    |      |      |   |
| 5. FRM    | 3.83 | 0.84 | .310 | .408 | .405 | .382 | —    |      |   |
| 6. AE     | 3.92 | 0.83 | .342 | .405 | .368 | .376 | .510 | —    |   |
| 7. PO     | 3.88 | 0.81 | .517 | .548 | .604 | .550 | .540 | .589 | — |

Note. Construct scores are item means. All correlations  $p < .001$ .

To limit common method bias, respondents were assured of anonymity, all scale points were labelled, and predictor and criterion items appeared in separate sections [56]. Statistically, the first unrotated factor explained 38.9% of the variance. Full-collinearity VIFs ranged from 1.49 to 2.61, below 3.3 [47]. A single-factor CFA fitted poorly (CFI = .561; RMSEA = .124) and significantly worse than the seven-factor model ( $\Delta\chi^2(21) = 5362.8$ ,  $p < .001$ ). Taken together, these diagnostic results suggest that common method bias is unlikely to explain the observed associations fully, although such tests cannot establish its complete absence [46].

B. Measurement model

All standardised outer loadings exceeded .708 (.781–.886; all  $p < .001$ ), while outer VIFs remained below 3.2. The detailed estimates are reported in Table 6 and illustrated in Figure 3. Cronbach’s  $\alpha$  (.911–.940),  $\rho_A$  (.912–.942) and  $\rho_C$  (.931–.950) fell between .70 and .95, and the AVE values (.692–.721) exceeded .50, satisfying commonly used assessment criteria (Table 7) [16]. All HTMT ratios were below .85, with the highest value (PC–PO: .652) having an upper one-sided 95% confidence bound of .703 [49]. The Fornell–Larcker criterion and the examined cross-loadings provided additional support

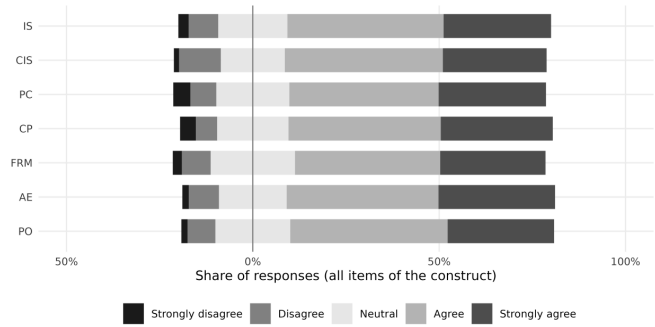


Figure 2: Distribution of responses by construct

Note. Bars pool all items of each construct; neutral responses are split evenly around zero, disagreement is plotted to the left and agreement to the right.

for discriminant validity, as documented in Figure 4 and Tables 8–9. A CFA estimated with robust maximum likelihood fitted the data well ( $\chi^2(881) = 922.95$ ,  $p = .159$ ; CFI = .996; TLI = .996; RMSEA = .011; SRMR = .030), according to established fit criteria [50]. Its factor loadings (.726–.870), composite reliability estimates, and AVEs ( $\geq .630$ ) were also consistent with the PLS measurement assessment; the model-fit estimates are reported in Table 10.

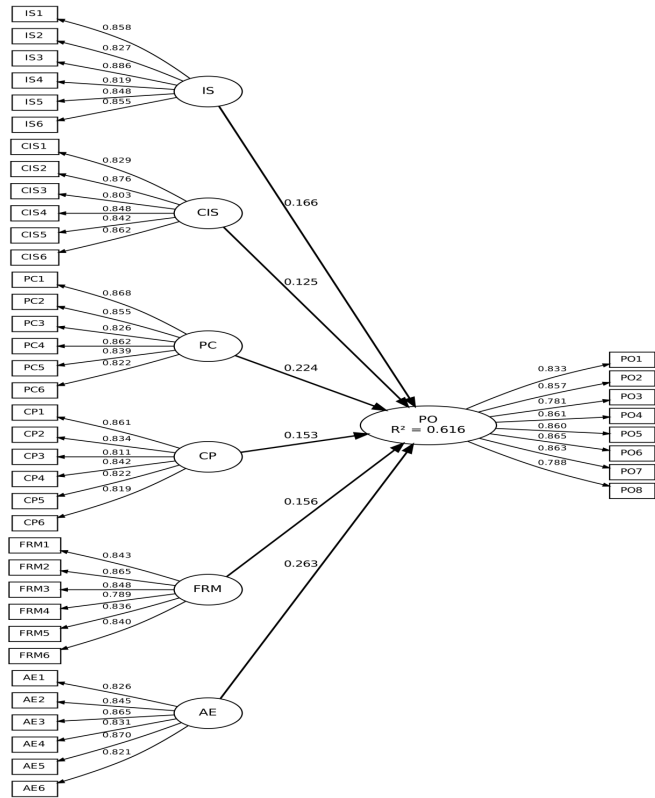


Figure 3: Estimated measurement model

Note. Values on the indicator arrows are standardised outer loadings; values on the structural arrows are standardised path coefficients.

Table 6: Outer loadings

| Construct / item                            | Loading | t     | 95% CI       | VIF   |
|---------------------------------------------|---------|-------|--------------|-------|
| Stakeholder identification (IS)             |         |       |              |       |
| IS1                                         | .858    | 59.73 | [.828, .884] | 2.717 |
| IS2                                         | .827    | 48.06 | [.791, .859] | 2.267 |
| IS3                                         | .886    | 72.12 | [.860, .908] | 3.157 |
| IS4                                         | .819    | 44.00 | [.781, .853] | 2.277 |
| IS5                                         | .848    | 53.93 | [.814, .877] | 2.481 |
| IS6                                         | .855    | 56.64 | [.823, .883] | 2.733 |
| Communication and information sharing (CIS) |         |       |              |       |
| CIS1                                        | .829    | 53.28 | [.798, .858] | 2.269 |
| CIS2                                        | .876    | 72.93 | [.851, .898] | 2.947 |
| CIS3                                        | .803    | 42.51 | [.763, .837] | 2.119 |
| CIS4                                        | .848    | 52.79 | [.816, .877] | 2.566 |
| CIS5                                        | .842    | 52.56 | [.808, .872] | 2.510 |
| CIS6                                        | .862    | 64.38 | [.834, .887] | 2.807 |
| Participation and consultation (PC)         |         |       |              |       |
| PC1                                         | .868    | 65.90 | [.839, .891] | 2.742 |
| PC2                                         | .855    | 55.74 | [.822, .882] | 2.590 |
| PC3                                         | .826    | 36.96 | [.778, .864] | 2.370 |
| PC4                                         | .862    | 57.84 | [.830, .888] | 2.768 |
| PC5                                         | .839    | 48.78 | [.802, .870] | 2.462 |
| PC6                                         | .822    | 45.27 | [.783, .854] | 2.202 |
| Collaboration and partnerships (CP)         |         |       |              |       |
| CP1                                         | .861    | 61.24 | [.830, .886] | 2.676 |
| CP2                                         | .834    | 47.67 | [.797, .865] | 2.323 |
| CP3                                         | .811    | 36.60 | [.764, .851] | 2.136 |
| CP4                                         | .842    | 51.43 | [.807, .872] | 2.453 |
| CP5                                         | .822    | 41.61 | [.780, .856] | 2.318 |
| CP6                                         | .819    | 47.37 | [.782, .850] | 2.173 |
| Feedback and response mechanisms (FRM)      |         |       |              |       |
| FRM1                                        | .843    | 51.24 | [.809, .873] | 2.516 |
| FRM2                                        | .865    | 62.74 | [.835, .888] | 2.824 |
| FRM3                                        | .848    | 57.62 | [.818, .876] | 2.486 |
| FRM4                                        | .789    | 37.79 | [.747, .827] | 1.943 |
| FRM5                                        | .836    | 54.27 | [.804, .864] | 2.392 |
| FRM6                                        | .840    | 48.73 | [.803, .871] | 2.482 |
| Assessment and evaluation (AE)              |         |       |              |       |
| AE1                                         | .826    | 44.98 | [.787, .859] | 2.281 |
| AE2                                         | .845    | 50.07 | [.808, .875] | 2.474 |
| AE3                                         | .865    | 56.74 | [.833, .892] | 2.841 |
| AE4                                         | .831    | 50.81 | [.796, .861] | 2.338 |
| AE5                                         | .870    | 65.53 | [.842, .894] | 2.839 |
| AE6                                         | .821    | 41.68 | [.779, .856] | 2.209 |
| Project outcomes (PO)                       |         |       |              |       |
| PO1                                         | .833    | 48.66 | [.796, .863] | 2.633 |
| PO2                                         | .857    | 55.11 | [.824, .885] | 2.927 |
| PO3                                         | .781    | 34.80 | [.734, .820] | 2.110 |
| PO4                                         | .861    | 61.14 | [.830, .887] | 3.002 |
| PO5                                         | .860    | 58.90 | [.828, .886] | 2.933 |
| PO6                                         | .865    | 60.05 | [.834, .891] | 3.076 |
| PO7                                         | .863    | 65.48 | [.835, .887] | 2.983 |
| PO8                                         | .788    | 36.97 | [.743, .827] | 2.142 |

Note. Bootstrap with 5,000 resamples; all  $p < .001$ .

C. Structural model

Inner VIFs ranged from 1.41 to 1.79, indicating no critical collinearity. As the detailed structural estimates in Table 11 and the graphical results in Figure 5 indicate, all six practices were positively and significantly related to project outcomes, and all effects remained significant after Holm’s [51] correction (largest adjusted  $p = .001$ ). H1–H6 were therefore supported. Assessment and evaluation was the strongest predictor ( $\beta = .263$ ,  $f^2 = .119$ ), followed by participation and consultation ( $\beta = .224$ ). Communication and information sharing had the smallest unique effect ( $\beta = .125$ ). The model explained

Table 7: Reliability, convergent validity and discriminant validity (HTMT)

| Construct | Loadings  | $\alpha$ | $\rho_A$ | $\rho_C$ | AVE  | IS   | CIS  | PC   | CP   | FRM  | AE   |
|-----------|-----------|----------|----------|----------|------|------|------|------|------|------|------|
| IS        | .819–.886 | .923     | .924     | .939     | .721 |      |      |      |      |      |      |
| CIS       | .803–.876 | .919     | .920     | .937     | .712 | .480 |      |      |      |      |      |
| PC        | .822–.868 | .920     | .922     | .938     | .715 | .500 | .543 |      |      |      |      |
| CP        | .811–.861 | .911     | .912     | .931     | .692 | .398 | .484 | .610 |      |      |      |
| FRM       | .789–.865 | .915     | .915     | .934     | .701 | .337 | .446 | .441 | .420 |      |      |
| AE        | .821–.870 | .919     | .919     | .936     | .711 | .372 | .441 | .401 | .412 | .557 |      |
| PO        | .781–.865 | .940     | .942     | .950     | .704 | .556 | .590 | .652 | .596 | .584 | .634 |

Note. IS = stakeholder identification; CIS = communication and information sharing; PC = participation and consultation; CP = collaboration and partnerships; FRM = feedback and response mechanisms; AE = assessment and evaluation; PO = project outcomes. Columns IS–AE report HTMT ratios. Item loadings with bootstrap confidence intervals are reported in Table 6.

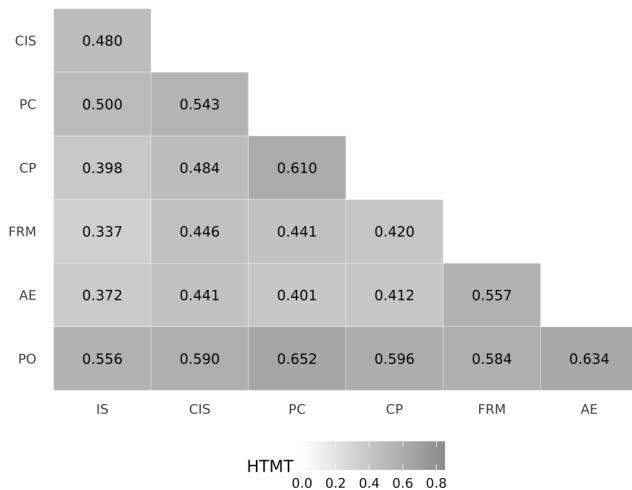


Figure 4: Heat map of HTMT ratios

Note. Shading intensity increases with the HTMT value; the scale ends at the .85 threshold.

Table 8: Fornell–Larcker criterion

| Construct | IS   | CIS  | PC   | CP   | FRM  | AE   | PO   |
|-----------|------|------|------|------|------|------|------|
| IS        | .849 |      |      |      |      |      |      |
| CIS       | .444 | .844 |      |      |      |      |      |
| PC        | .461 | .500 | .845 |      |      |      |      |
| CP        | .366 | .445 | .561 | .832 |      |      |      |
| FRM       | .311 | .409 | .405 | .384 | .837 |      |      |
| AE        | .343 | .405 | .369 | .376 | .510 | .843 |      |
| PO        | .520 | .550 | .609 | .554 | .543 | .590 | .839 |

Note. Diagonal entries are the square roots of AVE; off-diagonal entries are latent-variable correlations.

61.6% of the variance in project outcomes (adjusted  $R^2 = .610$ ), indicating substantial explained variation in this sample while leaving some outcome variance unaccounted for [16]. The individual effect sizes were small ( $f^2 = .025$ –.119) when interpreted using conventional guidelines [52]; this pattern is consistent with several correlated engagement practices sharing explanatory variance, as further illustrated in Figure 6.

### D. Predictive power

PLSPredict with 10 folds and 10 repetitions yielded positive  $Q^2_{\text{predict}}$  values for all eight outcome indicators (.323–.501). The PLS-SEM model produced lower prediction errors than

Table 9: Cross-loadings

| Item | IS   | CIS  | PC   | CP   | FRM  | AE   | PO   |
|------|------|------|------|------|------|------|------|
| IS1  | .858 | .352 | .395 | .328 | .297 | .290 | .438 |
| IS2  | .827 | .384 | .398 | .303 | .265 | .290 | .441 |
| IS3  | .886 | .419 | .419 | .330 | .291 | .302 | .469 |
| IS4  | .819 | .321 | .389 | .300 | .203 | .303 | .404 |
| IS5  | .848 | .399 | .402 | .330 | .267 | .290 | .470 |
| IS6  | .855 | .381 | .344 | .271 | .253 | .270 | .420 |
| CIS1 | .382 | .829 | .406 | .410 | .395 | .325 | .502 |
| CIS2 | .396 | .876 | .436 | .393 | .292 | .350 | .482 |
| CIS3 | .346 | .803 | .405 | .344 | .337 | .347 | .442 |
| CIS4 | .397 | .848 | .432 | .390 | .355 | .363 | .462 |
| CIS5 | .361 | .842 | .398 | .322 | .355 | .324 | .434 |
| CIS6 | .364 | .862 | .456 | .387 | .333 | .344 | .452 |
| PC1  | .382 | .456 | .868 | .498 | .355 | .343 | .559 |
| PC2  | .399 | .466 | .855 | .491 | .315 | .299 | .531 |
| PC3  | .377 | .392 | .826 | .372 | .342 | .273 | .463 |
| PC4  | .432 | .391 | .862 | .449 | .342 | .279 | .506 |
| PC5  | .372 | .418 | .839 | .505 | .369 | .350 | .491 |
| PC6  | .378 | .408 | .822 | .520 | .332 | .323 | .530 |
| CP1  | .331 | .368 | .516 | .861 | .358 | .312 | .492 |
| CP2  | .311 | .422 | .462 | .834 | .332 | .324 | .478 |
| CP3  | .312 | .356 | .429 | .811 | .274 | .319 | .437 |
| CP4  | .322 | .389 | .479 | .842 | .343 | .338 | .460 |
| CP5  | .256 | .342 | .462 | .822 | .326 | .315 | .423 |
| CP6  | .292 | .342 | .449 | .819 | .281 | .269 | .470 |
| FRM1 | .279 | .380 | .331 | .380 | .843 | .464 | .450 |
| FRM2 | .249 | .348 | .345 | .350 | .865 | .447 | .471 |
| FRM3 | .250 | .317 | .360 | .297 | .848 | .437 | .470 |
| FRM4 | .265 | .314 | .342 | .307 | .789 | .359 | .457 |
| FRM5 | .221 | .329 | .317 | .314 | .836 | .422 | .441 |
| FRM6 | .299 | .368 | .336 | .281 | .840 | .433 | .434 |
| AE1  | .294 | .323 | .316 | .332 | .433 | .826 | .496 |
| AE2  | .277 | .369 | .312 | .304 | .464 | .845 | .495 |
| AE3  | .318 | .326 | .321 | .330 | .448 | .865 | .480 |
| AE4  | .271 | .338 | .310 | .334 | .417 | .831 | .476 |
| AE5  | .321 | .352 | .308 | .298 | .396 | .870 | .530 |
| AE6  | .251 | .342 | .300 | .305 | .423 | .821 | .505 |
| PO1  | .412 | .442 | .511 | .419 | .469 | .469 | .833 |
| PO2  | .431 | .480 | .511 | .463 | .469 | .523 | .857 |
| PO3  | .423 | .424 | .451 | .382 | .365 | .442 | .781 |
| PO4  | .406 | .465 | .492 | .453 | .491 | .522 | .861 |
| PO5  | .506 | .492 | .548 | .536 | .479 | .514 | .860 |
| PO6  | .438 | .476 | .503 | .475 | .457 | .500 | .865 |
| PO7  | .441 | .466 | .573 | .514 | .475 | .508 | .863 |
| PO8  | .425 | .439 | .491 | .464 | .426 | .477 | .788 |

Note. The loading in each indicator's assigned construct column is the primary loading.

Table 10: Confirmatory factor analysis

| Model                           | $\chi^2$ | df  | p      | CFI  | TLI  | RMSEA [90% CI]    | SRMR |
|---------------------------------|----------|-----|--------|------|------|-------------------|------|
| Seven-factor CFA (hypothesised) | 922.95   | 881 | .159   | .996 | .996 | .011 [.000, .019] | .030 |
| Single-factor CFA (Harman)      | 6084.59  | 902 | < .001 | .561 | .540 | .124 [.121, .127] | .111 |

Note. Robust maximum likelihood (MLR); Yuan–Bentler scaled  $\chi^2$ ; robust CFI, TLI and RMSEA. Scaled  $\Delta\chi^2(21) = 5362.77$ ,  $p < .001$ , in favour of the seven-factor model. Composite reliability (CR) and AVE of the seven-factor model: IS CR = .923, AVE = .666; CIS CR = .919, AVE = .656; PC CR = .920, AVE = .658; CP CR = .911, AVE = .630; FRM CR = .915, AVE = .642; AE CR = .919, AVE = .654; PO CR = .940, AVE = .663.

the linear regression benchmark for every outcome indicator, measured using both RMSE and MAE (Table 12), which indicates high relative predictive power [17].

Table 11: Structural model results

| Hypothesis                                   | $\beta$ | SE   | t     | p      | 95% CI       | $f^2$ | VIF  | Supported |
|----------------------------------------------|---------|------|-------|--------|--------------|-------|------|-----------|
| H1: IS $\rightarrow$ PO                      | .166    | .035 | 4.79  | < .001 | [.098, .233] | .051  | 1.41 | Yes       |
| H2: CIS $\rightarrow$ PO                     | .125    | .038 | 3.27  | .001   | [.050, .200] | .025  | 1.60 | Yes       |
| H3: PC $\rightarrow$ PO                      | .224    | .041 | 5.47  | < .001 | [.145, .305] | .072  | 1.79 | Yes       |
| H4: CP $\rightarrow$ PO                      | .153    | .043 | 3.59  | < .001 | [.068, .238] | .039  | 1.61 | Yes       |
| H5: FRM $\rightarrow$ PO                     | .156    | .039 | 4.04  | < .001 | [.082, .234] | .042  | 1.52 | Yes       |
| H6: AE $\rightarrow$ PO                      | .263    | .039 | 6.77  | < .001 | [.187, .338] | .119  | 1.50 | Yes       |
| H7: SE $\rightarrow$ PO (higher-order model) | .785    | .019 | 41.08 | < .001 | [.750, .826] | 1.61  | —    | Yes       |

Note. Percentile bootstrap with 5,000 resamples (two-tailed).  $R^2$  (PO) = .616 for H1–H6 and .616 for H7. SE = overall stakeholder engagement (higher-order construct).

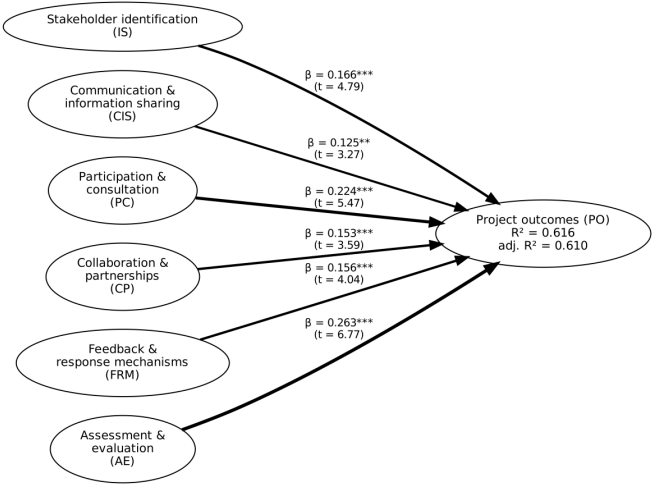


Figure 5: Structural model results (first-order model)

Note. \*\* $p < .01$ ; \*\*\* $p < .001$ . Arrow width is proportional to  $\beta$ .

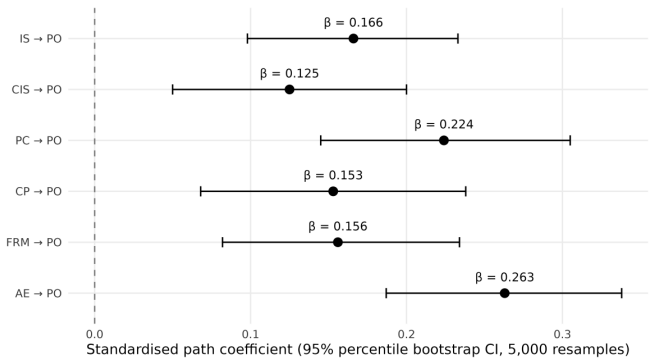


Figure 6: Path coefficients with 95% bootstrap confidence intervals

Note. None of the confidence intervals includes zero.

E. Higher-order model

In the reflective–formative higher-order model, all six practices had positive and significant weights on overall stakeholder engagement (.159–.335;  $VIF \leq 1.79$ ), with assessment and evaluation (.335) and participation and consultation (.285) displaying the largest weights, as depicted in Figure 7. Overall engagement was strongly related to project outcomes ( $\beta = .785$ ,  $p < .001$ ,  $R^2 = .616$ ), supporting H7. Because Mode B weights in a single-predictor model tend to maximise ex-

Table 12: PLSpredict results

| Indicator | $Q^2_{predict}$ | RMSE PLS | RMSE LM | MAE PLS | MAE LM |
|-----------|-----------------|----------|---------|---------|--------|
| PO1       | .393            | .720     | .748    | .592    | .614   |
| PO2       | .441            | .725     | .760    | .572    | .592   |
| PO3       | .323            | .839     | .857    | .654    | .671   |
| PO4       | .426            | .743     | .778    | .593    | .618   |
| PO5       | .501            | .644     | .671    | .522    | .541   |
| PO6       | .433            | .780     | .811    | .621    | .656   |
| PO7       | .474            | .693     | .710    | .547    | .564   |
| PO8       | .391            | .693     | .739    | .549    | .579   |

Note. 10-fold cross-validation, 10 repetitions; LM = linear regression benchmark. Lower RMSE/MAE values for PLS than for LM indicate superior out-of-sample prediction.

plained variance, we re-estimated the model with a reflective–reflective (Mode A) higher-order construct and with a unit-weighted composite of all 36 engagement items. These specifications yielded  $\beta = .782$  and  $\beta = .777$ , respectively, providing evidence that the central association is not simply an artefact of the chosen weighting scheme (Table 13).

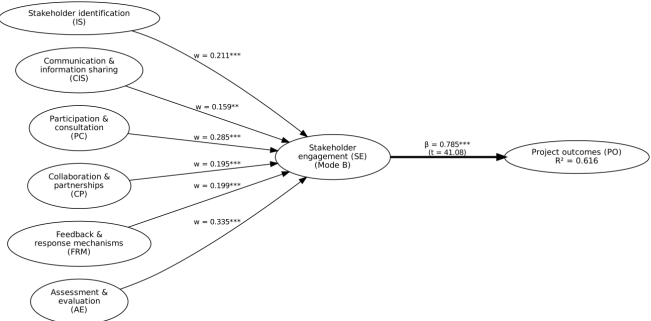


Figure 7: Higher-order model

Note.  $w$  = outer weight; \*\* $p < .01$ ; \*\*\* $p < .001$ .

Table 13: Alternative specifications of overall stakeholder engagement

| Specification                                             | $\beta$ (SE $\rightarrow$ PO) | $R^2$ (PO) |
|-----------------------------------------------------------|-------------------------------|------------|
| Reflective–formative HOC (Mode B; main)                   | .785                          | .616       |
| Reflective–reflective HOC (Mode A)                        | .782                          | .611       |
| Unit-weighted composite (mean of 36 items)                | .777                          | .604       |
| Weight of IS in Mode B HOC ( $t = 4.78$ , $VIF = 1.41$ )  | .211                          |            |
| Weight of CIS in Mode B HOC ( $t = 3.28$ , $VIF = 1.60$ ) | .159                          |            |
| Weight of PC in Mode B HOC ( $t = 5.51$ , $VIF = 1.79$ )  | .285                          |            |
| Weight of CP in Mode B HOC ( $t = 3.60$ , $VIF = 1.61$ )  | .195                          |            |
| Weight of FRM in Mode B HOC ( $t = 4.07$ , $VIF = 1.52$ ) | .199                          |            |
| Weight of AE in Mode B HOC ( $t = 6.97$ , $VIF = 1.50$ )  | .335                          |            |

Note. For the unit-weighted composite,  $\beta$  is the correlation between the mean of the 36 engagement items and the mean of the eight PO items.

F. Importance–performance map analysis

The importance–performance map analysis, detailed in Table 14 and Figure 8, shows that assessment and evaluation had the highest importance (.255) as well as the highest performance (72.9 on a 0–100 scale). Participation and consultation was the second most important practice (.200) but

had the lowest performance (70.4), placing it in the "priority for improvement" quadrant. Performance varied within a narrow band (70.4–72.9), so priorities are driven mainly by differences in importance.

Table 14: Importance–performance map

| Practice                                    | Importance | Performance | Quadrant                 |
|---------------------------------------------|------------|-------------|--------------------------|
| Stakeholder identification (IS)             | .156       | 71.57       | Possible overkill        |
| Communication and information sharing (CIS) | .119       | 71.07       | Low priority             |
| Participation and consultation (PC)         | .200       | 70.41       | Priority for improvement |
| Collaboration and partnerships (CP)         | .142       | 71.70       | Possible overkill        |
| Feedback and response mechanisms (FRM)      | .150       | 70.74       | Low priority             |
| Assessment and evaluation (AE)              | .255       | 72.93       | Keep up the good work    |

Note. Importance = unstandardised total effect on PO; performance = mean rescaled score (0–100). PO performance = 72.21.

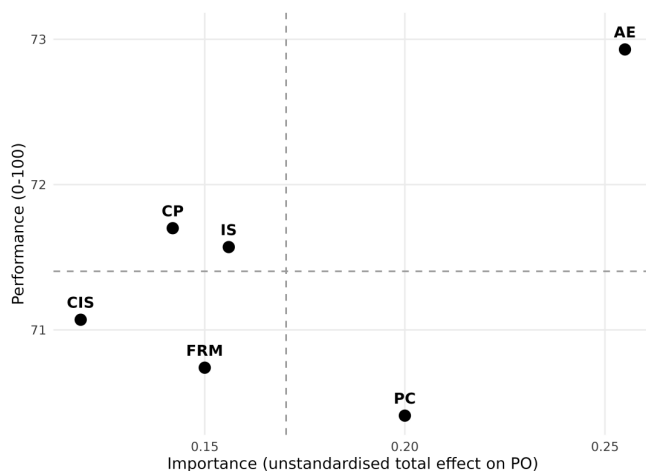


Figure 8: Importance–performance map for project outcomes

Note. Dashed lines mark the mean importance and mean performance of the six practices.

### G. Robustness checks

Table 15 summarises the robustness checks, and Tables 16–19 report the detailed results. The central associations between stakeholder engagement practices and project outcomes remained stable after controlling for organisation size, professional experience, and industrial sector. Projects in the energy and utilities sector reported slightly weaker outcomes than manufacturing projects. Ramsey's RESET specification test [53] did not indicate general model misspecification, whereas the quadratic term for assessment and evaluation was negative and statistically significant, although its measured effect size was small (Table 17). In the Gaussian copula analyses [44], [54], none of the individual copula terms was statistically significant in the single-copula specifications (Table 18). In the joint model, the copula term for feedback and response mechanisms reached significance. Because the copula terms correlated very highly with their predictors ( $r \geq .976$ ), which makes these estimates unstable [55], we interpret this as weak

evidence of endogeneity for that path. Finally, PLSc and CB-SEM produced path estimates within .016 of their PLS-SEM counterparts, and all six structural relationships remained statistically significant across the alternative estimators (Table 19).

Table 15: Summary of robustness checks

| Check                                        | Result                                                                                                           | Implication                                                      |
|----------------------------------------------|------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|
| Control variables (size, experience, sector) | Core paths $\beta = .124$ –.268, all $p \leq .001$ ; energy sector $\beta = -.081$ ( $p = .035$ ); $R^2 = .623$  | Results not driven by organisational or sectoral characteristics |
| Nonlinearity                                 | RESET $F = 1.43$ , $p = .240$ ; $AE^2$ $\beta = -.066$ ( $p = .005$ , $f^2 = .020$ ); other quadratic terms n.s. | Linear model adequate; mild diminishing returns for AE           |
| Endogeneity (Gaussian copulas)               | Single-copula models: all n.s.; joint model: c(FRM) $p = .028$ ; copula–predictor $r = .976$ –.988               | Weak evidence of endogeneity for FRM; interpret with caution     |
| Influential observations                     | Excluding 6 outliers: max $ \Delta\beta  = .007$ ; $R^2 = .617$                                                  | Results not driven by outliers                                   |
| Alternative estimators                       | PLSc $R^2 = .673$ ; CB-SEM $R^2 = .669$ ; max $ \Delta\beta  = .016$ ; all $p \leq .010$                         | Results robust to estimator choice                               |
| Higher-order specification                   | Mode A HOC $\beta = .782$ ; unit-weighted composite $r = .777$                                                   | H7 not an artefact of Mode B weighting                           |

Note. Bootstrap with 2,000 resamples for control and quadratic models and 1,000 resamples for copula models.

Table 16: Structural model with control variables

| Path                                        | $\beta$ | t     | p      | 95% CI         |
|---------------------------------------------|---------|-------|--------|----------------|
| IS $\rightarrow$ PO                         | .173    | 4.83  | < .001 | [.099, .241]   |
| CIS $\rightarrow$ PO                        | .124    | 3.31  | .001   | [.050, .195]   |
| PC $\rightarrow$ PO                         | .212    | 5.16  | < .001 | [.135, .293]   |
| CP $\rightarrow$ PO                         | .152    | 3.53  | < .001 | [.067, .236]   |
| FRM $\rightarrow$ PO                        | .150    | 3.89  | < .001 | [.076, .228]   |
| AE $\rightarrow$ PO                         | .268    | 6.87  | < .001 | [.192, .344]   |
| Organisation size $\rightarrow$ PO          | .032    | 1.03  | .303   | [-.027, .095]  |
| Experience $\rightarrow$ PO                 | .017    | 0.63  | .531   | [-.037, .070]  |
| Sector: construction $\rightarrow$ PO       | -.004   | -0.12 | .903   | [-.072, .064]  |
| Sector: mining & chemicals $\rightarrow$ PO | -.023   | -0.66 | .506   | [-.092, .042]  |
| Sector: food & pharma $\rightarrow$ PO      | -.010   | -0.29 | .773   | [-.081, .058]  |
| Sector: energy & utilities $\rightarrow$ PO | -.081   | -2.12 | .035   | [-.154, -.003] |

Note. Reference sector: manufacturing.  $R^2 = .623$ ; 2,000 resamples.

Table 17: Quadratic effects

| Term                              | $\beta$ | SE   | t     | p    | 95% CI         | $f^2$ |
|-----------------------------------|---------|------|-------|------|----------------|-------|
| IS <sup>2</sup> $\rightarrow$ PO  | .034    | .024 | 1.43  | .154 | [-.015, .079]  | .005  |
| CIS <sup>2</sup> $\rightarrow$ PO | .008    | .028 | 0.30  | .763 | [-.049, .061]  | .000  |
| PC <sup>2</sup> $\rightarrow$ PO  | -.023   | .025 | -0.91 | .361 | [-.071, .028]  | .002  |
| CP <sup>2</sup> $\rightarrow$ PO  | .007    | .027 | 0.26  | .795 | [-.047, .057]  | .000  |
| FRM <sup>2</sup> $\rightarrow$ PO | .031    | .029 | 1.04  | .298 | [-.023, .095]  | .004  |
| AE <sup>2</sup> $\rightarrow$ PO  | -.066   | .023 | -2.85 | .005 | [-.112, -.020] | .020  |

Note. Each term added separately to the linear model (standardised scores; 2,000 resamples). RESET:  $F = 1.43$ ,  $p = .240$ .

## V. Discussion

This study examined which stakeholder engagement practices are associated with the outcomes of industrial projects. All six practices were positively associated with project outcomes, and together they explained more than three-fifths of the observed variance while also demonstrating strong out-of-sample predictive performance. However, the estimated magnitude and practical relevance of their individual contributions differed substantially across the six dimensions.

Table 18: Gaussian copula tests

| Model       | Term   | Estimate | SE   | t     | p    |
|-------------|--------|----------|------|-------|------|
| Copula IS   | c(IS)  | .071     | .162 | 0.44  | .660 |
| Copula CIS  | c(CIS) | -.118    | .186 | -0.63 | .526 |
| Copula PC   | c(PC)  | -.119    | .137 | -0.87 | .388 |
| Copula CP   | c(CP)  | .057     | .151 | 0.38  | .706 |
| Copula FRM  | c(FRM) | .325     | .182 | 1.79  | .075 |
| Copula AE   | c(AE)  | -.257    | .169 | -1.52 | .129 |
| All copulas | c(IS)  | .118     | .157 | 0.76  | .450 |
| All copulas | c(CIS) | -.136    | .190 | -0.72 | .475 |
| All copulas | c(PC)  | -.154    | .137 | -1.13 | .261 |
| All copulas | c(CP)  | .059     | .151 | 0.39  | .699 |
| All copulas | c(FRM) | .416     | .188 | 2.21  | .028 |
| All copulas | c(AE)  | -.292    | .174 | -1.68 | .093 |

Note. Bootstrap SEs (1,000 resamples). Predictor–copula correlations: .976–.988; Kolmogorov–Smirnov tests confirmed non-normality of all predictors ( $p < .01$ ).

Table 19: Path coefficients across estimators

| Path                 | PLS-SEM $\beta$ | p      | PLSc $\beta$ | p      | CB-SEM $\beta$ | p      |
|----------------------|-----------------|--------|--------------|--------|----------------|--------|
| IS $\rightarrow$ PO  | .166            | < .001 | .167         | < .001 | .163           | < .001 |
| CIS $\rightarrow$ PO | .125            | .001   | .117         | .008   | .115           | .010   |
| PC $\rightarrow$ PO  | .224            | < .001 | .234         | < .001 | .236           | < .001 |
| CP $\rightarrow$ PO  | .153            | < .001 | .152         | .004   | .155           | .002   |
| FRM $\rightarrow$ PO | .156            | < .001 | .154         | < .001 | .154           | < .001 |
| AE $\rightarrow$ PO  | .263            | < .001 | .279         | < .001 | .277           | < .001 |

Note. PLSc: 2,000 resamples; CB-SEM: MLR.  $R^2 = .616$  (PLS-SEM), .673 (PLSc), .669 (CB-SEM).

## A. Interpretation of the findings

*Assessment and evaluation as the strongest correlate.* One of the most distinctive empirical findings is that assessment and evaluation — measuring engagement effectiveness and stakeholder satisfaction, documenting lessons learned and involving stakeholders in reviews — was the strongest predictor of outcomes and the largest contributor to the engagement capability. Prior research has concentrated on the front end of engagement, namely identification and analysis [2], [28]. Our results suggest, more specifically, that closing the engagement cycle through systematic assessment and organisational learning may be especially important for favourable project outcomes. This interpretation is consistent with project-learning research showing that learning from projects does not happen automatically and requires deliberate, systemic routines [13], [35]. The negative quadratic term indicates diminishing marginal returns once a robust evaluation routine exists, consistent with the "too-much-of-a-good-thing" effect [57]. For managers, the practical question is therefore whether a sufficiently systematic evaluation routine exists and is used effectively, rather than simply how frequently or intensively assessment activities are performed.

*Participation and consultation as the main improvement priority.* Participation and consultation was the second strongest predictor, but it was the weakest-performing practice. Industrial project organisations in the sample thus appear more comfortable informing and coordinating stakeholders than sharing decision influence with them. This gap matters, because neglected stakeholders can obstruct implementation [8] and inclusive treatment of local communities improves performance [9]. Our findings extend this megaproject-based

evidence to a broad cross-section of industrial projects.

*The roles of identification, feedback, and collaboration.* Stakeholder identification, feedback and response mechanisms, and collaboration and partnerships each contributed moderately. Identification is a precondition of engagement [23], but its value appears to be realised mainly through the practices that follow it. Feedback mechanisms institutionalise engagement [32]. Their effect should nonetheless be interpreted cautiously, because the copula analysis hinted at endogeneity: projects facing difficulties may, for example, intensify their complaint handling. The collaboration finding is consistent with instrumental stakeholder theory's emphasis on trust and cooperation [15] and with project-level evidence on trust [34], [38].

*Communication and information sharing.* Communication showed the smallest unique structural coefficient even though its bivariate correlation with project outcomes remained substantial ( $r = .548$ ). A plausible explanation is that communication is the medium through which consultation, collaboration and feedback are enacted. Its contribution is therefore largely shared with those practices, consistent with evidence that communication improves success partly by shaping conflict dynamics [33]. Because we did not test mediation, this explanation remains a proposition for future research.

*Comparison with previous quantitative evidence.* Our results are consistent with recent survey-based studies reporting that stakeholder management improves project performance and stakeholder satisfaction in Malaysian residential projects [12], and that managing stakeholder engagement strengthens the effect of initiation activities on project success in Iran [11]. Whereas those studies treated stakeholder management as an aggregate construct or a moderator, our decomposition shows which practices carry the effect. The explanatory power of our model ( $R^2 = .616$ ) further suggests that engagement accounts for a substantial share of the variation in industrial project outcomes, although omitted factors such as technical complexity and contractual arrangements are likely to explain part of this variance as well.

*Stakeholder engagement as an integrated capability.* The contrast between the small individual effect sizes and the strong effect of the higher-order construct indicates that the practices create value jointly. This supports multidimensional conceptions of engagement [4], evidence of interdependent stakeholder-management success factors [10] and the shift from managing stakeholders to engaging with them [3].

## B. Theoretical implications

First, the study refines instrumental stakeholder theory [15], [22] at the project level. It shows that the performance value of engagement is unevenly distributed: its observed association with project outcomes is greatest when stakeholders are given opportunities to participate and when engagement is systematically evaluated and learned from, and weakest for information provision considered on its own. Second, the study links stakeholder engagement to project-learning theory by identifying evaluation as a core mechanism of engage-

ment, with boundary conditions suggested by its curvilinear effect. Third, by modelling engagement as an empirically assessed higher-order capability whose association remains robust across the reported alternative specifications, the study bridges stakeholder theory and the capability perspective [24]. It also offers a measurement approach for future research [26]. Fourth, it extends a literature dominated by megaprojects in Western and East Asian settings [2], [9] to industrial projects in an Arab emerging economy.

### C. Practical implications

For project owners, managers, and decision-makers, the importance–performance analysis offers a practical and comparatively clear set of priorities. First, embed participation and consultation in project plans: involve key stakeholders in defining objectives and requirements, consult them before major decisions and at stage gates, and consult affected communities. Second, institutionalise an efficient evaluation routine incorporating explicit engagement indicators, stakeholder-satisfaction measures, and an accessible repository of lessons learned; given the small observed quadratic effect, additional evaluation intensity may yield diminishing marginal benefits once a sufficiently systematic routine has been established. Third, manage engagement as an integrated system with clear ownership in project governance rather than adopting isolated practices. Fourth, formalise accessible grievance channels and close the loop by informing stakeholders of the actions taken. For regulators and professional bodies, integrating community-consultation and grievance-mechanism requirements into the approval of industrial projects and into project-management training could raise engagement standards across the sector.

### D. Limitations and future research

Several methodological limitations should inform the interpretation of these findings. First, the cross-sectional research design does not establish causal direction, and the copula results suggest that reverse causality cannot be excluded for feedback mechanisms. Longitudinal designs that track engagement across project phases are needed. Second, predictors and outcomes were reported by a single informant per project. Although procedural and statistical checks suggest that method bias does not account for the findings, they cannot rule it out [56]. Future studies should use objective outcome data (e.g., schedule and cost variance, recorded disputes and HSE incidents) or multiple informants, including external stakeholders. Third, non-probability sampling within one region limits generalisability, and replications in other emerging economies are needed. Fourth, the higher-order construct could not be validated through redundancy analysis because no global engagement item was included. Fifth, heterogeneity across project types and moderating conditions, such as project complexity, size and contract type, were not modelled. Finally, the proposed explanatory mechanisms—for example, that communication operates through consultation

and collaboration, or that stakeholder engagement is associated with better outcomes through reduced conflict—remain untested pathways that should be examined directly in future longitudinal and mediation analyses.

## VI. Conclusion

Across the sampled industrial projects, systematic stakeholder engagement was consistently associated with more favourable reported project outcomes, although the individual practices were not equally important in explaining outcome variation. Evaluating engagement and giving stakeholders a genuine voice in decisions are the strongest levers, and the practices create most value when managed as an integrated capability. The central pattern of findings remained stable across the reported control-variable analyses, alternative construct specifications, and alternative estimation methods. Taken together, these findings suggest that stakeholder engagement deserves to be treated as a core and integrated project-management capability rather than as a peripheral, stand-alone communication task.

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## Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the research reported in this manuscript.

## Ethics approval and consent to participate

Participation in this study was entirely voluntary. All participants were informed about the purpose of the research, the voluntary nature of their participation, and the confidentiality of their responses. Informed consent was obtained from all participants prior to data collection. All collected data were handled confidentially and used exclusively for academic research purposes.

## Data and code availability

The datasets and annotated R scripts used for the statistical analyses in this study are available from the corresponding author upon reasonable request, subject to applicable confidentiality and data protection requirements.

## Author contributions

Jamilah Abdullah Al Jarallah: Conceptualization, Methodology, Investigation, and Writing – Original Draft.

Hanan Abdelrhman Al Edwan: Formal Analysis, Data Curation, Software, Visualization, and Writing – Review & Editing.

Faisal Sadun Alharbi: Literature Review, Methodology, Validation, and Writing – Review & Editing.

All authors have read and approved the final version of the manuscript and agree to be accountable for their respective contributions.

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