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# Issues and Challenges Affecting Supply Chain in Project Delivery: Construction Professional Perspectives †

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**Abstract:** Supply chain management integration in construction project delivery emerged from strategies to improve competitiveness, increase profits, and gain control over the various factors influencing project delivery and performance. Hence, this study assesses the challenges of supply chain management in construction project delivery using the perspective of construction professionals in South Africa. A structured questionnaire was developed to obtain data from construction professionals in Durban, South Africa. Descriptive statistics and the Kruskal–Wallis test were conducted to determine construction professionals' perspectives towards challenges affecting supply chain management in construction project delivery. According to the study's findings, the essential challenges affecting supply chain management in construction project delivery in South Africa include weak procurement strategies, difficulties with scheduling flexibility, poor construction design, poor budget management, non-integration of automation systems in the SCM process, insufficient planning of the project before starting, and sub-contractors' lack of understanding of SCM concepts. The study recommends that construction project delivery be guided by effective procurement systems, effective budget management, integration of automation in the supply chain, and enabling government policies.

**Keywords:** construction professionals; challenges; project delivery; supply chain management; South Africa



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## 1. Introduction

The complexity of construction operations, methods, and the interplay of activities among stakeholders have continued to impact project delivery [1]. These include the complexity and sheer magnitude of several factors influencing project planning, design, procurement, construction, administration, maintenance, and management in construction project delivery [2–5]. However, this sector is often criticised for its poor performance at almost every level of its operations. Ref [1] admitted that determining methods that match the characteristics of a construction project is a critical step toward the success or failure of project delivery. However, this continued negative perception has prompted a call for a dramatic change in how the sector operates and functions, especially since the industry fails to keep up with technological and systems advancements [1,6]. Companies across various sectors globally apply supply chain management (SCM) due to its demonstrated results, such as reduced delivery time, improved financial performance, greater customer satisfaction, and building trust among suppliers [7].

Supply chain management (SCM) integration in construction project delivery emerged from strategies to improve competitiveness, increase profits, and gain control over the various factors and variables influencing project delivery and performance [4,8]. Hence, ref. [9] noted that supply chain (SC) in the construction sector refers to the strategic management of operations, tasks, flow of information, and processes involving various independent

organisational networks and interaction relationships in delivering value in project completion and performance. According to Nugroho et al. [10], SCM in construction projects describes the operational flow and strategic cycle, including workers, materials, equipment, subcontracting, and project completion. These components are technologically connected by security and communication systems to integrate the parties involved in construction delivery to give the customers the efficiency of quality and service operations [10].

A supply chain also involves interaction and collaboration between companies to deliver products, goods, or services to the last customers [11,12]. The construction sector supply chain plays a significant role in the competition of the construction market through the relationship between clients, suppliers, and contractors, mainly regarding purchasing and production planning [12,13].

According to [14,15], the lack of reliable site production systems, such as limited information flow and not being shared on time, delays in material orders, material delivery, and construction schedules, affected the project supply chain. Nonetheless, while the benefits of SCM are widely recognised, the challenges affecting SCM created knowledge gaps in construction project delivery that need to be empirically studied. Researchers have explored and established several benefits, problems, and challenges affecting SCM in the construction sector, particularly in developing countries [16,17].

Researchers have explored and established several benefits and strategies to improve SCM in various sectors [16–18], and multiple challenges affecting SCM, mainly using the artificial intelligence approach in SCM in the construction sector, creating a knowledge gap in emerging countries, particularly South Africa. This study uses the perspectives of construction professionals in the South African construction industry to assess the challenges of supply chain management in construction project delivery. This will help bridge the knowledge gaps and further enrich its application among construction stakeholders in project delivery. Hence, the preliminary findings of this study will provide an understanding of the challenges of supply chain management in construction project delivery and a potential future research direction for SCM in the construction sector.

## 2. Literature Review

The operations of the construction industry are linked with a cluster of sectors, including banking and material and equipment manufacturers, contracting organisations, and so forth [12]. However, the industry encounters several challenges influencing project delivery performance [19]. Al-Werikat [12] asserted that SCM could become very complex in large projects due to the variety of site materials and parties (sub-contractors and suppliers) involved in the project delivery. Likewise, ref. [20] attributed the challenges of SCM in project delivery to fragmented supply chains, unavailable data, a lack of good team relationships, and a culture of one-of-a-kind projects. In addition, ref. [21] noted the influence of underestimation of materials costs, excessive weather conditions, additional scope modifications to meet specifications and testing requirements, political interference, the late delivery of critical materials, and the incompetence of crucial project members on SCM in the project delivery. Consequently, SCM integration in construction project delivery encountered challenges such as insufficient project planning, delay in the delivery of materials, design changes during project implementation, sub-contractor incompetence, delays in responding to decision-making, and temporary stoppages owing to inclement weather [12,22,23]. Effective supply chain management in construction project delivery could help mitigate bad construction design, ineffective schedule management, poor budget management, poor construction methods, poor human resource management, and the lack of good team relationships [24,25]. the demand for inappropriate selection criteria, inappropriate risk allocation, discontinuous and low demand issues, and frequently changing orders in specifications affect project delivery [12,26].

According to [27], construction project delivery is driven by the principles of the supply chain, in which successful project management is a balance between combinations of project management actions, project-related and human-related factors, and external factors

such as the economy, specific project management models, and software. However, [28] identified challenges that hinder SCM in project delivery, including a lack of skilled service providers, undefined service providers' roles, unclear project specifications, and weak procurement strategies. This is because SCM in construction delivery is the management of resource activities and relationships between suppliers and consumers from upstream to downstream in terms of construction services [10]. This often resulted in a lack of stability throughout the construction firm's concurrent projects [28]. To this end, ref. [16] highlighted challenges common to SCM in project delivery as a lack of understanding of SCM concepts, inability to develop measures for monitoring alliance, lack of appreciation of others' performance, difficulties of mutuality, deficiency of procurement systems/processes, failure to broaden the supply chain vision beyond procurement or product distribution, non-integration of automation in SCM process, difficulties of scheduling flexibility in operations, and fear of loss of control. Nonetheless, there are still various difficulties in integrating automation processes or artificial intelligence in supply chain management to improve key performance indicators, foster economic sustainability, and inform decision-making in construction project delivery [18].

## 3. Methodology

This study uses construction professionals' perspectives to assess supply chain management challenges in construction project delivery. This study was conducted among construction professionals in Durban, in KwaZulu-Natal province, in the South African construction industry. Ref. [29] reported that the KwaZulu-Natal province accounts for the most prominent general building and civil engineering construction contracting firms registered as grades 2 to 4 with the Construction Industry Development Board (CIDB). The respondents were drawn from construction professionals based on their involvement, knowledge and experience in supply chain construction project delivery. This study area was selected because Durban is in a coastal zone with attractive construction project investments. Likewise, the study area was rated as one of the top five quality-of-living cities in Africa and the Middle East by Mercer Consulting in 2015 and 2016, which has increased quality delivery projects in the region. The respondents for this study were determined using the systematic random sampling method, because it eliminates the possibility of sample clustering, breaking the population into various clusters from which a simple random sample can be obtained [30], and evenly covers all the elements [25]. A simple random sampling method was adopted for the field survey using a structured questionnaire as a data collection instrument, with sixty-five questionnaires distributed to the selected respondents and 52 copies retrieved from the respondents. A five-point Likert scale was adopted using Strongly Agree = 5, Agree = 4, Neutral = 3, Disagree = 2, and Strongly Disagree = 1. The data obtained was analysed using IBM SPSS version 28. The reliability of the data collection instrument was examined using Cronbach's alpha, and it returned a 0.941 value above the 0.6 recommended minimum value and indicated a high degree of consistency [31]. This was followed by descriptive analysis, including percentage, frequency, mean score (MS), and standard deviation to rank respondents' perspectives of challenges in supply chain management in construction project delivery. The Kruskal–Wallis test compared respondents' perspectives based on their professional designations in construction project delivery. Therefore, refs. [30,32] described the Kruskal–Wallis test as a non-parametric test to determine the significant difference between two groups of respondents using a $p$-value at a 95% confidence level.

## 4. Results

The demographic information of the 52 professionals who participated in the study: The study findings show that, regarding the highest academic qualification of the respondents, 51.9% had bachelor's degrees, 19.2% had honour's-level degrees, 15.4% had master's degrees, 9.6% had matric certificates, 1.9% had a post-matric certificate, and 1.9% had doctorate degrees. The designations of professionals in this study comprise 32.69%

construction managers, 19.2% project managers, 17.3% quantity surveyors, 9.6% architects, 7.7% civil engineers, 5.8% town and regional planners, 3.85% electrical engineers, and 3.86% others. In addition, the respondents working experience indicates that 52% had 10–15 years of experience, 23% had 5–10 years of experience, 19.24% had 0–5 years of experience, and 5.76% had 15–20 years of experience. Likewise, Table 1 presents the ranking of the descriptive analysis using mean scores (MS) and standard deviation (SD) from identified challenges of supply chain management in construction project delivery in the South African construction industry. The professionals' perspectives of the identified challenges of supply chain management in construction project delivery were based on score ranking of a five-point Likert scale adopted using Strongly Agree = 5, Agree = 4, Neutral = 3, Disagree = 2, and Strongly Disagree = 1. Weak procurement strategies ranked first with 4.46 MS and 0.999 SD; unclear project specifications ranked second with 4.27 MS and 0.795 SD; difficulties with scheduling flexibility with 4.13 MS and 0.793 SD, poor construction design with 4.13 MS and 0.742 SD, and delay in the delivery of materials with 4.13 MS and 0.817 SD were ranked third. Consequently, poor budget management with 4.12 MS and 0.758 SD, excessive weather conditions with 4.12 MS and 0.732 SD, and inability to develop measures for monitoring alliance with 4.12 MS and 0.784 SD were ranked sixth. The non-integration of automation in the SCM process with 4.10 MS and 0.774 SD and insufficient planning of the project before starting with 4.10 MS and 0.774 SD ranked ninth. Sub-contractor lack of understanding of SCM concepts ranked eleventh with 4.08 MS and 0.860SD; poor human resource management ranked twelfth with 4.04 MS and 0.839 SD; communication breakdown in the material supply chain with 4.02 MS and 0.770 SD, and underestimation of the cost of the materials with 4.02 MS and 0.754 SD, ranked thirteenth. Design changes during project implementation ranked fifteenth, with 4.00 MS and 0.767 SD; ineffective schedule management, with 3.96 MS and 0.928 SD, and political interferences, with 3.96 MS and 1.009 SD, ranked sixteenth. The remaining variables with the lowest mean scores were ranked as follows: additional scope modifications to meet testing requirements with 3.92 MS and 0.788 SD and late delivery of material supply with 3.88 MS and 1.060 SD, ranked eighteenth; use of poor construction method ranked twentieth; and incompetence of key project members with 3.87 MS and 0.929 SD. The mean score (MS) values obtained < 3.50 indicate the importance of the twenty-one identified challenges of supply chain management in construction project delivery [33]. Similarly, Table 1 further shows the results of the Kruskal–Wallis non-parametric test conducted to compare the perspectives of the respondents who participated in the survey based on the professionals' designations (architects, construction managers, project managers, quantity surveyors, electrical engineers, civil engineers, town and regional planning, and others). Table 1 indicates that all the twenty-one identified challenges of supply chain management in construction project delivery had no significant difference with Asymp. Sig. values ranging from 0.096 to 0.998, above 0.05 minimum *p*-value recommended and Chi-Square values ranging from 0.764 to 12.148 [31,32]. This implies confidence in the respondents' perspective regarding the challenges perceived in supply chain management in project delivery.

The study findings indicated that weak procurement strategies, unclear project specifications, difficulties with scheduling flexibility, poor construction design, and delays in the delivery of materials were the fifth highest-ranked variables contributing to challenges of SCM in construction project delivery. These findings agree with refs. [14,15], who attributed challenges such as limited information flow, delays in material orders, delivery, and construction schedules due to a lack of reliable site production systems, which affected the SCM in project delivery. The study findings also support Saad's [27] conclusion that a lack of skilled service providers, undefined roles, unclear project specifications, and weak procurement strategies affect SCM in project delivery. Consequently, the study findings ranked challenges affecting supply chain management in project delivery as poor budget management, excessive weather conditions, inability to develop measures for monitoring alliance, non-integration of automation in the SCM process, insufficient planning of the project before starting, and sub-contractor lack of understanding of SCM concepts. The

study aligns with Meeampol and Ogunlan [24], and Ogunbayo et al. [25], who asserted that effective supply chain management in project delivery could help mitigate poor construction design, ineffective schedule management, and poor budget management. Similarly, the findings conforms with Adade [16], who highlighted challenges common to SCM in project delivery as a lack of understanding of SCM concepts, inability to develop measures for monitoring alliance, deficiency of procurement system, non-integration of automation in SCM process, and difficulties of scheduling flexibility in operations. Thus, the findings further emphasised that the demand for inappropriate selection criteria, poor human resource management, inappropriate risk allocation, discontinuous and low demand issues, and frequently changing orders in specifications affect project delivery [12,26]. Contrarily to previous findings, additional scope modifications to meet testing requirements, late delivery of material supply, poor construction methods, and incompetence of key project members were the lowest-ranked challenges affecting SCM in project delivery in the study area. In contrast, [1] admitted that determining methods that match the characteristics of a construction project is a critical step toward the success or failure of project delivery. In addition, [22] noted the influence of underestimation of materials costs, additional scope modifications to meet specifications and testing requirements, and late delivery of critical materials as factors affecting SCM in the project delivery.

**Table 1.** Ranking of challenges of SCM in construction project delivery.

| Identified Challenges of SCM | Mean | Std. Dev. | Rank | Chi-Square | Asymp-Sig |
|---|---|---|---|---|---|
| Weak procurement strategies | 4.46 | 0.999 | 1 | 7.690 | 0.361 |
| Unclear project specifications | 4.27 | 0.795 | 2 | 0.764 | 0.998 |
| Difficulties of scheduling flexibility | 4.13 | 0.793 | 3 | 4.275 | 0.748 |
| Poor construction design | 4.13 | 0.742 | 3 | 2.367 | 0.937 |
| Delay in the delivery of materials | 4.13 | 0.817 | 3 | 5.185 | 0.637 |
| Poor budget management | 4.12 | 0.758 | 6 | 2.465 | 0.930 |
| Excessive weather conditions | 4.12 | 0.732 | 6 | 5.092 | 0.649 |
| Inability to develop measures for monitoring alliance | 4.12 | 0.784 | 6 | 12.148 | 0.096 |
| Non-integration of automation in the SCM process | 4.10 | 0.774 | 9 | 5.919 | 0.549 |
| Insufficient planning of the project before starting | 4.10 | 0.774 | 9 | 5.489 | 0.601 |
| Sub-contractor lack of understanding of SCM concepts | 4.08 | 0.860 | 11 | 8.429 | 0.296 |
| Poor human resource management | 4.04 | 0.839 | 12 | 4.781 | 0.687 |
| Communication breakdown in the material supply chain | 4.02 | 0.700 | 13 | 1.697 | 0.975 |
| Underestimation of the cost of the materials | 4.02 | 0.754 | 13 | 2.992 | 0.886 |
| Design changes during project implementation | 4.00 | 0.767 | 15 | 2.414 | 0.933 |
| Ineffective schedule management | 3.96 | 0.928 | 16 | 2.407 | 0.934 |
| Political interferences | 3.96 | 1.009 | 16 | 1.461 | 0.984 |
| Additional scope modifications to meet testing requirements | 3.92 | 0.788 | 18 | 2.646 | 0.916 |
| Late delivery of material supply | 3.92 | 0.737 | 18 | 8.799 | 0.267 |
| Use of poor construction method | 3.88 | 1.060 | 20 | 5.752 | 0.569 |
| Incompetence of key project members | 3.87 | 0.929 | 21 | 2.667 | 0.914 |

## 5. Recommendations and Conclusions

This study uses the perspective of construction professionals in the South African construction industry to assess the challenges of supply chain management in construction project delivery. The study findings identified that weak procurement strategies, unclear project specifications, difficulties with scheduling flexibility, poor construction design, delays in the delivery of materials, poor budget management, excessive weather conditions, inability to develop measures for monitoring alliance, non-integration of automation systems in the SCM process, insufficient planning of the project before starting, and subcontractor lack of understanding of SCM concepts contributing to challenges of SCM in construction project delivery. These challenges were caused by construction stakeholders' inadequate knowledge of SCM concepts, non-integration of automation systems in SCM,

and poor budget management. The study suggests that to overcome the challenges in managing the supply chain in project delivery, construction firms, stakeholders, professional institutions, and government agencies must increase their knowledge of SCM in project delivery. However, the study findings explain that future research should consider artificial intelligence and integrating automation as practical indicators to measure, control, and improve supply chain management to evaluate and enhance project delivery. Likewise, the study recommends that construction project delivery be guided by effective procurement systems, effective budget management, integration of automation, and enabling government policies. The study's implications will help construction professionals, stakeholders, government agencies, and professional institutions identify challenges of supply chain management in construction project delivery and the need to develop strategies, knowledge, and understanding of supply chain management in construction project delivery. The study findings are limited to selected construction professionals in Durban, KwaZulu-Natal, one of the twelve provinces in South Africa, which limits the generalisation of the study findings in South Africa. Nonetheless, further study could explore a larger population involving professionals across the twelve provinces of South Africa compared to the findings of this study.

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