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Internal Factors Affecting Contractors' Performance and the Improvement Mechanisms

Zeleke Tirkaso Shalla[1], Desalegn Girma Mengistu[2*]

[1]PG student, Department of Construction Technology and Management, Hawassa University, Institute of Technology, Email: zetshalla@gmail.com

[2*]Assistant Professor, Department of Construction Technology and Management, Hawassa University, Institute of Technology, **Corresponding author**, Email: m.g.desalegn@hu.edu.et

Abstract

The purpose of this study is to assess the internal factors affecting contractors' performance in construction projects and indicate the potential improvement mechanisms in the context of the Ethiopian construction industry. Quantitative data was collected through a structured questionnaire. While the internal factors were evaluated and prioritized using the analytical hierarchy process (AHP), the improvement mechanisms were evaluated using the technique for order of preference by similarity to the ideal solution (TOPSIS). The findings indicated that the internal factors affecting contractors' performance are cash flow problem, payment delay to subcontractors, poor leadership, understaffing, poor equipment condition, lack of coordination, lack of training, improper planning and scheduling, ineffective communication, and lack of motivation. The identified improvement mechanisms are adopting dynamic management approach, hiring the right people, efficient organization structures, effective incentive mechanism, on time payment, well-established communication system, training, and continuous learning, developing knowledge sharing culture, standardization of working procedures and promoting group work. Identifying and evaluating the internal factors would help to take effective management measures by the top management. Contractors' capacity development is among the agenda of construction industry development in different countries. Hence, identification of the internal factors is important to governments to frame effective intervention strategies.

Keywords: AHP, Ethiopia, construction management, contractors' performance, internal factors, TOPSIS

1. Introduction

Construction industry continues to experience inefficiency and ineffectiveness and lags far behind all other industries in terms of performance (Taylor et al., 2010). Construction industry is a project-based industry where performance of the projects is one indicator of the industry's performance. The responsibility for successful implementation of a construction project depends heavily on the performance of the contractors (Xiao and Proverbs, 2003). Poor organizational level performance is one of the major reasons for poor quality, delayed completion of the projects and cost overrun (Eriksson & Westerberg, 2011). Performance of the construction industry is associated with competitiveness of the stakeholders, and

contractors are the key stakeholders of the industry. Hence, improving the overall performance of the industry needs enhancing the performance of contractors. The performance of contractors is affected by different internal and external factors. The internal factors are controllable by the contractors whereas the external factors are uncontrollable. However, the contractors should continually review the external factors and utilize critical factors to improve their competitiveness (Abraham, 2003). Studies have been conducted to determine factors that affect the performance of contractors in developing countries (Akogbe et al., 2013; Sweis et al., 2014; Hedidor, 2015; Nguyen & Chileshe, 2015 ;Adebisi et al., 2018); the common factors are poor communication, credit inaccessibility, inadequate project management, dearth of skilled workers, lack of subcontractor commitment and procedure. Similarly, in Ethiopia most of the construction projects delivered are not successfully executed in terms of different performance dimensions, and many studies have identified that poor construction management practice is among the factors causing the project performance shortfalls (Haile, 2016; Tagesse, 2017; Sinesilassie et al., 2018). This is associated with poor management practice and lack of the knowledge in handling specific type of projects.

The previous studies focus on the factors affecting contractors' performance without differentiating the internal and external. However, identifying and evaluating the internal factors will help to take effective management measures by the top management. Similarly, it helps to devise appropriate support mechanism by governments to enhance competitiveness of contractors. It is in this light that this study focuses on evaluating and prioritizing the internal factors affecting contractor performance in construction project and indicating potential improvement mechanisms.

2. Literature Review

Contractors are the main stakeholders in the construction projects. Realization of the plans, drawings and specifications is the role of the contractors (Xiao & Proverbs, 2003); however, their performance is affected by different factors. Some of the factors affecting contractors' performance in developing countries are lack of qualified manpower, limited access to working capital, shortage of materials, machinery, and weak use of modern technology (Hillebrandt 1999; IGC 2012). Similarly, as identified by Wong & Ng (2010) the common causes of poor performance of construction organizations are human capital issues, macroeconomic issues, adaptation to market conditions and budget issues. These factors affecting contractors' performance are internal and external factors. The contractors can control the internal factors and improve their performance. Performance is an indicator of capacity; hence, these internal factors are associated with contractors' capacity dimensions: management practices, financial capacity, and technical capacity.

Management capacity includes the monitoring and controlling procedures adopted, the ability of the contractors to deal with risk management, adequacy of the staffs deployed in the project, the contractor's knowledge of information technology and motivating employees (Wong, Nicholas, and Holt 2003). In enhancing the management capacity, the role of human resource is significant. Employee performance is an important success factor for construction companies (Medugu et al, 2011). Competent contractors deploy skilled manpower with good project management capacity and the ability to manage process and resources effectively during construction. Construction companies with talented people are more likely to succeed in the project (Barker and Ingram 2011). Improvement of quality, productivity, cost and time in projects is notable where skilled professionals are employed. Therefore, investing in training to enable employees to systematically develop and enhance their skills is critical to the lasting and sustainably success of any construction company. Similarly, improving performance needs effective communication (McKinney et al., 2004) an technological

capability (van Egmond-de Wilde-de & Smook, 2001). However, it should be noted that the absorption and adoption of technology cannot be achieved simply by acquiring and utilizing technology, but also requires efforts to develop the ability to master technology; the latter is a process of collecting or accumulating technological capabilities and should be regarded as a critical investment. In addition, it is indicted that difficulty in coordination between the parties is one of the factors that contribute to project poor performance (Assaf & Al-Hejji, 2006).

Financial strength of contractor and adequate cashflow are basic in ensuring execution of construction progress as planned (Ismail et al., 2013; Asinza et al., 2016). Financially sound construction companies can take higher risks with higher return and enjoy higher credibility and reputation (Gunhan & Arditi, 2005). The adequacy of financial capacity depends on the appropriateness of financial sources and effectiveness of financing throughout the construction process. Financial management includes planning, sourcing, and controlling the utilization of financial capacity during construction. Poor financial management can degrade productivity and profit levels, this requires decisive and proactive efforts of the contractors. Financial issues related to the cost and funding of a project has an overall effect on the contractors' performance and has implication on contractor reputability. Timely and accurate financial information are critical for construction firms, however, various business owners underestimate the significance of understanding how much money will be needed, not only to start a business but also to sustain it as it struggles to gain financial strengths. The key aspects for consideration in this aspect includes initial accuracy of project estimates and subsequent project controls and project accounting in relation to scope and schedule. Concerning technical capacity, it refers to the equipment owned and related operating staff with the required skills to efficiently utilize the equipment, expertise in work methodology, level of standardization and the ability to foresee technological adoptions to maintain reputability (Mengistu, 2019). Skilled staff entrusted with project execution should possess the technical expertise in the area.

These dimensions of capacity; management practice, financial capacity, and technical capacity are interrelated (Bajracharya et al., 2018); the performance of one dimensions affects the other. In addition, these capacity dimensions are affected by different external factors (Tang & Ogunlana, 2003). Understanding the condition and adopting effective management approach is suggested as a mitigation to enhance performance. Construction organizations should understand, and apply strategic planning and management principles to improve their competitiveness (Jaafari, 2000). Similarly, it is indicated that effective implementation of knowledge management helps to improve performance of the organizations (Robinson et al., 2001). Hence, in this particular study, two management practice areas are considered to mitigate impact of the internal factors: strategic management and knowledge management. These management practice areas are discussed in the subsequent paragraphs.

The focus of strategic management has changed from a primary emphasis on strategic planning to a comprehensive management technique that assists firms to attain strategic change by aligning organizational direction with organizational objectives (Price et al.2003). This change became necessary as a result of rapid change and competitiveness of the construction business environment that promotes strategic thinking (McGeorge & Zou, 2013). Competitive strategies are often seen as business-level strategies that provide significant advantages in explaining competitiveness of businesses in terms of profitability and long-term organizational performance (Veettil, 2008). In spite of the importance and contributions of these concepts in improving performance as witnessed in other industries, studies have revealed that the construction industry is yet to fully engage in strategic management to evolve long-term planning (Price et al., 2003; Dainty, 2007). In addition to that, construction firms can achieve internal strategy by using strategies in the development of construction capacity,

marketing strategies, personnel strategies, procurement strategies, organization strategies or knowledge strategies (Warszawski, 1996).

Knowledge management is a tool that organizations can use to improve their performance and stay ahead of their competitors. Nisha (2018) defined knowledge management as the process of creating, disseminating, using, and handling organizations' data and information. It involves a conscious effort to define structure, retain, and share workers' knowledge and experiences within companies. Knowledge management is the best practices that are applied in the organizations to manage organizational knowledge effectively towards the organizational performance. Inside the construction business sector, it is progressively being recognized that knowledge management can realize the genuinely necessary advancement and improve business execution the business requires (Davenport & Prusak, 1998). Knowledge management activities are seen as a vehicle for companies to meet their growth needs and enhance organizational effectiveness (Kamara et al., 2002). Robinson et al. (2005) argue that the benefits of using knowledge management in the construction industry are not immediately apparent. It is these characteristics that relate it with strategic management.

3. Methodology

In this study there are two specific objectives; specific objective one is identifying, evaluating, and prioritizing the internal factors affecting contractors' performance in construction projects. Specific objective two is indicating potential improvement mechanisms. Initially a thorough literature review was conducted to identify the factors and the potential improvement mechanisms. Later the quantitative data was collected through a structured questionnaire. While the internal factors were evaluated and prioritized using analytical hierarchy process (AHP), the improvement mechanisms were evaluated using technique for order of preference by similarity to ideal solution (TOPSIS). In the evaluation a preference scale for pairwise comparison was used; where: 1= Equal importance/Preferred, 3= Moderately important/preferred, 5= Strongly more important/Preferred, 7= Very strongly more important/Preferred, and 9= Absolutely more important/Preferred).

Fifty-seven purposively selected experts were completed the questionnaire among which the twenty-five responses were found to be inconsistent based on AHP consistency procedures, twelve responses were found invalid and fifteen found duly completed, valid and consistent. The twenty-five inconsistent questionnaires were sent back to their specific respondent, and they were requested to revise their answers to solve the consistency problem, among which six responses were found consistent, and the remaining were excluded from the analysis. After the screening, twenty-one consistent questionnaires were used in the analysis. Comparing with previous studies that adopted AHP, the number of the consistent data is adequate for the analysis. The participants in this study were working in different construction companies. The data summarized in Table 1 shows that fourteen (66.7%) of the respondents have been in construction business for over ten years, while seven (33.3%) had less than ten years' experience. Three (14.3%) were general managers, six (28.6%) were site engineer; three (14.3%) were office engineer; three (14.3%) were construction department head; two (9.5%) were contract administrator and four (19%) were architectural engineer and supervisors. Most of the experts possesses considerable experience in the construction industry. This is an advantage for the study as it ensures reliability of data and subsequent findings.

Table 1 Respondent Profile

Parameters	Number	Percent
Experience of Respondents		
2-5 year	2	9.5
6-10 year	5	23.8
11-15 years	8	38.1
>15 years	6	28.6
Position of Respondents		
General Manager	3	14.3
Site Engineer	6	28.6
Office Engineer	3	14.3
Construction department head	3	14.3
Contract Administrator	2	9.5
Others (e.g., officers of government departments and supervisors)	4	19.0

AHP is a method for solving decision-making problems, which considers proportionality of many factors and alternatives used in decisions. Deductive and inductive evaluation can be conducted using the AHP method, which allows the consideration of numerous factors and alternatives with the advantage of a response mechanisms and trade-offs at the same (Albayrak & Erensal, 2004). The structure of the AHP hierarchy starts with the main objective of the decision at the top level, the main criteria at the second level, the sub-criteria (if any) at the third level and the decision alternatives at the lower level of the hierarchy. There is no specific technique to generate the levels of the hierarchy; it all depends on the nature of the problems. In addition, creative thinking and people's viewpoints can be used to construct the AHP hierarchy (Saaty & Vargas, 2001). Procedure of the AHP involves the following steps:

Step 1: Construct the structural hierarchy, this is known as the AHP decision.

Step 2: Construct the pairwise comparison matrix of attribute i with attribute j yield a square matrix A_{n*n} Where a_{ij} denotes the comparative importance of attributes i with respect to attribute *j*. In this matrix, *aij=1* when *i=j* and *aji=1/aij*

$$A_{nn}=\begin{bmatrix} a11 & \cdots & a1n \\ \vdots & \ddots & \vdots \\ an1 & \cdots & ann \end{bmatrix} - - - - - - - - - - - - - - - - (Eq.1)$$

Step 3: Construct normalized decision matrix.

$$Cij = \frac{aij}{\sum_{j=1}^{n} aij} - (Eq.2)$$

i=1, 2, 3,..., n and *j*=1,2,3,…,n

Step 4: Construct the weighted normalized decision matrix

$$wi = \sum_{j=1}^{n} Cij/n - (Eq.3)$$

i=1,2, 3…., n

$$W=\begin{bmatrix} w1 \\ .. \\ wn \end{bmatrix} - (Eq.4)$$

Step 5: Calculate Eigenvector and Row matrix

$$E=N^{th} \text{ root value}/\Sigma N^{th} \text{ root value} - - - - - - - - - - - - (Eq.5)$$

$$\text{Row matrix}=\sum_{j=1}^{n} aij * ej1 - - - - - - - - - - - - - - - - (Eq.6)$$

Step 6: Calculate the maximum Eigenvalue, λ_{max}

$$\lambda max = \text{Row matrix/E} - - - - - - - - - - - - - - - - - (Eq.7)$$

Step 7: Calculate the consistency index and consistency ratio. To measure consistency of the inputs data, the consistency index is calculated by equation 8.

$$CI = {(\lambda max - n)}/{(n-1)} \quad ----------(Eq.8)$$

Where: Cl: Consistency index; λmax: The largest Eigen value; *n:* The size of the comparison matrix

Consistency ratio is a comparison between the consistency index and the random consistency index, as indicated in equation 9:

$$CR = {CI}/{RI} \quad ----------(Eq.9)$$

Where: CR: The consistency ratio; CI: The consistency index; RI: The random consistency index. If CR< 10% then the ratio has an acceptable evaluation of judgment (Saaty, 1980). Any results collected in this research with CR greater than 10% were removed before proceeding with the analysis.

TOPSIS defines an index called similarity to a positive ideal solution and distance from a negative ideal solution. This method then selects an alternative that has the greatest similarity to the positive ideal solution. This method was used to evaluate the improvement mechanisms in which the identified strategic and knowledge management parameters are closest to the identified and ranked factor with AHP. Initially, a total of a ten strategic management and seven knowledge management factors that helps to improve the performance of contractors were identified through the literature review. The TOPSIS method used the results of AHP as inputs for its application. The TOPSIS method procedure steps are presented below (Hwang and Yoon 1981):

Step 1: Define the problem that you need to know the optimal solution based on a set of alternatives and the set of criteria that alternatives will be judged based on them. Then conduct the decision matrix to evaluate each alternative based on defined criteria.

Step 2: Normalize the decision matrix using TOPSIS vector normalization formula as shows in Equation 10.

$$R= (r_{ij})_{mxn}= {xij}/{(\sum_{i=1}^{m} x2ij)^{1/2}} \quad ----------(Eq.10)$$

- ✓ Where, xij is the score of alternative *i* under criterion *j*.

Step 3: Build a weighted normalized decision matrix using Equation 11

$$Vij=wi*rij, \quad ----------(Eq.11)$$

- ✓ *j=1,2,3,……J and i=1,2,3,…..,n*

Step 4: Identify the positive ideal solution (PIS) and negative ideal solution (NIS) using the following equations.

$$A^{+} = \{v_1^{+}, v_2^{+} \ldots vn^{+}\} \text{ maximum values} \quad ----------(Eq.12)$$

- ✓ Where $v^{+} = \{maxi\ (vij)\ if\ j \epsilon J ; \min\ (vij)\ _{if}\ j \epsilon J^{-}\}$

$$A^{-} = \{v_1^{-}, v_2^{-\cdots\cdots} v_n^{-}\} \text{ minimum values} \quad ----------(Eq.13)$$

- ✓ Where $v^{-} = \{min\ (vij)\ if\ j \epsilon J; \max\ (vij)\ _{if\ j \epsilon} J^{-}\}$
- ✓ Where J is a set of beneficial criteria, and J^{-} is a set of non-beneficial criteria, this study was benefit criteria

Step 5: Use the formula of Euclidean distance to compute the distance of each alternative to the PIS and NIS to measure the separation of alternative *i* performance of to the PIS and NIS using Equation 14 and 15:

$$d^{+} = [\sum_{j=1}^{m} (vi\text{-}vj^{+})^{2}]^{1/2} \quad ----------(Eq.14)$$

$$d^{-} = [\sum_{j=1}^{m} (vi\text{-}vj^{-})^{2}]^{1/2} - - - - - - - - - - - - - - - - (Eq.15)$$

Step 6: Find the closeness coefficient of each alternative based on Equation 16.

$$cc_i = \frac{d_i^{-}}{d_i^{-} + d_i^{+}} \quad - - - - - - - - - - - - - - - (Eq.16)$$

Step 7: Based on the decreasing values of closeness coefficient, alternatives are ranked from most valuable to worst. The alternative having highest closeness coefficient (CC_i) is selected.

4. Analysis and Discussion

4.1. Internal factors affecting contractors' performance.

Structure of the AHP adopted in this study includes contractor performance as an objective in level one, the second level of the hierarchy contains the three dimensions of the capacity: management practice, financial capacity, and technical capacity as the criteria. The lowest level of the hierarchy contains the twenty-two factors under the capacity dimensions as decision alternatives. Based on the questionnaire, a pairwise comparison of factors with each other was completed by experts and the results are summarized in Table 2.

Table 2 The average weight ranking of the main category

Main Category	FRF	MRF	TRF	Weight	Rank
FRF	1	1	2	0.400	1
MRF	1	1	1 8/9	0.395	2
TRF	½	½	1	0.204	3

Abbreviations: *FRF= Financial Related Factors; MRF= Management Related Factors and TRF= Technical Related Factors.*

Table 2 shows the experts' opinion on the three criteria. The average weight ranking of the criteria determined by twenty-one experts indicates that financial related factors are the major followed by the management practice. The three capacity dimensions are interrelated, e.g., if the financial capacity is improved, a company can purchase equipment, train their employees, and improve its technical capability. Table 3 to 5 summarizes the average weight of the factors under each criterion.

Table 3 The average weight ranking financial related factor

FRF	PSFS	PBPC	WI	CFP	PDSC	PCE	Weight	Rank
PSFS	1	1	1 1/6	1/5	1/4	1	0.079	4
PBPC	1	1	7/8	1/5	2/9	1 1/9	0.073	6
WI	6/7	1 1/7	1	1/4	2/7	5/8	0.076	5
CFP	5 1/3	5	4 ¼	1	1 1/4	5	0.375	1
PDSC	4	4 ½	3 3/8	4/5	1	5 3/7	0.318	2
PCE	1	1	1 3/5	1/5	1/5	1	0.079	3

Abbreviations: *FRF= financial related factor, PSFS = poor selection of financial source; PBPC= poor budget planning and control; WI= weak investment; CFP= cash flow problem; PDSC= payment delay to subcontractors and PCE= poor cost estimation.*

The average weight ranking of financial related factors indicates that cashflow problem is followed by payment delay to subcontractor.

Table 4 The average weight ranking of management related factor

MRF	LC	LEM	ICS	PHSM	PL	INP	PPM	IPS	PRM	PQM	PDMP	Weight	Rank
LC	1	3	1 2/3	6 8/9	5/8	4/5	4	1 1/6	6 5/6	3 3/4	4 1/9	0.154	3
LEM	1/3	1	5/9	4 7/9	1/3	1/3	3 1/9	2/3	4 1/5	2	2 7/8	0.080	6

Table 4 The average weight ranking of management related factor

MRF	LC	LEM	ICS	PHSM	PL	INP	PPM	IPS	PRM	PQM	PDMP	Weight	Rank
ICS	3/5	1 7/9	1	5 5/8	3/7	½	3 4/5	¾	6	3 1/6	3	0.111	5
PHSM	1/7	1/5	1/6	1	1/6	1/5	2/5	1/5	7/9	1/3	½	0.021	11
PL	1 4/7	3 1/9	2 1/3	5 ¾	1	1 ¼	5 2/3	2 1/7	6 1/8	4 1/3	5 ½	0.202	1
INP	1 2/9	2 6/7	2	5 2/5	4/5	1	4 2/3	1 3/8	6 1/5	4 5/9	4 ½	0.170	2
PPM	¼	1/3	¼	2 2/5	1/6	2/9	1	¼	1 ½	2/3	4/5	0.034	9
IPS	6/7	1 5/9	1 1/3	5	½	¾	4	1	5 ¼	3 1/3	3 4/9	0.123	4
PRM	1/7	¼	1/6	1 2/7	1/6	1/6	2/3	1/5	1	4/7	2/3	0.024	10
PQM	¼	½	1/3	3	2/9	2/9	1 ½	2/7	1 ¾	1	1 3/8	0.044	7
PDMP	¼	1/3	1/3	2 1/7	1/6	2/9	1 2/9	2/7	1 ½	3/4	1	0.036	8

Abbreviations: *MRF= management related factor, LC= lack of coordination; LEM= lack of employees' motivation; ICS= ineffective communication system; PHSM= poor health and safety management; PL= poor leadership; INP= inadequate number of professionals; PPM= poor performance management; IPS= improper planning and scheduling; PRM= poor risk management; PQM= poor quality management; PDMP= poor decision-making process.*

The average weight ranking of management related factor indicates that poor leadership is followed by inadequate number of professionals- understaffing.

Table 5 The average weight ranking of technical capacity related factors

TRF	PSE	PEC	STS	ICM	LT	Weights	Rank
PSE	1	2/5	7/8	5/6	1	0.119	5
PEC	2 4/9	1	1 ¾	2 4/5	2 4/9	0.319	1
STS	1 1/7	4/7	1	1 1/7	1 1/7	0.152	3
ICM	1 1/5	1/3	7/8	1	1 1/5	0.124	4
LT	2 ½	¾	2	2 2/3	2 ½	0.286	2

Abbreviations: *TRF= technical capacity related factors; PSE= poor staff experience; PEC= poor equipment condition; STS= shortage of technical staffs; ICM= inappropriate construction method; LT= lack of training.*

The average weight ranking of technical capability related factor indicates that poor equipment condition is the critical factor.

After calculating all average weights for all levels of hierarchy and checking the consistency, the next step is to rank the critical factors according to their priorities based on the global weight. The Global weight of each alternative is calculated by equation 17; these results indicate the Final rankings:

$$G.WA,i = Wc,i * WA,i ----------(Eq.17)$$

Where i = 1, 2, 3…, n is category and alternative at each level; G = global weight of individual priorities; Wc is local weight of the criteria and WA is local weight of Alternatives.

The analysis result is summarized in Table 6: Ranking of the criteria and alternatives with local and global weights of factors. Based on the ranking order the top ten factors are discussed below. The ten factors are cashflow problem, payment delay to subcontractors, poor leadership, inadequate number of professionals- understaffing, poor equipment condition, lack of coordination, lack of training, improper planning and scheduling, ineffective communication system, and lack of employees' motivation. As the factors are interrelated, improvement of these vital factors can improve the remaining and the overall performance of the contractors.

Table 6 Ranking with Local and Global Weights of factors

Category	Local weight of category		Factors	Local weight	Global weight	Rank
Financial related Factors	0.401	PSFS	Poor selection of financial source	0.079	0.0315	12
		PBPC	Poor budget planning and control	0.073	0.0293	15
		WI	Weak investment	0.076	0.0305	14
		CFP	Cash flow problem	0.375	0.1501	1
		PDSC	Payment delay to subcontractors	0.318	0.1273	2
Management related factors	0.395	PCE	Poor cost estimation	0.079	0.0317	11
		LC	Lack of coordination	0.154	0.0611	6
		LEM	Lack of employees' motivation	0.080	0.0318	10
		ICS	Ineffective communication system	0.111	0.0437	9
		PHSM	Poor health and safety management	0.021	0.0084	22
		PL	Poor leadership	0.202	0.0800	3
		INP	Inadequate number of professionals - understaffing	0.170	0.0673	4
		PPM	Poor performance management	0.034	0.0134	20
		IPS	Improper planning and scheduling	0.123	0.0487	8
		PRM	Poor risk management	0.024	0.0095	21
		PQM	Poor quality management	0.044	0.0173	18
		PDMP	Poor decision-making process	0.036	0.0143	19
Technical related factors	0.204	PSE	Poor staff experience	0.119	0.0243	17
		PEC	Poor equipment condition	0.319	0.0652	5
		STS	Shortage of technical staffs	0.152	0.0310	13
		ICM	Inappropriate construction method	0.124	0.0253	16
		LT	Lack of training	0.286	0.0584	7

4.1.1 Cashflow problem

Cash is the most important resource of a construction organization (Al-Joburi et al., 2012). Financial management in a construction company is a complex process as the tasks must be carefully planned, monitored, and matched against the project plans and the budget. Efficient financial management is a predominant factor in successfully executing a project (Kenley, 2003). Inadequate cash inflows can directly affect the contractor's cash position if their expense is not carefully monitored. Poor cashflow management negatively impacts the construction company profitability which further impacts upon project success. Managing the cashflow of a construction company is important for contractors, as the difference between bankruptcy and survival can depend on how the company manages the flow of money in and out of the company.

4.1.2 Payment delay to subcontractors

Subcontracting is common practice in construction industry and most of the work on site is conducted by subcontractors (Manu, 2014). Contractors' performance is strongly associated with their relationships with the subcontractors (Kale & Arditi, 2001; Tan et al., 2017). The major source of finance for subcontractors is payment from the main contractor. Hence, payment delays can influence project progress and generate delays. It also causes cashflow problems to subcontractor(s) and these situations may affect the contractual relationship. Effective supply chain management: management of subcontractors and suppliers is a key for

success of contractors. As subcontractors may not have alternative financial sources, delaying payment creates financial crisis and the impacts are sometimes so harsh that the companies have to close down their services either temporarily or permanently. This indicates that payment delay to the subcontractor is the critical issue that should be tackled seriously by scrutinizing the factors that induce the late payment.

4.1.3 Poor leadership

Managers should devise systematic approaches to handle dynamic things that come across construction project life cycles (Alkhamali, 2014). In addition to this project managers need to have knowledge, leadership skill, and experiences to overcome unforeseen things that would happen to construction projects. Poor leadership indicates a lack of sufficient knowledge and skill to cope with both internal and external project environments. Unqualified project manager can severely hamper a project (Sinesilassie et al., 2018). Lack of knowledge or experience in managing a project concerning either technical or economic aspects can cause delays or time overrun. Without an effective leadership process, an organization will not be able to complete the project effectively.

4.1.4 Inadequate number of professionals- understaffing

Shortage of skilled workforce within the construction companies has the most negative influence on the contractor's performance. Performance of the construction companies is associated directly or indirectly with adequacy and competence of manpower in the company (Gudiene et al., 2013; Silva et al., 2008). The construction industry relies heavily on the proper supply of skilled workers (MacKenzie et al 2000). The shortage of skilled workers in the construction companies is caused by the lack of proper selection procedures and poor recruitment procedures, which adversely affects the success rate of construction projects and thus reduces the productivity of construction companies.

4.1.5 Poor equipment condition

Most of construction equipment in Ethiopia are not providing expected service and they have been experiencing frequent failures while rendering services (EEA, 2007). As a result, the construction project is delayed in completion and requires additional budget. In addition, these older machines embody rear technology, require spare parts, and consume more inputs, which reduces efficiency. Out-dated equipment, poorly trained staff, lack of qualified supervision, and unused equipment at construction sites are some of the problems faced by developing countries contractors (Ayarkwa et al.2010). In addition to the poor condition of equipment, many of the contractors do not own certain types of equipment that are required for the construction work. They rent the equipment when required. During the season when there are many construction projects, unavailability of equipment results in delay of projects.

4.1.6 Lack of coordination

The complexity of construction projects requires continuous coordination among many stakeholders with very different skills and experience. The construction industry has had a disappointing track record for decades due to the lack or inefficiency of the coordination process (Price & Andy, 2010). Depending on the complexity of the project, the construction process requires a high degree of coordination at design, procurement, and construction phases of construction projects.

4.1.7 Lack of training

Employees' performance is the key success factor for any construction company. Construction companies having competent human resources are more likely to be successful in their projects (Barker & Ingram, 2011). Therefore, investment in training that allows

employees to systematically develop and upgrade their skills is essential for the enduring and sustainable success of any construction company. As construction is technical by nature, continually evaluating technical experience of staff and filling the gap is source of success.

4.1.8 Improper planning and scheduling

Contractors often do not come up with practical and viable schedules. This failure is related to the inadequate experience of the contractor associated with the project. The consultant reviews and evaluates only the work programs submitted by the contractor based on experience and intuitive judgment. Inadequate schedule is the most critical risk, which constitutes a long-term problem causing delay in any construction projects (Muneeswaran et al., 2020). Developing a robust construction project schedule is one of the major factors towards construction projects' success (Derbe et al., 2020).

4.1.9 Ineffective communication system

Effectiveness of team communication for the design and delivery of construction projects is becoming increasingly important due to the growing technical and organizational complexity of construction projects (Kwofie et al., 2020). Poor communication at construction sites leads to many other negative effects (Senaratne & Ruwanpura, 2016). The reason for the poor communication is the lack of communication systems (Lubis, 2021). The impact of ineffective communication is project schedule delays, cost overruns and overall performance. Internal communication takes place within the organization and plays an important role in building positive relationships between superiors and subordinates, or between employers and employees. The impact of ineffective communication is usually large and is due to factors arising from the contractor's management practice (Gamil et al., 2019; Gamil & Abd Rahman, 2022).

4.1.10 Lack of employees' motivation

Workplace motivation is critical to the high productivity of an organization. Without employee motivation, the company goals cannot be achieved. Timely salary payments, training programs, relationships with colleagues, bonuses, and benefits are key factors influencing contractor performance. Motivation is an internal and external impetus that enhances the energy of employees, engages in continuous tasks, and enhances the desire to achieve the goals and objectives set by focusing on constant effort and desired outcomes (Mathis et al., 2017).

4.2 Measures to mitigate the internal factors

To evaluate the ten strategic management and the seven knowledge management parameters TOPSIS was used as analysis tool. The analysis results are summarized in Table 7 and the discussion is made in the subsequent subtopics.

Table 7 Mitigation mechanisms of the internal factors affecting contractors' performance

Code	Management practice area	dj+	dj-	CC	Rank
	Strategic management				
IM-1	Dynamic management approach	0.038	0.090	0.703	1
IM-2	Efficient organization structures	0.076	0.059	0.435	3
IM-3	Better allocation of resource	0.078	0.045	0.367	7
IM-4	Measuring organization performance	0.103	0.024	0.187	9
IM-5	Improve profit	0.108	0.024	0.180	10

Table 7 Mitigation mechanisms of the internal factors affecting contractors' performance

Code	Management practice area	dj+	dj-	CC	Rank
IM-6	Hiring the right people	0.081	0.066	0.447	2
IM-7	Well defined work plan	0.079	0.049	0.385	6
IM-8	Effective incentive mechanism	0.078	0.055	0.413	4
IM-9	Preparation of adequate funds	0.085	0.047	0.356	8
IM-10	On time payment	0.093	0.065	0.411	5
	Knowledge management				
IM-11	Training and continuous learning	0.232	0.201	0.464	2
IM-12	Developing knowledge sharing culture	0.216	0.185	0.461	3
IM-13	Well-established communication system	0.143	0.257	0.643	1
IM-14	Applying lesson learnt to reduce error and mistake at work	0.286	0.128	0.310	7
IM-15	Promoting group work	0.227	0.159	0.412	5
IM-16	Standardization of working procedures	0.250	0.200	0.445	4
IM-17	Experience recording	0.265	0.170	0.391	6

4.2.1 Strategic management

Strategic management is a management process specifically adopted to improve the operational and management performance of an organization. Applying strategic management techniques to a construction organization increases effectiveness, efficiency, flexibility, and improves organizational performance. The analysis result indicates, as per the ranking order, the improvement mechanisms are adopting dynamic management approach, hiring the right people, efficient organization structures, effective incentive mechanism, promoting group work, on time payment, well defined work plan, better allocation of resource, enough preparation of funds, measuring organization performance and improving profit margin.

The organizations need to adopt dynamic management approach/ application of the soft skills that suits the context in order to improve their organization performance; like knowledge of building and construction leadership qualities, time management skills, and appropriate verbal communication skills, quality management skill, time management skill, and the ability to use appropriate problem-solving tools. Hiring the right people at right time are the second most important improvement mechanism. Recruitment and selection are important human resource management functions for all types of business organizations. These are incudes the process of attracting and selecting job seekers, hiring the right people is essential to ensure business success (Henry & Temtime, 2009).

A good organizational structure influences a company's executive behavior. Structures not only characterize the capabilities of an organization, but also the processes that characterize its performance. Firm should have a clear strategic plan and appropriate, flexible organizational structure, which is compatible with the firm needs and could be easily updated or modified when needed. These good organizational structures in construction companies help to improve communication system, employee coordination problem, and weak leadership. Similarly, incentives and on time payments are the among mechanisms to improve contractors' competitiveness. Organizational incentive systems have a significant influence on the performance of projects and thus the organization overall. In construction company lack of motivation, lack of training, poor health and safety management, poor risk management can be improved by constructing effective incentive mechanism.

4.2.2 Knowledge management

Knowledge is undoubtedly central to organizational learning and innovation, and a knowledge management strategy should therefore be the cornerstone of improving performance in construction organizations (Robinson et al. 2001). Well-established communication system was ranked first as improvement mechanism. Information, contact documents and other relevant documents, must be stored, retrieved, and communicated at all stages of the construction life cycle. The success of any construction practice depends on how well the suppliers communicate with the contractor, sub-contractors, and other entities that support any activities in the line of construction (Al-Reshaid & Kartam, 1999). Effective communication system in construction company helps to improve communication problems from top managers to employees, poor decision-making process, poor leaderships, coordination problem, cash flow problems and improve construction methods of the company. Training and continuous learning ranked the second factors of improvement. The companies that applied training and continuous learning practices for developing their staff and workforces improved their task efficiency much better than the companies that did not utilize them.

Another improvement factor that helps the contractor is developing knowledge sharing culture. To enhance competitiveness and meet their goals, organizations need to ensure that their employees share their knowledge. The more knowledge about current and potential customer needs is shared among project team members, the better the understanding of real customer requirements. Developing knowledge sharing culture within construction companies can helps to minimize poor leadership, poor decision-making process, lack of training, improper planning and scheduling, poor staff experience. Personal discussions, at work or during social activities, with other project team members were used extensively for knowledge sharing, to assist the problem-solving and decision-making processes helps to enhance competitiveness.

Standardization of working procedures are also the fourth improvement factors. Standardization of working procedures in the construction projects increases the possibility of the contractor to finish within time and within budget and reduces risk, quality problems, in appropriate construction methods, and poor performance management this is one of the performance indicators in construction project. Effective teamwork is one of the most important factors for the success of any business in general and construction projects in particular. Manager can take various steps to promote teamwork in a project. Good cooperation between people working together as a team is essential when it comes to construction projects. This is not only for quality, but also for safety when working on a construction site. Effective teams bring many benefits to projects and organizations: improve quality of work, enhance health and safety, increase accountability within the team, enhance mutual understanding among team members, utilize resources, especially time, and generate more ideas and better decisions.

5. Conclusion

Internal factors affecting contractors' performance emanate from the capacity dimensions and hence are controllable by the contractors. Identifying and prioritizing these factors is important for the contractors to devise appropriate strategies and enhance their performance. In this study initially the factors were identified through literature review. Later quantitative data was collected through questionnaire and, factors were evaluated and prioritized using AHP. The structure of AHP adopted in this includes contractor performance as an objective in level one, the second level of the hierarchy contains three dimensions of the capacity: management practice, financial capacity, and technical capacity. The lowest level of the hierarchy contains twenty-two factors. Based on questionnaire pairwise comparison of factors with each other was completed by experts. The average weight ranking of the criteria determined by the

experts indicates that financial capacity related factors is the major dimension followed by the management practice and technical capacity related factors. Among the twenty-two factors under the three capacity dimensions, based on the global weight, the top ten factors are cashflow problem, payment delay to subcontractors, poor leadership, inadequate number of professionals- understaffing, poor equipment condition, lack of coordination, lack of training, improper planning and scheduling, ineffective communication system, and lack of employees' motivation.

Strategic and knowledge management are the main improvement mechanisms that help to improve contractors performance, where, the identified improvement mechanisms from both strategic and knowledge management are dynamic management approach, hiring the right people, efficient organization structures, effective incentive mechanism, on time payment, well-established communication system, training and continuous learning, developing knowledge sharing culture, standardization of working procedures and promoting group work.

References

Abraham, G. L. (2003). Critical Success Factors For The Construction Industry. *Proceedings of Construction Research Congress*, 1–9.

Adebisi, E. O., Ojo, S. O., & Alao, O. O. (2018). Assessment of factors influencing the failure and abandonment of multi-storey building projects in Nigeria. *International Journal of Building Pathology and Adaptation IJBPA*, *36*(2), 210–231. https://doi.org/10.1108/IJBPA-10-2017-0048

Akogbe, R. K. T. M., Feng, X., & Zhou, J. (2013). Importance and ranking evaluation of delay factors for development construction projects in Benin. *KSCE Journal of Civil Engineering*, *17*(6), 1213–1222. https://doi.org/10.1007/s12205-013-0446-2

Al-Joburi, K. I., Al-Aomar, R., & Bahri, M. E. (2012). Analyzing the Impact of Negative Cash Flow on Construction Performance in the Dubai Area. *Journal of Management in Engineering*, *28*(4), 382–390. https://doi.org/10.1061/(asce)me.1943-5479.0000123

Al-Reshaid, K., & Kartam, N. (1999). Improving Construction Communication: The Impact of The On-Line Technology. *8th International Conference On Durability of Building Materials and Components*, 2270–2276.

Albayrak, E., & Erensal, Y. C. (2004). Using analytic hierarchy process (AHP) to improve human performance: An application of multiple criteria decision making problem. *Journal of Intelligent Manufacturing*, *15*(4), 491–503. https://doi.org/10.1023/B:JIMS.0000034112.00652.4c

Alkhamali, K. S. H. (2014). *Leadership Style, Organizational Culture and Disputes in Public Construction, Ph.D. Thesis, Heriot-Watt University*.

Asinza, K., Kanda, E. K., Muchelule, Y., Mbithi, S., & County, N. (2016). Influence of Financial Capacity and Monitoring on Project Quality of Housing Construction in Nakuru County , Kenya. *International Journal of Research in Management, Science & Technolog*, *4*(3), 38–43.

Assaf, S. A., & Al-Hejji, S. (2006). Causes of delay in large construction projects. *International Journal of Project Management*, *24*(4), 349–357. https://doi.org/10.1016/j.ijproman.2005.11.010

Ayarkwa, J., Ayirebi-Dansoh, & Amoah, P. (2010). Barriers to Implementation of Environmental Management System in Construction Industry in Ghana. *International*

Journal of Engineering Science, *2*(4), 37–45.

Bajracharya, A., Ogunlana, S., Goh, C. S., & Tan, H. C. (2018). Conceptualising the nexus of projects, finance and capacity in construction business. *Frontiers of Engineering Management*, *5*(3), 289–297.

Barker, H., & Ingram, H. (2011). *Addressing scarce construction skills for competitive advantage: a case study,Training & Management Development Methods*. *25*(4), 549–559.

Dainty, R. S. and A. R. J. (2007). *Integrating Uncertainty Management in Strategic Planning Practice*. 886–895.

Davenport, T. H., & Prusak, L. (1998). Working knowledge: how organizations manage what they know. *Choice Reviews Online*, *35*(09), 35-5167-35–5167. https://doi.org/10.5860/choice.35-5167

Derbe, G., Li, Y., Wu, D., & Zhao, Q. (2020). Scientometric review of construction project schedule studies: Trends, gaps and potential research areas. In *Journal of Civil Engineering and Management* (Vol. 26, Issue 4). https://doi.org/10.3846/jcem.2020.12317

EEA. (2007). *Ethiopian Economic Association,The Current State of the Construction Industry*.

Eriksson, P. E., & Westerberg, M. (2011). Effects of cooperative procurement procedures on construction project performance: A conceptual framework. *International Journal of Project Management*, *29*(2), 197–208. https://doi.org/10.1016/j.ijproman.2010.01.003

Gamil, Y., & Abd Rahman, I. (2022). Impact of poor communication on dispute occurrence in the construction industry: a preliminary exploratory study of Yemen construction industry. *International Journal of Construction Management*, 1–7. https://doi.org/10.1080/15623599.2022.2092388

Gamil, Y., Abd Rahman, I., & Nagapan, S. (2019). Investigating the effect of poor communication in terms of cost and time overruns in the construction industry. *International Journal of Construction Supply Chain Management*, *9*(2), 94–106. https://doi.org/10.14424/ijcscm902019-94-106

Gudiene, N., Banaitis, A., Banaitiene, N., & Lopes, J. (2013). Development of a conceptual critical success factors model for construction projects: A case of lithuania. *Procedia Engineering*, *57*, 392–397. https://doi.org/10.1016/j.proeng.2013.04.051

Gunhan, S., & Arditi, D. (2005). Factors Affecting International Construction. *Journal of Construction Engineering and Management*, *131*(3), 273–282. https://doi.org/10.1061/(asce)0733-9364(2005)131:3(273)

Haile, T. (2016). *Comparative Evaluation of Project Performance Between Domestic and Chinese Contractors in Selected Federal Road Projects in Ethiopia*. MSc. Thesis, Addis Ababa University, Ethiopia.

Hedidor, D. (2015). Performance Evaluation of Private Contractors in the Eastern Region of Ghana. *International Journal of Construction Engineering and Management*, *4*(5), 165–179. https://doi.org/10.5923/j.ijcem.20150405.02

Henry, O., & Temtime, Z. (2009). Recruitment and selection practices in SMEs: Empirical evidence from a developing country perspective. *Advances in Management*, *3*(2), 635–672.

Hillebrandt, P. M. (1999). Problems of larger local contractors: causes and possible remedies. *Proceedings of CIB-TG29, Contractor Development, UCCIDAH in Conjunction with Department of Civil Engineering and Department of Architecture, Makerere University*, 25–33.

Hwang, C. L., & K Yoon. (1981). Multiple attributes decision making methods and applications. In *Berlin: Springer*.

IGC. (2012). *The Challenges and the Way Forward for the Construction Industry in Mozambique, International Growth Center*.

Ismail, A. R., Aftab, H. M., & Ahmad, T. (2013). Significant Factors Causing Cost Overrun in Large Construction Projects in Malaysia. In *Journal of Applied Sciences* (Vol. 13, Issue 2, pp. 286–293).

Jaafari, A. (2000). Construction Business Competitiveness and Global Benchmarking. *Journal of Management in Engineering*, *16*(6), 43–53. https://doi.org/10.1061/(asce)0742-597x(2000)16:6(43)

Kale, S., & Arditi, D. (2001). General contractors' relationships with subcontractors: A strategic asset. *Construction Management and Economics*, *19*(5), 541–549. https://doi.org/10.1080/01446193.2001.9709630

Kamara, J. M., Anumba, C. J., & Carrillo, P. M. (2002). A CLEVER approach to selecting a knowledge management strategy. *International Journal of Project Management*, *20*(3), 205–211. https://doi.org/10.1016/S0263-7863(01)00070-9

Kenley, R. (2003). *Financing Construction: Cash flows and cash farming*. https://doi.org/10.4324/9780203467398

Kwofie, T. E., Aigbavboa, C., & Thwala, W. (2020). *Effective Construction Project Delivery-Improving Communication Performance in Non-Traditional Procurement Systems*. Springer. https://doi.org/10.1007/978-3-030-49374-5

Lubis, Z. (2021). *The Importance of Communication Management Improving the Performance of Construction Project Managers in Developing Countries*. *56*(3), 473–484.

MacKenzie, S., Kilpatrick, A. R., & Akintoye, A. (2000). UK construction skills shortage response strategies and an analysis of industry perceptions. *Construction Management and Economics*, *18*(7), 853–862. https://doi.org/10.1080/014461900433131

Manu, E. (2014). *Supply Chain Management Practices in Construction and Interorganizational Trust Dynamics, Ph.D. Thesis, University of Wolverhampton*.

Mathis, R. L., Jackson, J. H., Valentine, S. R., & Meglich, P. A. (2017). *Human Resource Management* (5th ed.). Cengage Learning.

McKinney, E. H., Baker, J. R., Smith, D. R., & Davis, K. J. (2004). The role of communication values in swift starting action teams: IT insights from flight crew experience. *Information and Management*, *41*(8), 1043–1056. https://doi.org/10.1016/j.im.2003.10.006

Medugu, N. I., Rafee Majid, M., Bustani, S. A., Bala, K., Abdullahi, U., & Mbamali, I. (2011). *Craft Skills: Availability in the Nigerian Construction Industry: Perception of Contractors and World bank 2016 the need for skilled manpower.*

Mengistu, D. G. (2019). *Improving Determinant Factors to Facilitate Construction Industry Development in Ethiopia*. Ph.D. Thesis, National Institute of Technology Karnataka,

Surathkal, India.

Muneeswaran, G., Manoharan, P., Awoyera, P. O., & Adesina, A. (2020). A statistical approach to assess the schedule delays and risks in Indian construction industry. *International Journal of Construction Management*, *20*(5). https://doi.org/10.1080/15623599.2018.1484991

Nguyen, T. P., & Chileshe, N. (2015). Revisiting the construction project failure factors in vietnam. *Built Environment Project and Asset Management*, *5*(4), 398–416. https://doi.org/10.1108/BEPAM-10-2013-0042

Nisha, R. (2018). Knowledge management and recovery processes using IT: An approach towards Data Mining. *International Journal of Supply Chain Management*, *7*(6), 57–60.

Price, A. D. F., & Andy, K. (2010). Causes Leading to Poor site Coordination in Building Projects. *Organization, Technology and Management in Construction - An International Journal*, *2*(2), 167–172.

Price, A. D. F., Ganiev, B. V., & Newson, E. (2003). Changing strategic management practice within the UK construction industry. *Strategic Change*, *12*(7), 347–366. https://doi.org/10.1002/jsc.649

Robinson, H. S., Carrillo, P. M., Anumba, C. J., & Al-Ghassani, A. M. (2001). Linking Knowledge Management Strategy To Business Performance in Construction Organizations. *Association of Researchers in Construction Management Conference*, *1*(September), 577–586.

Robinson, H. S., Carrillo, P. M., Anumba, C. J., & Al-Ghassani, A. M. (2005). Knowledge management practices in large construction organisations. *Engineering, Construction and Architectural Management*, *12*(5), 431–445. https://doi.org/10.1108/09699980510627135

Saaty, T. L. (1980). *Analytic Hierarchy Process*. Springer. https://doi.org/10.1201/9780429504419-2

Saaty, T. L., & Vargas, L. G. (2001). *Models, Methods, Concepts and Applications of the Analytic Hierarchy Process*. Springer. https://doi.org/10.1057/jors.1962.41

Senaratne, S., & Ruwanpura, M. (2016). Communication in construction: a management perspective through case studies in Sri Lanka. *Architectural Engineering and Design Management*, *12*(1), 3–18. https://doi.org/10.1080/17452007.2015.1056721

Silva, N. De, Rajakaruna, R. W. D. W. C. A. B., & Bandara, K. A. T. N. (2008). Challenges faced by the construction industry in Sri Lanka : perspective of clients and contractors. *Building Resilience*, 158–169.

Sinesilassie, E. G., Tabish, S. Z. S., & Jha, K. N. (2018). Critical factors affecting cost performance : a case of Ethiopian public construction projects. *International Journal of Construction Management*, *18*(2), 108–119. https://doi.org/10.1080/15623599.2016.1277058

Sweis, R. J., Bisharat, S. M., Bisharat, L., & Sweis, G. J. (2014). Factors affecting contractor performance on public construction projects. *Life Science Journal*, *11*(SPEC. ISSUE 4), 28–39.

Tagesse, B. (2017). *Assessment of Construction Performance Challenges in Selected University Building Construction Projects* (Issue June). MSc. Thesis, Addis Ababa Universiy, Ethiopia.

Tan, Y., Xue, B., & Cheung, Y. T. (2017). Relationships between Main Contractors and Subcontractors and Their Impacts on Main Contractor Competitiveness: An Empirical Study in Hong Kong. *Journal of Construction Engineering and Management*, *143*(7), 1–11. https://doi.org/10.1061/(asce)co.1943-7862.0001311

Tang, Y. H., & Ogunlana, S. (2003). Selecting superior performance improvement policies. *Construction Management and Economics*, *21*(3), 247–256. https://doi.org/10.1080/0144619032000093765

Taylor, P., Radujkovi, M., Vukomanovi, M., & Burcar, I. (2010). Application of key performance indicators in South - Eastern European construction. *Journal of Cilil Engineering and Management*, *December 2012*, 37–41. https://doi.org/10.3846/jcem.2010.58

van Egmond-de Wilde-de, E. L. C., & Smook, R. A. F. (2001). The technology mapping methodology for benchmarking the construction performance. *CIB World Building Congress*, 1–11.

Veettil, N. M. K. (2008). *Strategy Formulation and Implementation in Manufacturing Organisations - The Impact on Performance*. Middlesex University Business School,United Kingdom.

Warszawski, A. (1996). Strategic planning in construction companies. *Journal of Construction Engineering & Management*, *122*(2), 133. http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=9704183913&site=ehost-live

Wong, C. H., Nicholas, J., & Holt, G. D. (2003). Using multivariate techniques for developing contractor classification models. *Engineering, Construction and Architectural Management*, *10*(2), 99–116. https://doi.org/10.1108/09699980310466587

Wong, J. M. W., & Ng, S. T. (2010). Business Failure in the Construction Industry: A Critical Review and a Future Research Agenda. *Proceedings of FIG Congress, Facing the Challenges – Building the Capacity*, 1–17.

Xiao, H., & Proverbs, D. (2003). Factors influencing contractor performance: An international investigation. *Engineering, Construction and Architectural Management*, *10*(5), 322–332. https://doi.org/10.1108/09699980310502937