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Study on Impacts of Psychological and Behavioral Aspects of Labors for Productivity Enhancement and Work Satisfaction in the Construction Sites

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Abstract:

By construction of vital infrastructure and influencing the built environment, the construction sector performs a crucial part in the growth of a country. However, difficulties with productivity can impede development and effectiveness, resulting in project delays, cost overruns, and lowered quality. One important component that affects the effectiveness and success of building projects is labor efficiency whose performance is highly guided by the psychological impacts of their interpersonal surroundings, target pressure and relations between the co-workers at the working site. The objective of this research study is to examine and comprehend the variables that highly determine the efficiency in performance of laborers which is being done by using Relative Importance Index (RII) tool. A thorough assessment of the literature and an investigation of workers from various trades who are involved in construction projects are both part of the study. The study offers beneficial perspectives into obstacles and opportunities for increasing labor productivity and gives suggestions to improve staff performance.

Keywords: Psychological Impacts, Co-workers Relationship, Construction industry, Labor productivity Enhancement, Relative Importance Index (RII).

1. INTRODUCTION

Building vital infrastructure and influencing a country's built environment, the construction sector is a pillar of national development. Nevertheless, despite its significance, the industry has substantial productivity-related difficulties that could impede its development and general effectiveness. Construction productivity problems can take many different forms, including project delays, cost overruns, and degraded quality, which result in less than ideal results. The effectiveness and success of construction projects are significantly impacted by labor productivity, which stands out as a crucial component. The level of productivity attained by the construction workers has a direct impact on the costs and timing of projects. Projects can be completed more quickly and under budget because to higher labor efficiency, which enhances the competitiveness and profitability of construction enterprises overall. Even though the significance of labor productivity is becoming more widely acknowledged, making significant increases can be challenging due to a number of impacting factors. Productivity levels are greatly influenced by workforce-related problems such inadequate training, lack of desire, and skill shortages. Additionally, project management techniques like planning, scheduling, and coordination have a significant impact on how productive the workforce is. Furthermore, the use and integration of technology, such as BIM and advanced construction tools, can have a major influence on labor productivity.

The effectiveness and efficacy that labor resources are used in construction projects to create desired outputs is referred to as construction labor productivity. It is a crucial indicator of how effectively a construction team completes jobs and projects within a certain amount of time [1]. In most of the world, construction labor productivity has lagged behind other industries and been declining steadily for years. Because it directly affects project timetables, prices, and quality, considering worker productivity while making economic decisions the overall success and profitability of construction projects [2]. The workforce's education and training, project management techniques, technology adoption, site circumstances, and regulatory laws are just a few of the variables that having an effect on labour efficiency of the construction sector. Construction businesses can save money and become more competitive by using a productive staff to complete more work in less time [3]. Low productivity, on the other hand, can lead to delays in projects, increased expenses, and lost profitability.

Figure 1 Motivation for labour productivity in construction sector

To improve the productivity of the construction workforce, businesses frequently use techniques like skill development of workforce and training, incorporating cutting-edge techniques like Building Information Modeling (BIM) and automated processes, effective project planning and scheduling, along with some site managerial procedures [4]. Additionally, cooperation and communication among various building process stakeholders are essential for maximizing productivity and minimizing inefficiencies. Given the growing need for infrastructure development and the requirement for sustainable practices, understanding and improving construction worker productivity are of highest importance in the modern construction sector [5]. In order to increase productivity, cut costs, and produce effective project outcomes, it entails ongoing examination and improvement of labor management, construction procedures, and the incorporation of cutting-edge technologies.

This study's main goal is to discover and comprehend the variables that have an impact on worker:s efficiency in the construction industry. The study intends to evaluate the impact of these factors on construction productivity by identifying major factors impacting productivity through a standardized questionnaire and assessing the survey's results using the relative relevance index. Additionally, the research aims to offer useful insights into the obstacles and chances for increasing productivity in building projects. The study's findings will be used to provide useful suggestions and tactics to improve labor performance, cut down on project delays, and save money—all of which will help the construction sector as a whole develop and function more effectively.

2. RELATED WORK

The study described in [6] used the relative autonomy index (RAI) and aggregated motivation index (AMI) to statistically quantify the work autonomy (WA) of on-site construction employees in Vietnam. Construction labor productivity (CLP) was positively and significantly impacted by WA, according to the findings of structural equation modeling (SEM). The objectives of [7] are to identify and prioritize methods for managing construction materials that have the potential to boost labor productivity in multi-story construction projects. Using a two-phase mixed-methods research methodology, the study was conducted in Victoria State, Australia. Phase-I data was reviewed to determine the approaches for managing materials in order of priority. Long-lead substances recognition (RII = 0.92), procurement strategies for substances (RII = 0.85) and materials timelines for shipment (RII = 0.75) are found to be the three most vital construction material handling strategies. Although the Kingdom of Bahrain's construction industry is dealing with a number of problems, it is safe to state that one of the largest is low labor productivity. The major objective of [8] is to identify, explore, and rank the critical elements affecting Bahrain's construction industry's employee efficiency . The results obtained fill a knowledge gap about variables affecting labor productivity in the construction sector. Industry practitioners can use the results to gain a deeper understanding of factors affecting workers' efficiency, which will help them operate more efficiently and at a reasonable level of competitiveness. The goal of the study was to determine which HRM techniques were most effective in raising worker productivity in building construction projects [9]. A mixed-methods strategy involved data collecting through questionnaires given to contractors during Phase II and interviews with 19 experts during Phase I. The top three essential HRM practices were identified as being clear responsibility delegation,

organizational structure stability, and crew composition. Combining these strategies can increase the efficiency of construction assignments in the Australian construction sector.

Construction worker's efficiency is influenced by a variety of elements (factors and practices) that vary depending on the project. There is currently no established measurement method or modeling strategy for analyzing how parameters affect worker efficiency in the construction industry. In [10], a study that uses context-sensitive questionnaires to identify key characteristics determining labor productivity reveals contextual heterogeneity between important parameters. The research investigation uses data from 141 surveys distributed to respondents in the areas of project management including trade across six Canadian projects in either residential or commercial contexts. Through investigation, the most crucial elements influencing labor productivity on manufacturing and construction projects were found. The study conducted in [11] attempts to simulate causal links between elements having impact on labour efficiency in the construction industry employing a system dynamics (SD) framework and the decision-making trial and evaluation laboratory (DEMATEL) technology. The top 60 factors affecting worker productivity were categorized into five major areas based on earlier investigation and interviews with specialists. Findings from 63 Iranian building specialists identified specific components.

Academics and researchers from all around the world find productivity assessment in the construction sector to be an interesting issue for research; a company needs to be able to sustain itself due to the industry's increasing internationalization. In an attempt to tackle the high cost of inadequate productivity on massive development and infrastructure projects, numerous research have been done to pinpoint the factors influencing construction productivity. The four aspects mentioned in [12]—"(1) administrators, (2) technical, (3) manual labor, and (4) external"—are to be assessed in terms of how they affect productivity in the building industry. Each of these categories is further divided into a number of other variables that control these four main regions. Construction sector productivity is recognized as a crucial indicator of their efficacy of performances and competitiveness of the sector. Numerous studies have been conducted with a focus on the breakdown of the influencing elements and the temporal trends of changes in construction productivity, respectively [13]. Analytical with method and macroeconomic labor productivity in the building industry are covered in [14]. Statistics currently available frequently ignore profitable activity involving goods and services for building. Findings from the Norwegian construction sector show that labor productivity is both increasing in terms of value added per working hour and not decreasing. In a comprehensive way, the study done in [15] examined the intricate interconnectedness of the factors influencing or impeding construction productivity at the industry, project, and activity levels.

Table 1 Summary of the Related work

Study	Objective and Methodology	Key Findings
[6]	Measure WA utilizing RAI and AMI	WA positively and significantly impacts CLP
[7]	Identify priority materials managerial practices	Identification of long-lead materials, procurement strategies, and schedules of delivering material are essential
[8]	Rank critical elements affecting labour efficiency in construction industry of Bahrain	Offers insights for achieving competitiveness and cost-effective operations
[9]	Identify most significant HRM practices for developing labor productivity	Important factors include straightforward responsibility delegation, a stable organizational framework, and crew composition
[10]	Identify key parameters influencing labour productivity	Context-sensitive surveys reveal top parameters in building and industrial projects
[11]	Model causal relations among factors affecting labor productivity	Top 60 factors grouped into 5 categories, identified factors in Iranian construction industry
[12]	Assess areas affecting construction productivity	Four areas (management, technological, labor, and external) and their parameters explored
[13]	Decompose influential factors and temporal trends of construction productivity changes	Focus on industry performance efficiency and competitiveness
[14]	Address macro-economic labor productivity and methodological issues	Norwegian construction labor productivity not declining, productive in value added per working hour
[15]	Examine the interrelationship of the elements that influence or hinder building productivity	systemically evaluates the business community, project, and levels of activity

The gap found in the above table is the absence of detailed study on the variables influencing labor productivity in Indian building projects. There appears to be a paucity of research focusing on the Indian setting, despite the fact that numerous studies have examined productivity analysis in the construction industry abroad. There is no mention of study explicitly focusing on Indian building projects in the existing studies that are covered in the information provided; instead, the studies largely focus on various nations including Vietnam, Australia, Bahrain, Canada, and Iran. By identifying, ranking, and assessing the elements having an impact on labor efficiency in the Indian construction industry, this study seeks to address this constraint.

3. RESEARCH METHODOLOGY

In survey research, there are two main methods for gathering data: questionnaires and in-person interviews. Due to its effectiveness and applicability, a questionnaire was selected as the ideal data collection method for this study. The survey was created as a self-administered web application so that respondents could conveniently submit their answers, saving the researcher both time and resources. However, it should be emphasized that compared to in-person interviews, online surveys frequently have a lower response rate. An extensive literature analysis that focused on worker efficiency in the construction sector and a survey given to workers from different trades involved in the construction project were used to gather the data for this investigation.

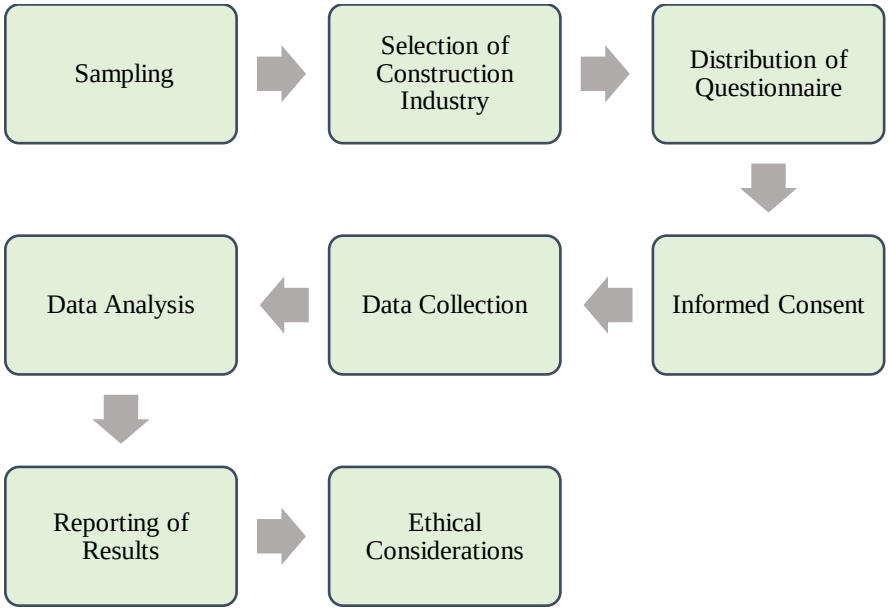


Figure 2 Flow Chart for Methodological Approach

Data gathering is essential to the study's success in achieving its principal goal. A stratified random sampling technique is used in the research design to choose participants from the construction sector, assuring representation from a range of trades and professions. Based on the availability of construction projects and the willingness of industry participants to participate, the chosen construction industry is unique to a certain location or nation. Selected participants are given access to the self-administered web-based questionnaire via online survey platforms or email invitations, enabling quick data submission. Participants get an informed consent form outlining the research's goals, confidentiality policies, and ability to withdraw before taking part. A total of 550 questionnaires were distributed; 478 of those were returned, and 473 were kept for data processing. Data accuracy was ensured by the research team's discovery of no missing data in the answers. The Statistical Package for the Social Sciences (SPSS) software will be used to evaluate the quantitative data obtained from the questionnaire, allowing descriptive statistics and inferential analysis to discover relevant factors influencing labor productivity.

Influential Elements Impacting Construction Labor Efficiency

Numerous scholars have been interested in the topic of factors affecting labor productivity in the construction sector for a long time. For instance, the study of [16] identifies a total of 45 important elements that have a significant impact on worker efficiency in the construction industry and are categorized into the following six categories: Man-power (7 factors), managerial (13 elements), enthusiasm (8 aspects), work background (5 factors), assignment based on projects (7 factors), and external (5 factors) are the first five factors to consider. Table 2 lists some of the important factors that can affect labor productivity in the construction sector and is

divided into various areas. Additionally, certain hypotheses were developed based on these components. According to hypothesis 1, the workforce has an impact on worker efficiency in the construction industry. According to Hypothesis 2, external influences affect labor productivity in the construction industry.

Table 2 Categories of Different Factors

Category	Factors
Workforce	Skill level and competence of workers
	Motivation and job satisfaction of workers
	Workforce availability and allocation
	Labor turnover and absenteeism
Materials and Equipment	Adequacy and accessibility of materials
	Availability and condition of equipment
	Efficient material handling and storage
Project Management	Effective project scheduling and planning
	Coordination and communication among teams
	Use of lean construction principles
	Streamlined decision-making processes
Technology and Automation	Adoption of construction technology
	Integration of Building Information Modeling (BIM)
	Use of automated construction equipment
External Factors	Weather conditions and environmental factors
	Regulatory constraints and permits
	Access to transportation and logistics
	Labor laws and union regulations

Questionnaires

Five different groups of questions were used to classify the elements impacting labor productivity for this study. One response was required for each aspect when respondents were asked to list factors affecting productivity under typical circumstances. The responses were based on the respondents' knowledge, skill, and experience rather than being project-specific. This straightforward approach made it possible to compile a thorough list of the variables influencing labor productivity in building construction. To collect epidemiological data, questionnaires are frequently employed. They can be self-administered or given out during interviews. Self-administered questionnaires can help with uniformity by removing any potential systematic disparities in interviewing methods, but they must be written in a way that is unmistakably understood by all respondents. When gathering data on complicated subjects, an interviewer may be necessary in some circumstances.

Pilot Survey

The results of the pilot study, which included the identification of numerous elements, data collection, and findings, were incorporated into the questionnaire part to increase its effectiveness. After removing the incomplete responses from the 55 questionnaires that were distributed to owners of building construction companies, 37 complete responses were obtained. The pilot study made clear the need for better questionnaire design, the removal of pointless questions, and the clarification of specific questions. As a result, the topic-related survey was

upgraded, featuring a quicker turnaround time, a better structure, and user-friendly features like auto-save and transparent progress tracking. Throughout the survey's duration, respondents received guarantees about the privacy of their answers.

It is well known that disturbances can happen in the context of construction projects and range in severity. In order to account for these changes, the study created four condition levels: "not appropriate," "does not have impact," "partially impacts it," and "straight-forwardly affects it it." To enable respondents to precisely determine the severity degree of each unfavorable situation, clear and plain specifications were provided for each standard condition. The degree of measurement was carefully evaluated when choosing the best research methodology, which led to the employment of ordinal scales in this study. As shown in Table 2, data are rated or ranked using integers in either ascending or decreasing order using an ordinal scale. The assigned numbers (1, 2, 3, 4) are just used as number labels for differentiation; they do not represent absolute amounts or equal distances between the scales.

Table 2. Ordinal Scale Utilized for Measuring Collected Data

	Not Appropriate	**Does not have impact**	**Partially Affects it**	**Straight-forwardly affects it**
Ordinal Scale	1	2	3	4

After conducting the survey of published literatures and attention on group talks, a comprehensive strategy was expressed to collect field data, develop an assessment method, and generate mathematical values for the study. Effective communication with respondents was crucial to ensure their complete understanding of the relevant terminology, procedures, and rules used during data collection. Two distinct approaches were employed to analyze the survey results:

i. Ordering the different components based on their importance and evaluating their Relative Importance Index (RII).

ii. Assessing the significance of the questionnaire's factors.

The Relative Importance Index (RII) was specifically designed to gauge the opinions of professionals involved in building projects. RII is calculated as follows:

$$RII \text{ (Relative Importance Index)} = \frac{\sum W}{A} \times N$$

W = is the amount of significance that respondents assigned to each factor, which varies from 1 to 4, A is the highest weight (4), N represents the whole set of responses gathered for the ordinal scale.

$$W\ ranges \begin{pmatrix} 1 & 3 \\ 2 & 4 \end{pmatrix} \times Number\ of\ respondents\ for\ each\ degree$$

4. RESULTS ANALYSIS

In this section, we examine the findings from the field survey that were discovered through the examination of respondent information. The replies gathered from construction firms were the primary subject of this study, which was entirely focused on building construction projects. Figure 3 depicts the replies the survey received from various construction firms, including residential, commercial, industrial, government, engineering, and owner entities.

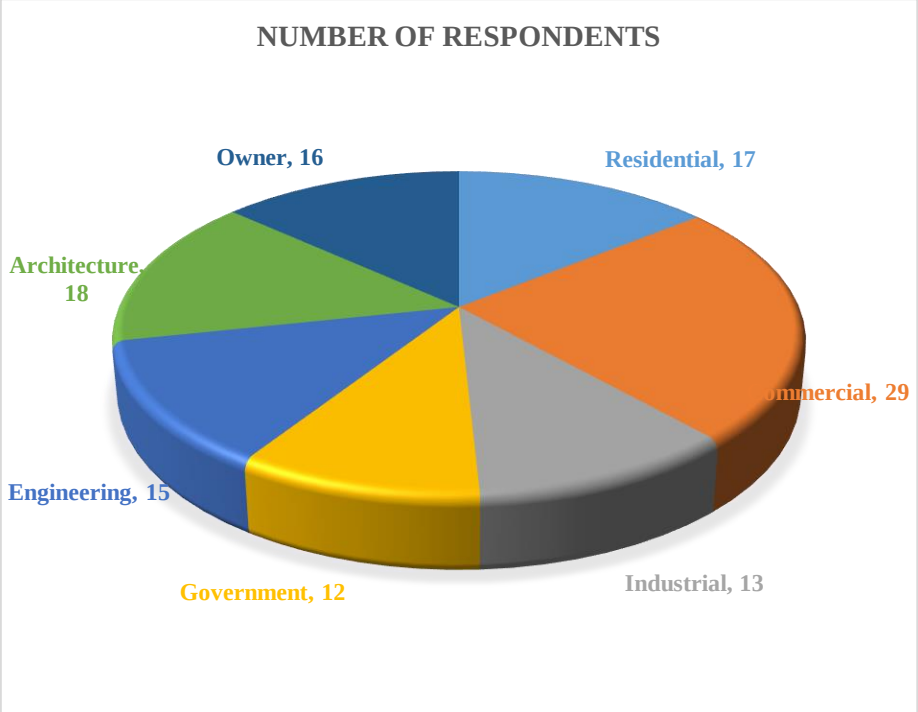


Figure 3 Number of Respondents based on Constructional Organizations

These numerous perspectives from various types of construction businesses provide illuminating details regarding the variables influencing labor productivity in the construction industry. In order to acquire data for the online survey, we got in touch with a wide range of specialists involved in constructing construction projects. Project managers, engineers, architects, contractors, and other important figures in the building industry made up this group. Table 3 below displays the responses from this group's members.

Table 3 Job Profile of the Respondents

JOB PROFILE	NUMBER OF REPLYING PARTIES
MANAGER OF PROJECTS	28
PROJECT-BASED ENGINEER	42
ARCHITECT	30
OTHER (APM, APE, SCHEDULER, ESTIMATOR)	20

Factors affecting labor productivity based on Relative Importance Index (RII)

Numerous variables influencing worker productivity were examined and rated according to how they affected various categories. In terms of its detrimental effect on labor productivity, worker disloyalty came in at 39th overall and eighth in the manpower category. With a significant Relative Importance Index (RII) of 224182, worker miscommunication ranks first in the manpower category and 32nd overall among factors impacting labor productivity. With a RII of 154633, lack of workplace competition placed eighth in the manpower category. Considering that aging might naturally reduce productivity on the job site, laborers' age came in third within the manpower group with a RII of 216534.

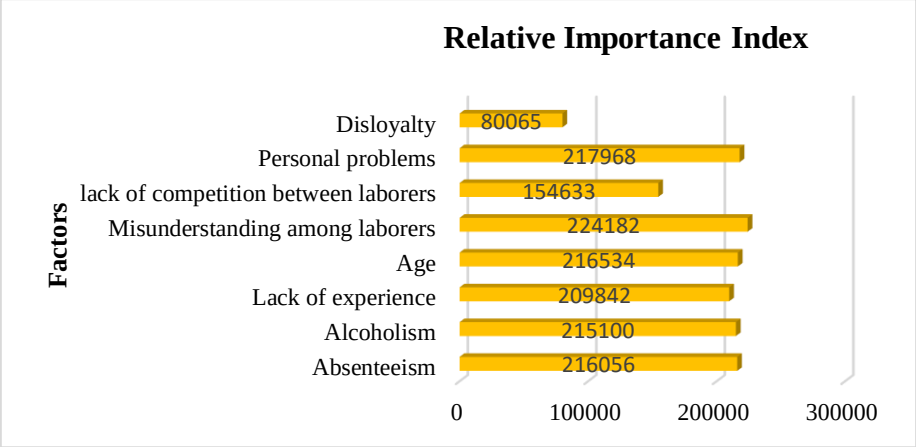


Figure 4 Relative Importance Index (RII) of Different Factors

Personal difficulties, which could cause interruptions and have a detrimental impact on worker productivity and safety, came in second in the personnel category with a considerable RII of 217968. These results emphasize the significance of resolving worker interpersonal and communication problems to raise general productivity on construction based projects.

Labor Productivity Impacted by Resource Factors

The availability of various resources has a considerable impact on poductivity of labor in constructing profession. Among them, it was discovered that the lack of essential building materials, subpar building materials, and an increase in material costs all significantly impacted worker productivity. Material resources, which make up a sizeable amount of project expenditures, are essential for boosting productivity. For tasks to be completed effectively, the necessary supplies must be available, and in many nations, this is the biggest factor determining labor productivity. Inefficient material management might result in longer workdays and lost time. Similar to this, having easy access to a building site, enough lighting, and access to tools and equipment for construction are all crucial for preserving worker productivity. Poor site conditions and unexpected site circumstances can both have a substantial impact on worker productivity, increasing contractors' costs and delays.

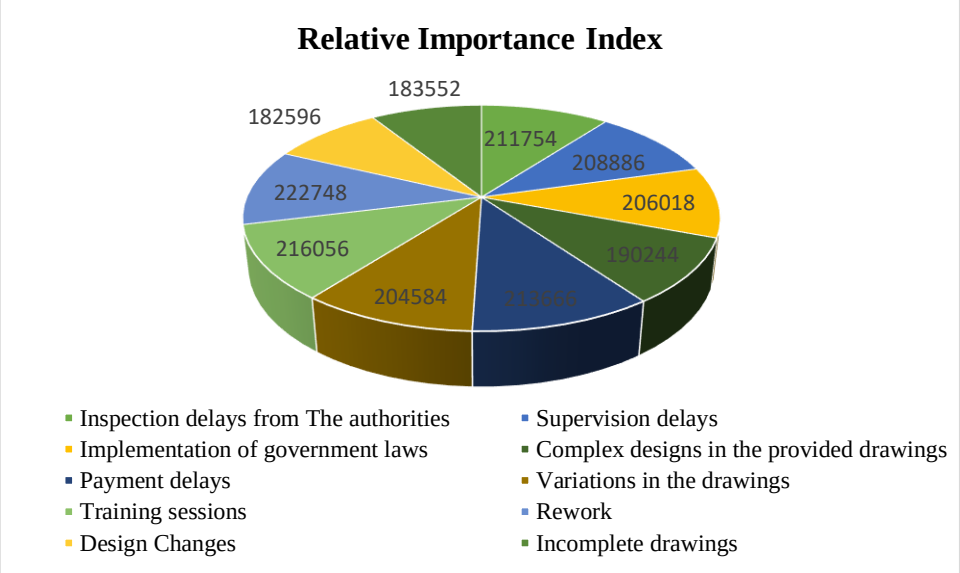
Table 4 Ranking of Impact of Resource Factors on Labour Productivity

Resource Factors	RII	Rank
Rise in the cost of materials	181162	6
Site characteristics that be different from the plan	203628	2
Shortage of required materials used in construction	160369	10
lacking the necessary equipment or tools	200760	3
Limited access to construction site	179728	7
Material storage location	179250	8
Insufficient lighting	195024	5
Inadequate construction method	134557	11
Poor site conditions	199326	4
Inadequate transportation facilities for workers.	205062	1
Quality of required work	177816	9

To avoid redoing important work, wasting resources, and delaying projects, high-quality work must be ensured. It can be quite difficult to get workers to construction sites if there aren't enough transportation options, especially if they're outside of cities with lots of public transportation options. The numbers in the table 4 are the scores given by the Resource Impact Index (RII) to each factor affecting worker productivity in the construction sector. Higher values denote a greater degree of effect. The RII values quantify the degree to which each element affects worker productivity. For instance, the RII value for the factor "Inadequate transportation facilities for workers" is 205062, making it the factor with the greatest influence on productivity. Contrarily, "Inadequate construction method" has the lowest RII value, 134557, indicating that it has the least impact on labor productivity. Identifying those concepts enables stakeholders and construction managers to focus their attention on the most pressing issues, thereby increasing productivity on building sites.

Labor Productivity Affected by External Factors

Figure 5 shows the numerous external factors that have an impact on labor productivity in the construction sector. With a RII of 208886, supervision delays placed fifth in the external category, while government inspection delays placed fourth with a RII of 213666, both of which had a considerable impact on labor productivity. The factors affecting labor efficiency have been identified as drawing revisions, incomplete drawings, and design adjustments. Drawings with intricate designs also have an impact on labor productivity. Rework, project funding challenges, and payment delays were identified as critical elements that had a significant impact on worker productivity. It was also discovered that rules and training programs for newcomers in the construction industry have a considerable impact on labor productivity. These results highlight the significance of efficient management, prompt payments, and thorough planning for raising total worker productivity in building projects.



The table gives details on a number of variables affecting labor productivity in the construction sector. The first column on the left lists the variables. The middle column provides the Relative Importance Index (RII) for each element, which quantifies the importance of each factor in affecting labor productivity. Based on survey respondents' impressions and assessments of each component, the RII is calculated. The influence on worker productivity is greater when the RII value is higher. Based on their RII values, the factors are sorted, with the factor with the highest RII coming in first and the one with the lowest RII coming in last. The factors are ranked here from 1 to 10. For instance, "Rework" is placed first and has the highest RII value of 222748, which shows that it has the greatest impact on labor productivity of all the components provided. However, "Design Changes" is placed tenth and has the lowest RII value (182596), indicating that it has a significantly smaller impact on labor productivity than the other components.

Labor Productivity in Construction Sector Impacted by Miscellaneous Factors

The rating standards for the miscellaneous category are shown in Table 5. Lack of power and/or water supply had a RII of 194068, placing third in the miscellaneous group of factors affecting worker productivity. Building site accidents came in third among other accidents with a RII of 12000. It was shown that accidents had a major negative influence on worker productivity, causing everything from complete task halt due to fatalities or serious injuries to minor impacts from steel wires and nails. With a RII of 187376, the weather placed seventh overall and

fifth in the category of unrelated factors among the 40 variables affecting labor productivity. Extreme weather has a severe impact on building tasks, and high temperatures can significantly reduce production. Working overtime rated second in the category of other factors and tenth overall among affecting variables, with a RII of 196458. Issues like increased absenteeism and decreased safety may result from working overtime. With a RII of 199326, the absence of a clearly defined project purpose came in top place in the other group and has a considerable influence on labor productivity due to a number of variables, including subpar project management, a lack of planning, and inadequate training.

Table 5 Ranking of Impact of Miscellaneous Factors on Labour Productivity

Miscellaneous Factors	RII	Rank
Purpose of the project is not clear	199326	1
Functioning Overtime	196458	2
Scarcity in delivery of power and/or water	194068	3
Accidents occurred throughout construction	190244	4
Condition of Weather	187376	5

The table 5 shows the RII rankings and scores for different variables affecting labor productivity in the construction sector. An impact on worker productivity that is more significant is correlated with a higher RII score. The factor "Project objective is not well defined" has the highest RII score and is ranked first in the table, as can be seen, indicating that it has the greatest impact on labor productivity. In contrast, "Weather conditions" ranks sixth with the lowest RII score, indicating a considerably less significant impact on worker productivity. By addressing these issues, building sites can increase labor productivity and project efficiency.

5. CONCLUSION

The study examined the key elements influencing labor productivity in the construction sector, providing project stakeholders and construction managers with useful information. The research shows how crucial it is to deal with issues involving the workforce, improve project management methods, and implement cutting-edge technology like Building Information Modeling (BIM). Miscommunication, a lack of workplace rivalry, and employee disloyalty have emerged as significant workforce-related problems that affect productivity. The accessibility and effective management of resources, tools, and site conditions are also crucial. In addition to design changes and rework, external factors like monitoring and delays in government inspections have a big impact on labor productivity. By taking care of these issues, construction companies can boost labor productivity, cut down on project delays, and enhance overall project results, which will result in more affordable and competitive construction projects in the modern industry.

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