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CRITICAL FACTORS AFFECTING LABOR PRODUCTIVITY WITHIN CONSTRUCTION PROJECT IMPLEMENTATION: A PROJECT MANAGER'S PERSPECTIVE

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Abstract. The present study aims to identify critical factors affecting labor productivity within the construction project implementation from the project manager's viewpoint. By a comprehensive review of the previous studies, this study identified 45 critical factors impacting construction labor productivity, which were grouped as primary 6 groups include: manpower, management, work condition, project, and external factors. A total of 56 valid samples were collected by 65 project managers' respondents who completed a structured questionnaire survey according to their previous participation in or directly implementation construction projects. These critical factors were ranked based on their relative important index and descriptive statistics (i.e. mean and standard deviation). The analysis of the identified critical factors indicated that the most significant critical factors impacting construction labor productivity are 'ability of construction management, 'financial status of stakeholders', 'work discipline', 'design changes', 'timeliness of remuneration', 'economic conditions', 'lack of supervision', 'accident', 'availability of labors', and 'availability of materials'

Keywords: critical factors; labor productivity; construction project implementation; affecting; project managers

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1. Introduction

For the economy of any country, the value of the construction industry has a significant contribution to the nation's gross domestic product. Despite the applied technological advancements, the construction industry remains a human-intensive industry (i.e. dependent upon effort and performance of the workforce) (Jarkas et al., 2014). Therefore, labor productivity plays a key role in assessing the success of construction projects which reflects the significant effect of this resource in the construction sector, meaning that any enhancement in labor productivity will contribute a high deal to enhance the project effectiveness (i.e., quality, cost, and time performances) (Mahamid, 2013b). In many countries, the construction labor cost would account for between 30% and 50% of the total cost of a construction project, so construction labor productivity as a determinant impacting almost construction projects' profitability (El-Gohary and Aziz, 2014, Hanna et al., 2002, McTague and Jergeas, 2002). Improving labor productivity seems is one of the most important objectives for any organization due to the fact it displays the efficiency and effectiveness conversion of sources into marketable merchandise and it determines commercial enterprise profitability (Wilcox et al., 2000). In this regard in the field of construction, many researchers have been conducted to purpose improvement labor productivity of construction practitioners (i.e., construction managers, engineers, architectures, and builders). Poor construction labor productivity is a major cause of influencing the quality, duration, and cost of construction projects (Mahamid, 2013b). Also, previous studies indicated that the loss of construction labor productivity is affected by various factors related to workforce, management, equipment and tools, materials, technology, and environment (Mustapha and Naoum, 1998, Van Tam et al., 2018, Enshassi et al., 2007, Alaghbari et al., 2019). However, perception of what factors affecting construction labor productivity may different depending on the roles of respondents in the construction project implementation (Perera et al., 2014). Therefore, the aim of this study is that identify and assess the critical factors impacting labor productivity within construction investment project implementation on basis of the awareness of project managers. The findings are expected to build a platform to implement better appropriate tasks towards improving construction labor productivity.

2. Literature Review

Productivity has been calculated is the ratio of the produced-outputs to the inputs that used to create the outputs (Coelli et al., 2005). In the construction context, construction labor productivity has been calculated is the rate of between the work units accomplished (i.e., outputs quantity) and the work hours (i.e., inputs for labors) (Ghoddousi and Hosseini, 2012, Enshassi et al., 2007). To enhance construction labor productivity, identifying critical factors that have influence labor productivity in the organization of construction projects is necessary. Therefore, various factors impacting labor productivity in the construction sector have been proposed and categorized by numerous scientific researchers from different countries as represented in the previous researches.

The studies of (Lim and Alum, 1995) conducted in Singapore that indicated that the most factors impacting construction labor productivity include difficult with the manpower recruitment, on-site supervisors recruitment, high labor income rate, construction site absenteeism, and problems of communication with oversea construction workers, whereas, in Saudi Arabia, top five factors include workforce experience and skills, lack of communication by construction stakeholders, poor relations between employees and their managers, timeliness of remuneration, and schedule delay (Mahamid et al., 2013). In Iran construction industry, (Zakeri et al., 1996) stated that lack of materials, severe weather and on-site conditions, low quality of equipment and tools, drawing quality, change orders, and proper equipment shortages which were the most factors impacting labor productivity, while, as shown in the research of (Jarkas et al., 2012), the top critical factors that have an important effect on construction labor productivity in Qatar such as supervision, labor skills, lack of materials, lack of experienced labor, communication, shortage of leadership of construction managers, high-temperature, delays in responding to "Requests For Information", shortage of providing labor with transportation, and percentage of work subcontracted.

(Alaghbari et al., 2019) studied factors impacting construction labor productivity in Yemen, the studies classified a total of 52 factors into four main categories that are human/labor group (8 factors), management group (17 factors), technical and technological group (12 factors), and external group (15 factors). In Bahrain, (Jarkas, 2015) grouped 37 factors into 4 primary categories that are management (19 factors), technological (11 factors), labor (3 factors), and external (4 factors), while (Jarkas et al., 2015) stated that there were 33 factors affecting construction labor productivity in Oman, which grouped into 4 four categories, including management (13 factors), technological (12 factors), labor (3 factors), and exogenous (5 factors). A total of 45 factors impacting labor productivity in building projects in the Gaza Strip were proposed by (Enshassi et al., 2007), who categorized these factors into 10 groups that are manpower (10 factors), leadership (3 factors), motivation (6 factors), time (5 factors), materials/tools (3 factors), supervision (4 factors), project (4 factors), safety (7 factors), quality (3 factors), and external (2 factors). The study of (Hiyassat et al., 2016) was conducted in Jordan, which indicated that 27 variables influencing construction labor productivity that were categorized by dimensions such as by dimensions such as creating a plan, the relations between craftsman and managers, education levels and labor experience, climate conditions, adopted technology, labor motivation, safety conditions, worker personal problems, and impact of religion.

In many years, the topic of factors influencing construction labor productivity has been concerned by numerous researchers. Consequently, various critical factors influencing construction workforce productivity have been demonstrated and grouped by lots of studies from many countries. However, the frequency and impact levels of these critical factors quite different from project to project or nation to nation, and even in the same construction project, depending on specific situations (Olomolaiye et al., 1998). Therefore, a task to divide these factors toward major global categories, it may relate and enclose to the numerous factors is critical. Based on referencing and considering previous studies, the present study synthesized critical factors impacting labor productivity in the construction implementation. A total of 45 critical factors influencing labor productivity within construction project implementation, which are divided into six categories as follows: (1) manpower (7 factors), management (13 factors), motivation (8 factors), work condition (5 factors), project (7 factors), and external (5 factors).

3. Research Methodology

The present study was carried out based on a questionnaire survey aimed at effectively collecting all the necessary data. As mentioned above, a total of 45 factors that impact labor productivity within the implementation of construction projects were identified. These factors were then tabulated in the form of a questionnaire.

The questionnaire survey was contained two major parts. The structured first part contains demographic information on the participants (i.e., education levels, qualifications, positions, and professional experience) whose main objective was to illustrate the participants in order to ensure reliability in this study outcomes. The structured second part contained the list of these identified factors. To collect needed data, participants were surveyed for interviews on the basis of their previous take part in or directly implementation construction investment projects in Vietnam. Based on their experience, they will assess the impact degree of the critical factors construction labor productivity following a 5-point Likert scale (i.e., 1-Very low effect, 2-Low effect, 3-Moderate effect, 4-High effect, 5-Very high effect).

For analyzing data, this study used the Relative Importance Index (RII) approach to evaluate the levels of impact of these critical factors influencing labor productivity within the construction project implementation. The RII method was adopted by numerous studies (i.e., (Alaghbari et al., 2019, Jarkas, 2015, Jarkas et al., 2012, Hiyassat et al., 2016, Gunduz and Abdi, 2020). The RII index was assessed based on the below formula 'Eq. (1)' as follows:

$$RII = \frac{\sum_{i=1}^5 W_i \times X_i}{5 \sum_{i=1}^5 X_i} \quad (1)$$

Where: W_i is the rating given to factor by the respondent ranging from one to five; X_i is the proportion of respondents scoring; i is the order score ranging between one and five.

Responses from the first part can be obtained through the appropriate response choice. In the second part participants needed to assess the factors that influence construction labor productivity on a Likert scale from 1 (very low influence) to 5 (very high influence). The RII index is applied to evaluate these factors influencing construction labor productivity as perceived by the participants and, therefore, a comparative analysis is possible.

The collection of case-specific data was conducted by respondents who engaged with construction projects in Vietnam and working as project managers. A total of 73 samples were distributed by email and face-to-face interviews. Only 65 answers were received, and 56 qualified responses for research, representing an effective rate of 76.7%.

4. Results and Discussions

In the present study, there are two software applications were applied to examine the findings, which are MS Excel 365 and SPSS 22. A total of 45 critical factors affecting labor productivity within construction project implementation have been identified and ranked on the basis of their descriptive statistics (i.e., mean and standard deviation), and the RII index.

4.1. Manpower factors group

Table 1: Ranking of factors under manpower group

Factors	M	SD	RII	Rank
Work discipline	3.946	0.840	0.789	1
Laborers' experience and skills	3.821	1.081	0.764	2
Age of laborers	3.714	1.124	0.743	3
Strength and physical of laborers	3.714	1.091	0.743	4
Absenteeism	3.696	1.094	0.739	5
Labor's education level	3.536	0.934	0.707	6
Personal problems	3.429	1.093	0.686	7

Note: M is Mean, SD is Standard Deviation, and RII is Relative Importance Index

Table 1 indicates the ranking of 7 factors related to the manpower category. The results statistics of project managers' respondents indicate that 'work discipline' with RII=0.789 was ranked the 1st in this group and ranked 3th in the overall ranking (Table 8), which proves that this factor has a very high impact on labor productivity within construction project implementation. This finding is in line with some previous studies (i.e., (Van Tam et al., 2018, Durdyev and Mbach, 2011, Enshassi et al., 2007, Gerges et al., 2011)). With RII=0.764, 'laborers' experience and skills' factor was ranked 2nd in this group and assessed 12th among all 45 factors, which indicates that the factor has a high influence on labor productivity. Followed by 'age of laborers' (RII=0.743), 'strength and physical of labor' (RII=0.743), 'Labor absenteeism' (RII=0.739) was ranked 3rd, 4th, and 5th respectively in the category. Finally, 'labor's education level' (RII=0.707), and 'personal problems' (RII=0.686) was assessed at the end of manpower group, and ranked 33rd, 39th in overall ranking respectively, which shows that these factors have a low impact on labor productivity within construction project implementation.

4.2. Management factors group

The ranking of 13-factor under management category was provided in Table 2, with RII=0.814, the surveyed project managers ranked ‘ability of construction management’ it the 1st in this group. This factor was also assessed is the first factor among 45 critical factors, which proves that this factor has a very high effect on labor productivity within construction project implementation. This evidence was further supported by (Ghahramanzadeh, 2013), who stated that project managers' incompetence is one of the serious issues barrier the labor productivity improvement in the Iran construction sector. The ranking is also in line with the study by (Ghoddousi and Hosseini, 2012), which showed that the competence of project managers as an important factor impacting the labor productivity of construction projects.

Table 2: Ranking of factors under management group

Factors	M	SD	RII	Rank
Ability of construction management	4.071	0.850	0.814	1
Financial status of stakeholders	3.982	0.963	0.796	2
Lack of supervision	3.875	0.634	0.775	3
Availability of labors	3.857	0.819	0.771	4
Availability of materials	3.839	1.156	0.768	5
Site management	3.714	1.074	0.743	6
Rework	3.679	1.309	0.736	7
On-site storage	3.679	1.011	0.736	8
Availability of equipment/tools	3.643	1.212	0.729	9
Lack of supervisors' experience	3.554	1.043	0.711	10
Working overtime	3.518	1.128	0.704	11
Communication	3.482	1.206	0.696	12
Construction methods	3.375	1.169	0.675	13

With the RII ranging between 0.796 and 0.768, four factors have a significant effect on construction labor productivity such as ‘financial status of stakeholders’, ‘lack of supervision’, ‘availability of labors’, and ‘availability of materials’ which ranked 2nd, 3rd, 4th, and 5th in this ground and evaluated 2nd, 7th, 9th, and 10th among al critical factors, in turn. In fact, construction activities are implemented with many resources, one of which financial, labors, materials play an important role. Many buildings needed a large amount of capital and almost of contractors perceive it exceptionally troublesome to bear the high daily execution expenses in the case of laborers’ salaries are delayed (Mahamid, 2013a). The outcomes of researches (i.e., (Hai and Van Tam, 2019, Alinaitwe et al., 2007, Kadir et al., 2005), which demonstrated that the limitation of finances as a problem in improving labor productivity. With the RII ranging between 0.704 and 0.675, the surveyed project managers ranked three factors are ‘working overtime’, ‘communication’, and ‘construction methods’ at the end of this group, which reveals that three factors have a very low influence on construction labor productivity.

4.3. Motivation factors group

Table 3 provides the ranking of factors relevant to the motivation category, 8 critical factors are identified under this group. The surveyed respondents ranked factors of ‘timeliness of remuneration’ (RII=0.782) and ‘amount of remuneration’ (RII=0.764) were ranked the first and the second in this category, and assessed the 5th, and 11th overall ranking, respectively. The finding indicates that these factors as determinants impact on construction labor productivity. This ranking was supported by the studies of (Ghoddousi et al., 2014, Tabassi and Bakar, 2009), which explained that managers are the good perception that construction craftsman still has to face with low salary, which has been identified as a problem in many countries and late payments have a dramatic effect on the main aspects of productivity in the construction sector (Tam et al., 2004, Jarkas and Radosavljevic, 2013, Perera et al., 2014, Kaliba et al., 2009).

Table 3: Ranking of factors under motivation group

Factors	M	SD	RII	Rank
Timeliness of remuneration	3.911	0.880	0.782	1
Amount of remuneration	3.821	1.011	0.764	2
Work satisfaction	3.804	1.313	0.761	3
Promote opportunities	3.732	1.228	0.746	4
Rewards/Punishments	3.679	1.309	0.736	5
Motivation of laborers	3.589	1.290	0.718	6
Lack of labor recognition programs	3.375	1.001	0.675	7
Creating competition	3.339	1.405	0.668	8

With the RII ranging between 0.761 and 0.736, three factors have a significant impact on labor productivity in construction project implementation such as ‘work satisfaction’, ‘promote opportunities’, and ‘rewards/punishments’ which ranked 3rd, 4th, and 5th in this category and 13th, 16th, and 26th among 45 critical factors, respectively. Finally, factors of ‘motivation of laborers’, ‘lack of labor recognition programs’, and ‘creating competition’ were ranked at the end in the motivation group, with RII are 0.718, 0.675, and 0.668 respectively. The ranking reveals that this 3-factor has a low effect on construction labor productivity.

4.4. Work condition factors group

As demonstrated in Table 4, with RII=0.786, the analysis result indicated that ‘accident’ factor was ranked the 1st in this group and the 8th overall ranking, which shows that the factor has a very high impact on labor productivity within construction project implementation. Followed by the factor of ‘healthy and safety conditions’ (RII=0.754) was assessed the second in the work condition group and 14th among all factors, which reveals that this factor as a determinant on construction labor productivity. The evidence in the line with the outcomes of some previous studies (i.e., (Ghoddousi et al., 2015, Ghoddousi and Hosseini, 2012), which explained that the construction industry is known for its poor working conditions and the adoption of health and safety measures in several developing countries.

In this category, the factor of ‘working security’ (RII=0.746) was ranked the 3rd in this category and 15th among 45 factors, whereas ‘working space’ (RII=0.707) was ranked the 4th under work condition group and 25th overall ranking. With RII=0.682, ‘height of work site’ was evaluated at the end of this group and 40th among all factors. This ranking indicates that the factor has a very low impact on construction labor productivity.

Table 4: Ranking of factors under work condition group

Factors	M	SD	RII	Rank
Accident	3.857	0.943	0.771	1
Healthy and safety conditions	3.768	1.009	0.754	2
Work security	3.732	0.963	0.746	3
Working space	3.536	0.852	0.707	4
Height of work site	3.411	1.092	0.682	5

4.5. Project factors group

Table 5 demonstrates the ranking of factors relevant to the project group, 7 critical factors are identified under this category. With RII=0.786, the surveyed respondents ranked ‘design changes’ is the 1st position in this group and the 4th among 45 critical factors, which indicates that this factor has a significant impact on labor productivity within construction project implementation. This ranking was further supported by the study of (Enshassi et al., 2007), which demonstrated that specification alteration during the construction project organization was the primary factor impacting labor productivity.

Table 5: Ranking of factors under project group

Factors	M	SD	RII	Rank
Design changes	3.929	0.871	0.786	1
Effective project	3.696	0.913	0.739	2
Drawing quality	3.679	0.855	0.736	3
Project location	3.571	1.024	0.714	4
Design complexity	3.554	1.111	0.711	5
Sub-contractor	3.446	1.174	0.689	6
Project type	3.250	1.014	0.650	7

With the RII ranging between 0.739 and 0.714, three factors have a significant effect on construction labor productivity such as ‘effective project s’, ‘drawing quality’, and ‘project location’ which ranked 2nd, 3rd, and 4th under project category and assessed 20th, 23th, and 30th overall ranking, respectively. Finally, critical factors such as ‘design complexity’ (RII=0.711), ‘sub-contractor’ (RII=0.689), and ‘project type’ (RII=0.650) were ranked at the end of this category. The ranking reveals that these factors have a low influence on labor productivity within construction project implementation.

4.6. External factors group

Table 6: Ranking of factors under external group

Factors	M	SD	RII	Rank
Economic conditions	3.893	0.966	0.779	1
Weather conditions	3.679	1.377	0.736	2
Regulation and law	3.607	1.139	0.721	3
Social culture	3.482	0.934	0.696	4
Geological and hydrological conditions	3.375	1.169	0.675	5

The results of Table 6 indicate that 5-factor of the external group has been ranked by the RII index under perceptions of project managers. The surveyed respondents evaluated ‘economic conditions’ (RII=0.779) was the first in this category and ranked sixth overall ranking, which indicates that the factor as a determinant having a significant influence on labor productivity in the construction project implementation. Followed by factors of ‘weather conditions’(RII=0.736), and ‘regulation and law’ were assessed the second and third positions in the group and 24th and 28th among 45 identified factors, respectively. The finding was supported by studies of (Kaming et al., 1997, Van Tam et al., 2018), which demonstrated that construction activities are significantly impacted by weather conditions. Finally, with RIIs are 0.696 and 0.675, ‘social culture’ and ‘geological and hydrological conditions’ were ranked at the end of this group, which proves that these two factors have a low impact on construction labor productivity.

4.7. Overall ranking critical factors influencing labor productivity within construction project implementation

The overall perceived impacts of all 45 factors were shown in Table 7. As provided, the top five ranking critical factors influencing labor productivity within construction project implementation as follows: ‘ability of construction management’, ‘financial status of stakeholders’, ‘work discipline’, ‘design changes’, ‘timeliness of remuneration’, ‘economic conditions’, ‘lack of supervision’, ‘accident’, ‘availability of labors’, and ‘availability of materials’. The ranking reveals that the top ten factors have a significantly important impact on construction labor productivity.

Table 7: Overall ranking critical factors influencing labor productivity within construction project implementation

Factors	M	SD	RII	Rank
Ability of construction management	4.071	0.850	0.814	1
Financial status of stakeholders	3.982	0.963	0.796	2
Work discipline	3.946	0.840	0.789	3
Design changes	3.929	0.871	0.786	4
Timeliness of remuneration	3.911	0.880	0.782	5
Economic conditions	3.893	0.966	0.779	6
Lack of supervision	3.875	0.634	0.775	7
Accident	3.857	0.943	0.771	8
Availability of labors	3.857	0.819	0.771	9
Availability of materials	3.839	1.156	0.768	10

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Factors	M	SD	RII	Rank
<i>Amount of remuneration</i>	3.821	1.011	0.764	11
Labors' experience and skills	3.821	1.081	0.764	12
Work satisfaction	3.804	1.313	0.761	13
Healthy and safety conditions	3.768	1.009	0.754	14
Work security	3.732	0.963	0.746	15
Promote opportunities	3.732	1.228	0.746	16
Age of labors	3.714	1.124	0.743	17
Strength and physical of labors	3.714	1.091	0.743	18
Site management	3.714	1.074	0.743	19
Effective project	3.696	0.913	0.739	20
Absenteeism	3.696	1.094	0.739	21
Rework	3.679	1.309	0.736	22
Drawing quality	3.679	0.855	0.736	23
Weather conditions	3.679	1.377	0.736	24
On-site storage	3.679	1.011	0.736	25
Rewards/Punishments	3.679	1.309	0.736	26
Availability of equipment/tools	3.643	1.212	0.729	27
Regulation and law	3.607	1.139	0.721	28
Motivation of laborers	3.589	1.290	0.718	29
Project location	3.571	1.024	0.714	30
Design complexity	3.554	1.111	0.711	31
Lack of supervisors' experience	3.554	1.043	0.711	32
Labor's education level	3.536	0.934	0.707	33
Working space	3.536	0.852	0.707	34
Working overtime	3.518	1.128	0.704	35
Social culture	3.482	0.934	0.696	36
Communication	3.482	1.206	0.696	37
Sub-contractor	3.446	1.174	0.689	38
Personal problems	3.429	1.093	0.686	39
Height of work site	3.411	1.092	0.682	40
Lack of labor recognition programs	3.375	1.001	0.675	41
Geological and hydrological conditions	3.375	1.169	0.675	42
Construction methods	3.375	1.169	0.675	43
Creating competition	3.339	1.405	0.668	44
Project type	3.250	1.014	0.650	45

5. Conclusions and recommendations

The present study aimed to identify a total of 45 critical factors influencing labor productivity within construction project implementation, which were grouped into the main 6-category that are manpower, management, work condition, project, and external factors. The data was collected by 56 valid surveyed questionnaires with participants of construction project managers, and critical factors were ranked based on their RII index and descriptive statistics. The results highlight the primary factors impacting construction labor productivity in construction projects as perceived by project managers, including ‘ability of construction management’, ‘financial status of stakeholders’, ‘work discipline’, ‘design changes’, ‘timeliness of remuneration’, ‘economic conditions’, ‘lack of supervision’, ‘accident’, ‘availability of labors’, and ‘availability of materials’.

On the basis of the findings, the following recommendations are suggested as a way to improve labor productivity within the construction project implementation.

1. Project management unit should encourage construction project managers to learn practical skills and real experience about construction management through programs of regular training the help them to keep up to date and aware of valuable project management skills that have to be enhanced.
2. The project management unit should create workshops and training courses to help project managers to improve the managerial experience and skills as well as keep management activities on construction sites to enhance quality and prevent incorrect productions.
3. It is necessary owners should pay progress payment to contractors on time because it affects the contractors’ ability to finance the work, leading to a shortage in materials and delay payments to laborers which affect their motivation to work.
4. The project management unit should introduce regulations and rules in the working environment to control the work discipline of the construction workforce. Besides, it is necessary to create recognition programs (i.e. rewards or punishment) to encourage laborers to keep their discipline on site which also makes significant restriction accidents in the construction project implementation.
5. Project managers should supervise and control materials supply for each specific construction project. This schedule should involve the time required to supply materials and the materials available on the local market to supply the required materials in time. In addition, the project management unit should require contractors should also select a reasonable storage location for purchased materials in each project, which should be easily accessible and close to implement projects and to avoid wastage of labor time for multiple-handling materials.
6. The project management unit should reduce design changes by the way that strongly controls the quality of drawings at the design stage order to explore errors or conflicts which can restrict reworks. Also, applying for construction management technology advances (i.e., building information modeling-BIM, scan to BIM,...) in the construction project implementation should be encouraged which can lead to improving project performance and profit maximum.

Although some results have been concluded from the present study, the authors encourage other researchers to replicate this topic in many different areas, countries, so that the important factors revealing elsewhere, and the bases platform the related findings can further support to the comprehensive theoretical understanding of the more complex problems of the construction labor productivity topic and the critical factors related with specific socioeconomic conditions and cultural backgrounds.

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