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Factors Affecting Labor Productivity in the Construction Industry: A Case Study of Engineering Companies in Western Mazandaran Province

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Abstract

The construction industry is a vital driver of economic growth, yet it faces persistent challenges related to labor productivity. This study investigates the factors affecting labor productivity in the construction industry, focusing on engineering companies in western Mazandaran Province, Iran. A quantitative, correlational research design was employed. Data were collected from 108 employees across 7 construction companies using two standardized questionnaires measuring five key productivity factors: 1) Organizational/managerial factors, 2) Job-Related Factors (JRF), 3) Physical/psychological work environment factors, 4) Individual Factors (IF), and 5) Factors creating an atmosphere of intimacy and collaboration. Data were analyzed using Pearson correlation and stepwise multiple regression in SPSS 21. Results revealed that all five factors significantly and positively influence Human Resource (HR) productivity. The regression model explained 41.2% of the variance in productivity, with JRF and IF emerging as the strongest predictors. These findings provide actionable insights for construction managers seeking to enhance workforce efficiency through targeted improvements in organizational practices, job design, work environment, and employee engagement.

Keywords: Labor productivity, Human resource management, Construction industry, Productivity factors, Workforce efficiency.

1 | Introduction

The construction industry plays a pivotal role in national economies, contributing significantly to employment, infrastructure development, and Gross Domestic Product (GDP). However, the industry is notorious for its relatively low productivity growth compared to other sectors, which has prompted extensive research into the determinants of Construction Labor Productivity (CLP). In developing countries like Iran,

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where the construction sector forms a substantial part of the economy, understanding and improving labor productivity is of paramount importance [1].

Labor productivity is a critical success factor in construction projects. It is defined as the ratio of output (work completed) to input (labor hours or cost). Low productivity leads to project delays, cost overruns, quality issues, and reduced competitiveness for construction firms. The inherently project-based, dynamic, and labor-intensive nature of construction makes productivity management particularly challenging. Numerous factors, ranging from individual worker characteristics to organizational policies and external environmental conditions, influence how efficiently labor is utilized on construction sites [2].

The need for effective Human Resource Management (HRM) to enhance productivity is more critical than ever. Construction companies must create conditions that foster worker motivation, skill development, creativity, and job satisfaction. This requires a systematic approach to identifying and addressing the root causes of low productivity. According to Robbins [3], productivity in organizations is achieved when both efficiency and effectiveness are maximized. While international studies have extensively explored construction productivity factors, there is limited empirical research focusing on the specific context of Iran, particularly in smaller regional centers like western Mazandaran Province.

This study addresses this gap by investigating the factors that affect labor productivity in engineering companies operating in this region. The findings are expected to provide evidence-based recommendations for local construction managers, Human Resource (HR) professionals, and policymakers seeking to improve workforce efficiency and project outcomes.

2 | Literature Review

2.1 | Concepts of Efficiency, Effectiveness, and Productivity

In management literature, productivity is often understood as the combination of efficiency and effectiveness [3]. Efficiency refers to "doing things right," focusing on the ratio of outputs to inputs. It measures how well resources (labor, materials, capital) are utilized to produce outputs. An efficient worker or process produces a high volume of output with minimal waste of resources.

Effectiveness, on the other hand, is about "doing the right things." It concerns the degree to which organizational goals and objectives are achieved [4]. An organization is effective if it successfully attains its stated purpose, such as meeting client requirements or achieving a specific level of customer satisfaction.

Productivity integrates both concepts: A productive organization is both efficient (uses resources wisely) and effective (achieves its goals). Achieving high productivity is a continuous process that requires organizations to constantly seek better ways to work while ensuring their efforts align with strategic objectives.

2.2 | Definition and Importance of Productivity

Productivity has been defined in various ways across disciplines. In economics, productivity is viewed as the effective and efficient use of economic resources to achieve maximum potential. At its core, productivity is about achieving the maximum output with minimal input. It applies to all levels: Individual, organizational, and national [3].

The importance of productivity cannot be overstated. For construction firms, higher productivity translates into:

- I. Reduced project costs and enhanced profitability.
- II. Improved competitiveness in bidding and winning contracts.
- III. Better resource allocation and project scheduling.
- IV. Higher quality of workmanship and client satisfaction.
- V. A more motivated and engaged workforce.

2.3 | Key Factors Affecting Labor Productivity

A recent systematic review by Jian et al. [2] identified critical factors affecting CLP. These factors can be broadly classified into internal and external categories.

External factors (environment): These are factors largely outside the control of an organization's management but significantly impact operations. They include cultural factors (societal values regarding work and innovation), economic factors (inflation and wage levels), and social factors (population demographics, education levels).

Internal factors (organization): These factors are within the control or influence of management and are therefore critical levers for improving productivity. According to Fulford and Standing [5], they include:

- I. Human resources: The skills, motivation, and engagement of employees.
- II. Workplace physical/environmental factors: Layout, lighting, noise, safety, and comfort.
- III. Compensation: A fair and performance-based reward system.
- IV. Training and development: Continuous skill enhancement programs.
- V. Technology: The appropriate use of tools, machinery, and methods.
- VI. Rewards and recognition: Positive reinforcement and acknowledgment for good performance.
- VII. Organizational culture: The norms, values, and assumptions that shape behavior.
- VIII. Quality of work life: Efforts to make work more interesting, meaningful, and less stressful.
- IX. Management style: The leadership approach employed.

2.4 | Employee Motivation Theories

Understanding employee motivation is fundamental to improving productivity. Two classic theories are particularly relevant to construction productivity.

Maslow's Hierarchy of Needs [6]: Maslow proposed that human needs are arranged in a hierarchy, from basic physiological needs (food, shelter) to safety, social belonging, esteem, and finally self-actualization. In the workplace, this theory suggests that employees must have their lower-level needs met (e.g., fair wages, job security) before they can be motivated by higher-level factors such as recognition, challenging work, and opportunities for growth.

Herzberg's Two-Factor Theory [7]: Herzberg [7] distinguished between hygiene factors and motivators. Hygiene factors (company policies, supervision, working conditions, salary) are essential to prevent dissatisfaction but do not necessarily motivate employees. Motivators (achievement, recognition, responsibility, advancement, and the work itself) are what truly drive satisfaction and high performance. For construction workers, providing meaningful work, opportunities for achievement, and recognition can significantly enhance motivation and productivity.

2.5 | The Role of Rewards and Compensation

The relationship between compensation and productivity is well-documented. Shaw and Gupta [8] demonstrated that pay system characteristics significantly influence employee performance and retention. Their research found that variable pay systems (e.g., bonuses, performance-based pay) are more strongly associated with the performance of high-quality employees.

Similarly, Pouliakas [9] investigated the impact of bonus intensity on job satisfaction and found that while financial incentives are important, their effect is moderated by factors such as perceived fairness and the overall work environment. This suggests that construction companies must design reward systems that are not only competitive but also perceived as equitable by workers.

Sirota and Klein [10] in their book “The Enthusiastic Employee” argue that creating a positive work environment where employees feel valued, respected, and engaged is more effective in the long term than purely financial incentives. They emphasize the importance of recognition, fair treatment, and opportunities for personal and professional growth.

2.6 | Employee Participation and Collaboration

Employee participation and creativity are also vital for productivity. When employees are involved in decision-making processes, they develop a sense of ownership and commitment. Participatory management fosters innovation and encourages employees to contribute their ideas for improvement. Creating a climate of trust, respect, and collaboration is essential to unlock the full potential of the workforce [10].

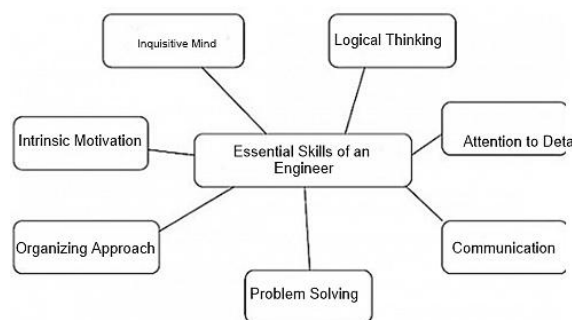


Fig. 1. Conceptual framework of study.

2.7 | Review of Related Studies

Several studies have explored CLP from various angles.

International studies:

- I. Shehata and El-Gohary [1] provided guidance on improving CLP, highlighting the importance of site management, skill training, and work planning. Their study emphasized that productivity improvement requires a systematic approach addressing multiple factors simultaneously.
- II. Fulford and Standing [5] found that collaborative practices, a focus on value engineering, and standardized processes are key to boosting construction productivity. They argued that the construction industry has the potential for significant productivity gains through improved collaboration and trust among project stakeholders.
- III. Ulubeyli et al. [11] examined planning engineers' estimates on labor productivity, finding significant gaps between theoretical planning and on-site reality. Their research highlighted the importance of accurate productivity estimation and the need for better integration between planning and execution.
- IV. Jian et al. [2] conducted a systematic review and meta-analysis of critical factors affecting CLP. Their comprehensive analysis synthesized findings from numerous studies and identified consistent patterns across different countries and project types, providing a robust framework for understanding productivity determinants.

Domestic studies: Several studies in Iran have examined factors affecting HR productivity:

- I. Yavari [12] studied factors affecting HR productivity in a petrochemical company. The study found that managerial-structural factors were ranked highest by managers, while economic-reward factors were ranked highest by employees.
- II. Bardbar [13] identified organizational/managerial factors and physical/psychological environment as key factors for productivity among hospital staff.

- III. Aghaei et al. [14] using the Balanced Scorecard (BSC) model, identified 45 indicators affecting HR productivity, categorized into four BSC dimensions: customer, financial, internal processes, and learning/growth.

3 | Research Methodology

3.1 | Research Design

This study employed a quantitative, correlational research design to examine the relationships between the independent variables (five factors affecting productivity) and the dependent variable (HR productivity). A correlational design is appropriate as it allows the researcher to measure the strength and direction of these relationships without manipulating the variables [4].

3.2 | Research Hypotheses

Based on the literature review and the study's objectives, the following hypotheses were formulated:

Main Hypothesis:

H0: Factors affecting productivity have a significant positive impact on HR productivity in construction companies.

Sub-hypotheses:

H1: Organizational/Managerial factors have a significant positive impact on HR productivity.

H2: Job-Related Factors (JRF) have a significant positive impact on HR productivity.

H3: Physical/Psychological factors of the work environment have a significant positive impact on HR productivity.

H4: Individual Factors (IF) have a significant positive impact on HR productivity.

H5: Factors creating an atmosphere of intimacy and collaboration have a significant positive impact on HR productivity.

3.3 | Population and Sample

The statistical population of this study comprised all employees of construction companies in western Mazandaran Province, Iran. The total population was approximately 1,200 employees. A multistage cluster sampling method was used to select 7 companies. Within these companies, the total number of employees was 150. From this subset, a simple random sample of 108 employees was selected using Morgan's table to ensure adequate statistical power [4].

3.4 | Data Collection Instrument

Data were collected using two validated, standardized questionnaires. Both questionnaires have been previously validated and tested for reliability in the Iranian context.

- I. Factors affecting productivity questionnaire: This questionnaire consisted of 20 items measuring the five independent variables:
 - *Organizational/managerial factors.*
 - *JRF.*
 - *Physical/psychological work environment.*
 - *IF.*
 - *Intimacy/collaboration factors.*
- II. HR productivity questionnaire: This questionnaire consisted of 26 items adapted from the Achio productivity model to measure the dependent variable.

Responses were recorded on a Likert scale. The reliability (internal consistency) of the instruments, as reported in previous studies and tested in this research, was measured using Cronbach's alpha. The values are presented in *Table 1*.

Table 1. Reliability coefficients (Cronbach's Alpha).

Variable	Cronbach's Alpha
HR productivity	0.86
Organizational/managerial factors	0.72
JRF	0.75
Physical/psychological work environment	0.91
IF	0.79
Intimacy/collaboration factors	0.77

3.5 | Data Analysis

The collected data were analyzed using SPSS 21 statistical software. The analysis was conducted in two stages:

- I. Descriptive statistics: Frequency distributions, percentages, means, and standard deviations were calculated for demographic variables (age, education, work experience, gender) and the main study variables.
- II. Inferential statistics:
 - *Kolmogorov-Smirnov (K-S) Test: To check the normality of the data distribution.*
 - *Pearson correlation coefficient: To assess the bivariate linear relationship between each independent variable and the dependent variable.*
 - *Stepwise multiple regression: To determine the extent to which the set of independent variables could predict HR productivity and to identify the strongest predictors.*

4 | Results

4.1 | Descriptive Statistics of the Sample

The majority of respondents were male (87.6%), with a significant proportion possessing a Master's degree (58.4%) and having 5-10 years (46.4%) of work experience. Most respondents were aged 35-45 years (51.2%).

Table 2. Demographic characteristics of the sample (n=291).

Characteristic	Category	Frequency (n)	Percentage (%)
Gender	Male	255	87.6
	Female	36	12.4
Age	25-35 years	60	20.6
	35-45 years	149	51.2
	>45 years	82	28.2
Education	Bachelor's	95	32.6
	Master's	170	58.4
	PhD	26	8.9
Work experience	3-5 years	37	12.7
	5-10 years	135	46.4
	10-15 years	88	30.2
	>15 years	31	10.7

4.2 | Descriptive Statistics of Main Variables

The means and standard deviations of the main variables are presented in *Table 3*. The "HR Productivity" variable had the highest mean (72.76), while "JRF" had the lowest mean (13.40). This indicates that, according to the sample, organizational commitment and intimacy factors are more strongly perceived than the clarity of job roles and rewards.

Table 3. Descriptive statistics for study variables.

Variable	Mean	Standard Deviation
HR productivity	72.76	19.025
Organizational/managerial factors	13.29	3.269
JRF	13.40	3.437
Physical/psychological work environment	13.77	3.426
IF	14.08	3.493
Intimacy/collaboration factors	14.02	3.532

4.3 | Inferential Statistics Results

The Kolmogorov-Smirnov test confirmed that the data for all variables were normally distributed ($p > 0.05$), allowing for the use of parametric tests.

4.3.1 | Correlation analysis

Pearson correlation coefficients (see *Table 4*) revealed a significant and positive correlation between all independent variables and the dependent variable ($p < 0.01$). This means that higher scores on any of the five productivity factors are associated with higher levels of HR productivity. The strongest bivariate relationships were observed for JRF ($r = 0.445$) and IF ($r = 0.444$).

Table 4. Pearson correlation coefficients.

Variables	1	2	3	4	5	6
HR productivity	1					
Organizational/managerial factors	0.432**	1				
JRF	0.445**	0.307**	1			
Physical/psychological environment	0.429**	0.230**	0.318**	1		
IF	0.444**	0.311**	0.321**	0.312**	1	
Intimacy/collaboration factors	0.431**	0.280**	0.378**	0.359**	0.334**	1

** $p < 0.01$.

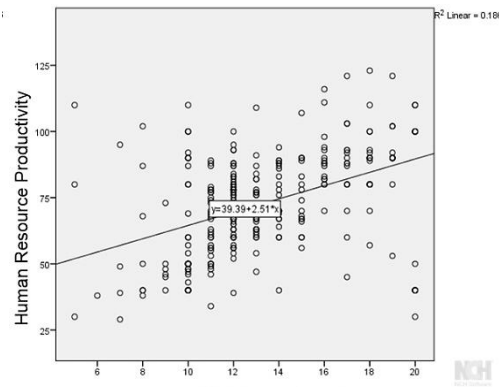


Fig. 2. Scatter plot showing correlation between JRF and HR Productivity.

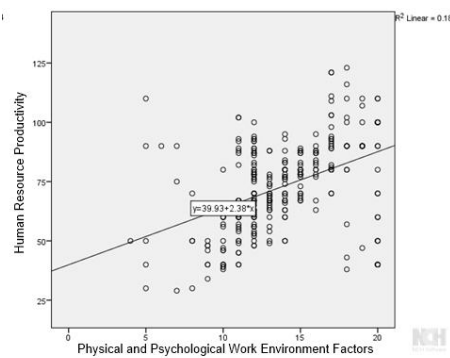


Fig. 3. Scatter plot showing correlation between IF and HR Productivity.

4.3.2 | Stepwise regression analysis

Stepwise multiple regression was performed to determine which of the five productivity factors were the most significant predictors of HR productivity. The results are summarized in *Table 5*.

Table 5. Stepwise regression model summary.

Model	Variables Included	R	R ²	Adjusted R ²	Std. Error of the Estimate
1	JRF	0.445	0.198	0.195	17.069
2	JRF, IF	0.547	0.299	0.294	15.983
3	JRF, IF, Organizational/managerial factors	0.598	0.358	0.351	15.329
4	JRF, IF, Org/man, physical/psych environment	0.635	0.403	0.395	14.802
5	JRF, IF, Org/man, env, intimacy/collab	0.650	0.422	0.412	14.589

The stepwise regression introduced variables in the following order:

- I. JRF alone accounted for 19.5% (Adjusted R²) of the variance in HR productivity.
- II. Adding IF increased the explanation to 29.4%.
- III. Adding organizational/managerial factors increased it to 35.1%.
- IV. Adding physical/psychological work environment increased it to 39.5%.
- V. Finally, adding intimacy/collaboration factors produced a model explaining 41.2% (Adjusted R²) of the variance.

The final regression equation, as shown in *Table 6*, indicates that all five factors remain significant predictors.

Table 6. Regression coefficients for the final model.

Variable	Unstandardized Coefficients (B)	Standardized Coefficients (Beta, β)	t-value	Sig.
(Constant)	-0.903		-0.070	0.944
JRF	1.049	0.190	3.689	0.000
IF	1.086	0.199	3.931	0.000
Organizational/managerial Factors	1.286	0.221	4.487	0.000
Physical/psychological work environment	1.104	0.199	3.953	0.000
Intimacy/collaboration factors	0.858	0.159	3.069	0.002

The standardized beta coefficients (β) show the relative strength of each variable as a predictor. JRF ($\beta = 0.190$) and IF ($\beta = 0.199$) were the strongest predictors, followed closely by Organizational/Managerial Factors ($\beta = 0.221$) and Physical/Psychological Environment ($\beta = 0.199$). The Intimacy/Collaboration Factors ($\beta = 0.159$) also made a significant, albeit smaller, contribution.

4.4 | Hypothesis Testing

Based on the correlation and regression results, all hypotheses were supported. The main hypothesis, that "factors affecting productivity have a significant positive impact on HR productivity," is accepted. Similarly, all five sub-hypotheses, confirming the significant positive influence of each factor, are accepted.

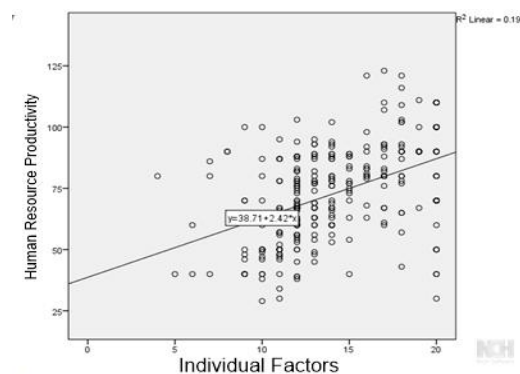


Fig. 4. Bar chart showing the Beta (β) coefficients for the five predictor variables.

5 | Discussion

The primary objective of this study was to investigate the factors influencing labor productivity in the construction industry of western Mazandaran. The findings provide strong empirical support for the significance of multiple interconnected factors.

- I. Overall impact: The results confirm that factors affecting productivity collectively explain a substantial portion (41.2%) of the variance in HR productivity. This aligns with the fundamental premise of the literature that productivity is multi-faceted and not attributable to any single cause [1], [2].
- II. Role of JRF: The strong predictive power of JRF is consistent with Herzberg's theory [7], which posits that job content (motivators) is key to employee satisfaction and performance. In the construction context, where work can be repetitive and physically demanding, it is not surprising that aspects like task clarity, clear goals, and fair compensation are potent drivers of productivity. When employees understand their roles and see a fair connection between effort and reward, they are more engaged and effective.

- III. Significance of IF: The finding that IF (like worker skills, abilities, and personal characteristics) are a strong predictor highlights the importance of skilled labor. This echoes the findings of earlier studies [13]. Investment in recruiting, selecting, and training workers pays off in higher productivity. Furthermore, as Sirota and Klein [10] note, a positive, supportive environment is essential for employees to apply their skills and abilities to their fullest potential.
- IV. Impact of organizational/managerial factors: The influence of organizational policies and management style is a logical finding. Management has a direct role in creating the conditions for high productivity through clear strategies, fair performance evaluation, and fostering a competitive yet supportive climate. This finding is consistent with studies by Fulford and Standing [5] and Ulubeyli et al. [11] that emphasize effective management as the cornerstone of organizational efficiency.
- V. Physical and psychological environment: The work environment's impact on productivity is well-documented. A comfortable, safe, and healthy workplace reduces fatigue, stress, and accidents, which in turn improves efficiency. This is particularly relevant in construction, where hazardous conditions are common. The positive influence of environmental factors also aligns with the theory of quality of work life, suggesting that as physical and psychological well-being improves, employee output and morale increase.
- VI. Importance of intimacy and collaboration: This factor, while sometimes overlooked in productivity studies, is crucial. The construction industry is inherently collaborative, involving multiple trades and stakeholders. A workplace characterized by mutual respect, trust, and psychological safety encourages open communication, teamwork, and collective problem-solving, all of which contribute to a more productive environment [10]. This finding is consistent with the systematic review by Jian et al. [2] which identified social and relational factors as significant determinants of productivity.

6 | Conclusion

This research has successfully identified five key factors—organizational/managerial, job-related, physical/psychological work environment, individual, and intimacy/collaboration—as significant influencers of labor productivity in construction companies. The findings suggest that no single factor is a silver bullet; rather, a holistic approach addressing all these dimensions is necessary to achieve sustainable gains in productivity.

The regression model, explaining 41.2% of the variance, demonstrates that these factors are substantial contributors. Job-related and IF emerged as particularly strong drivers, but organizational policies, environmental conditions, and a collaborative culture are also essential. For construction managers and HR professionals, this means that to boost productivity, they must look beyond traditional tools and create a work system that combines clear roles, appropriate rewards, a supportive environment, and a culture of trust and teamwork.

By addressing these factors, construction companies can expect not only to improve project outcomes but also to create a more positive and sustainable workplace culture.

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Conflicts of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability

The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request. All relevant data supporting the findings of this study are included in the published article.

Authors' Contributions

N. J. A.: Conceptualization, Methodology, Investigation, Data Collection, Formal Analysis, Writing—Original Draft, Visualization.

N. A.: Supervision, Validation, Data Curation, Writing—Review & Editing, Project Administration.

All authors have read and approved the final version of the manuscript.

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Consent for Publication

All authors have reviewed and approved the final manuscript and have provided their consent for publication.

Ethics Approval and Consent to Participate

This study was conducted in accordance with the ethical principles of research involving human participants. Participation in the survey was voluntary, and informed consent was obtained from all respondents before completing the questionnaires. The confidentiality and anonymity of participants were strictly maintained throughout the research process. Ethical approval was not required according to the institutional regulations applicable to questionnaire-based social science research.

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