# Critical Drivers of Successful Operations Management in Construction Subcontracting: A Sequential SLR- AHP Approach

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## ABSTRACT

Subcontracting (SC) constitutes a significant portion of construction project activities, yet ineffective management can lead to project failures. This study identifies and prioritizes the critical drivers of successful operations management in construction subcontracting. Using a sequential SLR-AHP approach, the study first conducted a systematic literature review (SLR) to extract key drivers from existing research. The findings were then validated through an expert survey using the Analytical Hierarchy Process (AHP). The results highlight 'Timely Payment by the Contractor' as the most critical driver, underscoring the importance of financial reliability in sustaining workflow efficiency and subcontractor performance. 'Execution Capability of Subcontractors' and 'Mutual Trust and Fairness' ranked second and third, emphasizing the need for capacity-building initiatives and a collaborative project environment. These findings provide valuable insights for improving operations in construction subcontracting works.

**Keywords:** Analytical hierarchy process; Construction industry; Drivers; Operations; Systematic literature review; Subcontracting

## INTRODUCTION

Subcontracting (SC) is a business strategy that main contractors employ to address construction market uncertainties and transfer risks, such as completion risks, financial risks, and employee responsibility (Schaufelberger & Holm, 2017) Subcontracting (SC) in construction has become increasingly prevalent in recent decades (Zubair et al., 2016; Mbachu et al., 2022) due to the growing complexity of construction projects, the scarcity of skilled labor, the drive to maximize profits, and the need to reduce risk, Studies indicate that in Zambia more than 50%, and in some specific sectors up to 90% of projects involve subcontracting (Mudzvokorwa et al., 2020). In South Africa, around 70% of building and 30% of civil construction project works are performed through subcontracting (CIDB, 2013) while in Nigeria, a minimum of 70% of the projects rely on subcontracting (Okunlola, 2015)

Subcontracting (SC) enhances project performance if properly managed (RICS, 2021). On the contrary, poor SC has been identified as a potential risk for project performance. Previous studies have identified poor SC as one of the reasons for project delays and cost overruns (Al Daoor et al., 2020). Olanrewaju et al. (2022) also underscored poor SC as one of the reasons for poor quality, delay, and project disputes. The subcontracting supply chain has been highlighted as problematic because of antagonistic relationships between the main contractor and subcontractor, poor communication, blame culture, a lack of focus on serving the ultimate end user, and other reasons (Rompoti et al., 2020) These factors impact project performance and highlight the need for a structured evaluation of subcontracting success factors.

While studies have been conducted on individual SC major activities, including subcontractor selection (Karaman & Sandal, 2022); the contractor-subcontractor relationships (Tan et al., 2017); conflicts and disputes in SC (Magazi & Kikwasi, 2022); payment issues (Al Daoor et al., 2020), and others. There is a knowledge gap regarding the key drivers of successful operations management in construction subcontracting. This study aims to bridge this gap by systematically identifying and ranking these key drivers to enhance subcontracting performance and project success. The findings will offer valuable insights for construction industry stakeholders to optimize subcontracting operations, enhance project performance, and minimize risks associated with poor subcontracting operations. The article is structured into six sections: Section 2 presents the literature review, Section 3 outlines the research methodology, Section 4 provides the data analysis and results, Section 5 discusses the findings, and Section 6 presents the conclusions and recommendations.

## LITERATURE REVIEW

The construction industry is characterized by complexity and time-constrained projects. High complexity, uniqueness of activities, and the number of required technologies urged construction firms to consider outsourcing strategies, including SC (Fridkin & Kordova, 2022). Subcontracting (SC) is a well-established practice in the construction industry (Daoor et al., 2020). It is subletting the obligations of the main contractor stipulated in a separate main contract with the project owner. In some cases, a project owner directly nominates the subcontractor to carry out part of the main contract works (RICS, 2021).

The main contractor can lower its operational costs and improve competitiveness with SC. Subcontracting (SC) is also an efficient and economical means of accessing resources (Al Daoor et al., 2020) Subcontracting (SC) is invaluable for construction projects as it allows specialization and creates market access to local subcontractors. Due to the mentioned and other benefits of SC, the reliance of the construction industry on SC has increased (Magazi & Kikwasi, 2022). However, rather than contributing to better project performance, SC could exacerbate project outcomes (Koshe & Jha, 2016) According to Osama, El & Wefki (2023), one of the primary reasons for the delay of construction projects is poor SC performance. If SC is not managed properly, it could result in project cost overrun and poor quality of work.

Construction project owners demand that their projects be delivered on time, on budget, free from defects, right the first time, and safely by the construction firms involved (Mbachu et al., 2022).

The success of construction projects largely relies on subcontractor performance, as main contractors depend on them to carry out a significant portion of the work. However, it is not only the subcontractor who is the responsible party for SC performance. The other major project stakeholders, including the contractor and project owner, also contribute their share to the success or failure of SC in a project (Chamara et al., 2015)

Contracting is widespread in construction project management (Schaufelberger & Holm, 2017) The execution of construction projects involves contracting (to formally hire) an external organization. This external organization itself might involve other different organizations allied by numerous contractual agreements. Initially, the project user or owner contracts with the main contractor are sometimes mentioned as the systems development organization (SDO) responsible for the overall project.

In turn, the main contractor enters contracts with secondary parties—such as subcontractors, consultants, material suppliers, and to carry out specific portions of a construction project. These secondary parties, in turn, may establish contracts with tertiary parties, further extending the subcontracting network (Schaufelberger & Holm, 2017) The main contractor is hired by the project user or owner to manage the overall construction project. From a market point of view, where the contractor operates primarily as the buyer, it is responsible for buying materials, equipment, and services necessary for project execution. This position entails evaluating the state of the market, negotiating contracts with suppliers, and making sure the products and services acquired adhere to project requirements, quality standards, and financial limitations (Nwaguru et al., 2022). Project budgets, schedules, and success are all impacted by the contractor's capacity to handle procurement.

Conversely, from an engineering- contract perspective, the contractor assumes the role of the seller. In this case, it will be accountable for delivering specified services, products, or completed projects to the project owner or client (Plessis & Oosthuizen, 2019). This includes adhering to regulatory requirements, contractual agreements, and industry standards throughout the project lifecycle. Subcontracting (SC) makes it possible to handle market uncertainties in the construction industry and to transfer risks, including completion and financial risks. It lowers direct costs as well as overhead, enabling the main contractor to work with firms that have reduced overhead and a better understanding of the market dynamics, practices, and processes (Al Daoor et al., 2020) Additionally, SC makes it easier to complete high-quality work, utilizing specialized subcontractors who possess the required expertise in particular trades. The non-adoption of SC could request a great amount of manpower and equipment that would be, at some moment, sub-used (CIDB, 2013)

Operations management in subcontracting plays a crucial role in ensuring project efficiency, cost-effectiveness, and quality outcomes. It involves coordinating resources, schedules, and stakeholder relationships to optimize subcontractor performance. Effective management enhances workflow continuity, minimizes disputes, and fosters collaboration between contractors and subcontractors (Magazi & Kikwasi, 2022; Tan et al., 2017).

Previous studies have identified a range of factors influencing subcontracting operations. Specifically, the effectiveness of construction subcontracting work is shaped by subcontractor-related factors (Ali et al., 2024), subcontractor-contractor interactions (Debelo & Weldegebriel, 2022), and contractor-related factors (RICS, 2021). Regarding the methodology, Ali et al. (2024) first utilized BIM to identify subcontractors' estimation errors and cost deviations. Then, using data from 234 projects, they applied machine learning algorithms (logistic regression, decision tree, and Naive Bayes) to predict subcontractor failure. Debelo and Weldegebriel (2022) used a mixed research design, survey, and interviews to explore and rank the subcontractor-contractor interaction factors affecting subcontracting performance. This study seeks to systematically identify and rank the key drivers within these three categories that impact the operations of subcontracting works.

## RESEARCH METHODOLOGY

In this study, a sequential mixed research design was employed, beginning with a Systematic Literature Review (SLR) to identify and synthesize existing research on the key drivers of successful operations management in construction subcontracting. The SLR focused on peer-reviewed articles and conference proceedings to explore different drivers of successful

operations management. A questionnaire was then developed to rank the key drivers, filled by purposefully selected twenty-one experts in the Ethiopian construction industry. AHP is used to assign weights to items and then rank them based on these weights (Saaty, 1990).

## Systematic Literature Review /SLR/

A systematic literature review (SLR) was initially adopted to examine the existing scholarly publications on the key drivers of successful operations management in construction SC. SLR involves a comprehensive, transparent, scientific, and replicable search of relevant studies on the subject of study (Masè, 2020; Saunders et al., 2016).

To conduct the SLR, the researcher adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 (Matthew et al., 2021). The data were acquired from Scopus, Web of Science, and ProQuest databases. The query strings and keywords used for the search were: ("subcontracting") and ("construction"). On the exclusion criteria, the authors discarded duplicate articles and articles written in other than English language. Book reviews and book chapters were excluded. Prior studies on engineering; business, management, and accounting; social sciences; environmental science; architecture, operations resource management; economics, econometrics and finance; construction business technology; science technology; and multidisciplinary studies were incorporated. Studies conducted from 2000-2024 were included. Figure 1 illustrates the procedures followed for the screening and selection of articles.

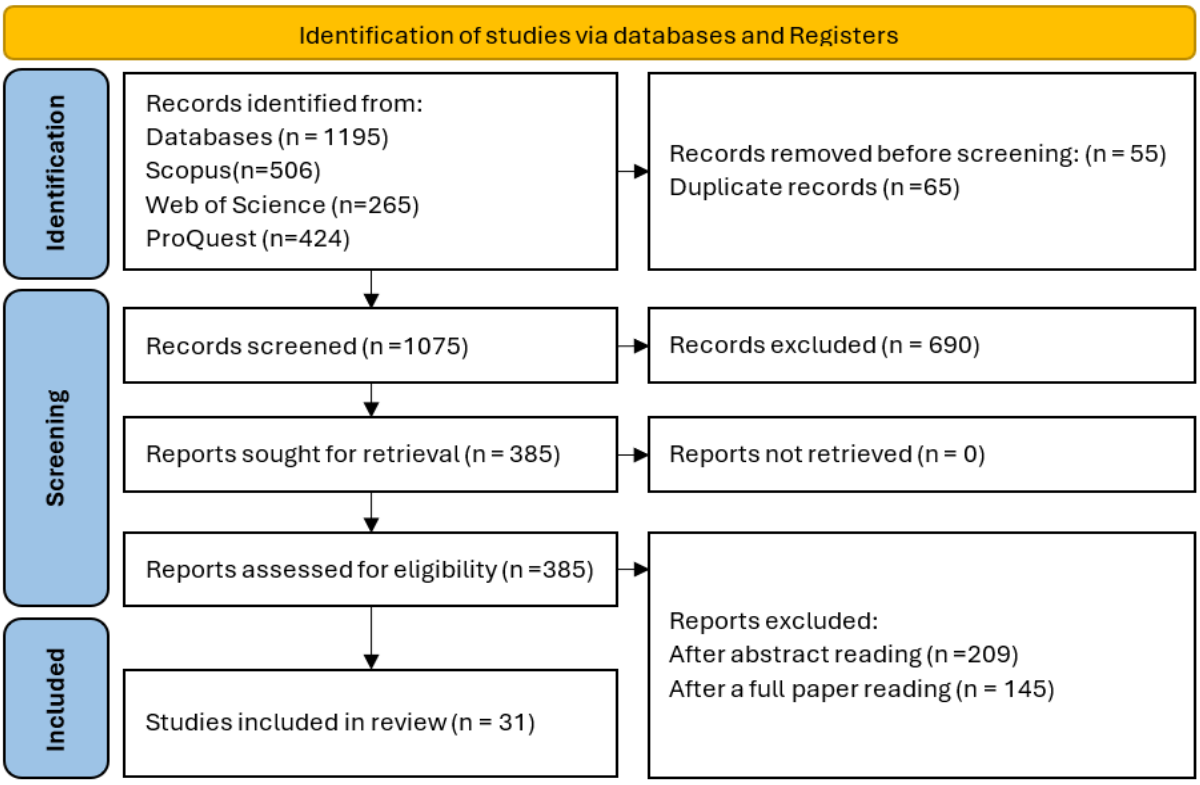


**Figure 1: PRISMA 2020 flow diagram for identification of studies for synthesis**

The 31 publications that had been screened were then examined to see what had been studied about the key drivers of effective operations management in construction subcontracting.

## Analytic Hierarchy Process/AHP/

Analytical Hierarchy Process (AHP) was utilized to understand the relative importance that construction industry experts ascribe to various drivers that influence operations management of construction subcontracting works. The AHP process essentially comprises developing a pairwise comparison matrix, normalizing, and obtaining the corresponding rating by averaging each row. Consistency ratio is calculated to determine the coherence of judgments (Saaty, 1990).

The Analytical Hierarchy Process (AHP) enables solving a complex decision problem by decomposing it into different criteria in a hierarchical structure (Gudienė et al., 2014; Taherdoost, 2017). It is based on a relative pairwise comparison matrix to prioritize criteria in a certain decision-making situation. AHP has several advantages when compared with other multi-criteria decision techniques. These include: the technique is not complicated because it is easier to compare the criteria in pairs than all at a time. It is also a mathematically grounded and straightforward approach (Hubbard et al., 2010; Podvezko & Sivilevičius, 2013).

The questionnaire was designed to facilitate pairwise comparisons, allowing respondents to systematically evaluate the relative significance of each driver. The process followed these steps: Pairwise Comparisons – Drivers were evaluated against each other using Saaty's fundamental scale of relative importance, which ranges from 1 (equal importance) to 9 (extremely more important), 1,3,5,7, and 9. Reciprocal values (1/3, 1/5, 1/7, 1/9) were used to indicate the inverse level of importance when one driver was considered less significant than another.

## RESULTS

### Phase I - Systematic Literature Review /SLR/

The thematic analysis of the screened articles was done using ATLAS.ti25 software to explore the drivers of successful operations management in construction SC. For the analysis using ATLAS.ti25, different codes were initially generated from the quotations extracted from the screened articles. Subsequently, meaningful code groups and categories that are associated with the drivers of successful operations management in construction SC were established. The identified drivers were grouped into three categories: Contractor-related; Subcontractor-related; and Contractor-Subcontractor collaboration. Table 1 is a summary of the identified drivers of successful operations management in SC with the corresponding reference authors.

**Table 1: Drivers of successful operations management in construction subcontracting**

| No | Driver | Authors |
|---|---|---|
| **1** | **Contractor-Subcontractor Collaboration** | |
| | 1.1 Mutual Trust and Fairness | (Kadan et al., 2024; Omotayo et al., 2022; White & Marasini, 2014; Wu et al., 2023; Zhang et al., 2016) |
| | 1.2 Long-term Partnership | (Cao & Wang, 2014; Eom et al., 2015; Lee et al., 2009; Omotayo et al., 2022) |
| | 1.3 Power Symmetry/Balance | (Deep et al., 2022; Wu et al., 2023) |

| | | |
|---|---|---|
| | 1.4 Effective Communication | (Eom et al., 2015; Fridkin & Kordova, 2022; Lew et al., 2020) |
| | 1.5 Lean Construction Practice | (Eom et al., 2015; Kadan et al., 2024; Maturana et al., 2007; Yin et al., 2014) |
| **2** | **Subcontractor-Related Drivers** | |
| | 2.1 Adherence to Quality Standards and Specifications | (Fridkin & Kordova, 2022; White & Marasini, 2014)(Lew et al., 2012; (Ng & Tang, 2010) |
| | 2.2 Availing Manpower and Other Resources | (Eom et al., 2015; Lew et al., 2020; Yin et al., 2014) |
| | 2.3 Meeting Milestones/Execution Capability/ | (Maturana et al., 2007; Shi et al., 2022) |
| **3** | **Contractor-Related Drivers** | |
| | 3.1 Coordination of Subcontractors | (Lee et al., 2009; Tan et al., 2017; White & Marasini, 2014) |
| | 3.2 Planning and Budgeting | (Fridkin & Kordova, 2022; Yin et al., 2014) |
| | 3.3 Timely Payments | (Lew et al., 2020; Rostiyanti et al., 2020; Youssef et al., 2023) |

**Source:** ATLAS.ti25 Code-Document Analysis Output

## Phase II - Analytic Hierarchy Process /AHP/

In phase II, expert opinions were gathered through surveys, and pairwise comparisons were used to assess the relative importance of each driver. The AHP model calculates the weights for each factor, allowing for a ranking of the drivers, with the results providing actionable recommendations to enhance operations management of subcontracting. A structured questionnaire was designed to gather empirical data through pairwise comparisons of the eleven drivers identified in the SLR. The questionnaire was distributed to twenty-one expert panelists with substantial experience in the Ethiopian construction industry, particularly in subcontracting. The educational and professional profile of expert panelists is illustrated in Table 2.

**Table 2: Educational and Professional Profile of Expert Panelists**

| Respondent ID | Education Level | Field of Study | Years of Experience | Role in the Construction Industry |
|---|---|---|---|---|
| R1 | MSc | Construction Management | 17 | Senior Project Director |
| R2 | MSc | Civil Engineering | 14 | Contract Administrator |
| R3 | MBA | Project Management | 13 | Operations Manager |
| R4 | BSc | Civil Engineering | 14 | construction supervisor |
| R5 | PhD | Construction Management | 24 | Academic & Industry Consultant |
| R6 | MSc | Structural Engineering | 19 | Senior Site Engineer |
| R7 | BSc | Construction Management | 21 | Project Coordinator |
| R8 | MSc | Civil Engineering | 12 | Quality Assurance Manager |
| R9 | MSc | Construction Management | 15 | Senior Cost Engineer |

| | | | | |
|---|---|---|---|---|
| R10 | MSc | Project Management | 15 | Project Director |
| R11 | BSc | Construction Technology | 24 | Procurement Manager |
| R12 | MSc | Construction Management | 15 | Academic & Industry Consultant |
| R13 | MSc | Civil Engineering | 20 | Construction Manager |
| R14 | BSc | Structural Engineering | 12 | Site Supervisor |
| R15 | MSc | Project Management | 19 | Operations Manager |
| R16 | BSc | Construction Management | 21 | Contract Specialist |
| R17 | MSc | Civil Engineering | 15 | Senior Consultant |
| R18 | MSc | Construction Technology | 18 | Quality Control Manager |
| R19 | BSc | Civil Engineering | 12 | Project Engineer |
| R20 | MSc | Construction Management | 20 | Cost Control Manager |
| R21 | PhD | Construction Management | 18 | Academic & Senior Consultant |

The Analytical Hierarchy Process (AHP) was utilized to prioritize the key drivers influencing operations management of subcontracting works. AHP involves a structured methodology for decision-making based on pairwise comparisons, enabling the relative importance of multiple criteria to be quantified. The process followed these steps: Pairwise Comparisons: Drivers were evaluated against each other based on Saaty's fundamental scale of relative importance, ranging from 1 (equal importance) to 9 (extremely more important); Matrix Normalization: The pairwise comparison matrix was normalized to calculate the relative weights of each driver by averaging across rows; Eigenvector Calculations: Eigenvalues and eigenvectors were computed to derive the priority weights for each drivers; and Consistency Check: The Consistency Index (CI) and Consistency Ratio (CR) were calculated to ensure reliable judgments.

$$CI = \frac{\lambda_{max} - \mathrm{n}}{\mathrm{n} - 1}$$

The pairwise comparisons were deemed consistent with a CR of 0.09, which is below 0.1. The results provided weights to rank the eleven drivers, reflecting their significance in achieving operational excellence in subcontract works. This method ensures that subjective judgments are structured, reducing biases and improving decision-making quality. The drivers and their AHP weights were ranked as illustrated in Table 3.

**Table 3: AHP rankings and weights for the drivers of operational excellence in subcontracting**

| Rank | Driver | Category | AHP Weight |
|---|---|---|---|
| 4 | Adherence to quality standards | Subcontractor-Related | 0.085 |
| 6 | Long-term Partnership | Contractor-Subcontractor | 0.076 |
| 5 | Power Symmetry/Balance | Contractor-Subcontractor | 0.080 |
| 7 | Effective Communication | Contractor-Subcontractor | 0.065 |
| 9 | Lean Construction Practice | Contractor-Subcontractor | 0.039 |
| 10 | Coordination of Subcontractors | Contractor-Related | 0.028 |
| 11 | Planning and Budgeting | Contractor-Related | 0.027 |
| 1 | Timely Payments | Contractor-Related | 0.225 |
| 2 | Mutual Trust and Fairness | Contractor-Subcontractor | 0.150 |

| | | | |
|---|---|---|---|
| 8 | Availing Manpower and Other Resources | Subcontractor | 0.047 |
| 3 | Execution Capability of Subcontractors | Subcontractor | 0.177 |

Timely Payments (AHP=0.225) emerged as the most critical driver. Its dominance underscores the central role of financial reliability in maintaining workflow continuity, minimizing disputes, and supporting subcontractor performance. Execution Capability of Subcontractors (AHP=0.177) and Mutual Trust and Fairness (AHP=0.150), ranked second and third respectively, emphasize the importance of a collaborative project environment. Trust reduces conflicts, while effective communication fosters clarity and alignment among project stakeholders. The results offer valuable insights into the dynamics of subcontracting works, providing a practical framework for stakeholders to prioritize and address critical drivers of operations management in subcontracting works.

## DISCUSSIONS

The success of subcontracting operations largely depends on contractor-subcontractor collaboration, contractor-related drivers, and subcontractor-related drivers, which significantly influence project efficiency and performance. A key factor in collaboration is mutual trust and fairness, which minimizes conflicts and fosters a cooperative environment (Wu et al., 2023; Kadan et al., 2024). When subcontractors perceive fairness in reward distribution, decision-making, and interactions, they are more likely to engage positively, strengthening long-term partnerships that improve project outcomes (Omotayo et al., 2022). Furthermore, balancing power dynamics between contractors and subcontractors ensures open communication and resource sharing, preventing conflicts and enhancing decision-making (Deep et al., 2022).

Contractor-related drivers, particularly the coordination of subcontractors, play a vital role in optimizing resource allocation and minimizing delays. Efficient planning and budgeting help subcontractors integrate their work within the broader project scope, reducing cost overruns and ensuring smooth execution (Lew et al., 2020; Yin et al., 2014). Additionally, timely payments by contractors are critical for maintaining subcontractor financial stability and operational efficiency, as payment delays often lead to disputes and project disruptions (Rostiyanti et al., 2020; Youssef et al., 2023).

On the subcontractor side, adherence to quality standards and execution capability are fundamental to achieving project milestones. A structured appraisal system for evaluating subcontractor performance based on workmanship, safety, and resource management can enhance overall project quality (Fridkin & Kordova, 2022; White & Marasini, 2014). Moreover, subcontractors must ensure they have adequate manpower and resources to meet project demands, which requires proactive planning and coordination with contractors (Eom et al., 2015; Lew et al., 2020). Execution capability, encompassing technical expertise and operational efficiency, is crucial for maintaining workflow continuity and mitigating risks of cost overruns and delays (Shi et al., 2022).

## CONCLUSIONS

Using a sequential Systematic Literature Review (SLR)-Analytical Hierarchy Process (AHP) methodology, this study identified and prioritized the critical drivers of effective operations management in construction subcontracting. The SLR provided a thorough basis for analysis by methodically extracting important drivers from the body of current literature.

Based on expert opinions, the AHP approach then facilitated a structured decision-making process to evaluate the relative rankings of these drivers. The empirical findings highlighted 'Timely Payment by the Contractor'; 'Execution Capability of Subcontractors'; and 'Mutual Trust and Fairness' as the top three critical drivers that could enhance the operational management of construction subcontracting works.

The findings provided valuable insights for contractors, subcontractors, project owners, consultants, and other stakeholders to understand their gaps and design and implement corresponding strategies to boost project operational performances. The study also contributed to the existing body of knowledge on construction subcontracting, where operational challenges are more pronounced.

Future research could explore the applicability of these drivers across different project types, regions, and technological advancements, as well as examine how digital tools like PMIS and BIM can enhance subcontracting operations. Additionally, studies could investigate how evolving subcontractor selection criteria, payment structures, and contractor-subcontractor relationships impact the effectiveness of subcontracting operations management.

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