

# **People, Process, and Adaptation: The Mediating Role of Hybrid Project Management in the Success of Public Vocational Training Projects. Evidence from NAVTTC Skill-Development Projects in Pakistan**

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## **Abstract**

In developing economies, public vocational training projects are often overspending and overscheduled, but the success criteria proven in private sector and western contexts do not necessarily apply to public agencies. In this study, the critical success factors (CSFs) that impact on the success of projects undertaken by the National Vocational and Technical Training Commission (NAVTTC) of Pakistan are identified and the impact of the project management approach (PMA) is tested between the identified CSFs. Five CSFs (team capability, customer (trainee) involvement, training and learning culture, psychological safety, and data quality and model validation) were measured, and PMA was included with a multi-dimensional measure of project success, in a cross-sectional survey of 185 NAVTTC project professionals. Data was analysed using SPSS for reliability analysis, Pearson correlations and Hayes' PROCESS (Model

4) mediation with bootstrapped confidence intervals. Data quality was the strongest single correlate with project success ( $r = 0.72$ ,  $p < .01$ ), while the other four CSFs were also all strongly and positively correlated with project success ( $r = 0.64\text{--}0.71$ ,  $p < .01$ ). PMA partially mediated every CSF–success relationship, carrying 39–54% of each total effect while significant direct effects remained. Ninety-three percent of respondents reported hybrid practices, and the combined model explained roughly 75% of the variance in success. The study takes CSF theory to an under-researched public vocational context, places adaptive project management at the core of the process linking human and technical factors to the delivered outcomes, and provides quantitative evidence for the agility of hybrid beyond the IT industry.

**Keywords:** critical success factors, project success, hybrid project management, mediation, psychological safety, vocational training, Pakistan

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## 1. Introduction

Vocational skills training is a key pillar of socio-economic development in Pakistan. The country has one of the youngest populations in the world with a high and increasing rate of youth unemployment, whose ability to generate a demographic dividend relies significantly on the effectiveness of its technical and vocational education and training (TVET) system. To address the issue of youth unemployment and increase employability, the National Vocational and Technical Training Commission (NAVTTTC), the federal agency responsible for technical and vocational education, has introduced large scale programmes funded by the government, including the Prime Minister's Youth Skill Development Programme and Matric-Tech programmes. These programmes are delivered at both federal and provincial level and involve a range of stakeholders including trainers, administrators, industry partners and training participants.

Many NAVTTTC projects, however, face difficulties in implementation, including budget overruns, schedule slips, public stakeholder disagreements, and difficulties in maintaining gains, which result in short-term benefits and hinder long-term goals. This performance gap is costly: failed or delayed skill-development projects represent a direct loss of public funds and a missed opportunity to equip young people for the labour market. To solve the pattern, the critical success factors (CSFs) that are relevant in this particular institutional context and the mechanisms by which these factors work need to be known.

CSFs have been well documented in international project management research and are classified as human, organizational, and technical (Belassi & Tukel, 1996). Clear objectives, strong top-management support, and competent teams (Pinto & Slevin, 1987) have been identified as CSFs and are grouped into human, organizational, and technical categories. But the bulk of it comes from the private sector and developed economies and much of it applies to information technology or construction projects. The public vocational sector in Pakistan, however, is bureaucratic, resource-poor, and hierarchical, and there is often a lack of meaningful engagement with stakeholders, and management prototypes are rarely adapted to local conditions. The degree to which globally recognized success factors work in this context, as well as their strength and configuration is therefore an empirical question that has yet to be tested, and a locally rooted and evidence-based framework of CSF is not well established.

This study fills that gap by testing five CSFs from the human, stakeholder, learning, and technical domains: team capability, psychological safety (human); customer (trainee) involvement (stakeholder); training and learning culture (learning); and data quality and model validation (technical). More importantly it presents the project management approach (PMA): traditional, agile or hybrid as a mediator, assuming that more agile approaches could be more appropriate for the complexity and dynamism of public-sector training work than plan-driven control. The research questions are: (1) Which human, organisational, and technical factors determine NAVTTC project success, and how strongly? (2) How does the project management approach impact those outcomes? How do factors like psychological safety and data quality relate to training results and stakeholder satisfaction?

The contribution contains both practical and theoretical components. In practical terms, the findings enable NAVTTC, the Ministry of Education and similar public bodies to prioritize limited resources and allocate them towards team building, stakeholder engagement, monitoring systems, or methodological reform, and they support the development of context-specific policy and evidence-based decision-making on the design and implementation of vocational projects. Theoretically, the study contributes towards the field of public vocational education in a developing country, which has received relatively little attention in the academic literature, and models the project management approach as the mechanism that binds human and technical factors to delivered results; by foregrounding soft factors like psychological safety and technical factors

like data practices, the study also contributes to the theoretical field of project success, which is dominated by contingency and systems theories. The second part of the paper summarizes the relevant literature and formulates the hypotheses, outlines the methodology, presents the empirical findings, explains the implications, and concludes with recommendations, limitations, and suggestions for future research.

## **2. Theoretical Background and Hypotheses**

### **2.1. Contingency and systems perspectives**

Two complementary theories form the foundation of the study. Contingency theory holds that no management practice is universally effective; a method succeeds only when it fits the project's type, size, complexity, and organisational environment (Shenhar, 2001). An innovative, uncertain job rewards flexible, collaborative management, while routine well-defined jobs benefit from structured, plan-driven control. In the case of NAVTTC, the above logic means that the way training is managed must be aligned with the configuration of actors, the rules and the resources of the commission, as well as with the nature of the training projects, which have a dynamic, stakeholder-oriented approach to training, so flexible and agile training methods are better suited than traditional ones, with their fixed curricula and homogenous beneficiaries. Contingency logic also suggests that a successful CSF implementation will lead to poor outcomes when it is implemented in an inappropriate manner, making the value of capability, engagement, learning, safety, and data a function of the approach in which they are implemented.

Systems theory is not a theory of any one thing, but a theory of a whole system of interacting parts: people, processes, technology, and environment; success is not a function of any single part but is dependent on the interaction of the parts as a whole (Fortune & White, 2006). Good management techniques are not enough to fix poor data systems or weak stakeholder engagement and capability is not enough to fix poor stakeholder trust. This view could motivate the study of multiple CSFs, the focus on their inter-relations, and the interrogation of how human and technical conditions (time, cost, scope) are coordinated with organizational and human factors (team, stakeholders, culture) by adaptive PM practices. Put together, contingency theory highlights a situation's match with the approach to management, and systems theory highlights the interrelationship of several factors. The two come together in the same statement: context-specific combinations of interacting

factors are vital to the success of NAVTTC projects, and no single factor is responsible and this is central to the conceptual model that follows.

## **2.2. Critical success factors**

### **2.2.1. *Team capability***

The project management literature repeatedly acknowledges the skills, experience, cohesion, communication, role clarity, and adaptability of the project team as one of the most positive project management CSFs. Team competence and collaboration are among the most important factors for success in agile software projects (Chow & Cao, 2008) and in construction and engineering, the higher the team's competence and problem-solving ability, the better their performance (Jitpaiboon et al., 2019; Berssaneti & Carvalho, 2015). Fortune and White (2006) emphasize the need for appropriate personnel, and Belout and Gauvreau (2004) emphasize the human resource aspect, especially in relation to the organization's context. Capability is important particularly when recruitment and development are limited by bureaucratic procedures, such as in many public works projects in developing countries (Irfan et al., 2021). Capability in NAVTTC projects can range from technical delivery (curriculum design and training provision) to softer skills in terms of coordination and communication, while lack of these capabilities can have a negative impact on even the most well-designed plans.

**H1:** Team capability positively influences NAVTTC project success.

### **2.2.2. *Customer (trainee) involvement***

The involvement of customers is the engagement of trainees (the main beneficiaries) and other stakeholders (industry partners and communities) in project decisions and feedback. Stakeholder engagement is a key CSF, especially in projects involving multiple stakeholders and public sector participation, since it helps to clarify requirements, minimize misunderstandings, increase buy-in and enhance satisfaction (Alias et al., 2014). In developing-country public projects, real participation can enhance relevance and sustainability (Osei-Kyei & Chan, 2015; Ajibike et al., 2022) and manage expectations and prevent conflict (Kumar et al., 2023), while token or bureaucratic participation can lead to scope change, low satisfaction and delays (Alzahrani & Emsley, 2013). In NAVTTC projects, participation can be expressed as trainee feedback on

content, participation in internship/placement planning, alignment of programmes with employer needs etc. and these are more likely to lead to positive outcomes like employment and skill acquisition, thus being a beneficiary-centric approach.

**H2:** Customer (trainee) involvement positively influences project success.

### ***2.2.3. Training and learning culture***

A sustained culture of staff development, knowledge sharing, and lesson documentation helps teams absorb uncertainty and improve performance, and is a core tenet of modern and, especially, agile practice (Tsoy & Staples, 2021; Tam et al., 2020). In NAVTTC projects, this is done at two levels: firstly, project staff benefit from project management and technical skills training, which also incorporate transfer of learning from earlier projects; and secondly, training outcomes benefit the beneficiaries in that curricula are kept current with industry needs. Some evidence has been found suggesting that professional development is a key factor in successful project implementation (Hussain et al., 2024); however, the constraints of the public sector can generate a mismatch between the need for professional development and its actual provision, as suggested by Irfan et al., (2021). Cultures of knowledge sharing are associated with project success (Bogopa & Marnewick, 2022), and learning-oriented teams perform better in adaptive settings, suggesting that a strong learning culture will both raise outcomes directly and reinforce other factors such as agile practice and data use.

**H3:** Training and learning culture positively influences project success.

### ***2.2.4. Psychological safety***

Psychological safety describes "a team's belief that the environment is safe for taking risks: speaking up when they make a mistake; asking questions; acknowledging their own ignorance; and sharing ideas" (Edmondson, 1999). It allows for early problem detection, information flow, and problem solving together without fear of being punished or ridiculed. It is also associated with quality, knowledge sharing, adaptability, innovation and stakeholder satisfaction in project settings (Barros et al., 2024; Trinh & Feng, 2020), and many practitioners have deemed it to be one of the most important factors of effective teams. It plays a crucial role in agile and complex projects where communication and trust are key. However, a hierarchical organisation (typical of a

government organisation) can be a disincentive to employees to report issues, which can let them go untouched. In the West, evidence shows that open team climates are associated with project success, but the link between team climate and user outcomes is less well understood in South Asian public projects, and NAVTTC is an ideal test case to explore the relationship between psychological safety and subsequent coordination and results, even in a traditionally hierarchical culture.

**H4:** Psychological safety positively influences project success.

### ***2.2.5. Project management approach***

Project management approach is the way the project is planned and managed, usually either traditional (plan-driven, sequential, tightly controlled) or agile (iterative, flexible, stakeholder-oriented) or a mixture of the two. The improvements that agile or hybrid approaches bring over traditional methods is a live question, especially in the stakeholder-rich and dynamic settings (Ciric Lalic et al., 2022; Gemino et al., 2021). Formal governance that incorporates trainee feedback can manage uncertainty more effectively than strict up-front plans and evidence from construction and large public developments argue for embedding formal planning with adaptive responsiveness. While some organisations in developing countries are still using traditional, rigid methods, agile adoption has been linked to increased client satisfaction and project success (Serrador & Pinto, 2015; Wafa et al., 2022). This study assesses PMA categorically (traditional, agile, hybrid) and perceptually (suitability, flexibility, stakeholder consultation, timely delivery) to relate the quality and fit of the approach to outcomes rather than the name.

**H5:** An adaptive (agile/hybrid) project management approach positively influences project success.

### ***2.2.6. Data quality and model validation***

Data quality and model validation are related to the ability to rely on project data in a reliable, accurate and appropriate manner for decision-making purposes, as well as checking project plans and assumptions against conditions that exist in reality. Data-driven project management is becoming more prevalent, as timely and accurate performance, risk, and outcome information helps to take appropriate action; and when the information is inaccurate or outdated, ineffective

decisions are made and resources are wasted (Bogopa & Marnewick, 2022). Monitoring and evaluation (M&E) systems that track success criteria and support continuous improvement are central to this factor, and model validation ensures that the project's underlying theory of change still holds and is updated when assumptions fail. High-quality data and fast feedback loops are necessary for agile projects (Tsoy & Staples, 2021), and data-driven monitoring can prevent cost and schedule overruns (Ahmed et al., 2023). Public-sector data systems are often weak in developing countries, which affects accountability (Ajibike et al., 2022); for many centres and trainees, keeping accurate enrolment, attendance and expenditure records is difficult and critical for NAVTTC. Although it is crucial for CSF, this aspect is comparatively less studied in the CSF literature (Sajida & Kusumasari, 2023).

**H6:** Data quality and model validation positively influence project success.

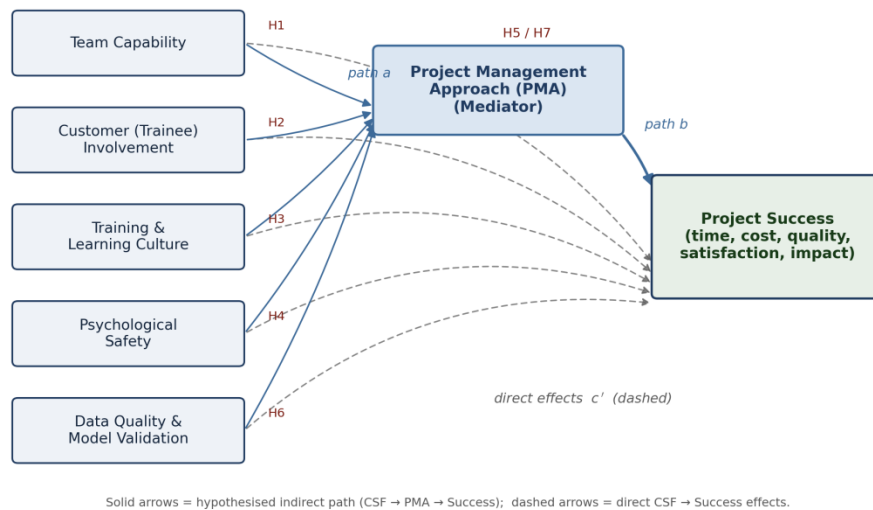
### **2.3. The mediating role of the project management approach**

Combining these arguments, this study suggests the project management approach to moderate the CSF–success relationships as a process by which human and technical strengths are translated into delivered outcomes. Enabling characteristics that support or coincide with the adoption of more appropriate and adaptive methods include capable, trusting, learning-oriented teams that embrace iterative, collaborative work practices like regular reflection and adaptation; strong stakeholder engagement and participation that results in flexibility and responsiveness, characteristic of agile and hybrid management; and reliable data that allows for evidence-based adjustments, as required for adaptive management. Through a better-fitting approach, these factors then translate into higher success.

At the same time, each CSF should also affect success directly, independent of the approach capable teams execute better regardless of method, engaged stakeholders are more satisfied and supportive, and reliable data averts problems. Full mediation is therefore implausible; partial mediation, in which a significant indirect path through PMA coexists with a significant direct path, is the theoretically expected pattern. This dual-pathway logic is consistent with both the contingency theory (the right approach is the one that, given the context, is inserted between factors and outcomes) and systems theory (project elements interact, and success emerges from various interacting pathways). Although there are indications in previous research of such mediation (e.g.,

agile practices as a result of capability), such models have not been tested directly, and this study attempts to fill that gap.

**H7:** The project management approach partially mediates the effect of each CSF (H1–H4, H6) on project success.



*Figure 1: Conceptual framework. Five critical success factors influence project success both directly (dashed) and indirectly through the project management approach (solid)*

### 3. Methods

#### 3.1. Design

A quantitative, cross-sectional survey design was used to test the hypothesised relationships. The study is descriptive-explanatory and deductive; it summarizes the conditions in NAVTTC projects and checks the theory-based hypotheses regarding the impact of CSFs and PMA on success. In the context of the research-union proposed by Saunders et al., it represents a positivist, mono-method quantitative approach. The Likert scales allowed for a relatively large sample size and sufficient variance for regression and mediation analysis, as in previous CSF studies (Chow & Cao, 2008; Hyväri, 2006).

#### 3.2. Population and sampling

The target population were professionals who had knowledge of project planning and delivery for NAVTTC funded skill development projects and included project managers, coordinators,

trainers, M&E officers, administrators, contractors, and consultants. The directly affected population was estimated at around 450. Convenience sampling due to geographic dispersion and access constraints, with deliberate effort to ensure coverage across roles and across major centres (Islamabad head office, and centres in Punjab and Khyber Pakhtunkhwa).

Applying Yamane's (1967) formula for a finite population,  $n = N / [1 + N(e)^2]$ , with  $N = 450$  and a 5% margin of error at 95% confidence, yields a target of  $n \approx 212$ . After distribution via Google Forms and official channels and removal of 27 incomplete cases, the final analytic sample was  $N = 185$  — over 40% of the estimated population, indicating high sector coverage.

### 3.3. Measures

All substantive constructs were measured with multi-item 5-point Likert scales (1 = strongly disagree, 5 = strongly agree), higher scores indicating more favourable conditions. Items were adapted from validated sources and tailored to context: team capability (4 items; Tam et al., 2020; Irfan et al., 2021) assessing skills, collaboration, role clarity, and adaptability; customer involvement (4 items; Tsoy & Staples, 2021; Sajida & Kusumasari, 2023) covering trainee participation in decisions, use of feedback, market relevance, and perceived value of input; training and learning (4 items; Tam et al., 2020; Hussain et al., 2024) measuring continuous-learning culture, information relevance, access to development resources, and lesson documentation; psychological safety (4 items; Barros et al., 2024, after Edmondson, 1999) capturing safety to voice opinions, treatment of mistakes as learning, mutual respect, and freedom to ask questions; PMA (4 Likert items plus one categorical approach question; Gemino et al., 2021; Ciric Lalic et al., 2022) covering suitability, flexibility, stakeholder consultation, and support for timely delivery; data quality and model validation (4 items; Tsoy & Staples, 2021; Ahmed et al., 2023) covering data reliability, evidence-based decisions, monitoring systems, and use of reports for improvement; and project success (5 items; Lamprou & Vagiona, 2022; Irfan et al., 2021) capturing the iron triangle of time, cost, and quality plus stakeholder satisfaction and long-term impact.

A multi-criteria success measure recognizes that success is not just about schedule and budget compliance, but also value delivery and stakeholder fulfilment. Content validity was based on literature and face validity was obtained from two scholars in project management and one

representative from NAVTTC, but with little change in wording (for example, trainees as 'Customers' because they are the actual beneficiaries). The instrument was then pretested with 10 target respondents to ensure clarity, and length of statements; some statements were reworded for consistency of interpretation, and pretest scales of the target respondents all had an  $\alpha \geq 0.70$ . Demographic items (age, gender, education, experience, marital status, and optional role) were gathered to explain the sample and to detect response-bias patterns, not for hypothesis testing.

### **3.4. Data collection and ethics**

Data were collected over four weeks in November–December 2025, mostly online through the Google Forms format, as the respondents were geographically distributed, but also some were collected in paper format at a NAVTTC workshop and subsequently entered into the database to also include those who were not so comfortable using Google Forms. An introduction explained the objective of the study, assured anonymity and confidentiality, and provided an estimate of the completion time of 10-15 minutes; reminder emails and telephone calls were employed to increase response rate for under-represented groups. The participation was voluntary (respondents were free to skip questions or withdraw at any time), and informed consent was implied by asking a mandatory participation question. No personally identifying information (names or employee IDs) was gathered; this was significant since some items addressed project problems and management, and anonymity prompted honest responses. After preliminary screening, there was no straight-lining or outliers to consider removing, and 27 cases with missing CSF and success items were excluded to support reliable multivariate analysis, leaving a final analytic sample of  $N = 185$ .

### **3.5. Analysis strategy**

Analyses were conducted using IBM SPSS v28, and the PROCESS v4 macro (Hayes). Demographic and composite constructs were summarised descriptively; composite distributions were reasonably symmetrical, without significant skewness, and parametric testing was conducted under the central limit theorem. Instruments were internally tested for internal consistency using Cronbach's alpha (Nunnally, 1978; threshold 0.70) and alpha-if-item-deleted was checked to ensure that none of the items reduced the internal consistency of the instrument; composite scores were then derived by averaging the items. Pearson correlations among the five CSFs, PMA, and

success provided the initial test of H1–H6 and screened for multicollinearity, none of the inter-factor correlations reaching the 0.80 threshold that would signal redundancy.

Mediation (H7) used PROCESS Model 4, with each CSF entered separately as predictor (X), PMA as mediator (M), and success as outcome (Y). Single-mediator models were chosen over a combined specification for conceptual clarity and to prevent the multicollinearity of the highly correlated CSFs. Each analysis estimated path a ( $X \rightarrow \text{PMA}$ ), path b ( $\text{PMA} \rightarrow Y$  controlling X), the direct effect c' ( $X \rightarrow Y$  controlling M), and the indirect effect  $a \times b$ , the last tested with 95% bias-corrected bootstrap confidence intervals based on 5,000 resamples; an interval excluding zero indicates a significant indirect effect. Because demographics varied across projects and the focus was on project-level factors, respondent age, experience, and role were not entered as controls, and project size and budget were not directly measured. Regression diagnostics were satisfactory: residual plots indicated linearity and homoscedasticity, minor negative skew was addressed through bootstrapping, Cook's distance values were below 1 (no influential outliers), and multicollinearity was acceptable ( $VIF \approx 2\text{--}3$ , well below the threshold of 10). The conditions for valid regression and mediation analysis were therefore met.

## 4. Results

### 4.1. Sample profile

Most respondents had a mid-career status and were highly educated. The majority of participants were in the 36–45 age range, and approximately half were over 35, which is similar to the age distribution of the workforce in the sector, which is largely involved in technical careers and in government project offices; and the majority of participants were male, reflecting the professional and academic profile of the instructors and project directors. More than half of the respondents had over 10 years of project experience, allowing for a more knowledgeable pool, familiar with NAVTTC operations, which enhances the quality of the perceptual data, although it is noted that there is a gender imbalance and a significant central staff concentration. Roles encompassed project directors, training coordinators, M&E specialists, and instructors, and no single project dominated the sample. Strikingly, 93% described their approach as hybrid, with only a handful of pure traditional or agile projects (Table 1) a headline pattern discussed further below.

**Table 1:** Respondent and project profile (N = 185)

| Characteristic | Category          | n   | %    |
|----------------|-------------------|-----|------|
| Age            | Below 25          | 6   | 3.2  |
|                | 25–35             | 46  | 24.9 |
|                | 36–45             | 91  | 49.2 |
|                | 46–55             | 41  | 22.2 |
|                | Above 55          | 1   | 0.5  |
| Gender         | Male              | 148 | 80.0 |
|                | Female            | 36  | 19.5 |
|                | Prefer not to say | 1   | 0.5  |
| Education      | High school       | 2   | 1.1  |
|                | Bachelor's        | 56  | 30.3 |
|                | Master's          | 56  | 30.3 |
|                | PhD               | 71  | 38.4 |
| Experience     | Under 1 year      | 27  | 14.6 |
|                | 1–5 years         | 22  | 11.9 |
|                | 6–10 years        | 43  | 23.2 |
|                | 11–15 years       | 59  | 31.9 |
|                | Over 15 years     | 34  | 18.4 |
| Approach used  | Hybrid            | 172 | 93.0 |
|                | Traditional       | 10  | 5.4  |
|                | Agile             | 3   | 1.6  |

*Note.* Percentages are of the analytic sample and may not sum to 100 due to rounding.

#### 4.2. Descriptive statistics and reliability

All constructs recorded high means (4.25–4.39 on the 1–5 scale) with moderate dispersion ( $SD \approx 0.59$ – $0.66$ ), indicating broadly favourable perceptions but enough variance to differentiate projects. The positive skew is itself informative: participants generally regard NAVTTC projects as successful, so the analysis emphasises relative differences rather than absolute levels. Every scale exceeded the 0.70 reliability threshold, ranging from 0.80 to 0.87, and no item deletion would have improved alpha materially (Table 2).

**Table 2:** Construct descriptive statistics and internal consistency

| Construct                         | Items | M    | SD   | Cronbach's $\alpha$ |
|-----------------------------------|-------|------|------|---------------------|
| Team capability (CSF1)            | 4     | 4.33 | 0.61 | 0.799               |
| Customer involvement (CSF2)       | 4     | 4.25 | 0.63 | 0.798               |
| Training & learning (CSF3)        | 4     | 4.36 | 0.59 | 0.798               |
| Psychological safety (CSF4)       | 4     | 4.30 | 0.66 | 0.831               |
| Project management approach (PMA) | 4     | 4.34 | 0.61 | 0.853               |
| Data quality & validation (CSF5)  | 4     | 4.33 | 0.64 | 0.859               |
| Project success (outcome)         | 5     | 4.39 | 0.61 | 0.870               |

*Note.* Scales range 1–5; N = 185. The categorical approach item is excluded from the PMA scale.

### 4.3. Correlations (H1–H6)

All five CSFs correlated positively and significantly with project success ( $r = 0.64$ – $0.72$ ,  $p < .01$ ), supporting H1–H6. Data quality showed the strongest single association with success ( $r = 0.72$ ), narrowly ahead of psychological safety and training (each  $\approx 0.71$ – $0.72$ ), team capability ( $0.71$ ), and PMA ( $0.71$ ), while customer involvement, though robust, was the weakest correlate ( $r = 0.64$ ). By social-science standards these are strong relationships, and their consistency provides clear bivariate support for the proposition that each critical factor is materially associated with NAVTTC project performance.

The inter-factor correlations were also substantial but remained below 0.80 ( $0.65$ – $0.76$ ), signalling related yet distinct predictors and limiting multicollinearity concerns. This pattern is itself informative: successful projects appear to do many things well at once — capable teams, open climates, engaged stakeholders, active learning, and data-driven management tend to co-occur, consistent with the systems view that project elements operate together rather than in isolation. Team capability correlated highly with psychological safety ( $0.73$ ), suggesting a virtuous cycle in which competent teams build trust and trusting teams develop competence. Notably, PMA correlated most strongly with psychological safety ( $0.76$ ) and team capability ( $0.74$ ), and also substantially with data quality ( $0.72$ ) and stakeholder involvement ( $0.68$ ), foreshadowing its integrative, mediating role: adaptive approaches appear more feasible where teams are capable and climates are trusting, and may in turn reinforce those very conditions (Table 3).

**Table 3:** Means, standard deviations, and Pearson correlations

| Variable                | M    | SD   | 1   | 2   | 3   | 4   | 5   | 6   | 7 |
|-------------------------|------|------|-----|-----|-----|-----|-----|-----|---|
| 1. Team capability      | 4.33 | 0.61 | —   |     |     |     |     |     |   |
| 2. Customer involvement | 4.25 | 0.63 | .67 | —   |     |     |     |     |   |
| 3. Training & learning  | 4.36 | 0.59 | .71 | .69 | —   |     |     |     |   |
| 4. Psychological safety | 4.30 | 0.66 | .73 | .66 | .72 | —   |     |     |   |
| 5. PMA                  | 4.34 | 0.61 | .74 | .68 | .70 | .76 | —   |     |   |
| 6. Data quality         | 4.33 | 0.64 | .68 | .65 | .68 | .74 | .72 | —   |   |
| 7. Project success      | 4.39 | 0.61 | .71 | .64 | .71 | .72 | .71 | .72 | — |

Note. N = 185. All correlations significant at  $p < .01$  (two-tailed). PMA = project management approach.

#### 4.4. Mediation (H7)

PROCESS Model 4 was estimated separately for each CSF. In every case, path a (CSF→PMA) and path b (PMA→success) were positive and highly significant ( $p < .001$ ), the direct effect  $c'$  remained significant, and the bootstrapped indirect effect excluded zero — the signature of partial mediation. The path-a coefficients (0.66–0.73) show that stronger CSFs are consistently associated with more suitable, adaptive project approaches, while the significant path-b coefficients (0.39–0.51) confirm that the approach in turn drives success even after controlling for the CSF. Because each direct effect  $c'$  also remained significant, PMA carries part but not all of every relationship.

The indirect effects ranged from 0.27 to 0.33 and accounted for 39–54% of each total effect (Table 4). Customer involvement was the most mediated variable ( $\approx 54\%$ ), meaning that the pay-off is in the push for iterative and collaborative practice with customers: without adaptability, involvement can be symbolic. Psychological safety and data quality had roughly 39–41% of the variance explained and a strong direct effect, with most of the advantage transmitted via other channels, including technical execution, coordination and timely control. The magnitude of the indirect effects is practically meaningful on the 1–5 scale — for example, a one-point rise in stakeholder involvement is associated with a 0.33-point gain in success transmitted through a better-fitting approach, against a success mean of 4.39. The combined regression accounted for close to 75% of the variance in success (when including all five CSFs and PMA, however, some of the individual coefficients were not statistically significant, reinforcing the evidence for the single-mediator models). The direct and PMA-mediated components of each total effect are shown in Figure 2.

**Table 4:** Mediation of CSF–success relationships by the project management approach

| Predictor (X)             | a:<br>$X \rightarrow \text{PMA}$ | b:<br>$\text{PMA} \rightarrow Y$ | c': direct | Indirect $a \times b$ [95%<br>CI] | %<br>mediated |
|---------------------------|----------------------------------|----------------------------------|------------|-----------------------------------|---------------|
| Team capability           | 0.733                            | 0.407                            | 0.406      | 0.298 [0.155, 0.456]              | 42            |
| Customer involvement      | 0.655                            | 0.506                            | 0.284      | 0.331 [0.185, 0.489]              | 54            |
| Training & learning       | 0.729                            | 0.412                            | 0.436      | 0.300 [0.176, 0.432]              | 41            |
| Psychological safety      | 0.698                            | 0.392                            | 0.386      | 0.273 [0.141, 0.410]              | 41            |
| Data quality & validation | 0.679                            | 0.394                            | 0.415      | 0.268 [0.155, 0.396]              | 39            |

Note. N = 185. Coefficients are unstandardised; all a, b, and c' paths  $p < .001$ . Confidence intervals are bias-corrected bootstrap estimates (5,000 resamples); intervals excluding zero indicate significant indirect effects. Y = project success.

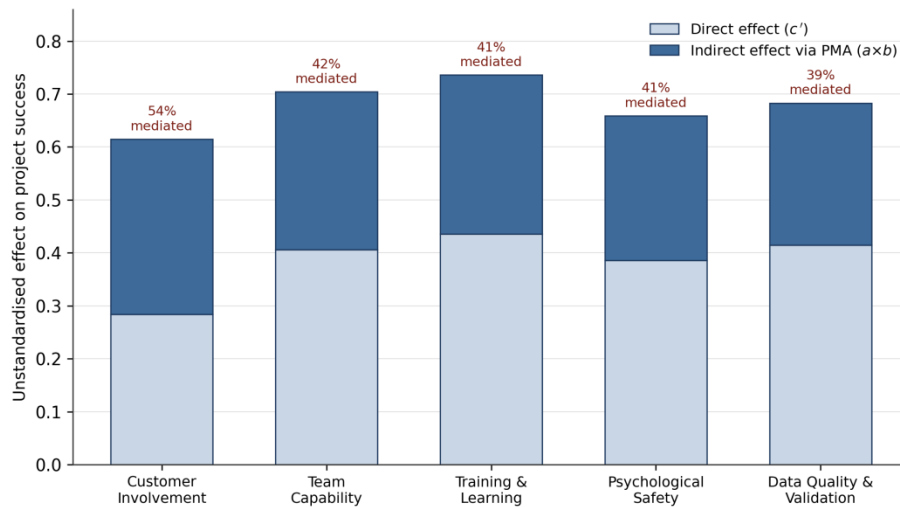


Figure 2: Decomposition of each CSF's total effect on project success into a direct component (c') and an indirect component transmitted through the project management approach ( $a \times b$ )

## 5. Discussion

The findings reveal that the CSFs are globally accepted critical success factors for public vocational training in Pakistan and that an adaptive project management approach is the pathway by which the impact of many of the CSFs is realised. The results provide a locally based alternative to the extensive literature from the private sector and the West and contribute to a systems-based understanding of project success.

### 5.1. Critical success factors in a public vocational context

The correlation between team capabilities and success ( $r \approx 0.71$ ) confirms the findings of Chow and Cao (2008), Hyväri (2006), and Belassi and Tükel (1996) that people make projects successful, further validating that team competence is significant even in a bureaucracy with limited recruitment and development. However, although bivariate strength is comparatively low ( $r \approx 0.64$ ), which indicates that it is less likely to be a direct driver, the high mediation share suggests that it is more likely to be indirect in these projects, operating through the management process, and hence responsibility for it needs to be substantive and institutionalised, not symbolic, to make it a meaningful driver. Training and learning culture ( $r \approx 0.71$ ) aligns with the notion that ongoing training and learning and the sharing of knowledge based on uncertainty and performance reduce uncertainty and enhance delivery, similar to agile thinking, and backed by evidence that learning-oriented teams outperformed (Tam et al., 2020; Bogopa & Marnewick, 2022); projects that invested in internal capacity building were more successful.

A particularly interesting result is psychological safety ( $r \approx 0.72$ ), as despite a hierarchical public sector culture, open, blame-free team climates are always linked to better performance, and this is an extension of Edmondson's (1999) earlier findings in a public sector context where the evidence is limited from South Asia. This implies that even in formally hierarchical organizations, immediate team climates can be made safe, and that it pays off. The single strongest correlate was data quality and model validation ( $r \approx 0.72$ ), with the message being that monitoring, evaluation, and evidence-based adjustment are pivotal – projects with quality and updated data, clear KPIs, and proper monitoring systems were more successful, while poor data quality creates accountability issues and hampers timely identification and rectification of problems. This is an important factor that does not have the same degree of focus compared to the classic human and organisational CSFs and should be explored more extensively in the future.

### 5.2. The project management approach as mediator

The key finding is that PMA partially mediates all CSF–success relationships. A portion of the benefit of each factor is mediated by its ability or overlap with a more appropriate and adaptive method, and there is also a substantial direct effect. This makes PMA not only one of six, but a systems synthesiser or a meta-CSF (meta-communication synthesiser), a mechanism that converts human and technical capacities into achieved results. Effective, in other words, is not enough – it

needs to affect implementation of the project. A team that is well-resourced but deeply entrenched in a rigid framework of bureaucracy or an ambitious team without a capable and trustworthy team will each produce less than what their configuration says they should. It has particularly high correlations to psychological safety and team capability, implying some sort of chicken-and-egg relationship: capable, trusting teams employ adaptive practices, and adaptive practices support psychological safety, learning and data use, with project components co-synchronising as systems theory predicts.

Mediation has a sense of logic to it. Customer involvement is the most mediated factor ( $\approx 54\%$ ) and aligns with the principles of the Agile Manifesto: collaboration and responsiveness, whereby stakeholder input yields most value when projects are iterative and malleable enough to act on it, or else it risks tokenism. This is an empirical indication that adaptive methods and stakeholder engagement reinforce each other. Team capability, learning, psychological safety, and data quality have larger direct effects ( $\approx 39\text{--}42\%$  mediated), indicating that effective teams with learning focuses, psychologically safe teams, and reliable data contribute to improved outcomes in ways other than simply through the method itself, yet also continue to influence project journey towards hybrid practice, consistent with observations of teams adapting their methodology to their context (Gemino et al., 2021). Five mediations, all partial, confirm H7 as specified, and as in contingency theory (fit of approach to context) and in systems theory (interacting, multi-causal pathways). The key takeout is that the investments should be made on Factors and Method together, capability development coupled with agile change management and evidence-based systems, not separately.

### **5.3. The dominance of hybrid practice**

The fact that 93% of respondents detected hybrid approaches is remarkable on its own. It marks a practical compromise between the rigidity of bureaucracy and the agility of training projects, blending formal planning with adaptive responsiveness. However, the lack of purely agile projects is no surprise in the near absence of them in the public sector, with a smaller number of high-performing purely traditional projects showing that there is not a one-to-one match between rigid practices and dynamic training environments. These results are quantitative field evidence that agility outside of IT is possible and useful for government skill-development projects, in addition to a predominantly qualitative or anecdotal literature of public-sector agility (Gemino et al., 2021;

Serrador & Pinto, 2015), and to the contingency proposition that success depends on the alignment of approach and context.

#### **5.4. Theoretical implications**

The study has theoretical contributions in several respects. It brings together and focuses CSF knowledge on public vocational education in a developing economy, and empirically links the widely cited factors in a bureaucratic context where the applicability of these factors had not been verified. It bridges the gap between the CSF and success, extends beyond the linear direct-effect models found in previous research, and reveals that factors are not independent of one another, but rather are mediated through the project management approach. It does this by reinforcing the contingency theory, which is an inappropriate approach that reduces the gains from strong CSFs, and by adding to the systems theory by providing evidence for interdependencies between the elements of the project. The study extends agile and hybrid evidence to a non-IT, public sector setting and emphasizes soft or psychological factors, including psychological safety and team culture, as well as the hard or technical factors, thereby providing a more balanced and realistic partial-mediation argument for project success, and suggesting additional psychological, emotional, and sociological evidence that could be examined.

#### **5.5. Practical implications**

The findings have implications for NAVTTC and similar agencies in terms of priorities. To build up human capital and team dynamics, through targeted recruitment, continuous training, role allocation, investment in soft skills such as communication and collaborative leadership, with support from peer-learning groups and mentorship. Second, ensure that there is an institutionalisation of meaningful stakeholder engagement (such as via advisory boards, inception needs assessment and regular structured feedback cycles) and that project staff have the space to respond flexibly to the changes based on that feedback, in order to ensure that participation is clearly evident in decisions rather than being symbolic. Third, implement and institutionalise "hybrid" or "agile" practices, such as shorter planning cycles, incremental piloting and scaling, cross-functional teams, and more frequent review meetings that view plans as things that can be changed, instead of fixed, and focus on outcomes rather than process. Fourth, improve monitoring and data use through establishing centralised management-information dashboards, establishing

clear KPI targets, ensuring data reliability with independent M&E, and embedding a data-driven culture for actioning data in real time. Fifth, foster a sense of psychological safety by leading with inclusion and no-blame, using post-phase lessons-learned meetings, and by leaders modelling openness by highlighting problems early. These factors operate, at least in part, through the management approach so the CSFs are also a useful checklist for project audits and health checks. The overall takeaway for government and donors is that changes in “software” (people, engagement and process) can provide higher returns than investing in “hardware.”

### **5.6. Limitations and future research**

These findings are limited by several factors. Because of the cross-sectional and self-reported design of the study, associations are not necessarily causal, and may well be confounded by the common method and social-desirability bias that likely affected the positively skewed ratings, as well as by the possibility of ceiling effects in the success measure; respondents might also use their own internal, deliverable-based definitions of success rather than an independent external evaluation. Limitations included convenience sampling and the disproportionate representation of male-dominated, central locations in the sample, and the clustering of hybrid projects making direct comparisons across approach types difficult. The measurement of success and the CSFs were perceptual, not based on independent records such as completion rates, placement results or audited budgets. Longitudinal or mixed-method designs should be promoted in future research to enhance causal inferences, with the inclusion of objective outcome and process measures, and the replication of the model in other sectors (such as construction and IT) for generalisability. Other mediators and moderators, including top-management support, organisational culture, and project complexity, could add more detail to the understanding of how and why these factors contribute to success.

## **6. Conclusion**

This study aimed to identify causes of success and the mechanism of NAVTTC vocational training projects. Based on contingency and systems theory and a survey of 185 professionals, five critical success factors (CSFs)—team capability, customer (trainee) involvement, training and learning culture, psychological safety, and data quality and model validation—are all strongly and

positively correlated with project success, and the project management approach partially mediates all of these relationships, accounting for between 39% and 54% of the direct effects. In a nutshell, success in this context is multi-causal: good people in good relationships working with stakeholders, making continuous learning a habit, and working on the basis of reliable data, succeed directly and through the implementation of adaptive, predominantly hybrid work styles that translate these advantages into outcomes. The takeaway for policy and practice is that in development projects, attention to "software" (people, engagement, and process) can be as important as focus on "hardware" (fiscal and financial instruments). Externalizing these factors in combination can provide a practical way to design more effective and impactful skill-development projects, while providing a flexible management framework that can be adapted to local context.

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