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A Critical Success Factors Framework for the Improved Delivery of Social Infrastructure Projects in South Africa

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Abstract: Social infrastructure projects (SIPs) play a critical role in fostering social and economic development in the public sector. However, SIPs often face significant challenges, partly due to a lack of research on critical success factors (CSFs) specific to these projects. Despite the importance of SIPs, scant research focuses upon enhancing SIPs' performance. Consequently, a CSF framework is developed for improving the delivery of SIPs in South Africa. Through a quantitative survey of 124 construction professionals, the study identified key factors essential for successful SIPs delivery. Data were analysed using descriptive and inferential statistics, revealing a significant consensus among infrastructure stakeholders on CSFs needed for successful SIP delivery. Constituent elements of the framework integrate CSFs related to clients, contractors, projects and project management factors; external factors were excluded from the framework due to a lack of supporting evidence. The study offers a practical understanding for infrastructure stakeholders in South Africa to: overcome the challenges that hinder SIPs' performance; and enhance the SIP delivery processes. Cumulatively, these palpable deliverables contribute to the nation's social and economic development objectives. While the research is focused on South Africa, the CSFs framework could inform SIP delivery strategies in similar socio-economic and institutional contexts globally. The study reveals that SIP success depends on the identified factors and offers a structured framework for improving project outcomes. The framework highlights CSFs, including effective monitoring and timely decision-making for clients; subcontractor coordination and quality assurance for contractors; economic stability and advanced technology for projects; and team collaboration and expertise utilisation for project management. This systematic approach could enhance effective planning, execution and evaluation of SIPs, leading to more efficient delivery. However, the study's focus on the Mpumalanga and Limpopo provinces limits the generalisability of the findings to other regions with different socio-economic and environmental conditions. Therefore, future research could explore the applicability of this framework in diverse social, political, and geographical contexts.

Keywords: construction industry; critical success factors; project delivery; social infrastructure

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1. Introduction

South Africa's public sector construction projects are classified as social infrastructure projects (SIPs) [1]. SIPs primarily cater for the public, with the government serving as the main custodian of the end product. These projects include public schools, clinics, hospitals, community health centres, government offices and interconnecting linear assets (such as road and rail) [2]. SIPs contribute to socio-economic development by providing job opportunities in the local communities where the projects are located [3]. Historically, about 4% of South Africa's gross domestic product (GDP) is allocated to economic infrastructure by the public sector [4]. According to the 2022/2023 Limpopo Department of Public Works Annual Report, 71% of the SIPs were achieved despite delays experienced on these projects [5]. As a result, a cost overrun of 3.4% was reported across various SIPs in 2022/2023. Major factors contributing to this performance include late delivery of materials, inadequate plant availability, frequent machine breakdowns, poor contractor performance and shortcomings within the Department of Public Works. Similarly, the Mpumalanga Department of Public Works' 2022/2023 Annual Report indicated that 73% of SIPs were achieved, influenced by intrinsic and extrinsic factors [6]. This resulted in a cost overrun of 2% across various SIPs. Major factors contributing to this performance include delays caused by excessive rainfall, community disruptions, civil commotion, riots and strikes; a late start by the contractor; slow contractor performance; and late payments, which led to cash flow challenges for the contractor. The poor performance of SIPs is also a concerning issue in many countries, including Trinidad and Tobago [7], Belgium [8] and Sweden [9]. These statistics on SIPs delivery in Limpopo and Mpumalanga provinces portray inherent inefficiency and possible incompetence amongst project stakeholders. Shivambu and Thwala [10] are in congruence with these findings and indicated that construction projects for public sector utilisation in South Africa are poorly delivered. Poor delivery of construction projects interrupts economic activities [3] and is often caused by the inadequate management of project constraints i.e., health and safety, time, cost and quality [11]. Many financially feasible projects end up experiencing cost overruns due to time overruns [12] and concomitant quality problems [13]. However, time overruns and construction project delays are a global challenge, especially in Asian and African countries, where overruns in construction projects are an omnipresent challenge [14]. For example: Al-Nahhas et al. [15] reported cost overruns of 27.7% and 21.4% in two public construction projects in Saudi Arabia; Johnson and Babu [16] reported that time and cost overruns are significant issues affecting construction project performance in Dubai; and Amini et al. [17] highlighted the persistent problem of overruns in Asian countries. Moreover, Nuako et al. [18] noted that overruns have severely impacted public construction projects in Ghana. Egwim et al. [12] identified key factors contributing to overruns in Nigerian construction projects, including inadequate project quality control, poor adherence to project schedules, contractors' financial challenges, political interference, unfavourable site conditions and price fluctuations. Overruns are detrimental to project progress and impact the contractor's profits negatively thus, forcing some into administration and bankruptcy [19,20]. Delivering successful SIPs is becoming increasingly significant due to their critical role in driving economic growth, improving public services and enhancing social welfare [16]. Successful SIPs contribute to national development by stimulating job creation, enabling infrastructure modernisation and attracting foreign investment [15]. Conversely, failure to deliver these projects effectively can lead to wasted resources, public dissatisfaction and economic setbacks [20]. To achieve the successful delivery of SIPs projects, it is imperative to consider the critical success factors (CSFs) for their effective delivery [21]. Although several studies in the prevailing body of knowledge have investigated CSFs [21–23] these studies lack consensus regarding the specific CSFs required to improve the project delivery of SIPs. Therefore, this research contributes to the existing discourse by considering the different perceptions of key SIPs stakeholders on which CSFs are required to augment project delivery and performance. Leading on from this knowledge acquired, fundamental objectives are to: develop a cogent CSF framework that improves the delivery of projects in South Africa to ensure a greater return on investment for SIP projects; and enhance the pace of SIP development to ensure an increase in socio-economic development is enabled for the benefit of the wider public.

2. Literature Review

2.1. A Review of Social Infrastructure Projects

SIPs play an essential role in enhancing social-economic development and improving citizens' overall quality of life [24,25]. In recent years, SIPs have garnered increased attention from policymakers, practitioners and scholars owing to their profound impact on social equity, economic growth and sustainable development [26]. The successful execution of SIPs necessitates a multifaceted approach that integrates various infrastructure stakeholders (i.e., contractors, clients, government bodies, private sector entities and local communities), addresses complex challenges and aligns with overarching societal objectives [20]. Consequently, researchers have sought to identify and examine the CSFs influencing the delivery, performance and outcomes of SIPs across different contexts and settings [2]. These CSFs comprise a wide spectrum of dimensions, including but not limited to, project management practices, stakeholder engagement strategies, financial management mechanisms, technological innovations and regulatory frameworks [27]. One prominent area of inquiry pertains to project governance and stakeholder collaboration. Effective governance structures, characterised by transparent decision-making processes, robust accountability mechanisms and inclusive stakeholder participation, have been identified as essential determinants of SIP success [7]. Fostering collaborative partnerships among infrastructure stakeholders is also deemed indispensable for promoting synergy, leveraging resources and maximising societal benefits [28].

Another key aspect of SIPs revolves around project financing and resource allocation. Given the substantial financial investments required for successful SIPs delivery, it is imperative to ensure that the project has: adequate funding mechanisms; cost-effective resource utilisation; and risk mitigation strategies in place [29]. These measures are essential to completing projects on time, within budget and to the required quality standards, thereby maximising their economic and social benefits [16]. Integrating innovative financing models, such as public-private partnerships, impact investing and crowdfunding, has emerged as a viable means of addressing funding gaps and promoting financial sustainability in SIPs [30]. Technological advancements and digitalisation under the guise of Industry 4.0 [31] have also reshaped the discourse of SIP delivery, offering opportunities for efficiency improvements, data-driven decision-making and enhanced service delivery [32,33]. Leveraging technologies such as building information modelling (BIM) [34], geographic information systems (GIS) [35] and the internet of things (IoT) [36] can facilitate seamless project planning, design optimisation and infrastructure asset management [37].

2.2. Critical Success Factors for Social Infrastructure Projects

Social infrastructure projects often fail to meet client expectations due to underperformance in areas such as timely delivery, a key success metric [38]. CSFs enhance SIP delivery for clients and end-users [7,23], shaped by intrinsic factors like project management, skilled labour and stakeholder communication, and extrinsic factors like regulatory compliance and economic stability [22,23,39]. Client commitment and active involvement are essential for clear communication, timely decisions and stakeholder alignment, reducing risks of delays and scope misalignment [1,22,26]. Top management support across organisations and agencies is crucial for resource allocation and adherence to project goals [20,38]. Effective procurement processes with robust strategies and proactive communication are vital to timely project completion [1,12,40]. Contractor capabilities, including financial and technical competence, skilled workforce management and quality assurance are critical for avoiding delays and ensuring compliance with standards [20,41,42]. Adhering to quality standards through rigorous control processes minimises cost overruns and delays [30,43].

The adoption of advanced technologies including BIM and IoT, improves monitoring, accuracy and sustainability in SIP delivery [44,45]. However, South Africa's digitisation lag underscores the need for incorporating these technologies [46]. External factors such as inflation, logistical challenges and political support also impact SIP success [1,21,26,39,40]. Clear project scope, effective site investigations, and adherence to specifications ensure timely and quality delivery [1,42,47]. Stakeholder collaboration fosters innovation and continuous improvement [46], while embracing digital advancements boosts efficiency and success [46,48]. Political support is critical for securing funding, streamlining regulations, and addressing industry challenges like resource shortages [21,26,40]. Table 1 summarises CSFs for social infrastructure projects, categorised across key dimensions.

Table 1. Key dimensions and CSFs for SIPs.

Dimension	Critical Success Factors	References
Client involvement and support	Clear communication of project objectives, timely decision-making, and stakeholder alignment. Active client participation addressing challenges and resource allocation.	[1,22,26]
	Commitment and proactive engagement to avoid delays and scope misalignment.	[22,26]
Management and leadership	Top management support from contractor organisations, government agencies, and stakeholders. Strategic programs and budgets for decision-making and resource allocation.	[20,38]
	Effective stakeholder communication and integration to ensure team alignment.	[22,44]
Procurement processes	Transparent procurement strategies with effective internal processes, vendor management, and communication.	[1]
	Timely approval of design changes and resource allocation to mitigate delays. Avoidance of unnecessary variations during construction.	[12,40]
Contractor capabilities	Financial and technical competence, including effective equipment and workforce management.	[41,43]
	Quality assurance plans ensuring compliance with client expectations and industry standards.	[42,43,49]
	Effective subcontractor coordination and skilled workforce management to prevent delays.	[41,49,50]
Quality assurance and control	Adherence to quality standards to minimise cost overruns and delays.	[30,43]
	Implementation of quality control processes (planning, training, monitoring, and evaluation).	[30]
Technology utilisation	Adoption of advanced digital technologies, such as BIM and IoT, for efficient project monitoring and control.	[33,45,46]
	Utilisation of robotics and automation for accuracy, sustainability, and efficiency in project execution.	[46,48]
	Addressing South Africa's digitisation immaturity to improve SIP delivery.	[47]
External influences	Navigating economic, social, political, and logistical challenges, such as inflation and resource shortages.	[1,21,26,39,40]
	Political support to secure funding, streamline regulatory frameworks, and mitigate operational challenges.	[21,26,40]

Table 1. *Cont.*

Dimension	Critical Success Factors	References
Project management practices	Clear project scope and stakeholder understanding to prevent scope creep.	[44,51]
	Effective site investigations to identify risks and ensure safety.	[47]
	Adherence to specifications and timely material supply to meet project deadlines and budgets.	[1,42]
	Collaboration among stakeholders for innovative solutions and continuous learning.	[52]

3. Research Methodology

The research methodology was grounded in interpretivism and postpositivism to explore the phenomenon under investigation [53]. Specifically, interpretivism was employed to obtain key CSFs from the prevailing extant literature and postpositivism was subsequently adopted to analyse primary opinion data collated. Hence, literature informed the data collection instrument developed. This epistemological approach has been adopted widely within construction literature and, hence, justifies its adoption in the present study [54]. The geographical context was set to cover CSFs for delivering SIPs in the Mpumalanga and Limpopo provinces of South Africa. The focus on Mpumalanga and Limpopo provinces is significant due to their strategic roles in South Africa's economic development and yet, enigmatically juxtaposed against historical poor project performance reported. Mpumalanga hosts critical energy infrastructure and mining operations, while Limpopo plays a vital role in agriculture and trade with neighbouring countries. Because both provinces face infrastructure challenges, they are ideal for studying the effectiveness of CSFs in SIP delivery. Recent government investments in these regions further highlight their importance for infrastructure development [1]. Primary quantitative data was collated via a survey research strategy [55] to facilitate a systematic data collection, spread across a large geographical distance. The target population for this study comprised a diverse range of infrastructure stakeholders who have worked on SIPs from 2016 to 2021, including consultants, contractors and client representatives. The population was obtained from the Mpumalanga Department of Public Works, Roads and Transport and Independent Development Trust Limpopo region and contained 600 stakeholders. Random sampling was employed to draw a sample of 234 with a 5% margin of error and a 95% confidence interval [56]. The sample size for this study was determined using the standard formula for calculating the sample size for a finite population, given the random sampling method and a confidence level of 95%. The formula used is:

$$n = (E^2 \times (N - 1) + Z^2 \times p \times (1 - p))/(N \times Z^2 \times p \times (1 - p))$$

where:

n = required sample size,
N = total population size (600 in this case),
Z = Z-value (1.96 for a 95% confidence level),
p = estimated proportion (0.5 is commonly used for maximum variability),
E = margin of error (0.05 for a 5% margin).

Substituting the values into the equation:

$$n = (0.05^2 \times (600 - 1) + 1.96^2 \times 0.5 \times (1 - 0.5))/(600 \times 1.96^2 \times 0.5 \times (1 - 0.5))$$

This calculation yields a sample size of approximately 234 respondents.

The target sample size was 234 and after applying the random sampling method, 103 valid responses were obtained, resulting in a response rate of 44%. Although this response rate is below the target sample size, it falls within the acceptable range of 20% to 30% for construction studies as recommended in existing literature [57]. As such, the sample size of 103 responses is considered satisfactory for this study.

3.1. Data Collection

Data were collected through a structured questionnaire administered via Google Forms. The questionnaire comprised three main sections *viz.*: (1) research ethics; (2) demographic information; and (3) CSFs. Section one provided background information on the study to allow respondents to provide informed consent. It also assured respondents of strict ethical protocols governing this work that covered aspects such as: anonymity; the right to withdraw at any time; data security; and the right to access the results in aggregate form post study completion [58]. Section two ensured that participants had sufficient knowledge to offer informed opinions. Section three on CSFs focused on eliciting expert opinion data on enhancing the delivery of SIPs. The CSFs under investigation were categorised into five thematic main factors derived from the literature, each with a specific number of items for respondents to complete (see Tables 3–7). The categories were as follows: *client-related* (seven $CR_{1–7}$ statements); *contractor-related* (nine $CRF_{1–9}$ statements); *project-related* (three $PR_{1–3}$ statements); *project management-related* (three $PM_{1–3}$ statements); and *external* (four $ER_{1–4}$ statements). These categories were based on a review of previous studies that identified them as the key contributors to the success of SIPs. For example, client-related factors focus on issues such as decision-making, procurement strategy and project oversight, which previous research has shown to be critical for project success. Similarly, contractor-related factors address aspects such as technical capabilities, quality assurance and financial stability, all of which have been emphasised in prior studies on successful project execution. Respondents were asked to consider each statement and indicate their level of agreement using a 5-point Likert scale, where 5 = strongly agree, 4 = agree, 3 = neutral, 2 = disagree and 1 = strongly disagree.

3.2. Data Analysis and Interpretation of the Findings

The Statistical Package for the Social Sciences (SPSS) version 28 was used to analyse the data. Demographic data presented in Table 2 illustrates that most participants were divided between consultants (frequency (f) = 37 or 36%), contractors (f = 25 or 25%) and client representatives (f = 24 or 23%). Although over half of the participants (57%) were not professionally registered, 44% were professionally registered either as Quantity Surveyors (f = 17 or 17%), Construction Managers (f = 14 or 14%), Architects (f = 8 or 8%) or Engineers (f = 6 or 6%). Most respondents (f = 98 or 95%) had a tertiary education including university degrees (f = 39 or 38%), postgraduate degrees (f = 32 or 31%) and national diplomas (f = 27 or 26%). The participants' years of experience, ranging from six years to over 11 years for 64% of respondents, alongside their professional registration and academic qualifications, support the reliability of their responses. While differences in experience levels may lead to varying perspectives, these variations are valuable for capturing a comprehensive view of SIP delivery challenges. Responses were analysed collectively, ensuring that input from highly experienced professionals balanced the input from those with fewer years of experience. This approach mitigates potential bias and ensures the overall reliability of the data.

Table 2. Demographic profile of the participants.

Characteristic	Category	Frequency (N = 103)	%
Designation in the project	Consultants	37	36
	Contractors	25	25
	Client representatives	24	23
	Other, construction supervisors, site foremen	16	16
Professional registration	Professional quantity surveyors	17	17
	Professional construction managers	14	14
	Professional architects	8	8
	Professional engineers	6	6
	Not professionally registered	57	56
Qualification	Postgraduate degrees	32	31
	Undergraduate degrees	39	38
	National diploma	27	26
	Other, trade certificates	1	1
Working experience	<one year	13	13
	1–2 years	12	12
	3–5 years	14	14
	6–10 years	24	24
	11–20 years	38	38
	21–30 years	0	0
	31 years and above	0	0

Descriptive statistics was used to analyse and report upon the respondent's profile and to rank the most significant factors important for the delivery of SIPs. Summary statistics adopted were: frequency, measures of central tendency (i.e., the arithmetic mean), measures of central tendency (i.e., standard deviation) and percentage. The purpose of descriptive statistics was to provide a comprehensive understanding of the respondent demographics and their relevance to the study, thereby establishing a foundation for the analysis of factors impacting SIP delivery. To ensure that the questionnaire measured the most significant factors important for the delivery of SIPs [59], the research ensured internal consistency through construct validity and content validity. Construct validity was achieved through exploratory factor analysis (EFA) to ascertain the factor loadings on a 5-point Likert scale. The EFA aimed to identify underlying patterns in responses and ensure the constructs measured were relevant and reliable. The use of descriptive statistics was justified because it allows for a broad understanding of the respondent demographics and provides a foundation for identifying the most significant factors affecting SIP delivery. While the mean scores (MSs) of items in the constructs were used to rank the items, both the MSs and factor loading of items were considered to determine the factors to retain and be included in the framework developed. To allow interpretation of the MSs, the following classifications were considered: strongly disagree ($\geq$1.00 and $\leq$1.80), disagree ($\geq$1.81 and $\leq$2.60), neutral ($\geq$2.61 and $\leq$3.40), agree ($\geq$3.41 and $\leq$4.20) and strongly agree ($\geq$4.21 and $\leq$5.00) [60]. Only high-impact factors were considered for inclusion in the framework, that is MSs $\geq$4.21 to $\leq$5.00 (strongly agree). Factor loadings of $\geq$0.7 are generally considered strong, which indicates that the item is strongly correlated with the underlying factor [61,62]. In this study only the items in the constructs with both factor loadings $\geq$0.7 and MSs of $\geq$4.21 to $\leq$5.00 are considered significant to the improved delivery of SIPs and, therefore, considered for the framework. The limitations of the descriptive statistical approach include its inability to establish causal relationships and its reliance on the accuracy of respondents' self-reported data. However, its strength lies in providing a clear overview of trends and distributions within the dataset. This approach was selected as it provides a balanced view, ensuring all variations in responses are captured, which is essential in understanding SIP delivery challenges across a broad range of professionals with different experience levels.

The types of statistical tests conducted were based on the purpose of ensuring the validity and reliability of the data. The use of descriptive statistics was aimed at understanding the respondents' profiles and identifying the key factors affecting the success of SIPs. Inferential analysis (the *t*-test) was conducted to determine statistical significance concerning the items in the constructs. These tests were chosen to provide an understanding of participant opinions across different experience levels and ensure that any conclusions drawn were based on reliable data. The *t*-test was selected due to its ability to assess whether differences in responses are statistically significant across different groups, providing understanding of varying perspectives within the respondent pool. While these statistical tests help to understand the data, they also come with limitations. For instance, the *t*-test assumes equal variance, which might not always be true across different respondent categories. The factor analysis results are also dependent on the appropriateness of the sample size and the suitability of the factor loadings. For this study, sample adequacy and appropriateness of data for factor analysis were ensured through Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity (BTS). These tests confirmed the dataset's suitability, with a KMO value ≥ 0.50 and a BTS p-value ≤ 0.05 indicating adequacy. Before items were accepted to define a construct, a cutoff value of 1 was used as the criterion for the eigenvalue [63]. KMO was used to measure sampling adequacy and BTS was applied. A dataset is considered adequate if it has a KMO value ≥ 0.50 and a BTS p-value ≤ 0.05 [64]. Factor analysis is considered appropriate if both the KMO and BTS criteria are met [55]. These tests were incorporated to ensure that the data was suitable for factor analysis, as they validate the sample's appropriateness, which is essential in obtaining accurate and reliable factor loadings. Cronbach's alpha was used to determine the internal consistency of the survey instrument [65] and yields a value between 0 and 1, with values below 0.7 generally indicating weaker reliability [59]. However, a value below 0.7 might be considered acceptable if the construct is theoretically significant [65,66]. If the mean score > 3.00 and the p-value < 0.05, most participants agreed; and if the mean score is <3.00 with a p-value < 0.05, most participants disagreed. Scores of 3.00 with a p-value > 0.05 indicate neutrality, while scores above or below 3.00 with a p-value above 0.05 do not provide clear evidence of agreement or disagreement with the items in the construct [67].

4. Results of EFA

4.1. Client-Related Factors

Table 3 illustrates that the Cronbach alpha for the CR factor was satisfactory at 0.85, surpassing the 0.7 limit. Consequently, further analysis employing factor analysis was undertaken. The KMO yielded a value of 0.84, exceeding the recommended threshold of 0.50, while Bartlett's test of sphericity returned a significant value ($p = 0.000$), below the recommended 0.05. Hence, factor analysis was considered appropriate as both the KMO and Bartlett's test of sphericity criteria were met. The EFA for the CR construct of the CSFs required to enhance the delivery of SIPs revealed an eigenvalue of 3.70 for factor 1, indicating a one-factor model as it surpassed the threshold of 1. Four of the seven items in factor 1 have loadings $\geq$0.7 and MSs $\geq$4.21 to $\leq$5.00, which makes the four items (CR_3, CR_5, CR_6, CR_7) in this factor significant to enhance SIP delivery. This implies these items are strongly correlated with the client factor and the high MS represents strong agreement by respondents that these items are a good representation of the CR factor.

Table 3. Client-related CSFs for SIPs.

Factor 1: Clients		Eigenvalue = 3.70 Variance = 52.92%	KMO = 0.84 BTS = 0.00		Cronbach Alpha = 0.85	
Code	**Item**	**Factor Loading**	**N**	**Mean**	**Std. Dev.**	**Rank**
CR_6	The client should always strive to make the right decisions at the right time.	0.776	103	4.92	0.575	1
CR_5	The client's procurement strategy should be proactive and not reactive.	0.770	103	4.92	0.593	2
CR_2	The client representatives should have the required skills and knowledge to oversee the social infrastructure projects.	0.640	103	4.61	0.581	3
CR_1	The client should give support throughout the project life cycle of the projects.	0.631	103	4.60	0.548	4
CR_3	The client should always monitor and control their projects to guarantee success.	0.794	103	4.47	0.698	5
CR_4	The client should also implement a flawless procurement strategy.	0.699	103	4.44	0.638	6
CR_7	The client should always monitor and control their construction projects in such a manner that will guarantee success.	0.763	103	4.42	0.721	7
	Total mean			4.55		

4.2. Contractor-Related Factors

The Cronbach alpha for the CRF was satisfactory at 0.85, exceeding the 0.7 threshold, as indicated in Table 4. The KMO measure of sampling adequacy was 0.79, above the recommended threshold of 0.50 and Bartlett's test of sphericity showed a significant value ($p = 0.000$) below the recommended 0.05. These results support the appropriateness of the factor analysis. The EFA for the CRF revealed two factors with eigenvalues > 1, factor 1 (4.27) and factor 2 (1.18), suggesting a two-factor model. For factor 1, two items (CRF_4 and CRF_5) had loadings $\geq$0.7 and MSs $\geq$4.21 to $\leq$5.00. For factor 2, three items (CRF_9, CRF_8 and CRF_7) met the same criteria. Hence, a total of five items are significant CRF for enhancing SIP delivery. The strong correlation between these items and the two CRF highlights their importance and the high MSs show the strong agreement respondents have regarding the significance of these factors for SIP delivery.

4.3. Project-Related Factors

The Cronbach alpha for the PR factor was considered slightly acceptable at 0.68 [68] as indicated in Table 5. The KMO sampling adequacy produced a value of 0.66 (surpassing the recommended threshold of 0.50) and Bartlett's test of sphericity returned a significant value ($p = 0.000$), below the recommended 0.05. Thus, based on these results, factor analysis was considered appropriate. EFA for the project-related construct revealed one factor with an eigenvalue (1.84) above one, indicating a one-factor model. Three items in this factor have loadings $\geq$0.7 and MSs $\geq$4.21 to $\leq$5.00, indicating the importance of these items (PR_1, PR_2 and PR_3) to SIP delivery. This indicates that these items are closely associated with the project-related factor and the high MS shows that respondents strongly agree that these project-related items are significant to enhance SIP delivery.

Table 4. Contractor-related CSFs for SIPs.

Factor 2: Contractors		Eigenvalue = 4.27 Variance = 47.44%	Eigenvalue = 1.18 Variance = 60.59%	KMO = 0.79 BTS = 0.00		Cronbach Alpha = 0.85	
Code	**Item**	**Factor Loading**	**Factor Loading**	**N**	**Mean**	**Std. Dev.**	**Rank**
CRF_9	The contractor should at all times be able to understand the scope of work for the construction project to succeed.	0.080	0.788	103	4.76	0.474	1
CRF_8	The contractor should be able to sequence work accordingly.	0.203	0.716	103	4.76	0.558	2
CRF_4	The contractor should be able to implement the quality assurance plan.	0.792	0.391	102	4.59	0.532	3
CRF_1	The contractor should be financially stable to execute the social infrastructure project.	0.672	0.029	103	4.59	0.550	4
CRF_3	The contractor should have a credible quality assurance plan for a social infrastructure project to be a success.	0.686	0.260	103	4.58	0.534	5
CRF_2	The contractor should have the technical capabilities to execute social infrastructure projects.	0.619	0.059	101	4.58	0.588	6
CRF_6	The contractor should have adequate manpower.	0.554	0.366	103	4.56	0.554	7
CRF_7	The contractor should have good employer and employee relations.	0.285	0.789	103	4.54	0.632	8
CRF_5	The contractor should have effective subcontractor coordination throughout the project.	0.745	0.352	102	4.45	0.669	9
	Total mean				4.60		

Table 5. Project-related CSFs for SIPs.

Factor 3: Projects		Eigenvalue = 1.84 Variance = 61.21%	KMO = 0.66 BTS = 0.00		Cronbach Alpha = 0.68	
Code	**Item**	**Factor Loading**	**N**	**Mean**	**Std. Dev.**	**Rank**
PR_3	The economy should be stable for the success of social infrastructure projects.	0.790	103	4.74	1.096	1
PR_2	The use of advanced technology in construction will increase the chances of the project to succeed.	0.810	103	4.71	0.934	2
PR_1	There should be readily available resources i.e., material, equipment and manpower.	0.746	103	4.60	0.624	3
	Average			4.68		

4.4. Project Management-Related Factors

Table 6 presents the Cronbach alpha for the PM factors, which was considered slightly acceptable at 0.68. The KMO measure of sampling adequacy returned a value of 0.660 (exceeding the recommended threshold of 0.50) and Bartlett's test of sphericity yielded a significant value (p = 0.000), below the recommended 0.05. These results indicated the appropriateness of conducting factor analysis. EFA for the PM construct revealed an eigenvalue above 1 (1.83) for one factor, indicating a one-factor model. For the PM factor, three items (PM_1, PM_2 and PM_3) have loadings $\geq$ 0.7 and MSs $\geq$ 4.21 to $\leq$5.00, which show the importance of considering these items in the delivery of SIPs. These results imply that the items are significantly connected to project management and the high MS indicates that respondents strongly agree that these project management items are critical to enhance SIP delivery.

Table 6. Project management CSFs for SIPs.

Factor 4: Project Management		Eigenvalue = 1.83 Variance = 61.15%	KMO = 0.66 BTS = 0.00		Cronbach Alpha = 0.68	
Code	**Item**	**Factor Loading**	**N**	**Mean**	**Std. Dev.**	**Rank**
PM_2	Project stakeholders should always work as a team for the construction project to be a success.	0.749	103	4.66	0.65	1
PM_1	Effective project integration management coupled with the right people for the job will improve the delivery.	0.805	103	4.59	0.55	2
PM_3	Project stakeholders' expertise is required for the project's scope to be executed as planned.	0.791	103	4.39	0.66	3
	Average			4.55		

4.5. External Factors

Table 7 reveals the Cronbach alpha for the external factor was weak at 0.51 but values below 0.7 might be considered if the construct is theoretically significant [65]. On this basis, 0.51 was considered. The KMO measure of sampling adequacy yielded a value of 0.60 (exceeding the recommended threshold of 0.50) and Bartlett's test of sphericity resulted in a significant value ($p = 0.000$), below the recommended 0.05. Therefore, factor analysis was considered appropriate to conduct. EFA for the external factors that enhance the delivery of SIPs revealed one factor with an eigenvalue above one (1.62), suggesting a one-factor model. Based on the criteria set and relative to the result of other constructs, external factors indicate less importance to SIP. While EF_1 has a high MS and EF_3 indicates a high factor loading, the results show that none of the items satisfied both criteria (factor loading ≥ 0.7 and MS ≥ 4.21 to ≤ 5.00). Consequently, none of the items could be validated for inclusion in the framework developed in this study to improve the delivery of SIPs.

Table 7. External CSFs for SIPs.

Factor 5: External		Eigenvalue = 1.62 Variance = 40.39%	KMO = 0.60 BTS = 0.00		Cronbach Alpha = 0.51	
Code	**Item**	**Factor Loading**	**N**	**Mean**	**Std. Dev.**	**Rank**
EF_1	There should be readily available resources i.e., material, equipment and manpower.	0.500	103	4.52	0.624	1
EF_4	The use of advanced technology in construction will increase the chances of the project to succeed.	0.600	103	4.20	0.964	2
EF_2	The economy should be stable for the success of social infrastructure projects.	0.680	103	4.10	0.934	3
EF_3	Political support is vital for the success of social infrastructure projects.	0.740	103	3.93	1.096	4
	Average			4.30		

5. Critical Success Factors for the Improved Delivery of SIPs

The *t*-test analysis was conducted to determine possible differences in respondents' opinions on the items considered in each construct (refer to Table 8). Again, where the MS is >3.00 and the p-value < 0.05, most participants agreed. If the MS is <3.00 with a p-value < 0.05, most participants disagreed. Scores of 3.00 with a p-value > 0.05 indicate neutrality, while scores above or below 3.00 with a p-value above 0.05 do not provide clear evidence of agreement or disagreement with the items in the construct [67].

Table 8. One-sample *t*-test results for all factors.

One-Sample Statistics Item Code	N	Mean	Std. Dev.	Test Value = 3.0 t	df	Sig. (2-Tailed) p	Agreed
Client Related Factors							
CR_1	103	4.60	0.548	29.644	102	0.00	Yes
CR_2	103	4.61	0.581	28.138	102	0.00	Yes
CR_3	103	4.47	0.698	21.33	102	0.00	Yes
CR_4	102	4.44	0.638	22.804	101	0.00	Yes
CR_5	102	4.92	0.593	25.389	101	0.00	Yes
CR_6	103	4.92	0.575	26.217	102	0.00	Yes
CR_7	103	4.42	0.721	19.948	102	0.00	Yes
Average		4.62	0.622	26.948	102	0.00	Yes
Contractor related factors							
CRF_1	103	4.59	0.550	29.372	102	0.00	Yes
CRF_2	101	4.58	0.588	27.091	100	0.00	Yes
CRF_3	103	4.58	0.534	30.096	102	0.00	Yes
CRF_4	102	4.59	0.532	30.372	102	0.00	Yes
CRF_5	102	4.45	0.669	21.892	101	0.00	Yes
CRF_6	103	4.56	0.554	28.619	102	0.00	Yes
CRF_7	103	4.54	0.632	25.159	102	0.00	Yes
CRF_8	103	4.76	0.558	29.866	102	0.00	Yes
CRF_9	103	4.76	0.474	37.613	102	0.00	Yes
Average		4.59	0.564	28.898	102	0.00	Yes
Project related factors							
PR_1	103	4.6	0.624	27.882	102	0.00	Yes
PR_2	103	4.71	0.934	34.846	102	0.00	Yes
PR_3	103	4.74	1.096	38.044	102	0.00	Yes
Average		4.68	0.884	33.590	102	0.00	Yes
Project management related factors							
PM_1	103	4.59	0.55	29.372	102	0.00	Yes
PM_2	103	4.66	0.65	25.918	102	0.00	Yes
PM_3	103	4.39	0.66	21.34	102	0.00	Yes
Average		4.55	0.620	25.543	102	0.00	Yes
External factors							
EF_1	103	4.52	0.624	24.80	102	0.00	Yes
EF_2	103	4.10	0.934	11.918	102	0.00	Yes
EF_3	103	3.93	1.096	8.631	102	0.00	Yes
EF_4	103	4.20	0.964	12.679	102	0.00	Yes
Average		4.30	0.904	14.327	102	0.00	Yes

Note: significant $p = 0.05$.

5.1. Client-Related Factors

The *t*-test results for CR factors show that on average there is no difference (M = 4.62; SD = 0.622) in the perception of participants regarding the items included in this construct $t(102) = 26.94$; $p \leq 0.05$. The p-value is <0.05 and the MS > 3.00, indicating that respondents showed strong agreement that all these items should be considered as client-related factors for SIP delivery. For instance, participants agreed that the client should provide support throughout the project life cycle (CR_1), Egwim [22] emphasises the importance of client dedication in construction projects. Participants agreed that the client should possess the necessary skills and knowledge to oversee SIPs (CR_2) and that they should actively monitor and control projects to ensure success (CR_3) and implement a flawless procurement strategy (CR_4). A proactive procurement strategy, as advocated in CR_5, helps identify risks that may impact SIP delivery. Participants also agreed that clients should make timely decisions

(CR6) and continuously monitor and oversee construction projects (CR_7); a finding that is in congruence with Alkhateeb et al. [69].

5.2. Contractor-Related Factors

The *t*-test results for CRF factors show that on average there is no difference (M = 4.59; SD = 0.564) in participants' perceptions regarding the items included in the contractor construct $t(102) = 26.94$; $p \leq 0.05$. With *p*-values < 0.05 and MS > 3.00, participants agreed that all items they evaluated in the contractor construct are significant for enhancing SIP delivery. Contractors should possess the financial capabilities to execute projects successfully (CRF_1). Okudan and Budayan and Gunduz and Almuajebh [41,43] highlight the importance of financial management in SIP delivery. Moreover, contractors should demonstrate technical capabilities (CRF_2) and ensure the maintenance of high-quality standards throughout projects (CRF_3), which is consistent with the study by Alao and Babalola [20]. Participants agreed that contractors must effectively implement quality assurance plans (CRF_4), echoing Okudan and Budayan [43] who stress the importance of adhering to quality assurance programs. The results show that effective subcontractor coordination (CRF5) and manpower allocation (CRF_6) are essential to the timely and cost-effective delivery of SIPs. Proper coordination ensures that tasks are completed in sync, reducing delays, while optimal manpower allocation maximises efficiency and resource use [41]. These factors could contribute to overcoming logistical and financial challenges, improving overall project performance and stakeholder satisfaction. Good employer-employee relations (CRF_7), proper work sequencing (CRF_8) and a clear understanding of project scope (CRF_9) are essential for successful SIP delivery. Studies by Chaichi et al. [70] and Assaad et al. [49] emphasise these factors, showing their critical role in ensuring smooth project execution, enhancing collaboration and reducing delays. These elements help in optimising resources, improving productivity and ensuring that projects meet client expectations.

5.3. Project-Related Factors

The *t*-test results show that on average there is no difference (M = 4.68; SD = 0.884) in the perception of participants regarding the items included in the project-related construct $t(102) = 33.59$; $p \leq 0.05$. The *p*-value < 0.05 and MS > 3.00 indicate strong agreement of respondents that the three project-related items are critical for SIP delivery. Participants agree that SIPs should have clear objectives to succeed (PR_1) and that the project scope should be clear to all stakeholders for SIPs to be successful (PR_2). These perceptions are supported by Tshehla [22], who argues that well-defined project scopes are essential for avoiding scope creep, variation orders, quality non-conformance and delays. Alkhateeb et al. [69] maintain that conducting site investigations during project planning is critical for developing a defined scope of work. Conducting site investigations during project planning is also crucial for developing a clear scope of work, leading to project success (PR_3).

5.4. Project Management-Related Factors

The *t*-test results show that on average there is no difference (M = 4.55; SD = 0.620) in the perception of participants regarding the items included in the contractor construct $t(102) = 25.54$; $p \leq 0.05$. The items achieving *p*-value < 0.05 and MS > 3.00 indicate strong agreement that the project management factors are critical to the delivery of SIPs. Participants agreed that effective project integration management, coupled with the right people for the job, will enhance the delivery of SIPs (PM_1). Participants also agreed that project stakeholders should always work as a team for the construction project to succeed (PM_2). These findings concur with the study by Chileshe and Kikwasi [71] which emphasised the importance of teamwork among project stakeholders for project success. Moreover, Tshehla [22] explains that project stakeholders' competence and expertise is essential for carrying out the project's scope as intended and within the planned scope (PM_3).

5.5. External Factors

Although it was established that none of the items meets the criteria for inclusion in the framework developed in this study, it is still essential to determine the level of agreement among respondents regarding the items in the external factors construct. Evidence accrued through the analysis leads to the logical conclusion that respondents largely agreed on the external factors relevant to SIP delivery. The t-test results show that on average there is no difference (M = 4.30; SD = 0.904) in the perception of participants regarding the items included in the contractor construct $t(102) = 14.32$; $p \leq 0.05$. This is evident in the constructs achieving p-value < 0.05 and MS > 3.00. Participants opine that there should be readily available resources, including material, equipment and manpower (EF_1). This opinion is supported by Mbachu and Nkado [46], who argue that economic drivers like inflation, currency stability and exchange rates should be considered when embarking on construction projects. Participants also agreed that a stable economy is essential for the success of SIPs (EF_2). This perception is supported by Wang et al. [21], who emphasised the importance of political support for the success of SIPs (EF_3). Similarly, the use of advanced technology in construction was deemed crucial for project success (EF_4). This is supported by Mbachu and Nkado [46] and Newman et al. [31] who highlighted the necessity for stakeholders to adapt to technological advancements in the construction industry to keep ahead of market competition.

6. Proposed Framework for the Improved Delivery of SIPs

SIPs success depends on the factors identified in this present study and therefore, addressing these factors would improve SIP delivery outcomes. The proposed outline framework presented in Figure 1 underscores the essential considerations for enhancing the delivery of SIPs. This framework provides a structured approach to achieving success in SIPs and is divided into three swim-lanes (*viz.*: stakeholders; CSFs; and project delivery) and a feedback loop to assist with knowledge management when used on multiple contracts. This systematic approach could enhance effective planning, execution and evaluation, ultimately leading to more efficient delivery of SIPs. Drawing from the study's findings, the framework incorporates critical factors across four key stakeholders *viz.*: clients, contractors, projects and project management.

6.1. Clients

Effective project monitoring and control by clients is essential to ensure they take an active role in managing their projects throughout their lifecycle, ensuring that key milestones are met and potential issues are addressed promptly. In congruence, Lindblad and Guerrero [72] highlighted that proactive client involvement is vital in optimising project performance and minimising risks. The clients' decision-making process is also crucial for responding to issues effectively, avoiding delays and cost overruns. Lin et al. [73] concur and emphasise the importance of strong client-contractor relationships, which are often built upon timely and well-considered decisions by the client. A proactive procurement strategy is also key in avoiding procurement delays and ensuring resources are readily available. Lindblad and Guerrero [72] call for proactive strategic planning in procurement to enhance project performance.

6.2. Contractors

Although coordinating the work of multiple subcontractors is often a complex task, contractors must ensure effective coordination of subcontractors. Ahankoob et al. [74]

emphasise the need for efficient resource management, which relates to ensuring that subcontractors have the prerequisite materials, labour and equipment to complete their tasks. Quality assurance implementation further ensures that the project meets the required standards, as contractors are responsible for maintaining construction quality throughout the project lifecycle [75]. Understanding the project scope ensures that all specifications and requirements are delineated and that the project is executed according to the specified objectives [76]. Employer-employee relations also play a significant role in creating a conducive working environment. Omopariola et al. [77] show that a contractor's experience and reputation (often shaped by their inherent ability to foster good relations within their workforce), can significantly impact the overall project outcome. Work sequencing is essential for maintaining an efficient workflow, ensuring that tasks are completed in a logical order to avoid delays and optimise project progression.

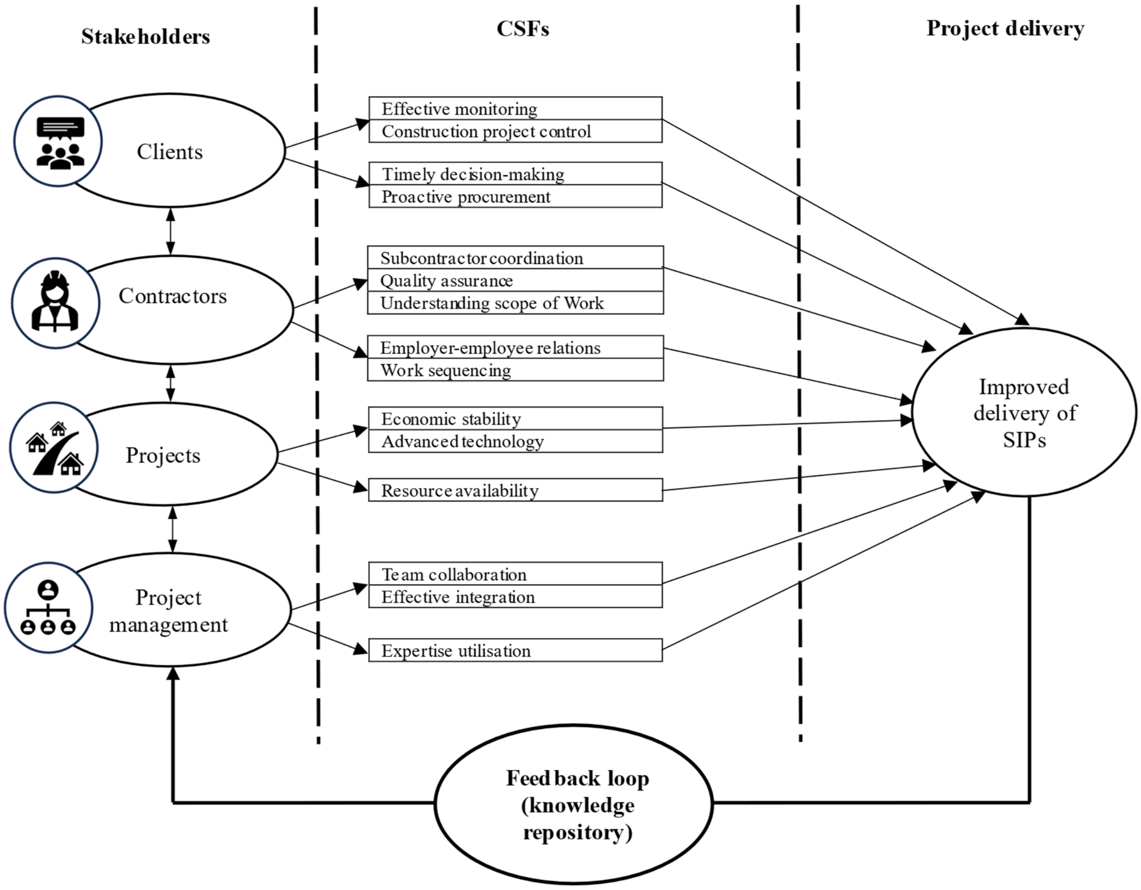

Figure 1. Proposed outline framework for the improved delivery of SIPs.

6.3. Projects

Economic stability is a key CSF for project success. A stable macro-economic environment allows projects to be executed without disruptions related to fluctuating costs or funding shortages [14]. Wang et al. [78] underscore the need for economic stability, noting that aligning project planning with favourable economic conditions can mitigate risks. Advanced technology is also a key factor for successful project outcomes because it enhances efficiency and precision in construction processes [31]. Ahankoob et al. [74] proffer that using advanced technology in construction, combined with effective resource management, can significantly boost project performance. Resource availability is another critical factor, as projects require continuous access to materials, equipment and labour to maintain their progress. Lin et al. [73] highlight how the availability of resources, particularly in uncertain environments, can affect project feasibility and success.

6.4. Project Management

The framework indicates that team collaboration is essential for the improved delivery of SIPs. Wang et al. [78] emphasise the importance of collaboration among stakeholders, stating that a well-coordinated team can better align their efforts towards achieving the project's objectives. Effective integration management involves ensuring that all project elements are aligned and that stakeholder contributions are effectively integrated. Proper integration management enhances the project's delivery by optimising the roles of each stakeholder [44]. Expertise utilisation is also crucial, as the combined knowledge and experience of stakeholders enable the project scope to be executed more efficiently. Ahankoob et al. [74] proffer that managing change and resolving conflicts within the project team are essential skills for project managers to fully leverage stakeholders' expertise.

7. Future Work

This research opens several clear avenues for further investigation, driven by the need for more practical and specialised applications. Creating statistical models is a critical first step, but the real value lies in their application and refinement. Firstly, the knowledge gained in developing the framework must now be tested through applied Participant Action Research (PAR) on live projects. The goal is to uncover the weightings of each CSF and refine their practical implementation, gaining deeper understanding of the complexities and lessons learned. For example, while the importance of effective client monitoring is well-established, it remains unclear which strategies offer the most optimal results. Could the integration of Building Information Modeling with other technologies, such as laser scan point clouds or advanced visualisation tools [79], provide the best solution? Identifying the optimal technological combination remains a crucial area for investigation. Secondly, as the framework is currently a theoretical model, its practical applicability requires the development of a graphical user interface (GUI) that allows practitioners to track, measure, and document improvements. These improvements should be quantifiable, with management and textual reports—especially those linked to BIM and other digital tools—potentially forming the basis for large language models [80] to analyse lessons learned within the feedback control loop (as illustrated in Figure 1). Third, testing and refining the user experience and product reliability will be critical. By applying and evaluating the framework in practice, we can gain comprehensive knowledge that will enhance both its user-friendliness and its accuracy. A longitudinal case study offers the most effective approach to achieving this refinement. Several more academic directions for future research should include expanding the framework's application to different geographical regions to explore potential variations in results, adapting it to various types of projects, and employing alternative methods to validate the outcomes presented.

8. Conclusions

Social infrastructure projects in the Mpumalanga and Limpopo provinces face significant challenges, including socioeconomic issues, construction site closures, discrepancies in bills of quantities, variation orders and inadequate budgeting, all of which collectively impede project success. This study presents a CSFs framework developed to address these challenges by focusing on key areas that affect the delivery of SIPs. By emphasising proactive client involvement, effective project monitoring, construction control and timely decision-making, clients can optimise project outcomes. Active client participation and strong client-contractor relationships are essential in minimising risks and improving project performance. For contractors, effective subcontractor coordination and quality assurance are critical to maintaining construction quality, while fostering strong employer-employee relations and understanding the scope of work helps create a productive working environment that positively impacts overall project outcomes. Additionally, work sequencing is crucial for ensuring that project tasks are carried out in a logical and timely manner. Contractors must also manage resources efficiently, ensuring that subcontractors have access to the materials and equipment necessary for timely project completion.

Regarding the factors relating to the project, factors such as economic stability, advanced technology and resource availability are crucial for the success of SIPs. Aligning project planning with favourable economic conditions is essential and the use of advanced digital technology plays a critical role in enhancing efficiency and overall project performance. The availability of key resources in uncertain environments significantly affects project feasibility and completion. Concerning project management, team collaboration, effective integration management and expertise utilisation are central to achieving successful outcomes. Effective management of change and conflicts enables project managers to leverage stakeholder expertise, ensuring project success. There was not enough evidence to include external factors in the study's framework, as the constructs could not be validated. The study's CSF framework provides an understanding of a structured approach for stakeholders to begin addressing these challenges. This study contributes to theory by developing a framework for CSFs in the delivery of SIPs. The framework provides a structured understanding of the critical factors influencing SIP success, offering a theoretical foundation for researchers interested in further exploring SIP delivery models. This framework can further be tested on construction projects globally. For practitioners, the study provides an understanding that can directly enhance decision-making processes and project outcomes. The research findings serve as a practical guide to optimise SIP delivery, mitigate risks, and ensure successful project implementation.

In conclusion, it is apparent that infrastructure (and construction) projects globally continue to be confronted by the omnipresent challenges of poor project performance. By taking a fresh perspective in the present paper and signposting the way for future research in this area, it is hoped that polemic debate will be generated and renewed vigour within the academic discourse will transpire. It is clear that simply repeating past mistakes will not generate the optimised sector desired for the future—the sector must be informed with robust research to stimulate a paradigm shift in thinking differently.

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