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Original Article

An Empirical Study on Success Factors for the Design and Build Approach in Tanzania's Water Sector

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Abstract

The Design and Build method has become increasingly adopted in Tanzania's water supply projects, yet the role and contribution of local contractors remain uncertain. The study aimed to assess the critical success factors influencing the Design and Build method in Tanzania's water supply projects, with a focus on perspectives from DAWASA and local contractors. The study employed the Relative Importance Index (RII) analysis and the Inter-Rate Reliability agreement test. The findings show that a Well-defined Project Scope (RII = 0.99, Rank 1) is the most influential factor, followed by Timely Payment (RII = 0.93, Rank 2), skilled workforce (RII = 0.90, Rank 3), Stable Leadership (RII=0.89, Rank 4), and Fast Approval Processes (RII = 0.80, Rank 5). These results emphasize the necessity of clear project planning, efficient financial management, and strong institutional support. ICC analysis further revealed consistent agreement among respondents; the ICC scores were Administrative Factors (ICC value of 0.92), Design-related Factors (ICC value of 0.791), Technical Factors (ICC value of 0.71), Regulatory Factors (ICC value of 0.689), and Financial Factors (ICC Value of 0.648). This indicates there are similar views about the importance of structured project scope, timely fund release, and effective leadership as key drivers for a successful project.

Keywords · Project delivery methods; Relative Importance Index; Inter-Rater Reliability; Design and Build; Water Supply Projects; Critical Success Factors; Tanzania

1. Introduction

Clients involved in project development continually seek procurement method that aligns with their objectives for time, cost, and quality (Windapo et al., 2022). Over the past few years, the design and build (D&B) contract strategy has been recognized as a potential alternative by the different stakeholders in the construction industry and is considered one of the possible ways to improve the sustainability of construction projects (Esperance and Sung-Hoon, 2023).

The D &B method aims at forming the collaboration of all parties involved i.e. architects, engineers, contractors, right from the beginning thus it affords many advantages such as extended communication, reduced difficulties and time consumption, cancellation of duplications of work, etc (Almuhannadi and Ghareeb, 2024). The emergent model is a faster and more effective way of accomplishing a project

since the transitions become smoother and the results are even better.

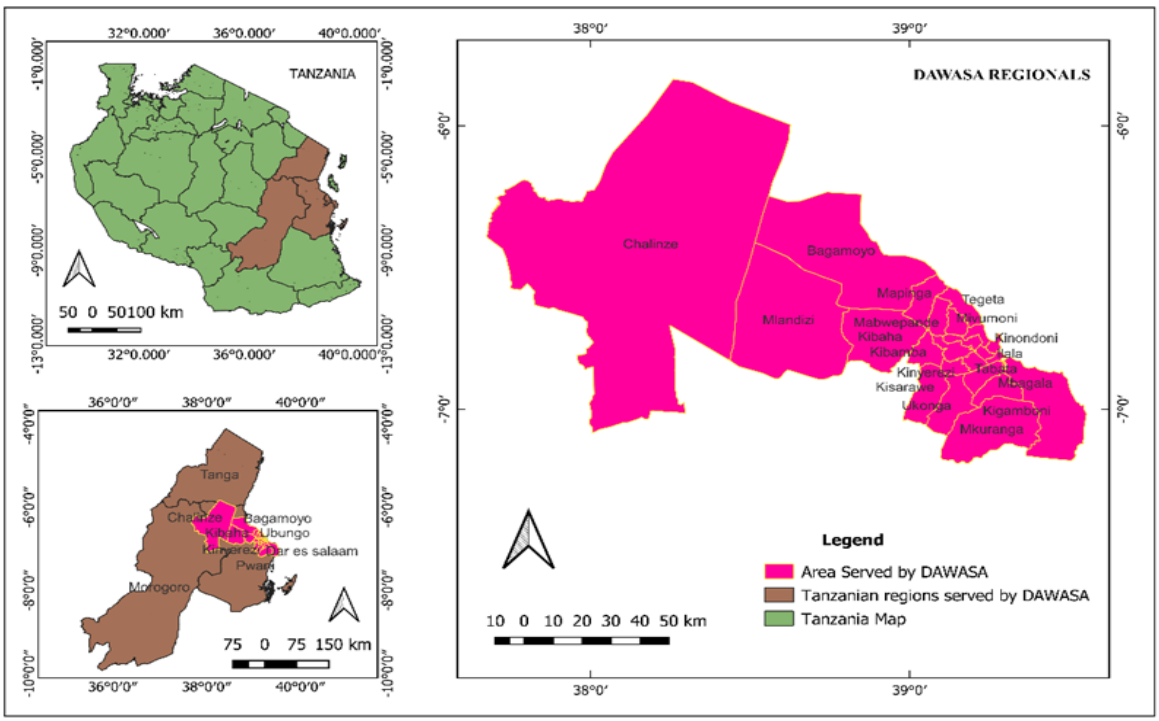


Figure 1: The Map Showing the Study Area

However, at the same time, contractors equipped with substantial financial and technical abilities only tend to benefit from this method, thereby creating an advantage for foreign firms in project execution (Saaidin et al., 2016). According to Tanzania Construction Policy, local industry involvement accounts for about only 20% of the total project value, which is an indication of the level of participation in the out-turned opportunities (NCC, 2004). The low level of participation is mostly a result of the fierce competition in the group of foreign contractors, and at the same time, local ones, including contractors, are facing capacity problems (Makenya and Mhando, 2021). The substandard performance of local contractors is attributable to the insufficient skills, lack of capital, challenging donor conditions, and the use of inefficient project delivery practices (NCC, 2004).

The objective of the current study is to examining factors that influence D&B water supply projects in Tanzania. It aimed to determine how each factor shapes project outcomes in terms of cost efficiency, timely delivery, quality standards, and overall sustainability. This research aims to generate empirical evidence that can inform policymakers, contractors, project managers, and stakeholders in Tanzania's construction and water sectors.

2. Material and Methods

2.1 Description of the Study Area

The study conducted the research at the Dar es Salaam Water and Sanitation Authority (DAWASA) in the Dar es Salaam region, as well as with local civil contractors working with DAWASA. The study intentionally selected these parties for two major reasons. Firstly, both DAWASA as well as local civil contractors are the key players in the planning and implementation of water supply projects all over the

country, thus leading to their high level of relevance regarding the study's objectives. Secondly, their location in Tanzania makes it easier to carry out the necessary arrangements and have access to them, which led to efficient data collection. By involving these participants, the study was able to explore more the practical side of the challenges and opportunities that come with local contractors' participation in design and build procurement methods in the Tanzanian water sector.

Table 2. Sample Size

SN	Respondents	Population	Sample size
1	Director	1	1
2	Engineer	32	27
3	Project Engineer (Supervisor)	6	5
4	Project Manager	1	1
5	Technician	14	12
6	Quantity Surveyor	1	1
7	GIS technician	2	2
8	Contractors	5	5
	Total	62	54

2.2 Sampling Techniques and Data Collection Techniques

The study adopted purposive and randomly sampling procedures to select its sample of respondents. Random sampling procedure used to select representatives from DAWASA and purposive sampling used to select local civil contractors. The sampled respondents were exposed to respond to a semi-structured questionnaire. This study used a semi-structured questionnaire to take advantage of its flexibility, allowing DAWASA and contractor experts to assess local contractors' participation in design and build water supply projects in Tanzania. To get a higher response rate in a very short time, questionnaire distributed face-to-face. Moreover, secondary data for complementing the primary data, these data obtained from DAWASA and CRB offices and website.

2.3 Data Analysis

2.3.1 Relative Importance Index

The study calculated the Relative Importance Index (RII) based on all possible factors. The results obtained are quantitative evidence to rank the factors according to their degree of importance, thus enabling the most critical factors to be identified and compared. This analysis converts the qualitative data into quantitative data, which makes subsequent data handling easier and more systematic. RII analysis has been widely used in various research construction projects to rank the most significant items according to their levels of importance (Kinemo, 2024). The relative importance index calculated using Equation 1.

$$RII=\sum WxX /A \times N \quad (1)$$

Where:

W= the weight given to each response, X= the frequency of each response, A= the highest weight (4 in this case), N= the total number of respondents.

According to Enshassi et al. (2009), the study transformed RI values into four importance levels: high (H) ($0.8 \leq RI \leq 1$), high medium (H–M) ($0.6 \leq RI \leq 0.8$), medium (M) ($0.4 \leq RI \leq 0.6$), medium-low (M-L) ($0.0 \leq RI \leq 0.4$)

2.3.2 Inter-rater Reliability Agreement Test

The Inter-rater reliability agreement test adopted to examine the differences between the views of the respondents about the factors that influence the success of the design and build method in water supply projects. The Intra-Class Correlation Coefficient (ICC) (Equation 2) measured the agreement as it takes into consideration the possible systematic bias in the ratings.

$$\text{ICC} = \frac{\text{Variance of different ratings among the subjects in the population P}}{\text{Total Variation}} \quad (2)$$

The ICC formula is more describe by Koo and Li (2016) in equation 3 below.

$$\text{ICC} = \frac{MS_B - MS_W}{MS_B + (k-1)MS_W} \quad (3)$$

Where:

MS_B = Mean square between subjects, MS_W = Mean square within subjects (error), k = number of rates or measurements.

A low ICC may indicate a low rater agreement, whereas a high ICC indicates high rater agreement. There are four common categories for ICC values:

ICC value < 0.40: Level of Significance is poor; 0.40 < ICC value < 0.59: Level of Significance is fair; 0.60 < ICC value < 0.74: Level of Significance is good; 0.75 < ICC value < 1.00: Level of Significance is excellent (Kinemo, 2024).

The ICC were analysed by using Statistical Package for Social Sciences Research Software (SPSS –version 22).

3. Results and Discussion

3.1 Demographic Information

This section explain the respondents' demographic attributes which some of them may influence water project to social and economic development. The demographic attributes include sex, education level, and experience

3.1.1 Respondent Experience

Table 3 displays the professional background of the water supply sector workers interviewed. The data show an experienced group in general. Most of the respondents (39%) had between five and ten years of experience, which strengthens the study's findings through practical knowledge. Twenty-eight percent (28%) of the participants had been in the industry for more than ten years; therefore, they brought deep expertise and long-term perspectives. On the contrary, 33% were with less than five years of experience and so, they could provide fresh ideas and newer industry viewpoints. As a result, the diverse experience levels of respondents reflect not only a great number of seasoned professionals but also the presence of emerging talents that can deepen and widen the study's findings.

Nevertheless, the results of this investigation match the results of earlier studies by Isango (2024), who found that 33.3% of the respondents indicated that their work experience was less than 5 years, 44.4% had from 5 to 10 years, and 22.3% were of more than 10 years of working experience.

Table 3: Years of experience of respondents in the construction of water supply projects

Variable	Category	Frequency	
		n	%
Years of Experience	Less than 5 years	15	33
	5–10 years	18	39
	More than 10 years	13	28

3.1.2 Sex of the Respondents

The figure 2 indicates that out of the total respondents, 37 are males, which is equivalent to 80%. This means that the male gender group has the highest number of members in the research. On the other hand, the number of females is nine, and they make up 20% of the total. While females make up a significant proportion of the sample, their representation is much less than that of males. This imbalance may limit the extent to which the findings fully capture gender-related perspectives within the water sector. Therefore, readers should interpret the results with caution regarding gender representation.

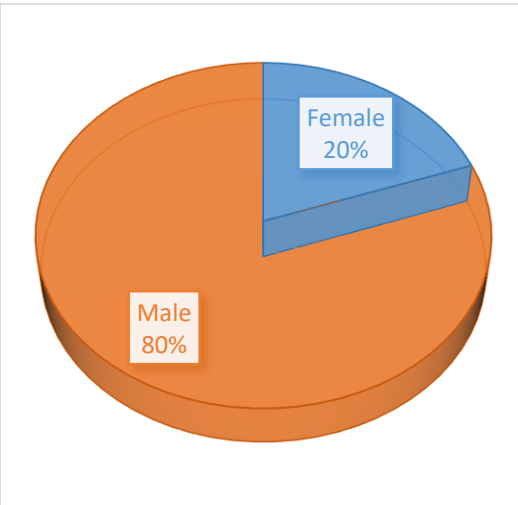


Figure 2: Sex of respondents

The current findings corroborate the gender-related data of the last study by Wambura (2023), where the majority of the respondents were males, making up 83.54%, while only 16.46% were females. Furthermore, the gender ratio of respondents in this research also agrees with that of the study by Kizaba and Yonah (2024) that had 84.09% of male respondents and 15.91% of female respondents. The new studies reveal a response pattern in which male participants predominate, likely reflecting the gender distribution of the investigated sector.

3.1.3 Education Level of Respondents

Figure 3 show that the majority of the respondents (67%) had bachelor degree while 22% had diploma and 11% had masters. Still, these outcomes are somewhat consistent with the conclusions of different experiments. For example, the research by Isango (2024), that evaluated the Impact of E-Procurement Practices on Organizational Performance in Tanzania, demonstrated that 17.8% of the respondents were certificate holders, 26.7% had diplomas, 40% held a bachelor's degree, 11.1% had a master's degree, and 4.4% had Ph.D. or other qualifications. In the same

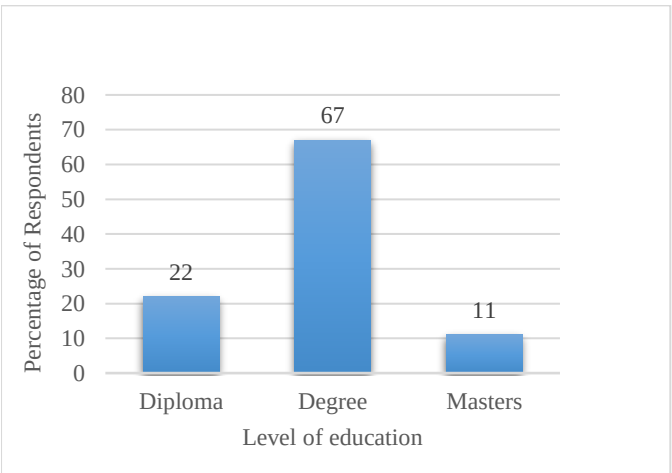


Figure 3: Education Level of Respondents

Table 4: Ranks of Factors that Contribute to the Success of the Design and Build Method in Water Supply Projects

Categories of Factors	Description of Factors	SN	n	W	RII	Rank	
Financial Factor	Timely Payments	F1	43	4	0.93	2	H
	Access to Credit	F2	29	3	0.48	10	M
	Cost-effective Procurement	F3	18	1	0.10	19	M-L
	Efficient Budget Management	F4	28	2	0.30	14	M-L
Regulatory Factors	Clear Guidelines	F5	36	3	0.59	7	M
	Fast Approval Processes	F6	37	4	0.80	5	H
	Minimal Bureaucratic Delays	F7	25	2	0.27	15	M-L
	Strong Legal Framework	F8	19	1	0.10	18	M-L
Technical Factors	Skilled Workforce	F9	41	4	0.90	3	H
	Advanced Technology	F10	30	2	0.33	12	M-L
	Effective Training Programs	F11	20	1	0.11	17	M-L
	Strong Project Management	F12	38	3	0.62	6	H-M
Design- related Factors	Well-defined Project Scope	F13	46	4	0.99	1	H
	Accurate Specifications	F14	36	3	0.59	7	M
	Efficient Design Approval Process	F15	33	2	0.36	11	M-L
	Minimal Design Modifications	F16	22	1	0.12	16	M-L
Administrative Factors	Stable Leadership	F17	41	4	0.89	4	H
	Effective Resource Allocation	F18	33	3	0.54	9	M
	Strong Stakeholder Collaboration	F19	30	2	0.33	12	M-L
	Transparent Decision-Making	F20	17	1	0.09	20	M-L

respondents were bachelor degree holders, 25.32% had diplomas, 10.12% were postgraduate degree holders, and 24.05% were certificate holders.

3.2 Factors That Contribute to the Success of the Design and Build Method in Water Supply Projects

The Relative Importance Index (RII) used to rank the factors influencing the success of Design and Build water supply projects. Table 4 summarizes the ranked

Table 5. ICC Analysis for Factors that Contribute to the Success of the Design and Build Method in Water Supply Projects

Category of Factors		Intraclass Correlation[b]	95% Confidence Interval		F Test with True Value 0			
			Lower Bound	Upper Bound	Value	df1	df2	Sig
Financial Factors	Single Measures	.479[a]	-0.689	0.955	2.838	3	3	0.207
	Average Measures	.648[c]	-4.44	0.977	2.838	3	3	0.207
Regulatory Factors	Single Measures	.526[a]	-0.655	0.961	3.216	3	3	0.182
	Average Measures	.689[c]	-3.801	0.98	3.216	3	3	0.182
Technical Factors	Single Measures	.550[a]	-0.284	0.96	4.277	3	3	0.132
	Average Measures	.710[c]	-0.794	0.979	4.277	3	3	0.132
Design-related Factors	Single Measures	.654[a]	-0.527	0.973	4.78	3	3	0.116
	Average Measures	.791[c]	-2.23	0.986	4.78	3	3	0.116
Administrative Factors	Single Measures	.851[a]	-0.044	0.99	86.75	3	3	0.002
	Average Measures	.920[c]	-0.092	0.995	86.75	3	3	0.002

factors, showing their relative levels of importance as identified by the respondents.

The findings in Table 4 reveal that the factor that influenced the most was a well-defined project scope (RII = 0.99, Rank 1). Such an extremely high value shows that the clarity of the project objectives, deliverables, and boundaries considered the basis for the success of the project. A clearly outlined scope will cut the project's uncertainties, mitigate disagreements, and give contractors a reliable basis for their planning and implementation. The findings also concur with Abdelghafar (2024) who stressed the pivotal aspect of scope clarity. Though this study gives project scope a higher priority, it is still a matter of local and institutional contexts when deciding on critical success factors as evidenced by the different ranking of the research of Kinemo (2024) and Venczel et al. (2021).

Also timely payment (RII = 0.93, Rank 2) which essentially confirms the absolute necessity of the prompt release of funds in order to keep the cash flow going, cover operating expenses and, most importantly, avoid delays that will, at the very least, double the costs of the whole project. Respondents thus see reliable payment mechanisms as the foundation of effective project execution. The present study findings are in harmony with Al-Juboori et al. (2021), who argued the necessity of timely payment and access to funds in similar projects in Iraq. Nonetheless, the oppositional results of Kinemo (2024) who considered timely payment as of a lesser importance imply that local economic conditions and institutional capacity can have a great impact on the perceived significance of the financial factors.

Not only that, also a skilled workforce (RII = 0.90, Rank 3), where human expertise was considered the key element in achieving project success. Highly skilled staffs are the lifeblood of complex technical tasks, quality maintenance, and even the resolution of unexpected problems, thus, making workforce proficiency the bedrock of project reliability. The skilled workforce echoes the argument of the Kinemo (2024) study, indicating its wide applicability while discrepancies with location-based studies such as Al-Juboori et al. (2021) signal that the local context is decisive. The affirmation of the significance of project management aspect which mainly involves oversight and risk control is in line with Rodrigues et al. (2024) findings. In addition, the current research is in agreement with Bentall et al. (1999) who gave more weight to the issues of advanced technology and training programs, hence, opening up the continuous need for capacity building.

However, stable leadership (F17) has an RII of 0.89 and a rank of four overall. Such a high score vividly illustrates how leadership stability is the key factor that allows for effective coordination, continuity of decision-making as well as confidence keeping among stakeholders throughout project implementation (Kumar et al., 2023). Fast approval processes (RII = 0.80, Rank 5), indicating that timely approvals are main tools in escaping delays, speeding up project start-up, and ensuring continuous exploitation (Frefer et al., 2018; Gabriel et al., 2024). Efficient approval mechanisms break down administrative bottlenecks, giving contractors the freedom to deploy their resources without facing unnecessary obstacles. The results of this research, however, correspond to the literature review Sohail and Cavill (2008) acknowledged the importance of minimizing bureaucracy and speeding up approval processes.

According to this study, a well-defined project scope is the factor that most of all is the foundation for the success of the design and build method in water supply project. This common emphasis underlines the fundamental role of the clarity of scope in averting uncertainty and bringing the different parties involved in the project to the same level of expectation, as explained by Naji et al. (2023). Thus, the need for rework is minimised, which also supported by Yang and Wei, (2010). Moreover, timely payments became the second most important factor that reflected the position of Asadi et al. (2023), who also made a point of its significance in the similar projects in Iraq. Contradictory the findings of Alashwal et al. (2024),

who put timely payment much lower, thus, suggesting that local economic conditions and institutional capacity may determine the perceived importance of the financial elements.

Furthermore, the research marked a skilled workforce as the third most crucial element that contributed to the success of D&B projects, pointing out the main aspect for the workforce to be efficiency and quality (Frefer et al., 2018). This finding corresponds with Alashwal et al (2024), thus, it is broadly relevant. On the other hand, Siddiquei et al. (2024) argued that the significance of the issue may change depending on the local context and therefore, stressing the need for contextual evaluation. In addition, the research suggests that stable leadership has more power to influence the success of Design and Build (D&B) methods in water supply projects. This discovery is in line with the views of Al-Juboori et al. (2021), who stressed the significance of efficient administration as one of the critical factors leading to success. Stable leadership was pointed out as a necessary condition to be able to maintain constant supervision and to facilitate strategic alignment throughout the period of project execution, thus, reflecting the emphasis made by UN-Habitat (2015) on leadership continuity in complex infrastructure initiatives. By shortening bureaucracy and speeding up approvals, these processes tackle the issues caused by regulatory delays and, consequently, cost overruns - an observation that is in line with the findings of Sohail and Cavill (2008).

The inter-rater reliability of the study assessed using the Intra-Class Correlation Coefficient (ICC) to determine the level of agreement among respondents across all categories of factors. The results indicate strong agreement, with ICC average measures ranging from 0.648 to 0.92 across the different factor groups, as presented in Table 5.

ICC analysis further demonstrated a generally consistent level of agreement among respondents across all categories of factors (table 5). Administrative Factors showed the highest level of reliability (ICC = 0.92), reflecting excellent consensus among participants. Design-related Factors also indicated strong agreement (ICC = 0.791), suggesting that respondents had similarly aligned perceptions regarding design issues. Technical Factors (ICC = 0.71) and Regulatory Factors (ICC = 0.689) exhibited moderate to strong reliability, implying that while there was agreement, some variability existed in how respondents evaluated these aspects. Financial Factors recorded the lowest ICC value (ICC = 0.648), indicating comparatively lower but still acceptable consistency. Overall, the results suggest that respondents shared broadly similar views, particularly on administrative and design-related factors contributing to the success of the Design and Build method in water supply projects, whereas financial considerations elicited opinions that are more diverse.

4. Conclusion and Recommendations

4.1 Conclusion

This study identified the critical success factors influencing the performance of Design and Build water supply projects within DAWASA, and as a leading utility, its experiences may offer partial insights into conditions within Tanzania's water sector. The findings from the Relative Importance Index (RII) analysis indicate that a clearly defined project scope is the most significant factor (RII = 0.99), highlighting its essential role in reducing uncertainty and minimizing design-related changes during project execution. Financial stability, particularly timely payments (RII = 0.93), emerged as a key driver of contractor performance and project continuity, while the availability of a skilled workforce (RII = 0.90) was found to significantly enhance technical efficiency and project quality. Also, stable leadership (RII = 0.89) plays an important role in ensuring effective project coordination and decision-making. Regulatory efficiency, particularly fast approval processes (RII = 0.80), was also identified as essential in reducing bureaucratic delays.

4.2 Recommendations

Based on the RII results (Table 4) and ICC analysis (Table 5), several key recommendations are proposed to improve the success of Design and Build water supply projects in Tanzania. Since project scope definition (RII = 0.99), timely payments (RII = 0.93), and skilled workforce availability (RII = 0.90) were the highest-ranked factors, project owners should prioritize the development of clear and detailed project scopes, ensure adherence to timely payment schedules, and strengthen workforce capacity through targeted training programs. Improvements in approval processes (RII = 0.80) and project management practices (RII = 0.62) are necessary to reduce delays and enhance efficiency. The importance of stable leadership (RII = 0.89) and stakeholder coordination should be emphasized to strengthen project governance. The ICC results confirm moderate to excellent agreement across all factor categories, particularly administrative factors (ICC = 0.920), indicating that these success factors are consistently recognized and should guide decision-making in Design and Build project implementation.

The study suggests that project owners should prioritize early and detailed scope definition, enforce timely payment systems, and invest in workforce development to improve project outcomes. Regulatory authorities should also streamline approval procedures to minimize delays in project execution.

Further research recommended to broaden the sample to other regions and infrastructure sectors, and to examine the causal relationships between critical success factors and project performance outcomes.

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Statements and Declarations

The authors declare that they have no competing interests related to this study. The research conducted independently without any commercial or financial relationships that could interpreted as a potential conflict of interest. Furthermore, this study did not receive any specific grant or financial support from funding agencies in the public, commercial, or not-for-profit sectors.

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