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ANALYZING OF INFLUENCING FACTORS AFFECTING LABOR PRODUCTIVITY IN CONSTRUCTION PROJECTS IN REMOTE AREAS

Mohamed Mahdy[1*] , Rafik K. Abdel Wahab[2,3], Moamen Abd El Raouf[2]

[1] Civil Engineering Department, Faculty of Engineering, Al-Azhar University, Cairo, Egypt

[2] Civil Engineering Department, Faculty of Engineering, Qena Branch- Al-AzharUniversity, Qena, Egypt.

[3] High Institute for Engineering and Technology in Obour City –Qalyobia -Egypt

***Correspondence:** mmmbehiry@gmail.com

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ABSTRACT

Construction projects in remote areas in Egypt are characterized by geographical isolation, limited resources, logistical difficulties, and harsh environmental conditions, all of which can significantly affect labor performance and productivity. Although remote areas are often viewed as barren, they represent great importance and wasted wealth in economic, cultural, and tourism terms. The problem lies in its distance from urban areas, and thus the lack of basic services such as health, transportation, water, and energy sources. This research aims to study the factors that affect labor productivity in construction Projects in remote areas. To achieve the main goal, the concepts of productivity were identified and analyzed, The criteria used to define a construction project as a remote project. As well as identifying the factors affecting labor productivity in the construction sector. Studying the factors that affect labor productivity, whether positively or negatively, is essential to enhance productivity in this study. In this study, A questionnaire was designed to collect the data divided into four main groups (50 factors) that affect labor productivity. The influencing factors and the relationship between them are: First, human factors. Secondly, administrative factors. Third, technical factors. Fourth, external factors. The questionnaire was distributed to several (100) employees who are working in one of the biggest contracting companies in Egypt. Importance index analysis was used to determine the factors affecting project labor productivity. The results showed that the most influential human factor is the experience and skill of the workers employed, the most influential administrative factor is the availability of materials on site, the most influential technical factor is the interruption of work due to a change in designs or specifications, and the most influential external factor is the difficulty of access to the site. These study results shed light on the most influential factors on labor productivity, which helps decision-makers focus on them. They also consider the importance of the factors with weak effects, which contribute to increasing productivity and accelerating the work of delayed or stalled projects in remote areas.

KEYWORDS: Labor productivity, workers' skills, availability of materials, construction projects, remote areas

تحليل العوامل المؤثرة على إنتاجية العمالة في مشاريع البناء بالمناطق النائية

محمد مهدى[1*]، رفيق خيرى[2,3]، مؤمن السيد[4]

[1] قسم الهندسة المدنية كلية الهندسة جامعه الازهر - القاهرة

[2] قسم الهندسة المدنية كلية الهندسة جامعة الازهر- قنا

[3] قسم الهندسة المدنية المعهد العالى للتكنولوجيا بالعبور- القليوبية

البريد الالكترونى للباحث: mmmbehiry@gmail.com

الملخص

تتميز المشروعات الانشائية فى المناطق النائية في مصر بالعزلة الجغرافية، و الموارد المحدودة ، والصعوبات اللوجستية، والظروف البيئية القاسية ، وكلاً منها يمكن أن يؤثر بشكل كبير على أداء العمالة والإنتاجية . وعلى الرغم من أن المناطق النائية غالبا ما ينظر إليها على أنها قاحلة، إلا أنها تمثل أهمية كبيرة وثروة مهدرة من الناحية الاقتصادية والثقافية والسياحية. وتكمن المشكلة في بعدها عن المناطق الحضرية، وبالتالي عدم توفر الخدمات الأساسية مثل الصحة والنقل والمياه ومصادر الطاقة. يهدف هذا البحث إلى دراسة العوامل التي تؤثر على إنتاجية العمالة في المشروعات الانشائية في المناطق النائية ولتحقيق الهدف الاساسي تم تحديد وتحليل مفاهيم الإنتاجية و كذلك المشروعات الانشائية و تحديد المعايير المستخدمة لتعريف المشروع الإنشائي كمشروع فى مناطق نائية. بالاضافة الى ذلك التعرف على العوامل المؤثرة على إنتاجية العمالة في قطاع البناء والتشييد. إن دراسة العوامل التي تؤثر على إنتاجية العمالة، سواء بشكل إيجابي أو سلبي، أمر ضروري لتعزيز الإنتاجية في هذه الدراسة. في هذه الدراسة تم تصميم استبيان لجمع البيانات و تم تقسيمه إلى أربع مجموعات رئيسية (٥٠ عاملاً) تؤثر على إنتاجية العمالة. ان العوامل المؤثرة والعلاقة بينهما هي: أولاً، العوامل البشرية. ثانياً، العوامل الإدارية. ثالثاً، العوامل الفنية. رابعاً، العوامل الخارجية. وقد تم توزيع الاستبيان على عدد (١٠٠) موظف و الذين يعملون في إحدى أكبر شركات المقاولات فى مصر . تم استخدام تحليل مؤشر الأهمية لتحديد أكثر العوامل المؤثرة على إنتاجية العمالة في المشاريع، وقد أظهرت النتائج أن العامل البشري الأكثر تأثيراً هو خبرة ومهارة العمالة المستخدمة، والعامل الإداري الأكثر تأثيراً هو توفر المواد في الموقع، والعامل الفني الأكثر تأثيراً هو انقطاع العمل بسبب تغيير في التصميمات أو المواصفات، والعامل الخارجي الأكثر تأثيراً هو صعوبة الوصول للموقع. أظهرت النتائج أن مجموعة العوامل الخارجية هي الأكثر تأثيراً على انتاجية العمالة فى المشروعات الانشائية فى المناطق النائية. وتساهم نتائج الدراسة هذه في إلقاء الضوء على أكثر العوامل تأثيراً على إنتاجية العمالة مما يساعد متخذي القرار على التركيز عليها، مع الأخذ في الاعتبار أهمية العوامل ذات التأثيرات الضعيفة مما يساهم في زيادة الإنتاجية وتسريع عمل المشاريع المتأخرة أو المتوقفة في المناطق النائية.

الكلمات المفتاحية: إنتاجية العمل، مهارات العمال، توفر المواد، مشاريع البناء، المناطق النائية.

1. INTRODUCTION

The construction sector plays an important role in the economy of any developing country. The construction industry is a significant contributor to the Egyptian economy and is regarded as one of its fastest-expanding sectors. It also contributed significantly to the economy, averaging 4.8 percent of GDP in 2015 [20]. Currently, the construction sector in remote areas suffers significantly from delays in project completion as well as overruns and an increase in costs, which are indicators of productivity problems [5].

Labor productivity plays a major role in the success of any project. However, it may be affected by many factors and variables and unexpected difficulties. These variables can include factors related to materials, tools and Equipment, construction methods, political factors, financing, the environment, etc. Low labor productivity is also one of the main reasons affecting cost and time overruns in construction projects. Accordingly, this factor should be given great attention by decision-makers and leaders in the construction sector [17]. Construction is also a labor-intensive industry, and this factor is considered very important and influential. The significance of labor productivity in construction cannot be overstated, as it directly impacts project performance in terms of cost, quality, and Time [9].

Labor productivity also constitutes a major importance in the construction sector in most countries, especially the cost of labor represents 30-50% of the total project cost [27]. The significance of labor productivity in construction projects lies in its ability to drive project success and overall performance [27].

The measurement of labor productivity in construction projects, particularly in remote areas, is a critical yet understudied topic despite its significant impact on project outcomes. This research gap necessitates a comprehensive investigation into the key factors influencing labor

productivity in remote construction projects. Measuring construction productivity accurately is essential for identifying areas of improvement and implementing effective solutions. This research showes the unique challenges faced in remote construction, including geographical isolation, limited resources, and harsh environmental conditions. These factors can significantly impact labor performance and overall project productivity. By focusing on the specific context of remote areas, this study sheds light on a critical need in the construction industry for targeted productivity improvement strategies.

The primary objectives of this study are to identify and analyze these crucial factors, providing construction industry professionals with a more nuanced understanding of the elements affecting labor productivity. Furthermore, this research aims to offer evidence-based recommendations to project managers for optimizing manpower utilization in remote areas.

2. THE AIM OF THIS STUDY

To examine the factors that affect labor productivity in the construction sector. In remote areas, the following is done to achieve the specified goal:

1. Analyze the concepts of productivity and labor productivity.
2. Definition and Characteristics of a construction project.
3. Identify the factors affecting labor productivity in the building and construction sector.

3. DEFINITIONS AND THEORETICAL FRAMEWORK FOR PRODUCTIVITY CONCEPT

The term productivity originally appeared in 1766 when it was first mentioned in an essay by Quesnay. Later, in 1883, productivity was defined as the "faculty to produce". In the early twentieth century, a more specific definition was "the relationship between output and the means utilized to achieve that output" [4].

It’s referred to Productivity in construction projects as the measure of efficiency and effectiveness of resources (such as labor, materials, and equipment) that are utilized to complete the desired scope of work within a given time frame while meeting quality standards and achieving project objectives [14]. Productivity is defined as the craft hours necessary to produce a unit of finished product [13].

Another way is defined as the units of production divided by the corresponding time of workers [6,10]. Productivity can be expressed in its simplest form; it is the relationship between a given outcome and the resources expended to produce that outcome. In simpler terms, it is units of work over units of input (or the inverse) [25].

There are many different outlooks on productivity definition, but they all reflect the same objective. In all contexts of productivity definitions, there was a consensus that it refers to output over input but they express output and input in different ways.

3.1 Construction project

Construction projects are complex undertakings that involve the planning, design, and execution of various activities to create or modify physical structures, such as buildings, infrastructure, or industrial facilities. A number of important factors, such as cost, quality, schedule requirements, social and environmental effects, and wider stakeholder interests, must be carefully considered in the field of construction project management [15].

According to the Project Management Institute (PMI, 2017), a construction project can be defined as "a temporary endeavor undertaken to create a unique product, service, or result." This

definition highlights the temporary nature of construction projects, which have a defined beginning and end, and the uniqueness of the final product or outcome [21].

Remote construction projects can be defined as "construction activities that are carried out at a location physically separated from the main project site, often facilitated by advanced communication and technology tools" [18]. This definition highlights the key distinguishing feature of these projects – the physical distance between the construction site and the various stakeholders involved, such as project managers, designers, and subcontractors.

The criteria used to define a construction project as a remote project, as identified by respondents in a study included travel time from the main office or branches and the duration of travel time. Specifically, around 63% of respondents indicated that the travel time from the main office or branches is between 100-300 km, while 37% stated it is between 301-600 km. Regarding travel time, 74% of respondents mentioned it takes between 1-4 hours, and 26% indicated it takes more than 4 hours [23]. One of the key characteristics of construction projects is their inherent complexity, which arises from the diverse range of activities, resources, and stakeholders involved. Construction projects typically require the integration of various disciplines, such as architecture, engineering, project management, and construction management, to ensure the successful completion of the project [16].

3.2 Factors affecting labor productivity in construction projects

The factors affecting labor productivity have been attracting much attention from researchers in the field of construction management. In Egypt, a study was conducted to explore the factors affecting labor productivity in the construction industry, with a focus on the role of leadership. This study employed a mixed-methods approach, combining surveys and interviews with construction professionals. The research findings highlighted the significant impact of effective leadership on labor productivity, including factors such as clear communication, participative decision-making, and fostering a positive work environment. The authors recommended providing leadership training programs and promoting a supportive organizational culture to leverage effective leadership for enhancing productivity [11].

Another study investigated the factors affecting construction labor productivity in Egypt. Using a survey-based methodology, they gathered information from 92 construction industry experts engaged in a range of projects. The study found that several important issues, such as low worker motivation, insufficient supervision, subpar site management, and material shortages, have a detrimental effect on labor productivity. The authors recommended implementing effective incentive programs, improving supervision and site management practices, and ensuring efficient material supply to enhance labor productivity on construction sites in Egypt [7].

Finding and ranking the elements influencing labor productivity was the goal of a study that was validated in the Libyan construction sector. To achieve this, a total of 30 productivity factors were recognized and categorized into three primary groups: Management, Technological, and Human/Labor. A questionnaire survey was conducted with a statistically demonstrative sample of contractors and embassies. The Management group was identified as the most important, followed by the Technological and Human/Labor group. Lack of labor supervision, experience and skill of labor, and construction technology were identified as the top three factors negatively affecting labor productivity. The study provides valuable recommendations to construction managers to achieve more effective management of construction labor forces [2].

A study on building projects in Pakistan explored factors that significantly affect labor productivity. The study, which adopted a quantitative approach, reviewed previous literature from the past decade, identified the critical factors that affect labor productivity, and conducted a survey employing the identified factors. Based on an analysis of the data obtained from 133 successfully answered questionnaires, the study identified 15 crucial factors influencing labor productivity. These include the shortage of materials, the shortage of equipment, a lack of supervision, low wages, old and inefficient equipment, overtime, delays in salary payments, worker's experience,

reward mechanisms, reworks, the height of working workplace, improper planning, worker's age, lighting and ventilation, and weather conditions. The study also made recommendations and suggestions to overcome labor productivity issues, such as providing basic amenities for laborers, ensuring employers give minimum wage, and offering training and improving skills to employees, among others [1].

4. METHODOLOGY

This research is based on a study that aims to collect all necessary information effectively. Provide the survey 50 factors influencing productivity collected from relevant previous studies and reviewed before Survey participants. The 50 factors included in the study were classified into four main groups: the human factors group and the technical and technological factors group. A group of administrative factors and a group of external factors.

4.1 Questionnaire design

The questionnaire included two sections:

The first section: contains general information about the sample members, including specialization, current work, and years of experience.

The second section: contains four tables representing the four groups of factors affecting productivity, in which a five-point Likert scale was applied in designing the questionnaire, extending from 1 (very low) to 5 (very high).

To define a structure, the questionnaire was evaluated after review and audit to ensure its effectiveness its suitability for building and construction projects in remote areas. The questionnaire consists of 50 factors affecting labor productivity in remote construction projects. Before distributing the questionnaire, ten questionnaires were sent to a group of specialized academics and consultants working in the construction sector via email, and they were asked to comment on the accuracy, comprehensiveness, and flow of the questionnaire. Questionnaire questions and answers.

The credibility and stability of the questionnaire questions were measured through the use of Cranach's alpha coefficient (α), and because of the options used to answer on a Likert scale forming a wide range (from 1 to 5), the extent of credibility in constructing the questionnaire questions was assessed. At the group level, as well as the credibility of each factor (50 workers) influencing labor productivity in construction projects in remote areas, analysis of Cranach's alpha coefficient (α) confirmed a high level achieved by the reliability of the questionnaire questions amounted to 0,934.

4.2 Sample population:

The target sample for the research is laborers working in various specializations. they work in one of the largest specialized contracting companies, which has extensive experience in the construction field for more than thirty years and has implemented more than one project in remote areas. Site laborers are the key players in executing construction activities; they are in the ideal position to express the factors that most affect their performance.

5. RESULTS

The following computer programs were used:

- Using the SPSS program to find the arithmetic mean of the strength of influence (1 to 5) for each factor separately, according to the answers of the participants in the questionnaire, and to find the frequencies that are used in calculating the coefficient Importance.
- Using Excel to apply the equation for calculating the importance factor.

First, the human factors that affect productivity in construction projects

Table 1 and **Fig. 1** show the human factors that affect labor productivity and the number of seven factors, where the factor "experience and skill of the workers employed" is considered the most human factor and came in first place with a strength of (88%) is followed in influence by the factor "leadership skills and efficiency in managing the site" with a strength of (86%) and in third place the factor "communication skills, lack of clarity of instructions and exchanging information on the site" showed that it is considered an important factor with a strength of (78%), Then the factor "Education level of workers" came in last place With a strength of (63%) as the least human factor affecting labor productivity in implementing building and construction projects in remote areas.

Table 1: human factors that affect labor productivity

Rank	Human factors	Mean	RII (%)
1	Experience and skill of the workers employed	4.4	88%
2	Leadership skills and proficiency in site management	4.32	86%
3	Communication skills and lack of clarity in instructions and exchange of information on site	3.89	78%
4	Skill in managing and following up on subcontractors	3.75	75%
5	Absenteeism from work (workers/supervisors) and failure to adhere to work hours	3.7	74%
6	The strength and physical structure of the worker	3.41	68%
7	Education level of workers	3.13	63%

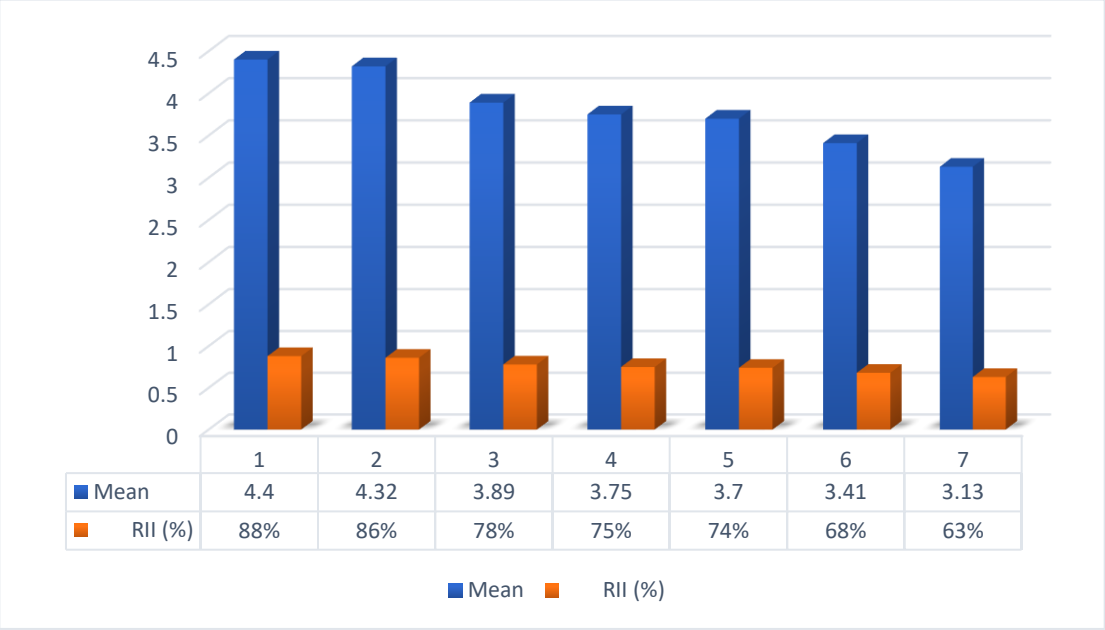


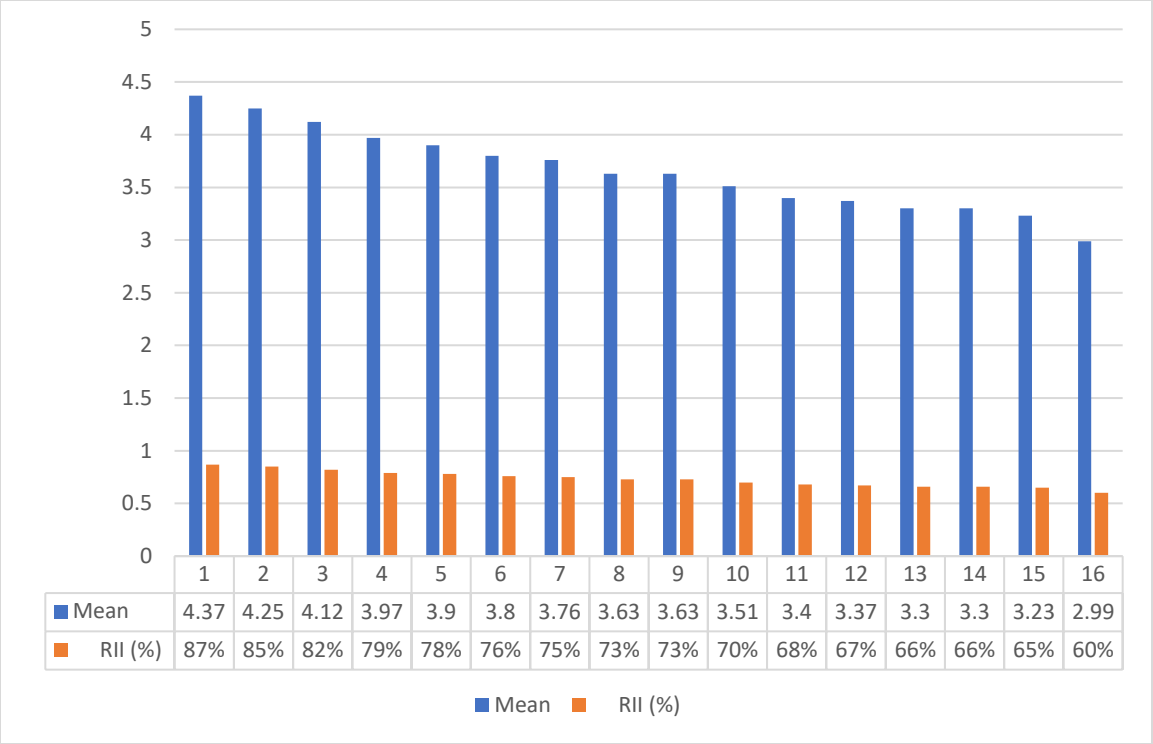
Fig. 1: human factors that affect labor productivity

Secondly, the administrative factors that affect productivity in construction projects

Table 2 and **Fig.** (2) show that the most administrative factors affect labor productivity in the implementation of construction projects, the factor "availability of materials on-site" with a strength of (87%) and comes second in influence to the factor "provides all executive and detailed drawings" with a strength of (85%) and then comes in terms of influence the factor "selecting a supervisory staff with sufficient numbers and competence in conducting work on the site." With a strength of (82%) in the third place. The results also showed that the factor "Providing the necessary tools and equipment on-site" came in the penultimate order with a strength of (79%) and came in the last ranking in the group of administrative factors affecting productivity in working construction projects was "services provided to workers (social insurance, insurance, and medical care)." strongly Its value (60%).

Table 2: Administrative factors that affect labor productivity

Rank	Administrative factors	Mean	RII (%)
1	Availability of materials on-site	4.37	87%
2	Provides all executive and detailed drawings	4.25	85%
3	Selecting a supervisory staff with sufficient numbers and competence in conducting work on-site	4.12	82%
4	Providing the necessary tools and equipment on site (cranes, shovels...)	3.97	79%
5	Planning, business flow and continuity, and planning during busy sites	3.9	78%
6	Working hours (if working 9 hours a day)	3.8	76%
7	Wage level of workers	3.76	75%
8	Providing services on site (water, electricity, bathrooms...)	3.63	73%
9	Nature of business ownership (private, government)	3.63	73%
10	Contract system for work (daily wage, lump sum, etc.)	3.51	70%
11	Daily rest hours during work (two hours)	3.4	68%
12	Giving workers some incentives and rewards	3.37	67%
13	Overtime working hours (4 additional hours or more per day)	3.3	66%
14	Good management during crises (political issues, demonstrations, natural disasters...)	3.3	66%
15	Nature of business management (individual or corporate)	3.23	65%
16	Services provided to workers (social insurance, insurance, medical care...)	2.99	60%

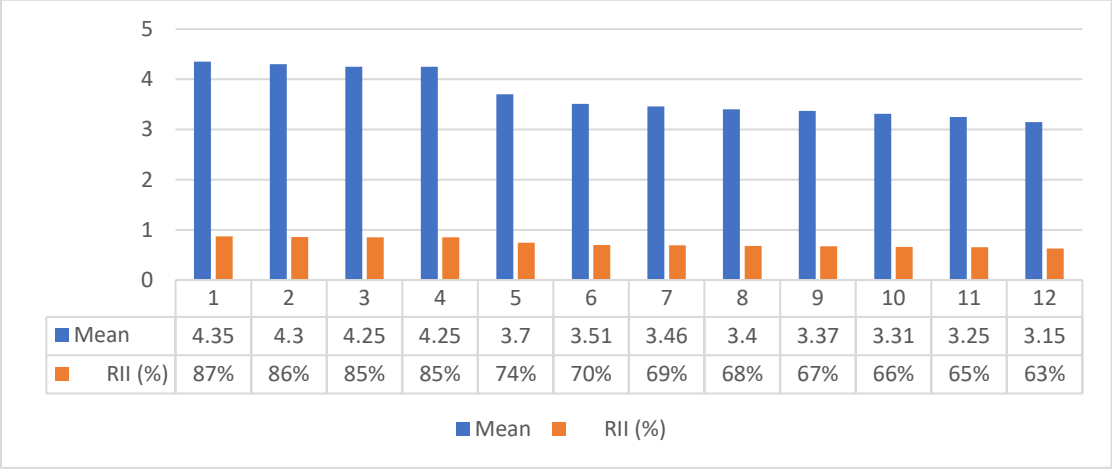


	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mean	4.37	4.25	4.12	3.97	3.9	3.8	3.76	3.63	3.63	3.51	3.4	3.37	3.3	3.3	3.23	2.99
RII (%)	87%	85%	82%	79%	78%	76%	75%	73%	73%	70%	68%	67%	66%	66%	65%	60%

Fig. 2: Administrative factors that affect labor productivity

Third, the technical factors that affect productivity in construction projects

Fig. 3 and **Table 3** Show the factor "work interruption (change in designs, specifications)" in the first place with a strength of (87%), and in the second place is the factor "architectural and construction designs (easy, complex, advanced)" with a strength of (86%) Then, in the third order of influence, there are two factors: "Project specifications" and "Construction technique and technology (traditional, advanced, prefabricated construction)" with strength of (85%). The results also showed that the factor "Type of project (residential, service, investment, Industrial)" came in the last ranking of technical factors affecting productivity in construction projects with a strength of (63%).



	1	2	3	4	5	6	7	8	9	10	11	12
Mean	4.35	4.3	4.25	4.25	3.7	3.51	3.46	3.4	3.37	3.31	3.25	3.15
RII (%)	87%	86%	85%	85%	74%	70%	69%	68%	67%	66%	65%	63%

Fig. 3: Technical factors that affect labor productivity

Table 3: Technical factors that affect labor productivity

Rank	Technical factors	Mean	RII (%)
1	Work interruption (change in designs, specifications...)	4.35	87%
2	Architectural and construction designs (easy, complex, advanced...)	4.3	86%
3	The accuracy and level of Project specifications	4.25	85%
4	Construction technique and technology (traditional, advanced, prefabricated construction)	4.25	85%
5	The quality of equipment required to work on the project	3.7	74%
6	The quality and nature of materials used in the project	3.51	70%
7	Project size	3.46	69%
8	Inspection delay/stringent by the engineer	3.40	68%
9	Ease of processing and preparing materials for work (cutting, roughening...)	3.37	67%
10	The amount of work available per day (daily workload)	3.31	66%
11	Rework	3.25	65%
12	Type of project (residential, service, investment, industrial...)	3.15	63%

Fourth, the external factors that affect labor productivity in construction projects

Table 4 and **Fig.** (4) shows the group of fifteen external factors and the extent of their impact on labor productivity during implementation in construction projects in remote areas, three factors showed a strong influence, in order from first to third, which are: The factor “Difficulty access to the site (workers and materials) “, the factor “availability of materials in the market” and the factor “The economic situation of the country” have a power of influence of (89%) (86%) (86%) respectively. The results also showed that the “General location and environment of the project site” factor has a strong influence, it was estimated (at 76%), and it showed the factor “Public vacations” effect of (68%) is considered the least influential external factor on productivity in implementing construction projects in remote areas.

Table 4: External factors that affect labor productivity

Rank	External factors	Mean	RII (%)
1	Difficulty access to the site (workers and materials)	4.45	89%
2	Availability of materials in the market	4.3	86%
3	The economic situation of the country (high prices, inflation...)	4.28	86%
4	Funding availability can delay or accelerate project timelines	4.24	85%
5	Availability of labor in the market and competition among them	4.16	83%
6	lack access to utilities like water and electricity	3.94	79%
7	The political and security situation (theft and threats)	3.94	79%
8	Weather Conditions (Heat or cold stress, Rainfall, Wind, etc.……)	3.83	77%
9	The general location and environment of the project site (highlands, deserts...)	3.78	76%
10	Procurement limitations can affect contractor selection and project execution	3.67	73%
11	Quality vs. speed trade-offs during the implementing project	3.6	72%
12	Changes in government priorities can alter project scopes or timelines	3.55	71%
13	Working under external pressures, whatever they may be, especially in Projects with a political dimension	3.47	69%
14	Technological Limitations (Lack of digital tools, Limited access for network, etc.)	3.42	68%
15	Public vacations such as holidays (Eid Al-Fitr, Al-Adha...)	3.4	68%

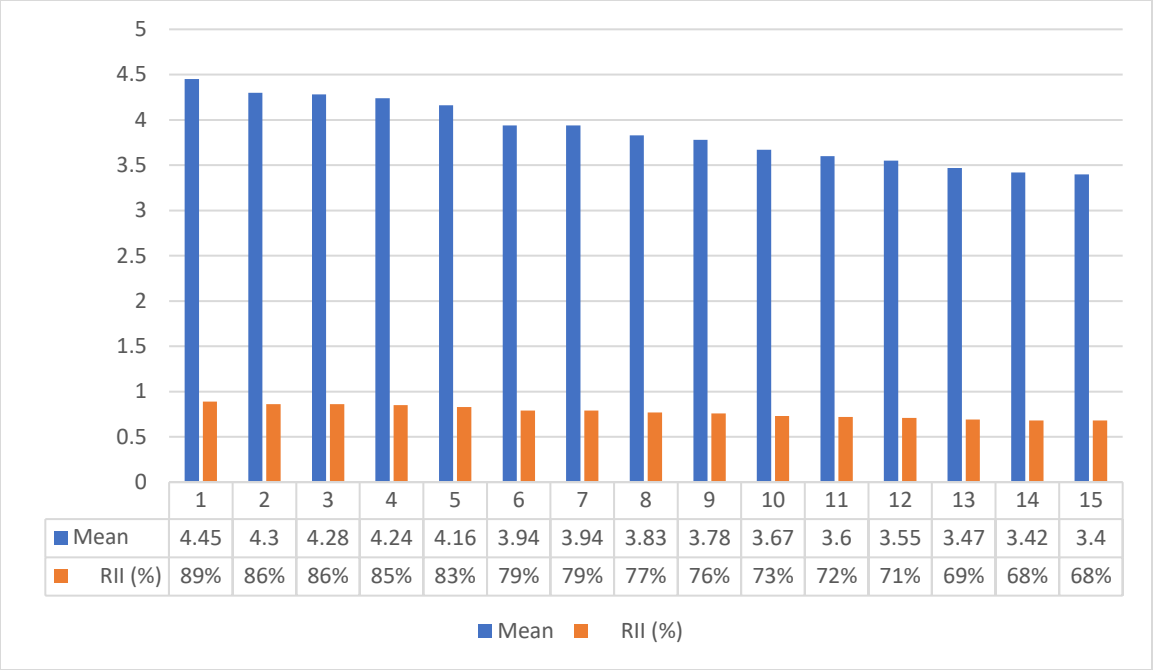


Fig. 4: External factors that affect labor productivity

From the previous analysis of the group arrangement, it was found that the External Factors had the first effect among the groups the Administrative factors group had the lowest group Impact on productivity in remote areas, as shown in **Table 5** and **Fig. 5.**

Table 5: ranks groups according to their impact on labor productivity in implementing construction projects in remote areas.

Rank	Set of Group	Mean	RII %
1	External Factors	3.87	77.4%
2	Human factors	3.8	76%
3	Technical factors	3.69	73.8%
4	Administrative factors	3.66	73.2%

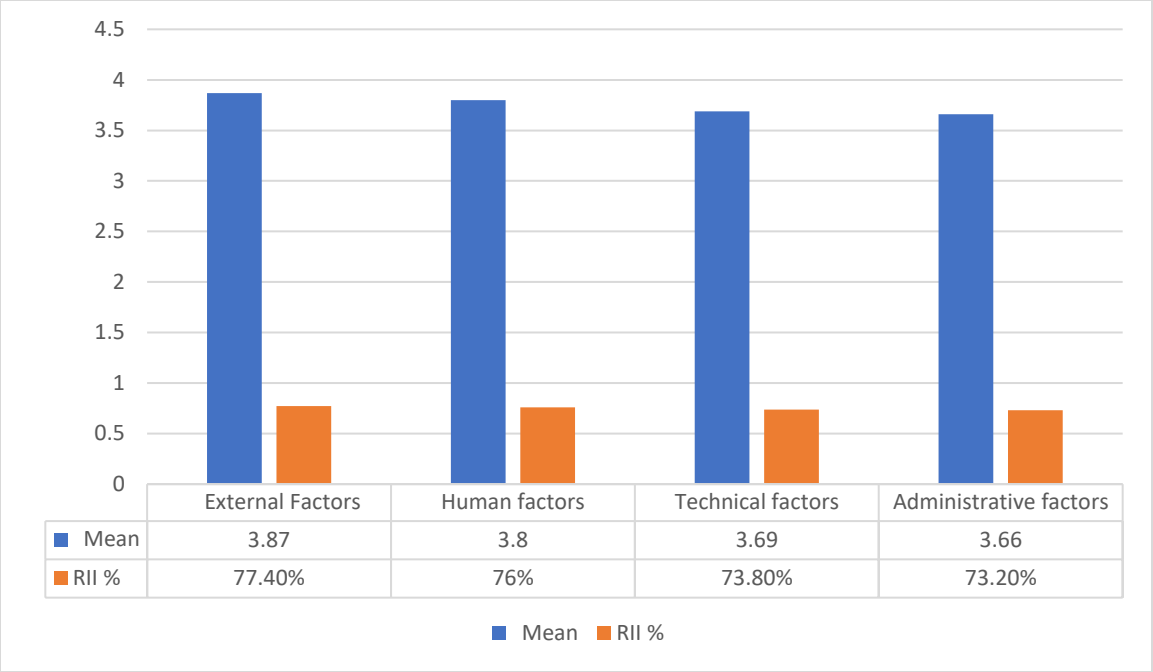


Fig. 5: Ranks groups according to their impact on labor productivity in implementing construction projects in remote areas.

6. ANALYSIS AND DISCUSSION

Through the results, it became clear that the factor **"Difficulty access to the site (workers and materials)"** ranked first among the most important factors affecting labor productivity in remote areas. it is indeed reasonable to expect that "difficulty of access to the site" would have a strong influence on research results related to labor productivity in remote areas. While the exact ranking might vary, it would not be surprising if "difficulty of access to the site" emerges as a first one of the top factors influencing labor productivity in research results. Here's why:

1. Direct Impact on Efficiency: Difficult site access can significantly slow down the movement of workers, materials, and equipment, directly impacting daily productivity.
2. Consistent Recognition: While specific rankings vary, site access and related factors (like site conditions and layout) are consistently recognized in studies as important factors affecting productivity.
3. Multiplier Effect: Site access difficulties can exacerbate other productivity challenges, such as material delivery delays, equipment utilization, and worker fatigue.
4. Project-Wide Impact: Unlike some factors that might affect only certain trades or phases, site access issues typically impact all aspects of a construction project.
5. Cost Implications: Difficult site access often leads to increased costs, which is a key concern in productivity studies.
6. Safety Considerations: Poor site access can create safety hazards, potentially leading to accidents, work stoppages, or a slower work pace.
7. Planning and Logistics: The need for extensive planning to overcome access difficulties can divert resources from other productive activities.

The factor "**experience and skill of the employed workers**" ranked second among the most important factors affecting labor productivity in remote areas. In a study conducted in the Kingdom of Saudi Arabia [17] and ranked first by research carried out in Vietnam [26]. We note that this factor in some studies was divided into two factors. A study performed in Trinidad and Tobago divided this factor into "**lack of workers' experience**" which is ranked third and "lack of workers' skills" which is ranked fifth [12]. In Egypt, a study was carried out and divided this factor into "skill of labor" which is ranked second, and "A shortage of experienced labor" which is ranked third [10]. Another study, it's Ranked as one of the top five factors negatively affecting labor productivity in building construction projects [15].

The factor "**availability of materials on-site**" ranked third among the most important factors affecting labor productivity in remote areas. We find that in many types of research in other countries, it ranked first among the factors affecting productivity in Iraq [24]. Also, it Ranked first in the resource management category at the individual factor level [22].

The factor **"Work interruption (change in designs, specifications...)"** ranked fourth among the most important factors affecting labor productivity in remote areas, and this result was consistent with the research conducted in Saudi Arabia, it was ranked also as fourth in most important factors affecting labor productivity [3]. Another study examining global construction industry factors ranked "design errors and changes during construction" as the seventh most critical factor affecting labor productivity [8].

The factor **"Leadership skills and proficiency in site management"** ranked fifth among the most important factors affecting labor productivity in remote areas. It's consistently ranked among the top factors affecting labor productivity in previous studies. In a study of construction site supervisory competencies, leadership ability was ranked fourth among the most important skills and abilities affecting the effectiveness of labor productivity [19].

It's noticed that the factor "**availability of materials in the market**" has a strong impact on labor productivity in remote areas. However, most Studies talked about the "shortage of materials", but it was not determined whether this shortage was due to their lack of availability on-site, or whether the shortage of materials was due to their unavailability in the market, which is considered one of a group of external factors that cannot be processed by the contractor. It is expected that this factor will have a strong influence, especially in remote areas as it often faces challenges in material procurement and transportation, which can lead to delays and increased costs [27]. Despite the importance of factors related to "Working under external pressures", "the level of workers' wages", and "workers' absence from work" among the top most important factors in several studies in different countries, these factors did not have a strong impact and were not among the most important five factors that affect labor productivity in construction projects in remote areas.

CONCLUSIONS

Based on the results of the study, this research clarifies some necessary recommendations for all workers and decision-makers in the construction industry sector in remote areas, which may contribute to increasing productivity in construction projects, these recommendations are:

1. Invest in proper infrastructure development to facilitate easier access for workers and materials.
2. Invest in comprehensive training programs for all workers to improve their skills and knowledge. This can include both technical skills related to specific trades as well as soft skills like teamwork and problem-solving.
3. Develop mentorship programs to pair experienced workers with newer ones to accelerate learning and improve overall competence.

4. Ensure strong leadership and management skills among supervisors and foremen. This includes the ability to plan, coordinate, and motivate workers.
5. Implement robust safety training programs to reduce accidents and injuries, which can significantly impact productivity.
6. Implement just-in-time inventory systems to minimize delays caused by material shortages. This requires careful planning and coordination with suppliers.
7. Consider partnering with local suppliers in remote areas to improve delivery times and reliability.
8. Adopt Building Information Modeling (BIM) software to improve planning, coordination, and visualization of projects. This can reduce errors and conflicts.
9. Implement a rigorous design review process to minimize work interruptions due to changes in designs or specifications.
10. Implement lean construction principles focused on waste reduction, just-in-time delivery, and continuous improvement.
11. Use look-ahead planning to proactively identify resource needs and minimize delays. Work with local authorities to improve access to utilities like water and electricity at remote project sites.
12. Develop comprehensive risk assessment and mitigation strategies specific to remote construction projects.

By implementing these recommendations, construction projects in remote areas can significantly improve productivity while maintaining safety and quality standards. The key is to leverage technology, optimize workflows, enhance worker skills, and address unique challenges posed by remote locations.

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