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A Meta-Analysis of Factors Affecting Construction Labour Productivity in the Middle East

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Abstract: Despite the importance of the construction sector for economic development, labour productivity in construction is lower than the productivity of other sectors. Construction productivity has been declining continuously for decades, especially in developing countries. The challenges of low productivity in construction are considered chronic problems. This has raised concerns among construction stakeholders to address the myriad of challenges that are undermining labour productivity growth. This study performed a metadata analysis of factors affecting construction labour productivity (CLP) growth in the Middle East. A systematic review of existing studies on labour productivity in construction was presented. Ten studies from the Middle East were selected for metadata analysis. The key factors affecting CLP in the region were identified and quantitative data from the selected studies were synthesised. Effect summaries derived from the analysis revealed that delays in responding to requests for information, inadequate workers' supervision, a shortage of skilled labour, the extent of change orders and clarity of technical specifications are the major factors affecting construction productivity. The study is limited to journal articles published in the Scopus database between 2000 and 2020. Middle East contractors can adopt the study's interventions to develop productivity improvement strategies for their organisations.

Keywords: Construction, Labour, Metadata analysis, Middle East, Productivity

INTRODUCTION

A large number of research geared towards understanding productivity have generated diverse perspectives that led to a wide range of definitions of productivity (Nasir et al., 2014). Productivity is relevant to every sector; thereby contributing to diverse knowledge and perceptions of its meaning. In the construction sector, productivity is understood as the units of work produced per man-hour (Ouga, Alinaitwe and Mwesige, 2020). The concept is usually expressed at the activity, project and industry levels (Yi and Chan, 2014), which are respectively concerned with productivity on construction tasks, construction projects and the industry's long-term productivity trends (Shan et al., 2016; Zhao and Dungan, 2014; Vogl and Abdel-Wahab, 2015; Borg and Song, 2015). Due to the growing knowledge that the construction sector considerably contributes to a booming economy, more than ever, productivity growth is becoming more important to the industry's stakeholders and policymakers (Fadejeva and Melihovs, 2010). This engenders several interventions from the construction stakeholders towards ensuring labour productivity in construction continues to grow (Vogl and Abdel-Wahab, 2015).

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Regrettably, labour productivity in construction is lower than the productivity of other sectors, particularly in developing countries (Neve et al., 2020). Although several research projects have been conducted to address this challenge (Olomolaiye, Wahab and Price, 1987; Kaming et al., 1997; Alinaitwe, Mwakali and Hansson, 2007), the construction industry has continued to be confronted with the issue of low productivity. Yap, Chow and Shavarebi (2019) expressed the problem of productivity in the construction industry as being "chronic". There are review-based studies on factors affecting construction labour productivity (CLP) (e.g., Naoum, 2016; Hasan et al., 2018). However, these studies were conducted qualitatively which leaves the possibility for subjectivity (Hosseini et al., 2018; Adebowale and Agumba, 2022).

Metadata analysis provides a quantitative integration of data from different studies. The analysis would largely address the bias in review-based studies of the CLP research field. The method will offer a quantitative measurement and analysis of data to achieve a more realistic and scientific precision of factors affecting labour productivity in construction operations. Metadata analysis has been applied to diverse domains in construction. These include delays in construction (Sanni-Anibire, Mohamad Zin and Olatunji, 2020), health and safety (Alruqi, Hallowell and Techera, 2018) and building information modelling (Noor and Yi, 2018). There is evidence in the literature that the Middle East is one of the regions with the highest number of publications in the CLP research field. This suggests the importance of CLP to the economic development of the region. Middle East countries include Bahrain, Cyprus, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Palestine, Qatar, Saudi Arabia, the Syrian Arab Republic, Türkiye, United Arab Emirates and Yemen. These countries share common ethnic groups, geographic features, religious beliefs and political histories. Given the proliferation of CLP studies in the region, the aggregation of factors affecting CLP in the Middle East will provide a more comprehensive understanding of factors affecting CLP than a single study specific to a country. The metadata analysis approach has the advantage of transparency in extracting and analysing knowledge to enhance accurate decision-making and policy formulation (Borenstein et al., 2009). The objective of this study is to present a systematic review of factors affecting labour productivity in the construction industry. Studies that are specific to the Middle East will further be extracted for metadata analysis. Subsequent sections present an overview of the CLP challenges, research method, discussions, conclusions and implications of the research.

OVERVIEW OF THE CLP CHALLENGES

Construction organisations in many countries are greatly concerned about their low level of productivity (Jarkas, Al Balushi and Raveendranath, 2015). There is a surfeit of evidence that productivity is a critical challenge confronting the construction industry in many countries (Jalal and Shoar, 2019). This is because high or low productivity is critical to construction projects' success (Adebowale and Agumba, 2022). Contractors' competitiveness is considerably dependent on their productivity (Kazaz and Ulubeyli, 2007). Arising from the low productivity of many contractors, cost and time overruns are frequent on most construction projects (Ghoddousi et al., 2015). Hari, Panday and Gupta (2016) posited that prevalent cost and time overruns in the construction industry are indicators of productivity

problems. The low productivity of craftsmen is considered one of the most daunting problems of contractors, especially those in developing countries (Kaming et al., 1997). Current construction productivity issue is also associated with disputes and abandonment of construction projects (Hari, Panday and Gupta, 2016). These have jointly or separately resulted in negative influences on construction project performance, project stakeholders and the business of construction (Hasan et al., 2018). According to Alinaitwe, Mwakali and Hansson (2007), improving construction productivity will help to address these challenges. Evaluating factors affecting productivity is a critical issue facing construction managers (Naoum, 2016). The first step in identifying opportunities to improve labour productivity is to identify the factors that influence them (Adebowale and Agumba, 2022). Once the factors are identified, managers can effectively act on them to reduce costs, improve planning and ultimately obtain a more accurate productivity forecast when estimating construction costs (Rivas et al., 2011).

Existing CLP Studies

This section reviews the existing literature on factors affecting CLP to obtain necessary evidence in the research area. Existing CLP studies have primarily used empirical research methods to identify the factors that affect construction productivity. Five research approaches highlighted by Fellows and Liu (2003) include experiment, survey, action research, ethnographic research and case study. According to Hasan et al. (2018), experimental research is costly as they take a long time to finalise. Generalisable results cannot be achieved with case studies as different projects face different problems (Alinaitwe, Mwakali and Hansson, 2007). Therefore, questionnaires are predominantly the data collection tool of choice in CLP research. The methods commonly used by researchers to identify the factors influencing CLP include the identification of a variety of factors based primarily on a review of the existing literature, focus group discussion, interviews or case studies, pilot tests of research questionnaires to identify salient factors influencing CLP, rank factors based on relative importance index and the survey results are often validated through focus groups discussion, interviews or case studies. Few studies preferred focus groups to identify the factors influencing CLP (Dai, Goodrum and Maloney, 2007), while most authors relied solely on a review of the existing literature to facilitate the identification of factors (Jarkas and Bitar, 2012; Jarkas, Kadri and Younes, 2012). More thorough factors are gathered by requesting the contributions of the industry practitioners (Jarkas, 2015). The results are more robust and relevant in their national context since local productivity factors are identified on the basis of focus group meetings and contributions from industry practitioners (Hasan et al., 2018). Rather than identifying local productivity factors through focus group meetings and input from industry professionals, most studies extract factors that influence CLP through a literature review, which may constitute bias in these studies.

The number of productivity factors selected for CLP research varied between studies in developed and developing countries. Among the studies, Afolabi et al. (2018) selected 17 factors in Nigeria, Jarkas, Al Balushi and Raveendranath (2015) selected 33 factors in Oman, Jalal and Shoar (2019) analysed 60 factors in Iran; and Dai and Goodrum (2011) identified a complete list of 85 factors in the USA. In each study, the list of the most influential factors was identified and reported. CLP studies are distributed in developed and developing countries. India, USA, Australia

and UK are the leading countries in terms of CLP research publications. The factors identified in different studies vary widely due to the specifications and conditions of each construction project. Structured questionnaires were mainly used to collect data for the CLP studies. Scholars have primarily sought the perceptions of project managers and craftsmen (Thomas and Sudhakumar, 2013), while a number of researchers have sought the perceptions of high-level industry professionals such as directors and senior executives.

Although studies show that different groups of study participants have general perceptions of the factors that influence CLP, there are still some differences in perception. Chan and Kaka (2007) highlighted the differences in perception between managers and workers about the factors that influence CLP. Managers have been found to place more emphasis on resource planning, while resource use is more important to workers. Similarly, Dai, Goodrum and Maloney (2007) stated that foremen give greater importance to factors related to project management and technical drawings, while factors related to construction materials are considered more important for artisans. Spanish-speaking workers considered factors related to supervisor, safety and work management as most important in increasing productivity, while English-speaking craftsmen preferred factors related to engineering drawing management (Dai and Goodrum, 2011). Ghoddousi et al. (2015) examined the perceptions of executive directors of construction organisations in their study. The study found some inconsistencies with the results of the previous studies, possibly because executive directors are not directly involved in construction operations; and as a result, there is a lack of awareness of site-related challenges hampering construction operations. On the contrary, Thomas and Sudhakumar (2013) found no significant differences in perception between project managers, superiors and artisans. Most research to date has identified factors that affect productivity from the contractor's point of view. Hasan et al. (2018) recommended the need to revisit the existing studies while taking the perceptions of various stakeholders into account.

Identifying the main factors that influence CLP is essential to increase productivity in the construction industry (Ghoddousi and Hosseini, 2012). If the factors influencing CLP are unknown, efforts to improve productivity will certainly not produce the desired result. Tables 1 and 2 summarise the results of existing studies during the last 26 years (1994 to 2020). Given that construction projects are labour-intensive and influenced by internal and external environments, construction productivity in developed and developing countries is influenced by many factors. However, scrutinising previous research suggests that some factors are more recurring than others (Hasan et al., 2018).

Table 1. A review of factors affecting CLP in developed countries

Author	Year	Country	No. of Factors	Major Findings
Hanna and Heale	1994	Canada	30	Foreman supervision; Availability of working drawings; Task sequencing; Equipment breakdown; Non-availability of construction equipment.
Kazaz and Ulubeyli	2007	Türkiye	9	Working at similar activities; Design complexity; Error tolerance; Weather conditions; Disruptions.
Chan and Kaka	2007	UK	59	Poor supervision; Simplicity of building design; Level of site experience; Information flow; Communication with subcontractors.
Kazaz, Manisali and Ulubeyli	2008	Türkiye	37	Quality of site management; Material management; Systematic flow of work; Supervision; Site layout.
Mojahed and Aghazadeh	2008	USA	5	Skills and experience of workforce; Management; Job planning; Workers' motivation; Material availability.
Dai et al.	2009	USA	57	Construction equipment; Project management; Craft workers' qualifications; Training; Foreman competency.
Valverde-Gascueña et al.	2010	Spain	11	Faulty works; Overcrowded work areas; Crew interference; Lack of on-site cleanliness; Equipment unavailability.
Dai and Goodrum	2011	USA	85	Errors on the drawings; Late response to drawing related questions; Project management pays monetary bonuses for good performance; Inadequate information from supervisors; Lack of health and safety training on projects.
Durdyev and Mbachu	2011	New Zealand	55	Reworks; Level of skill and experience of the workforce; Adequacy of method of construction; Buildability issues; Inadequate supervision and coordination.

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Table 1. (*Continued*)

Author	Year	Country	No. of Factors	Major Findings
Rivas et al.	2011	Chile	15	Lack of on-time delivery of materials; Insufficient number of tools; Problem associated with availability of sufficient trucks for moving materials or tools; Rework arising from client's change orders; Interference among crews.
Robles et al.	2014	Spain	35	Shortage or late supply of materials; Clarity of the drawings and project documents; Clear and daily task assignment; Tools or equipment shortages; Level of skill and experience.
Loosemore	2014	Australia	9	Relationship management; Tender practices; Project documentation and control; Project management and supervision; Planning.
Hwang, Zhu and Ming	2017	Singapore	26	Workers' experience; Technology; design changes; Workers' skill level; Planning and sequencing of work.

Table 2. A review of factors affecting CLP in developing countries

Author	Year	Country	No. of Factors	Major Findings
Alinaitwe et al.	2007	Uganda	36	Incompetent supervisors; Lack of skills from the workers; Rework; lack of tools/equipment; Poor construction methods.
Makulsawatudom, Emsley and Sinthawanarong	2004	Thailand	23	Lack of materials; Incomplete drawings; Incompetent supervisors; Lack of tools and equipment; Absenteeism.
Abdul Kadir et al.	2005	Malaysia	50	Material shortage at site; Non-payment to suppliers causing the stoppage of material delivery to site; Change order by consultants; Late issuance of construction drawing by consultants; Incapability of contractors' site management to organise site activities.

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Table 2. (*Continued*)

Author	Year	Country	No. of Factors	Major Findings
Enshassi et al.	2007	Palestine	45	Material shortages; Lack of labour experience; Lack of labour surveillance; Misunderstanding between labour and superintendents; Drawings and specifications alteration during execution.
Rivas et al.	2011	Chile	38	Materials; Tools; Rework; Equipment; Truck availability; The workers' motivational dynamics.
Ghoddousi and Hosseini	2012	Iran	31	Utilising the traditional construction methods instead of modern technology; Site manager is not experienced to handle challenges that arise in the field; Lack of proper tools and equipment on-site; Operatives do not possess skills and experience to perform the task; Site manager does not have the ability in training workers to perform their jobs properly.
Jarkas and Bitar	2012	Kuwait	45	Clarity of technical specifications; The extent of variation/change orders during execution; Coordination level among design disciplines; Lack of workers' supervision; Proportion of work subcontracted.
Attar, Gupta and Desai	2012	India	15	Lack of material; Delay in arrival of materials; Unclear instruction to workers; Workers strike; Financial difficulties of the owner.
Mahamid	2013	Saudi Arabia	31	Rework; Lack of cooperation and communication between construction parties; Financial status of the owner; Lack of labour experience; Lack in materials.
El-Gohary and Aziz	2014	Egypt	30	Workers' experience and skill; Incentive programs; Availability of materials and their ease of handling; Leadership and competency of construction management; Competency of workers' supervision.

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Table 2. (*Continued*)

Author	Year	Country	No. of Factors	Major Findings
Jarkas, Radosavljevic and Wuyi	2014	Qatar	38	Lack of financial incentive schemes; Slow decision-making process by owners; Remuneration scale; Delays in responding to requests; Shortage of skilled workforce.
Odesola and Idoro	2014	Nigeria	15	Craft workers' pride in their work; Lack of skills of the workers; rework; Incompetent supervisors; Workers' personal problems/poor economic condition of workers.
Jarkas	2015	Bahrain	37	Workers' skills; Coordination among design disciplines; Lack of workers' supervision; Errors and omissions in design drawings; Delays in responding to requests for information.
Jarkas, Al Balushi and Raveendranath	2015	Oman	33	Errors and omission in design drawings; Change to orders during execution; Delays in responding to requests for information; Lack of workers' supervision; Clarity of project specifications.
Hiyassat, Hiyari and Sweis	2016	Jordan	9	Planning; Worker-management relationship; Education and experience; Climate; Technology and equipment.
Afolabi et al.	2018	Nigeria	17	Availability of equipment and material; Supervision; Payment method; Welfare on site; Weather conditions.
Alaghbari, Al-Sakkaf and Sultan	2019	Yemen	40	Labour's experience and skill; Availability of materials in site; Leadership and efficiency in site management availability of materials in the market; Political and security situation.
Hai and Van Tam	2019	Vietnam	43	Experiences of workers; Workers' discipline; Types of salary payment; Quality of building materials; Ability to organise production.

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Table 2. (*Continued*)

Author	Year	Country	No. of Factors	Major Findings
Jalal and Shoar	2019	Iran	60	Fatigue; Lack of workers' motivation; Lack of skill; Schedule delay; Inflation in the cost of execution.
Adebowale and Smallwood	2020	South Africa	42	Inadequate workers' skills; Defective workmanship; Awarding contracts to lowest bidders; Industrial action resulting from political activities; Inadequate project planning.
Al-Rubaye and Mahjoob	2020	Iraq	21	Management of the construction site; Difficulty of entering or accessing the construction site because it requires entry and exit permissions; Work progress schedule that ensures the flow of work; Financial situation of the contractor; Effect of land acquisition.

RESEARCH METHODS

The research process entailed a systematic review of global CLP research and a metadata analysis of factors influencing CLP in the Middle East. A literature search was conducted using the systematic approach of the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) protocol guidelines. PRISMA offers evidence-based results and improves the quality of review reports through a transparent literature selection process (Alaloul et al., 2021). The Scopus database is the database with the largest number of publications in the field of construction; therefore, the database was preferred. Some of the construction research that has explored the Scopus database include Hosseini et al. (2018), Olawumi, Chan and Wong (2018), Vigneshkumar and Salve (2020) and Yi and Chan (2014). The search was carried out with the following search strings: "Factors Affecting Construction Productivity" or "Factors Affecting Construction Labour Productivity" or "Factors Influencing Construction Productivity" in the "articles title" of the database. The search took into account research projects conducted in Middle East countries from the year 2000 to 2020. The underlying reason for limiting sampled articles to documents published from 2000 to 2020 is to obtain contemporary issues confronting labour productivity in the Middle East. Figure 1 shows the research process using the PRISMA guidelines.

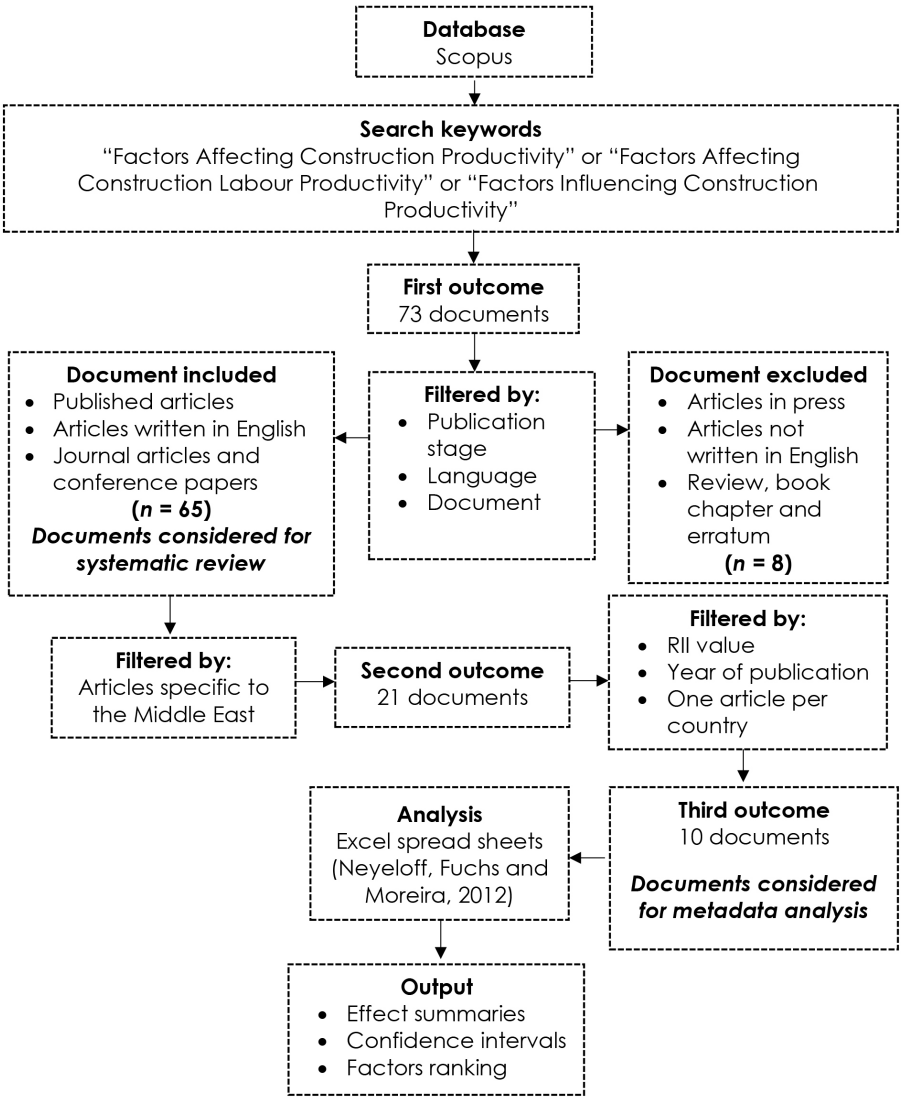

Figure 1. Research process

Over the years, the construction industry has evolved in the areas of technology, procurement, management and innovation. Therefore, it becomes essential to focus on recent articles that address the current issues. The Scopus database yielded 73 research articles. After this outcome, the database was filtered to obtain the most relevant research articles. There were 65 research articles that specifically investigated factors affecting CLP. The articles were relevant and considered for a systematic review. Relevant studies were distributed across different regions such as Africa, the Middle East, Europe and Asia, as shown in Table 3.

Table 3. Countries represented

Country	No. of Articles
Iran	4
Egypt	3
Vietnam	3
Saudi Arabia	2
Bahrain, Iraq, Jordan, Kuwait, Malaysia, Oman, Palestine, Qatar and Yemen	1 each
Total	21

Given that the objective of this study is to analyse the predominant factors that influence CLP in the Middle East, only 10 studies met the selection criteria and were therefore considered for metadata analysis. The selection criteria include research conducted in the Middle East, research conducted in the last 20 years (2000 to 2020), one article from each country and the Relative Importance Index (RII) values for the metadata analysis. The selected 10 Middle East studies reported several factors influencing CLP, as shown in Table 4.

Table 4. Selected Middle East-based studies for metadata analysis

S/N	Authors	Year	Country	No. of Factors Identified	No. of Citation (Until 1st October 2021)
1	Abdul Kadir et al.	2005	Malaysia	50	403
2	Enshassi et al.	2007	Palestine	45	458
3	Jarkas and Bitar	2012	Kuwait	45	378
4	Jarkas, Kadri and Younes	2012	Qatar	38	56
5	Mahamid	2013	Saudi Arabia	31	104
6	Hafez et al.	2014	Egypt	27	56
7	Jarkas	2015	Bahrain	37	77
8	Jarkas, Al Balushi and Raveendranath	2015	Oman	33	61
9	Alaghbari, Al-Sakkaf and Sultan	2019	Yemen	52	80
10	Toan et al.	2020	Vietnam	45	3

However, some of these factors were only reported in one or two studies. In order to obtain highly relevant factors, only factors that appear in at least three articles were considered. There were 35 factors reported in at least three articles. Subsequently, the RII values of the factors were extracted for analysis.

The metadata analysis includes the formulation of research questions. This study sought to answer the "what factors influence CLP in the Middle East?" A metadata analysis was carried out systematically with a set of results, based on quantitative analyses. A statistical combination of data from a number of studies

can estimate underlying effects more accurately than a single study. Therefore, the analysis in this study overcomes the limitations of small sample sizes by extrapolating a larger population of 10 CLP studies. Factors influencing CLP were grouped into four categories, which include: management, technological, human/ worker and external factors. The grouping is consistent with Alaghbari, Al-Sakkaf and Sultan (2019), Jarkas and Bitar (2012) and Sangole and Ranit (2013).

The outcome of the meta-analysis is the "effect" summary (Neyeloff, Fuchs and Moreira, 2012). The chosen model was determined by calculating the effect summary. The heterogeneity of the studies affects different populations in the selected studies. A fixed or random model could be selected depending on the homogeneity or heterogeneity of the sources. A fixed model assumes that differences in studies are due to sampling errors, while a random model takes into account and addresses differences in the sample population (Neyeloff, Fuchs and Moreira, 2012). The foregoing supports the adequacy of the random model to the heterogeneity of the sources. Furthermore, Sanni-Anibire, Mohamad Zin and Olatunji (2020) reported on the suitability of the randomised model for studies with heterogeneous sources. The random model requires a combination of sample size and effect size. The effect size is the RII value of the selected articles. Taking into account the size of the sample and the size of the effect, Neyeloff, Fuchs and Moreira (2012) recommended the formulas presented in Table 5 for computing the effect summary.

Table 5. Effect summary computation

S/N	Parameter	Abbreviation	Equation
1	Standard error	SE	$\frac{es}{\sqrt{es * n}}$
2	Variance	Var	SE^2
3	Individual study weight	w	$\frac{1}{SE^2}$
4	Cochran's statics	Q	$\Sigma\left(w * es^2\right) - \frac{\Sigma\left(w * es\right)^2}{\Sigma w}$
5	Modification constant	v	$\frac{Q - \left(k - 1\right)}{\Sigma w - \left(\frac{\Sigma w^2}{\Sigma w}\right)}$
6	Modified study weight	W_v	$\frac{1}{\left(SE^2 + v\right)}$
7	Effect summary	es	$\frac{\Sigma\left(w_v * es\right)}{\Sigma w_v}$
8	Standard error for effect summary	SE_{es}	$\sqrt{\Sigma \frac{1}{w_v}}$

RESULTS

Many studies preferred to use RII to rank the severity of factors affecting the CLP in the Middle East. However, some of the research adopted other statistical tools. For example, Jalal and Shoar (2019) adopted effect rates to classify factors affecting CLP in their study.

Hai and Van Tam (2019) adopted the impact index approach to rank the level of impact of factors. These studies and some of the research conducted in Iran, namely: Jalal and Shoar (2019), Ghoddousi and Hosseini (2012) and Rad and Kim (2018); in Iraq: Al-Rubaye and Mahjoob (2020); in Saudi Arabia: Almathami, Trigunarsyah and Coffey (2017); and in Vietnam: Hai and Van Tam (2019) were exempted from the analysis due to the lack of common analysis denominator. RII computation proposed by Dey, Prabhu and Subramani (2017) was adopted in this study.

$$RII = \frac{\sum w}{(A * N)} \quad \text{Eq. 1}$$

where $\sum w$ = weight of factor by response,
A = highest weight,
N = total number of respondents.

The values of RII and population (N) of the 10 studies selected are presented in Table 6. Literature has identified many factors that constitute impediments to CLP in the Middle East. From the selected studies, the average number of factors reported is 40.3 (as shown in Table 5). Some factors are repeatedly identified in the studies. The entire factors identified by these studies were scrutinised, where 35 factors were determined to be commonly studied by a minimum of three studies.

The selected Middle East research articles were printed and the factors in each article were thoroughly examined. Inclusion criteria were then determined for each factor to be considered for the analysis. To obtain factors relevant to the Middle East's productivity, factors present in one or two countries were considered less important to the region and were therefore discarded. For example, errors and omissions in design and drawings, which have been identified only in Bahrain (Jarkas, 2015) and Oman (Jarkas, Al Balushi and Raveendranath, 2015) as well as poor leadership by site managers, which was only found in Kuwait (Jarkas, Kadri and Younes, 2012) and Egypt (Hafez et al., 2014). Spreadsheets prepared by Neyeloff, Fuchs and Moreira (2012), which are useful for determining confidence intervals and effect summaries of quantitative data were utilised for the metadata analysis. The outcomes of the effect summaries and confidence intervals of 95% derived from the metadata analysis are presented in Table 7. The overall ranking of the 35 factors is shown as well as the ranking within the four classified groups. It also shows the confidence intervals of 95%, indicating a 95% possibility that the effect summary falls within the range indicated.

Table 6. RII values obtained from selected studies for metadata analysis

S/N	Factors Negatively Affecting CLP	Abdul Kadir et al. (2005) *N* = 100	Enshassi et al. (2007) *N* = 105	Jarkas and Bitar (2012) *N* = 180	Jarkas, Kadri and Younes (2012) *N* = 350	Mahamid (2013) *N* = 59	Hafez et al. (2014) *N* = 55	Jarkas (2015) *N* = 59	Jarkas, Al Balushi and Raveendranath (2015) *N* = 132	Alaghbari, Al-Sakkaf and Sultan (2019) *N* = 91	Toan et al. (2020) *N* = 56
1	Design complexity	0.711	–	0.796	0.412	–	0.727	0.567	0.612	0.848	–
2	Coordination among design disciplines	0.810	–	0.826	0.613	–	0.731	0.876	0.854	–	–
3	Clarity of technical specifications	–	–	0.843	0.786	–	0.793	0.619	0.862	0.844	–
4	Extent of change orders	0.848	0.800	0.837	0.771	–	0.724	0.625	0.896	0.850	0.786
5	Lack of incentive schemes	–	–	0.786	0.864	–	–	0.803	–	0.724	0.736
6	Proportion of work subcontracted	–	–	0.806	–	–	0.766	0.711	–	–	–
7	Construction method	–	0.621	0.524	–	0.444	0.756	0.748	0.806	–	0.765
8	Inspection delay	–	0.776	–	0.435	–	–	0.703	–	–	–
9	Inadequate workers' supervision	–	0.719	0.817	–	–	0.840	0.861	0.867	0.836	0.775
10	Rework	0.772	0.750	0.667	0.738	0.786	0.738	0.822	0.838	–	0.736

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Table 6. (*Continued*)

S/N	Factors Negatively Affecting CLP	Abdul Kadir et al. (2005) *N* = 100	Enshassi et al. (2007) *N* = 105	Jarkas and Bitar (2012) *N* = 180	Jarkas, Kadri and Younes (2012) *N* = 350	Mahamid (2013) *N* = 59	Hafez et al. (2014) *N* = 55	Jarkas (2015) *N* = 59	Jarkas, Al Balushi and Raveendranath (2015) *N* = 132	Alaghbari, Al-Sakkaf and Sultan (2019) *N* = 91	Toan et al. (2020) *N* = 56
11	Quality and availability of drawings	0.848	–	–	0.753	–	–	0.672	0.781	–	0.736
12	Material shortage at project site	0.912	0.895	0.529	0.801	0.709	0.720	0.761	0.776	0.878	0.768
13	Absenteeism	0.712	0.718	–	–	0.471	–	–	–	–	0.739
14	Inclement weather conditions	0.730	0.640	0.759	0.712	0.400	0.796	0.786	0.832	0.760	0.736
15	Problem of communication	–	–	0.521	0.723	0.780	–	0.555	–	0.814	0.696
16	Poor workers' motivation	–	0.690	0.694	–	0.573	0.833	0.719	0.739	–	0.718
17	A shortage of skilled labour	–	0.842	0.594	0.809	0.736	0.869	0.893	0.813	0.886	0.764
18	Working overtime	–	0.624	0.648	0.403	–	0.811	0.809	0.846	0.720	0.704
19	Unavailability of suitable tools and equipment	0.812	0.753	0.505	–	0.704	–	0.494	–	0.840	0.729

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Table 6. (*Continued*)

S/N	Factors Negatively Affecting CLP	Abdul Kadir et al. (2005) *N* = 100	Enshassi et al. (2007) *N* = 105	Jarkas and Bitar (2012) *N* = 180	Jarkas, Kadri and Younes (2012) *N* = 350	Mahamid (2013) *N* = 59	Hafez et al. (2014) *N* = 55	Jarkas (2015) *N* = 59	Jarkas, Al Balushi and Raveendranath (2015) *N* = 132	Alaghbari, Al-Sakkaf and Sultan (2019) *N* = 91	Toan et al. (2020) *N* = 56
20	Working within a confined space	0.736	0.703	0.547	–	0.488	0.633	0.685	0.769	–	0.707
21	Inadequate training	–	0.503	0.498	0.375	–	–	–	–	–	–
22	Payment delay	–	0.787	0.524	–	–	0.876	0.778	0.758	–	0.782
23	Physical fatigue	–	–	0.570	–	–	0.760	0.733	0.827	–	–
24	Poor site management	0.840	–	0.490	0.563	0.664	–	–	–	0.876	0.743
25	Unrealistic deadline for project completion	0.756	–	0.551	0.547	–	0.680	0.757	0.802	0.790	–
26	Accident	0.764	0.724	0.516	0.351	0.553	0.695	0.602	0.713	–	0.771
27	Stringent inspections	–	–	0.770	0.574	–	0.748	0.814	0.752	–	–
28	Economic conditions	0.712	–	–	–	–	–	–	–	0.842	0.779
29	Unsuitability of storage location	–	0.692	0.676	–	0.617	0.735	–	–	–	–
30	Government policies	0.766	0.608	–	–	–	–	–	–	–	0.721

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Table 6. (*Continued*)

S/N	Factors Negatively Affecting CLP	Abdul Kadir et al. (2005) *N* = 100	Enshassi et al. (2007) *N* = 105	Jarkas and Bitar (2012) *N* = 180	Jarkas, Kadri and Younes (2012) *N* = 350	Mahamid (2013) *N* = 59	Hafez et al. (2014) *N* = 55	Jarkas (2015) *N* = 59	Jarkas, Al Balushi and Raveendranath (2015) *N* = 132	Alaghbari, Al-Sakkaf and Sultan (2019) *N* = 91	Toan et al. (2020) *N* = 56
31	Project location	0.626	–	0.640	0.387	0.437	–	–	–	0.790	0.714
32	Lack of labour recognition programmes	–	0.618	0.437	0.488		–	–	–	–	0.675
33	Remuneration scale	–	–	–	0.828	0.607	–	–	–	0.780	–
34	Delays in responding to requests for information	–	–	0.767	0.822	–	–	0.830	0.878	–	–
35	Type of project	–	–	–	0.479	–	–	–	–	0.640	0.650

Table 7. Results from metadata analysis (effect summary, confidence interval and ranking)

S/N		Factors Affecting CLP	Effect Summary	Confidence Interval (95%)	Rank	
					Overall	Within Group
Management group	0.708	–	2	–	–	–
1	Man. 1	Lack of labour recognition programmes	0.555	0.605–0.505	33	19
2	Man. 2	Unsuitability of storage location	0.680	0.730–0.630	25	15
3	Man. 3	Stringent inspections	0.732	0.782–0.682	15	10
4	Man. 4	Unrealistic deadline for project completion	0.698	0.748–0.648	19	11
5	Man. 5	Inadequate training	0.459	0.509-0.409	35	20
6	Man. 6	Material shortage at project site	0.775	0.825–0.725	9	6
7	Man. 7	Unavailability of suitable tools and equipment	0.691	0.741–0.641	23	14
8	Man. 8	Payment delay	0.751	0.801–0.701	13	8
9	Man. 9	Poor site management	0.696	0.746–0.646	21	12
10	Man. 10	Proportion of work subcontracted	0.761	0.811–0.711	10	7
11	Man. 11	Inadequate workers' supervision	0.816	0.866–0.766	2	2
12	Man. 12	Accident	0.632	0.682–0.582	31	18
13	Man. 13	Lack of incentive schemes	0.783	0.833–0.733	7	5
14	Man. 14	Inspection delay	0.638	0.688–0.588	30	17
15	Man. 15	Working overtime	0.696	0.746–0.646	21	12
16	Man. 16	Coordination among design disciplines	0.785	0.835–0.735	6	4
17	Man. 17	Extent of change orders	0.793	0.843–0.743	4	3
18	Man. 18	Working within a confined space	0.659	0.709–0.609	29	16
19	Man. 19	Remuneration scale	0.738	0.788–0.688	14	9

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Table 7. (*Continued*)

S/N		Factors Affecting CLP	Effect Summary	Confidence Interval (95%)	Rank	
					Overall	Within Group
Workers group	0.723	–	1	–	–	–
1	Lab. 1	A shortage of skilled labour	0.801	0.851–0.751	3	1
2	Lab. 2	Physical fatigue	0.723	0.773–0.673	16	3
3	Lab. 3	Rework	0.761	0.811–0.711	10	2
4	Lab. 4	Poor workers' motivation	0.709	0.759–0.659	18	4
5	Lab. 5	Problem of communication	0.682	0.732–0.632	24	5
6	Lab. 6	Absenteeism	0.660	0.710–0.610	28	6
Technological group	0.695	–	3	–	–	–
1	Tec. 1	Construction method	0.666	0.716–0.616	27	4
2	Tec. 2	Quality and availability of drawings	0.758	0.808–0.708	12	2
3	Tec. 3	Design complexity	0.668	0.718–0.618	26	3
4	Tec. 4	Clarity of technical specifications	0.791	0.841–0.741	5	1
External group	0.687	–	4	–	–	–
1	Ext. 1	Inclement weather conditions	0.715	0.765–0.665	17	2
2	Ext. 2	Government policies	0.698	0.748–0.648	19	3
3	Ext. 3	Economic conditions	0.778	0.828–0.728	8	1
4	Ext. 4	Project location	0.555	0.605–0.505	33	4

The results indicate that the five most significant factors affecting CLP include: Man. 20: Delays in responding to requests for information; Man. 11: Inadequate workers' supervision; Lab. 1: A shortage of skilled labour; Man. 17: The extent of change orders; and Tec. 4: Clarity of technical specifications. The five least significant factors in their order of significance include Man 12: Accident; Tec. 5: Type of project; Man. 1: Lack of labour recognition programmes; Ext. 4: Project location; and Man. 5: Inadequate training. The mean values of the effect summaries calculated according to the four categories show that workers-related factors are

the most significant group affecting CLP. However, some previous studies, namely Alaghbari, Al-Sakkaf and Sultan (2019), Jarkas and Bitar (2012) and Sangole and Ranit (2013) found that the technological factors are the most significant group affecting CLP. Examining the top 10 critical factors affecting CLP in developing countries and the Middle East, three factors, which include: a shortage of workers' skills, lack of incentive programmes and inadequate supervision were found to be consistent in the studies from the Middle East and other developing countries. This suggests some level of commonalities in challenges confronting developing countries and the Middle East. Across studies, external groups were reported as the least significant factors, which is also consistent with the findings of this study. The most significant factors undermining CLP in the Middle East include delays in responding to requests for information, inadequate workers' supervision, a shortage of skilled labour, the extent of change orders and clarity of technical specifications. In terms of factors classification, workers and management-related challenges are predominant factors that affect the CLP in the Middle East, while external-related factors have a minimal influence.

DISCUSSION

This section presents a discussion of the most significant factors affecting CLP in the Middle East. The results were compared to the major findings in other developed and developing countries. Delays in responding to requests for information were a major barrier to site productivity in Kuwait, Qatar, Bahrain and Oman. Based on the perceptions of respondents surveyed in these countries, delays in responding to requests for information was ranked 10th, 25th, 22nd and 19th as a factor affecting CLP. Although, this factor was not ranked as one of the top five factors affecting CLP in these countries, its high mean score values (MSVs) however suggest that it is a major barrier to CLP in the four countries. A similar finding was obtained in a study conducted by Dai and Goodrum (2011) in the US. The study reported late response to drawing related information as one of the major challenges that were contributing to low productivity on construction job sites.

Challenges associated with workers' supervision have been largely reported in most of the studies in the Middle East, which suggests that supervision is a major issue preventing productivity growth in the region. Among the 10 Middle East countries, only studies conducted in three countries (Malaysia, Saudi Arabia and Qatar) have not reported inadequate workers' supervision as a challenge to CLP. Except in Qatar, where inadequate workers' supervision was ranked 22nd, the factor achieved a high ranking in Bahrain (1st), Palestine (2nd), Yemen and Vietnam (3rd) and Kuwait and Egypt (4th). The high ranking and MSVs of inadequate workers' supervision across different Middle East countries underscore the significance of workers' supervision challenges in the region. The findings of previous studies confirm that developed and developing countries alike are confronted with the problem of supervision on job sites. In developed countries, the factor was reportedly a major barrier to productivity growth in Canada (Hanna and Heale, 1994), the UK (Chan and Kaka, 2007), Türkiye (Kazaz, Manisali and Ulubeyli, 2008), the USA (Dai and Goodrum, 2011), New Zealand (Durdyev and Mbachu, 2011), Australia (Loosemore, 2014). Besides the identified countries in the Middle East, Uganda (Alinaitwe, Mwakali and Hansson, 2007), Thailand (Makulsawatudom, Emsley and

Sinthawanarong, 2004) and Nigeria (Afolabi et al., 2018) are developing countries from other regions that are reportedly affected by inadequate supervision.

Similar to most developing countries, skills shortage is one of the major challenges to productivity performance in the Middle East countries. Nine countries, with the exception of Malaysia, reported a shortage of skilled labour as one of the factors affecting construction productivity. The problem of skilled labour is critical to the productivity of the region as the factor was ranked as the most significant factor in Bahrain, Kuwait and Yemen. Similarly, a shortage of skilled labour was determined to be the second most significant productivity influencing factor in Palestine and Egypt. In Saudi Arabia and Qatar, skills shortage was ranked as the fourth and fifth most significant factor. Similar to the supervision problem, skills shortages in construction have been largely reported in developed and developing countries. The finding is consistent with Mojahed and Aghazadeh (2008) (in the USA), Durdyev and Mbachu (2011) (in New Zealand), Robles et al. (2014) (in Spain), Hwang, Zhu and Ming (2017) (in Singapore), Alinaitwe, Mwakali and Hansson (2007) (in Uganda) and Odesola and Idoro (2014) (in Nigeria).

Change orders contribute to delays and sometimes rework during construction project deliveries. Change orders, which are largely associated with clients and their professionals, have been one of the major obstacles to construction project deliveries. The prevalence of change orders is also evident in data gathered from the 10 Middle East countries. Only a study conducted in Saudi Arabia did not report change orders as a challenge to construction productivity. The extent of change orders achieved high MSVs in Oman (MSVs = 0.896), Yemen (MSVs = 0.850), Malaysia (MSVs = 0.848), Kuwait (MSVs = 0.837) and Palestine (MSVs = 0.800). These indicate that measures that mitigate the extent of change orders in the Middle East countries will significantly contribute to CLP growth in the region. Change orders as one of the major barriers to productivity growth in the Middle East is consistent with the findings of studies conducted in Chile (Rivas et al., 2011) and Singapore (Hwang, Zhu and Ming, 2017). Clarity of technical specifications was reported as a barrier to construction productivity growth. Complexity and ambiguity of design information have been recurring in productivity studies. Six studies conducted in the Middle East reported this factor as a challenge to construction productivity but Oman (MSVs = 0.862), Yemen (MSVs = 0.844) and Kuwait (MSVs = 0.843) achieved high MSVs which suggests the importance of the factor to CLP improvement.

The results of this study have lent insight into commonalities in the challenges confronting contractors in the Middle East and other developing countries. Problems associated with management resonate across the Middle East countries. Adopting strategic management and emerging technologies could meaningfully improve productivity performance in the Middle East countries. Strategic management should adopt a systemic approach to the entire processes involved in construction project deliveries. Skill development for new innovations would contribute to promoting the implementation of emerging technologies that would enhance the productivity of construction organisations in the region. Given the outcome of this study, Figure 2 presents a framework for CLP growth in the Middle East. The framework can further be unpacked by future studies.

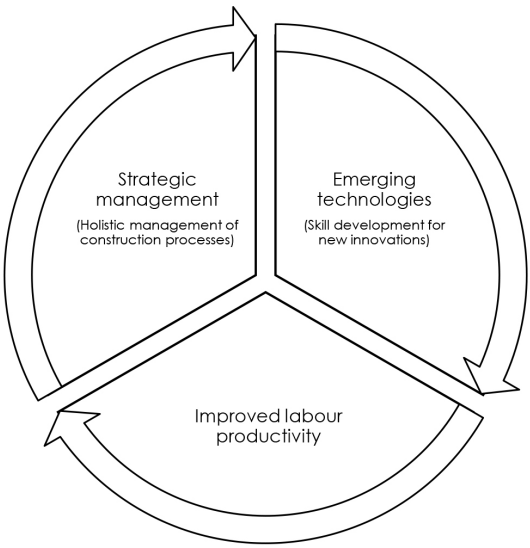

Figure 2. Construction productivity growth framework

CONCLUSION AND IMPLICATIONS

Volumes of CLP studies have achieved the objective of determining the important factors influencing labour productivity in the construction industry. This study found that some factors affecting CLP in different countries and regions differ from one another, while some factors are consistent. Scholars who have identified factors affecting CLP are largely subjective in their judgement. Some studies may have identified as many as 85 factors, while some may have focused only on nine factors. To our knowledge, a metadata analysis study that is focused on factors affecting CLP in the Middle East is still lacking. More generally, the CLP research field is also deficient in metadata analysis. Few research articles that review the existing literature relative to the factors affecting CLP were qualitative in nature. A meta-analysis-based systematic review provides a new direction and evidence-based results for CLP research.

Results of the metadata analysis were presented in the form of effect summaries using 95% confidence intervals. The study found delays in responding to requests for information, inadequate workers' supervision, a shortage of skilled labour, the extent of change orders and clarity of technical specifications as the major factors affecting the CLP in the Middle East. The results indicate that factors affecting CLP in the Middle East, especially problems associated with workers' supervision and a shortage of skilled labour are largely consistent with the findings of several studies conducted in developing countries. According to the classification of factors, workers and management-related challenges are the predominant factors affecting CLP in the region. The study's implications for professional practice entail the adoption of the study's key findings to evolve measures that promote productivity growth in the contractors' organisations. The construction industry in

the Middle East must begin to increasingly embrace strategic management and advanced technologies to achieve the desired productivity. For the region to achieve sustainable productivity growth, innovative technologies are essential to be adopted in practice. This would help to significantly reduce rework and improve communication of design intent. Similar studies are recommended for other regions such as Asia, Africa and Europe that have attracted special attention from researchers in the CLP research field. Such studies could compare the results obtained in this study with those from the regions. Although the Scopus database is the largest database in terms of publications, a single database constitutes a limitation to the research. It is recommended that future studies should consider more databases to ensure a more robust research approach.

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