

## RESEARCH ARTICLE

# Fostering transparency: Improvement of contractor selection criteria and practices

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**ABSTRACT** - Most plant maintenance projects (PMP) in chemical manufacturing companies worldwide rarely meet expectations or achieve their objectives. More than 80% of these projects face cost and time overruns. A key contributing factor is poor decision-making in contractor selection (CS) during the contractual phase of the project life cycle. It is therefore critical to select contractors with proven capability to deliver high-quality services in order to achieve better project outcomes. The objective of this paper is to identify the major contractor performance issues that contribute to project delays in PMP and to propose a framework for CS that can enhance project outcomes in chemical manufacturing companies. Contractor underperformance highlights the need for clear and acceptable selection standards during CS activities. This paper addresses existing deficiencies in contractor evaluation by identifying key performance areas and proposing improved methods for selecting contractors who can reduce long-term risks of delays and inefficiencies. Organisations can benefit from this framework by improving service delivery, promoting good governance, and demonstrating how transparency and accountability reduce corruption while ensuring projects achieve their intended outcomes. Effective CS also strengthens compliance with laws, rules, and regulations while enabling risk management that supports efficient operations and maximises business value.

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## 1. INTRODUCTION

Past research indicates that a high percentage of plant maintenance projects (PMPs) in chemical manufacturing companies worldwide perform poorly and fail to achieve their planned goals (Nikmatul et al., 2023). Many of these projects suffer cost and time overruns, with about 80% completed either ahead of schedule, on schedule, or behind schedule (Fertilizer Industrial Service Ltd., 2018). For example, contractor-related performance in PMP in Indonesia was unsatisfactory in firms such as Pupuk Kaltim Chemical Manufacturing Company during 2018 to 2020 (Wahyudhi, 2021). Another study identified delays of more than 20 months in a project, showing that in many cases, only a limited number of contractors were sufficiently qualified to handle large projects. This led to financial losses of several hundred thousand US dollars (Behboud et al., 2023). Similar problems have also been reported in Malaysian chemical manufacturing projects (Omran et al., 2023).

A review of previous studies shows that contractor performance is a leading cause of poor project outcomes (Tafesse, 2021; Yap et al., 2021). Selecting an appropriate contractor who can provide quality work for different projects is therefore crucial (Tafesse, 2021; Yap et al., 2021). This represents a necessary change that the industry must embrace in order to overcome its current challenges and become more efficient and competitive. Despite the importance of contractor selection (CS), limited efforts have been made to address this issue in PMP, particularly within the Malaysian chemical manufacturing sector (Tong et al., 2019; Khoso et al., 2021). Enhancing selection parameters can be beneficial since current practices rarely account for contractor vulnerabilities (Bohari et al., 2021). Many organisations continue to award contracts to the lowest bidder, but such an approach has frequently resulted in delays and poor project performance (Shehu, 2014; Bohari et al., 2021).

This paper develops a framework to enhance the CS decision-making process to improve performance in chemical manufacturing firms. Using the theory of constraints (TOC), the framework aims to establish and manage the main constraints of PMP, thereby reducing project delays through improved CS. Specifically, this study seeks to identify potential constraints in CS processes that have historically affected PMP, investigate which criteria have caused project delays, analyse the most critical constraining activities and their characteristics, and propose a set of criteria to manage these constraints and promote organisational improvement. The CS decision-making process is also important in governmental structures, which are known for emphasising accountability, transparency, and effectiveness in procurement governance (Marovic et al., 2021). These processes are guided by standardised and ethical regulations that reduce the risk of corruption and bias, thereby strengthening stakeholder confidence (Marovic et al., 2021). When CS is properly implemented, positive outcomes can enhance project performance and increase productivity by aligning with project goals. This research therefore establishes that effective procurement should be credible, efficient, accountable,

and sustainable, ensuring transparency, compliance, quality, performance, and risk management for improved project delivery and organisational portfolio management.

## 2. LITERATURE REVIEW

### 2.1 Theory of Constraints Application for Contractor Selection

The TOC is a management philosophy introduced by Eliyahu M. Goldratt. It states that every system, particularly a business or organisation, has a limited number of constraints that restrict its ability to achieve goals (Trojanowska and Dostatni, 2017). The concept is based on the principle that a chain is only as strong as its weakest link. Therefore, management must identify the weakest link, ensure improvements are made, and focus resources on strengthening this constraint to improve overall system performance. TOC emphasises that the total output of a system cannot be increased simply by managing each component independently. Instead, improvement is possible if the organisation identifies and manages its primary constraint, which in turn enhances throughput (Rahadi et al., 2021).

In this case, a constraint may appear as contractor performance problems that lead to delays and cost overruns. Applying TOC enables organisations to identify these issues, determine the most critical criteria for evaluation, and design plans to minimise them (Sayankar, 2015). The approach usually follows a five-step process: identify the constraint, exploit the constraint, subordinate all other processes to the constraint, elevate the constraint, and finally, return to the first step once the constraint has been removed. A new constraint will always emerge, and continuous improvement requires the repeated application of these steps. This cycle allows organisations to consistently move the system closer to its goals (Rahadi et al., 2021).

Applying TOC to CS requires continuous assessment and improvement of contractor selection practices. Feedback on project performance allows organisations to update and refine CS criteria to achieve better outcomes. Through this process, organisations improve their decision-making and maintain competitiveness. A key principle of TOC in CS is to view constraints not as obstacles but as opportunities for improvement (Sayankar, 2015). In this way, TOC provides a structured method for enhancing CS in chemical manufacturing companies. By applying TOC, companies can identify problems, propose appropriate criteria for better CS, and transform challenges into opportunities for long-term improvement (Rahadi et al., 2021; Sayankar, 2015).

### 2.2 The Impact of Contractor Selection on Governance

CS is a key instrument in governance, advancing transparency, accountability, and efficiency in procurement processes (Walraven et al., 2009). In several ways, CS contributes to maintaining governance structures (Marovic et al., 2021). Once clear and accessible selection criteria are defined, the probability of nepotism, favouritism, and corruption seeping into the organisation is reduced (Akuffo & Kivipold, 2020). Transparent CS also ensures that companies are held to account, as they must provide clear justification for how contractors are awarded projects. This, in turn, fosters trust and fairness among stakeholders (Wahab & Shavarebi, 2021). Furthermore, CS helps ensure that procurement actions comply with legal and ethical requirements (Sarava & Mas'ud, 2020). Organisations can strengthen governance mechanisms by aligning selection criteria with both regulatory standards and industry best practices (Xie et al., 2020). Forecasting potential legal issues and preparing appropriate responses protects organisations from negative consequences and promotes a corporate culture of honesty and integrity (Xie et al., 2020).

In addition, organisations should emphasise contractor expertise and past performance, as these factors improve project quality and outcomes (Ahadi et al., 2017). Contractors with proven capacity can also support human resource optimisation and strategic alignment, enabling successful projects based on evidence from secondary data (Nguyen & Watanabe, 2017). The focus should extend beyond marketing and bidding to include a systematic approach that promotes high product quality and consistent maintenance performance, contributing to departmental objectives and project success (Walraven & De Vries, 2009). In conclusion, by enhancing transparency, complying with legal and regulatory requirements, ensuring quality, improving project performance, and mitigating risks, these outcomes can be achieved through meticulous CS practices in governance. Organisations that adopt best practices in CS not only increase project success but also establish a culture of integrity, accountability, and efficiency within their governance framework.

### 2.3 Role of Contractor Selection Criteria in Project Success

Hiring a contractor is an essential part of project management (Chen et al., 2021). Effective CS paves the way for timely and cost-effective project completion (Kog & Yaman, 2016). Contractors must be assessed carefully, as inappropriate selection can lead to rework, delays, extra costs, and team conflicts (Marzouk et al., 2013). The process typically begins with inviting bidders who are evaluated using pre-defined criteria (Fong and Choi, 2000). These criteria often include the contractor's resources, financial stability, and experience, all of which are critical for project success (Watt et al., 2010). Resources are significant for successful project implementation. Many researchers also highlight the importance of contractor experience. For example, Gimhan et al. (2019) reported a link between contractor experience and the successful completion of projects within time and cost limits. Similarly, Hoseinpoor and Alborzi (2019) found a correlation between contractor experience and project success, noting that experienced contractors are more likely to complete projects successfully.

Technical skills are another important factor. Polat et al. (2017) found that contractors with high technical competence are more likely to win tenders. Likewise, Osati and Omidvari (2016) showed that such contractors are more capable of completing projects within time and budget. Financial stability also plays a crucial role. Radziszewska and Zielina (2015) reported that financially stable contractors are more likely to be selected and to complete projects successfully. Rahimi et al. (2017) confirmed that timely completion is achievable only for contractors with a financial position strong enough to sustain budgets throughout the project.

Managerial ability is also vital. Sawalhi and Hajar (2016) observed that contractors with good management skills are more likely to win contracts, while Effendi et al. (2019) found that they adhere more closely to budgets and timelines. Reputation is another significant factor. Shahvand et al. (2016) noted that contractors with a positive reputation are more frequently awarded contracts. Similarly, Asfath and Sebastian (2016) reported that such contractors usually complete projects within budget and time constraints. Although researchers have used different criteria, common themes emerge across studies. Some criteria, such as experience, financial stability, and technical skills, are widely accepted, while others vary depending on the type of project or its context. A thorough understanding of these criteria enables better decision-making and increases the likelihood of successful project outcomes. Therefore, this study recognises that while selection criteria may vary among scholars, notable similarities exist that can guide project success.

#### 2.4 Limitations of Previous Studies on Contractor Selection Criteria

The analysis of past research shows that the criteria used for CS have both strengths and weaknesses. Addressing these weaknesses is necessary to improve the selection process. For example, many researchers did not break down the criteria into sub-criteria to evaluate contractors in detail. Studies such as those by Abbasianjahromi et al. (2016), Effendi (2019), Gharedaghi and Omidvari (2017), Cheaitou et al. (2018), Ahadi et al. (2017), Hoseinpoor and Alborzi (2019), Ibadov (2015), Krzeminski (2015), Araujo et al. (2015), Osati and Omidvari (2016), Radziszewska and Zielina (2015), and Sharma and Batra (2016) omitted sub-criteria. This omission is important, since sub-criteria allow for more comprehensive and accurate evaluation.

Another limitation lies in the use of vague or impractical criteria, which makes it challenging to gather accurate information from contractors. Examples include criteria such as future workload and past failure history, as seen in studies by Alhumaidi (2015), Ighravwe and Oke (2019), and Polat and Bingol (2017). Similarly, the criterion "time requirement from the contractor" is not practical because the client should always determine the project completion time. A further weakness is that some studies relied on only one or a few criteria to evaluate contractors. Examples include the works of Effendi (2019), Bintoro et al. (2017), Cheaitou et al. (2018), Gharedaghi and Omidvari (2017), Hadidi and Khater (2015), Hajek et al. (2017), Heravi et al. (2016), Ighravwe and Oke (2019), Rahimi et al. (2017), Sawalhi and Hajar (2016), Trinkuniene et al. (2017), Yazdani et al. (2019), and Krzeminski (2015). Using a single or limited number of criteria is inadequate, as important factors may be overlooked and project needs may not be met.

Finally, many studies did not apply their criteria to real-world data to test effectiveness (Blonde et al., 2018). Instead, they relied mainly on theories and expert opinions without empirical validation. It is essential to collect and analyse real data to confirm whether the criteria can reliably predict contractor performance (Ajayi and Chinda, 2022). Incorporating real-world data not only improves credibility but also provides more useful guidance for industry professionals (Shahsavand et al., 2018).

#### 2.5 Poor Project Performance Root Causes

The importance of performance factors varies across countries. For example, a study on Moroccan projects by Bajjou and Chafi (2018) found that inadequate contractor training, late payments, dependence on subcontractors, mismanagement, and rework requirements were significant causes of delays and cost overruns. In a broader analysis, Anibire et al. (2020) identified common issues such as a lack of funds among contractors, shortages of construction materials, errors caused by personnel incompetence, low numbers of skilled labourers, conflicts among builders, poor site control, weak management teams, and equipment problems. Durdyev and Hosseini (2018), who reviewed studies from ten countries, reported that distorted communication channels, insufficient planning skills, shortages of materials, financial instability, inexperienced workforces, limited labour availability and ineffective site management practices were among the leading causes of delays in construction projects. Lowest bid acceptance was also identified as a significant contributor to project delays. For example, Aljamee et al. (2019) found in Iraq that awarding projects based on the lowest bid often led to financial difficulties, poor management, material shortages, late deliveries, lack of personnel, inexperienced contractors, and communication problems. In the Arabian Gulf, Mahdi and Soliman (2018) reported that unqualified staff recruitment was the leading cause of delays, with other factors including poor planning, weak management, contract disputes, and financial problems.

In Malaysia, Sambasivan and Soon (2007) and Yap et al. (2021) identified poor planning, weak site management, lack of experience, financial problems, subcontracting issues, shortages of trained labour, communication breakdowns, and inadequate quality control as causes of project delays. Despite the 14-year time gap between these two studies, the findings were strikingly similar, suggesting that these issues remain persistent. While specific challenges vary between countries, contractor-related errors appear to be a common factor across the globe. Comparisons of international delays with those in Malaysia reveal both shared and unique difficulties. For industry practitioners seeking to improve project timelines, these findings provide valuable insights into the root causes of delays.

Table 1 summarises the major contractor-related factors linked to poor project performance. Out of 135 issues identified by the previous researchers, ten key causes emerged as the most influential. These include shortages of equipment and materials, financial problems, poor planning and scheduling, lack of experience, weak site management, workforce shortages, unskilled labour, communication problems, subcontractor issues, and inadequate work quality. A thorough understanding of these issues is essential. Establishing a strong framework of selection criteria to evaluate contractor performance against these challenges can help improve project outcomes.

Table 1. Major contractor performance issues

Contractor's Main Issue in Project Event
<ul style="list-style-type: none"> <li>• Equipment and Material Shortages</li> <li>• Financial Problems</li> <li>• Poor Planning and Scheduling</li> <li>• Lack of Experience</li> <li>• Poor Site Management</li> <li>• Workforce Shortages</li> <li>• Unskilled Workforce</li> <li>• Communication Problems</li> <li>• Sub-Contractor Issues</li> <li>• Poor Work Quality</li> </ul>

### 2.5.1 Equipment and material shortages

Lack of critical materials and equipment impairs contractor performance (Effendi, 2019). Insufficient availability often causes delays or compromises quality (Osmani & Young, 2013). Effendi (2019) emphasised that evaluating the challenges contractors face in procuring necessary resources is essential. Assessing a contractor's ability to establish good relationships with suppliers can improve access to materials and equipment (Salehi, 2022). Similarly, the ability to apply alternative sourcing strategies can reduce the risks of shortages. Incorporating these considerations into CS makes projects more resilient, minimises disruptions, and improves the likelihood of successful completion.

### 2.5.2 Financial issues

Financial problems significantly affect contractor performance, influencing resource procurement, workforce management, and the ability to meet deadlines (Delina et al., 2021). Projects are often hampered by insufficient funding and limited budget allocations (Baumeister et al., 2022). These risks can be reduced by evaluating the contractor's financial stability, including cash flow management, financial statements, and credit ratings. Transparency in financial processes ensures accountability in resource allocation (Mazzoleni & Paredi, 2022). Contractors must also retain a skilled workforce despite financial constraints (Luvara & Chileshe, 2022). A competent team is critical for project delivery. Governance processes that emphasise sound financial management and workforce stability reduce risks linked to financial problems and increase the likelihood of successful project completion (Koopman & Cumberlege, 2021).

### 2.5.3 Poor planning and scheduling

Poor planning and scheduling often lead to deficient contractor performance. Mehdawi and Abuzwidah (2020) reported that delays result from timeline underestimation, poor sequencing of tasks, and weak resource allocation. Evaluating contractors' experience with projects of similar scale and complexity is therefore vital. Israel (2022) highlighted that reviewing whether contractors have previously completed projects on time provides insight into their scheduling capacity. Prioritising contractors with strong planning and scheduling records helps reduce risks associated with deficient practices. This ensures effective execution, timely delivery, and alignment with project budgets (Omran et al., 2023).

### 2.5.4 Poor experience

Inadequate contractor experience poses a significant risk to project performance, leading to substandard work and delays (Bajjou & Chafi, 2018). To address this, all aspects of a contractor's experience and capacity should be evaluated (Bajjou & Chafi, 2018). This includes reviewing prior involvement in similar projects to assess familiarity with requirements and challenges. Contractor knowledge, qualifications, certifications, and skills are essential in determining suitability for complex projects. Assessing past projects provides insight into work quality (Ruqaiishi & Bashir, 2015). Additionally, investment in workforce training reflects a contractor's commitment to skill development (Gibran & Ramadani, 2021). By incorporating these factors into CS, governance processes can reduce risks linked to a lack of experience.

### 2.5.5 Poor site management

Ineffective site management and supervision significantly reduce contractor performance and overall project success (Kim et al., 2022). Poor coordination, minimal oversight, and weak supervision can cause errors, rework, and productivity

losses (U-Sayee & Adomako, 2021). Assessing contractors' approaches to site supervision and team management is therefore essential (Manoharan et al., 2023). Evaluating communication and coordination practices can prevent misunderstandings and delays (Omran et al., 2023). It is also important to examine how contractors ensure quality on site and how they manage unforeseen events (Eragamreddy, 2024). By considering these dimensions, CS can ensure improved site management and supervision, leading to higher project outputs.

#### **2.5.6 Workforce shortage**

Shortages of workforce, particularly skilled labour, place contractors under immense pressure and affect project performance (Chen et al., 2023). Such shortages often delay projects and compromise quality. During the CS stage, it is important to evaluate contractors' ability to plan workforce needs (Mahdi & Soliman, 2018). Examining recruitment practices and professional networks provides insight into how effectively contractors attract and retain skilled workers (Khosro et al., 2021). It is also helpful to assess subcontractor networks, labour management practices, and contingency planning for workforce shortages (Aljamee et al., 2019). Incorporating these evaluations into governance processes ensures that contractors are better equipped to manage workforce shortages and deliver projects on schedule.

#### **2.5.7 Unskilled workforce**

An unskilled workforce contributes to poor performance, affecting both project quality and timelines (Bajjou & Chafi, 2018). To address this, several workforce-related factors should be considered during CS. These include evaluating the qualifications, skills, and expertise of workers to ensure capability. A contractor's commitment to workforce training and development reflects their dedication to skill improvement (Jeyseelan & Sathyamurthi, 2023). Reviewing workforce experience in similar projects also provides insight into preparedness (Anibire et al., 2020). Considering these factors during CS helps ensure that contractors maintain a skilled workforce capable of delivering high-quality work efficiently and on time.

#### **2.5.8 Communication issues**

Effective communication is essential for contractor performance and project success. Ruqaishi and Bashir (2015) noted that clear communication prevents misunderstandings and delays. Incorporating communication evaluation into CS can therefore reduce risks (Ruqaishi & Bashir, 2015). This includes assessing contractors' communication channels to ensure smooth information flow among stakeholders, and evaluating documentation methods for clarity (Yap et al., 2021). Understanding how contractors share information internally and externally supports collaboration and teamwork (Yoon and Bozorgi, 2022). Regular meetings and updates also facilitate openness and transparency (Muneer et al., 2022). Conflict resolution mechanisms are equally important. Muneer et al. (2022) emphasised that resolving disputes quickly prevents project delays. Proper record keeping of communications, decisions, and actions further strengthens transparency and accountability (Besson et al., 2023). Including communication assessments in CS helps governance practices ensure that contractors adopt effective communication strategies, thereby improving project outcomes and customer satisfaction.

#### **2.5.9 Sub-contractor issues**

Lack of skilful subcontractors may lead to poor contractor performance, causing delays, inferior work quality, and other coordination problems in projects (Ruqaishi & Bashir, 2015). In the CS process, several subcontractor-related factors must be evaluated to minimise risk. First, subcontractor qualifications must be reviewed to confirm their suitability for the specific skills and expertise required by the project (Kamau et al., 2022). Analysing a contractor's subcontractor network provides insight into access to a reliable and skilled resource pool. It is also important to assess how contractors oversee subcontractors, including their communication and coordination practices, as these are crucial for successful project implementation. Ensuring that subcontractors are matched appropriately to project requirements and standards strengthens the CS process (Kamau et al., 2022). Governance practices that include these evaluations ensure that contractors are supported by dependable and capable subcontractors who can contribute to successful project execution.

#### **2.5.10 Work Quality Issues**

Work quality issues seriously affect contractor performance, often resulting in rework, delays, and higher costs (Unegbu et al., 2020). To address these risks, quality-related factors must be included in CS. Ahadi et al. (2017) stressed the importance of evaluating a contractor's quality assurance and quality control (QA/QC) programme to confirm that rigorous measures are in place. Contractors must also comply with project specifications to achieve the expected quality outcomes (Araujo & Mota, 2016). Reviewing a contractor's project management processes helps determine whether they can consistently maintain quality throughout the project lifecycle (Abbasuanjahromi et al., 2018). In addition, certifications, training, and rework or defect rates provide evidence of a contractor's commitment to quality and continual improvement. Incorporating these quality-based considerations into CS enables governance processes to support contractors in prioritising quality assurance, compliance, and client satisfaction. This leads to higher standards of project delivery and better long-term outcomes.

### **3. METHODOLOGY**

This study involved a thorough extraction and analysis of data from previous research to define the major contractor performance issues that contribute to project delays in PMP within the chemical manufacturing industry. Academic

databases, industry publications, and reports were searched using specific terms such as ‘contractor performance’, ‘project delays’, ‘plant maintenance projects’, and ‘chemical manufacturing’. Collecting information from reliable and credible sources ensured that the researcher obtained a well-informed understanding of the subject area. During data extraction and analysis, emphasis was placed on identifying common characteristics and patterns in contractor performance concerns. This was achieved by synthesising results from earlier studies to highlight the most critical factors associated with delays in PMP. The identified issues are summarised in tabular form in Table 1, which outlines the main problems linked to contractor performance in chemical manufacturing companies. These issues were selected as being the most typical and influential in causing delays.

To refine the analysis of contractor performance issues and participants’ perceptions of delays, the study employed the TOC. The TOC approach was used to explain how the identified issues are interdependent and how they collectively contribute to project delays. Figure 1 illustrates the interrelationships between contractor performance concerns and their impact on project outputs. The framework highlights the three main criteria for evaluating contractors: management, skills and experience, and resources. These criteria are directly related to performance aspects that may act as constraints on projects. For example, under the management criterion, problems identified as potential constraints include poor planning and scheduling, financial issues, site management weaknesses, and communication difficulties. By applying the TOC approach, this study develops a framework to address contractor performance challenges in PMP. The framework provides chemical manufacturing companies with a structured method to identify and manage the most significant constraints affecting their projects. Understanding these limitations enables organisations to design targeted measures for improvement and enhance both contractor performance and project outcomes. For instance, if communication is identified as a limiting factor, companies can prioritise strategies to strengthen communication between the company and contractors. Similarly, if inadequate workforce skills are recognised as a problem, organisations may ensure that contractors engage a sufficiently skilled workforce or encourage additional training to build capacity.

#### 4. RESULTS AND DISCUSSION

This study applied the TOC to investigate major contractor performance issues that contribute to project delays in the PMP in the chemical manufacturing sector. Figure 1 presents the framework that explains the relationship between contractor performance issues and project performance. Referring to Table 1, the findings show at least ten significant constraints that significantly contribute to project delays. Monitoring criteria such as management, skills, experience, and resources, all of which are related to contractor performance, can help improve project outcomes in future PMPs. In Figure 1, the framework highlights that contractor performance issues are closely associated with project achievement. The evaluation focuses on three key areas: management, skills and experiences, and resources. These three criteria encompass the ten main sources of constraints that often lead to project delays. The management criterion is particularly associated with poor planning and scheduling, financial issues, weak site management and supervision, and communication problems. The skills and experience criterion includes inadequate subcontractors, poor work quality, insufficient contractor experience, and an unskilled workforce. Finally, the resources criterion involves shortages of equipment and materials, as well as shortages of labour.

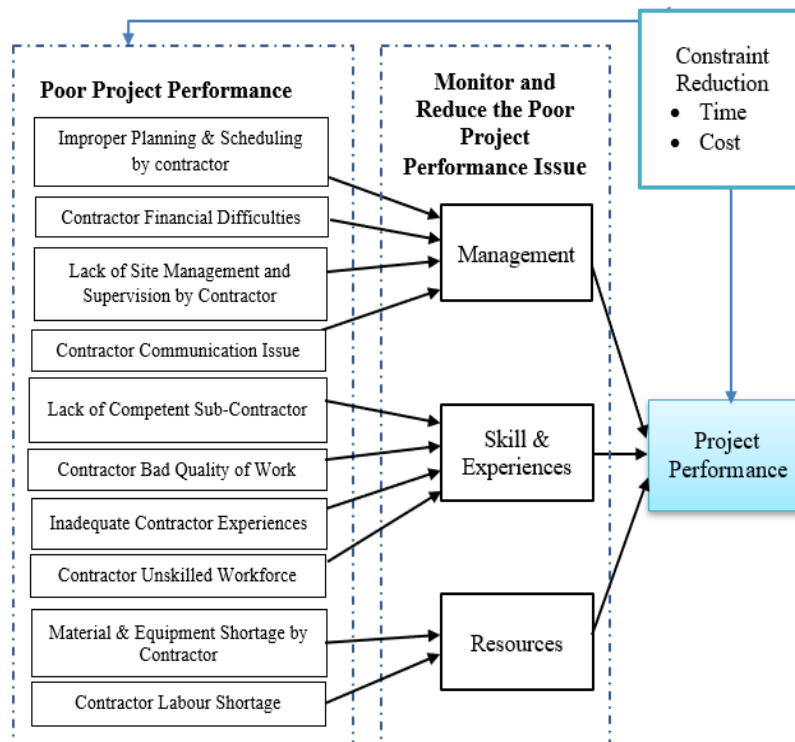


Figure 1. Contractor criteria selection for project improvement

Scope planning refers to the contractor's preparation of a work plan and schedule of activities. A problem in this area results in improper scheduling constraints (Mehdawi & Abuzwidah, 2020). A contractor with strong management skills will have qualified managers who can assess time and resource needs, produce a realistic plan of activities, and allocate funds effectively (Omran et al., 2023). Good planning also involves identifying areas of potential slowdowns or foreseeable delays. In chemical manufacturing, planning and scheduling are especially critical because projects involve multiple processes and hazardous materials (Mehdawi & Abuzwidah, 2020). Financial issues represent another important constraint. This involves the contractor's solvency and ability to manage expenditures after receiving a contract. Financially sound contractors possess adequate capital and are better able to control costs (Delina et al., 2021). Such contractors can also negotiate favourable terms with suppliers and subcontractors (Luvara & Chileshe, 2022). In chemical manufacturing, projects are typically capital-intensive, so sufficient funding is crucial for ensuring timely completion (Koopman & Cumberlege, 2021).

Poor site management and supervision also reduce contractor performance (Kim et al., 2022). Site management involves protecting workers, coordinating subcontractors, managing consignments, and maintaining safety and cleanliness (Kim et al., 2022). Contractors with good site management practices employ experienced site managers who can handle these responsibilities effectively (Eragamreddy, 2024). Communication problems represent another management constraint. Contractors must be able to communicate effectively with project owners, subcontractors, and other stakeholders. This includes providing regular updates, resolving conflicts promptly, and addressing issues as they arise (Yoon & Bozorgi, 2022). Strong management requires established communication channels and a culture of information sharing (Yoon & Bozorgi, 2022).

Subcontractor issues are part of the skills and experience criterion. These constraints involve the contractor's ability to select and manage subcontractors with the required expertise (Kamau et al., 2022). A competent contractor should have a comprehensive subcontractor prequalification process, clearly defined performance expectations, and strong communication and coordination systems (Kamau et al., 2022). In chemical manufacturing, where specialised tasks such as equipment installation are common, subcontractor competence is crucial for ensuring safety and reliability (Kamau et al., 2022). Work quality issues also fall under the skills and experience criterion. Poor quality often results in rework, delays, and additional costs (Unegbu et al., 2020). Contractors with strong quality management systems employ qualified quality control personnel, maintain rigorous QA/QC measures, and show a track record of delivering high-quality work. In chemical manufacturing, quality is directly linked to safety and environmental protection, making it especially critical (Unegbu et al., 2020).

Contractor experience is another key constraint. Experienced contractors are better equipped to anticipate problems, address risks, and formulate solutions (Bajjou & Chafi, 2018). They also benefit from established networks of reliable suppliers and subcontractors. (Bajjou & Chafi, 2018). In industries as complex as chemical manufacturing, experience helps avoid costly mistakes and delays (Gibran & Ramadani, 2021). An unskilled workforce further undermines contractor performance. Skilled labour is essential for specialised tasks in chemical manufacturing (Anibire et al., 2020). Contractors should therefore ensure that workers are trained, certified, and committed to continuous development (Bajjou and Chafi, 2018). Resource constraints include shortages of equipment, materials, and labour. Contractors with sound resource management build strong supplier relationships, maintain efficient procurement procedures, and implement inventory management systems to ensure the timely availability of resources (Salehi, 2022). They also establish backup strategies to deal with shortages. In chemical manufacturing, where projects often require customised materials and equipment, such planning is crucial. Labour shortages can also disrupt projects. Contractors must therefore maintain recruitment and retention systems, develop contingency plans, and build a pool of skilled workers (Chen et al., 2023; Mahdi and Soliman, 2018).

Overall, the framework demonstrates how evaluating contractors based on management, skills, experience, and resources can improve PMP outcomes. Strong management ensures planning, financial control, communication, and site supervision. Skills and experience highlight the importance of technical competence, subcontractor management, quality, and workforce capability. Resources ensure access to equipment, materials, and labour. By adopting this framework, chemical manufacturing companies can systematically evaluate potential contractors, reduce the risk of delays and cost overruns, and improve project outcomes. The framework also provides a basis for targeted strategies, such as requiring performance bonds for contractors with weak financial management or mandating training programmes for unskilled workers. This research contributes to the existing knowledge by exploring CS within PMP in chemical manufacturing organisations. However, several areas remain for future research. First, the proposed framework should be empirically tested through case studies and surveys in real projects. Data collected from firms on their CS processes, contractor performance, and PMP outcomes can help validate and refine the framework. Second, future studies could compare the effects of different CS criteria by assigning scores and applying statistical tests to identify those most correlated with project success. Third, research should expand beyond chemical manufacturing to other industries, such as construction, oil and gas, and pharmaceuticals, which may require different CS criteria due to varying project and regulatory contexts. Fourth, longitudinal studies could evaluate the long-term effects of CS decisions by tracking contractor performance over time. Finally, the use of advanced technologies such as artificial intelligence, big data analytics, and machine learning offers opportunities to improve CS by identifying performance patterns and predicting outcomes more accurately. Through these avenues of research, scholars and practitioners can enhance the CS process, ensuring more effective PMP implementation in chemical manufacturing and other industries.

## 5. CONCLUSIONS

This research provides a framework for CS that can significantly improve the CS process in PMP within the chemical manufacturing sector. The framework incorporates major contractor performance issues and applies appropriate evaluation criteria to address them, guided by the TOC. It rectifies inefficiencies in current contractor evaluation practices and advances the understanding and application of criteria for CS. An important implication of the framework is its contribution to good governance. By promoting transparency, building trust, reducing opportunities for corruption, and ensuring alignment with organisational goals, the framework enhances the likelihood of successful project outcomes. The integrity of this approach fosters accountability and strengthens governance processes. Although developed for the chemical manufacturing industry, the structured method presented here offers a transferable model for other complex industries. The methodological approach examines problems in terms of universal business functions, management, resources, and experience applied through the TOC problem-solving perspective. This enables the identification of bottlenecks within business functions and provides a flexible framework adaptable to other sectors. While the specific constraints may differ depending on the products or services involved, the process of identifying, categorising, and devising solutions remains the same. This makes the framework a systematic model that can be tailored to diverse industrial contexts for improving CS. The study also establishes a foundation for future research. Areas for further work include empirical validation of the framework, comparative studies across industries, longitudinal investigations of contractor performance, and the application of advanced technologies such as artificial intelligence, big data, and machine learning to enhance CS practices. These directions position the framework as a critical step forward in developing more effective project management and procurement strategies.

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## AUTHORS CONTRIBUTION

Muhammad Arman Alias (Writing – original draft, Methodology, Editing)

Fazeeda Mohamad (Formal analysis; Visualisation; Supervision, Data curation; Resources, Revision)

## AVAILABILITY OF DATA AND MATERIALS

The data supporting this study's findings are available on request from the corresponding author.

## ETHICAL STATEMENT

Not applicable.

## CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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