FACTORS AFFECTING LABOUR PRODUCTIVITY OF CONSTRUCTION WORKER ON CONSTRUCTION SITE: A CASE OF HANOI

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Abstract

Labour productivity of Vietnamese economy in general and of Vietnamese construction industry in particular is low in comparison with other countries. Boosting labour productivity is becoming an urgency and is attracting much attention from both domestic and foreign researchers. This paper focuses on a series of factors affecting labour productivity on construction site in Hanoi. The research aims to evaluate and rate the extent of impact of each factor to labour productivity. By referring to the outcomes of this study, Vietnamese construction contractors will be able to come up with workable solutions which will contribute towards a better performance of construction workers. On that basis, the productivity of construction firms and national economy will be improved correspondingly.

Keywords: productivity; labour productivity; factors affecting; construction worker.

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1. Introduction

In the context of increasingly widening international integration, labour productivity is one of the most important factors affecting the competitive capacity of national economy in general and of each business in particular. Although Vietnamese labour productivity has recently been improved, it is still lower than other countries in ASEAN. According to Seminars "Boosting productivity in the context of industrialisation", Vietnam's labour productivity is approximately equivalent to 7% that of Singapore, 17.6% of Malaysia, 36.5% of Thailand, 42.3% of Indonesia [1], 56.7% of Phillippines, especially 87.4% of Laos [2]. In recent years, although there have been great scientific and technological developments, they have not yet been exploited by Vietnamese construction firms. Specifically, labour productivity in construction is only equal to 85% of those obtained in other industries. The growth rate of productivity reaches about 10%, which is lower than average annual growth rate of about 16% [3]. One of the causes is the lack of applying advanced technology, heavy equipment and machine. Construction labour productivity, therefore, is one of the most important factors to productivity of business, which has a direct effect on labour productivity in construction field and national economy. Studying factors affecting construction labour productivity contributes to appraising effect level of each factor at its true worth, and then proposing effective solution for construction business.

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2. Factors affecting labour productivity of construction worker

Construction process has unique characteristics such as: long execution time, a large number of stages and stakeholders, labour productivity is consequently affected by differents factors [4]. By referencing literature and considering practices on construction site in Hanoi, the authors utilise 43 factors and divide into 8 groups as in Table 1. Of which, some are referenced from literature whilst the remains are proposed by the authors.

3. Research methodology

3.1. Method of measuring the influence of factors

Within the scope of the study, the authors used the method of The Relative Importance Index (RII) to measure the impact of these factors on labour productivity of construction workers on site in City of Hanoi based on the results of a survey collected all the necessary data.

The RII method uses an ordinal scale of 1 to 5 to determine the impact of each factor (1 - No impact, 2 - Low impact, 3 - Moderate impact, 4 - High impact, 5 - Very high impact). For the analysis of the level of influence, the RII method [32] uses the following equation:

$$\text{RII} = \frac{\sum_{i=1}^{5} \mathbf{W}_i \times \mathbf{X}_i}{\sum_{i=1}^{5} \mathbf{X}_i} \tag{1}$$

where $\mathbf{W}_i$ is the rating given to each factor by the respondents ranging from 1 to 5; $\mathbf{X}_i$ is the percentage of respondents scoring; i is the order score ranging from 1 to 5.

The influence of factors thereby is expressed through the following scale [32]:

$1.0 \leq \text{RII} < 1.8$: No impact;

$1.8 \leq \text{RII} < 2.6$: Low impact;

$2.6 \leq \text{RII} < 3.4$: Moderate impact;

$3.4 \leq \text{RII} < 4.2$: High impact;

$4.2 \leq \text{RII} < 5.0$: Very high impact.

To obtain the data used to identify RII, the authors designed a questionnaire to survey the opinions of those working in the construction industry on the impact of factors on labour productivity of construction workers. The sample size was determined according to the following formula [34] with a reliability of 95%:

$$m = \frac{z^2 \times P \times (1 - P)}{E^2} \tag{2}$$

$$n = \frac{m}{1 + \dfrac{m - 1}{N}} \tag{3}$$

where n is a sample size of limited population; m is a sample size of unlimited population; P is the degree of variance between the elements of population (usually $P = 0.5$); E is tolerance ($\pm 3\%$, $\pm 4\%$, $\pm 5\%$, ...); z is the distribution value corresponding to the reliability of choice (95% confidence, z value is 1.96); N is the total number of responses collected.

Table 1. Factors affecting labour productivity of construction worker

Factors		Factors	
A	Factors relevant to construction worker [5]	E	Factors relevant to working time
1	Age [6, 7]	1	Break time
2	Experiences of workers [2, 8, 9]	2	Delay time [7, 10]
3	Gender	3	Number of working hours [11]
4	Labor discipline [12]	4	Operating time [7]
5	Labor intensity	5	Preparing and finalizing time
6	Level of training [13, 14]	6	Working mode [15]
7	Physical ability	F	Factors relevant to labour condition [3, 16]
8	Psychophysiology ability [7]	1	Exposure to toxic substances [16]
B	Factors relevant to operation and management on construction site [11, 14, 17, 18]	2	Height of working place [7]
1	Ability to organize production	3	Intensity of lighting, ventilation
2	Application of technology [19]	4	Noise
3	Attitude towards employees [14, 20, 21]	5	Working in hazardous areas [22]
4	The manager's experience [23]	G	Factors relevant to labour safety [9, 13]
C	Factors relevant to motivation [24]	1	Arrangement of safety staff
1	Initiative at work	2	Occupational accidents [25]
2	Reward mechanism [20, 26]	3	Regulations on labor safety
3	Spiritual life	4	Safety equipment
4	Staff support	5	Safety signs [4, 13]
5	Training and improving skills [27]	6	The sense of observance of regulations by laborers [28]
6	Types of salary payment [20, 24, 29]	7	Training on labor safety
D	Factors relevant to tools and subject of labour	H	Factors relevant to natural environment and society [4, 30, 31]
1	Complexity of works	1	Geological and hydrological conditions
2	Material transport methods	2	Regulations, laws on construction [31]
3	Quality of building materials [7, 32]	3	Weather conditions [4, 9, 13]
4	Quality of working tools [33]		

3.2. The plan of survey

The author conducted a survey to collect data to determine the level of impact (5 levels) of 43 factors in 8 groups of factors affecting labour productivity of construction workers. By using di-

rect interview questionnaires, interviewees were construction workers on sites in Hanoi. 200 samples were sent.

Determine the sample size needed through following formula in which $z = 1.96; N = 200; P = 0.5$; pick $E = 0.04$ (4%). By using formulas (2) and (3) with value $m = 600$ and $N = 200$, the number of samples needed is 150. Thence, the number of samples needed is 150.

4. Data analysis

One of the most important stages was to collect accurate data, the total number of questionnaires sent was 200, the number of responses received and validated was 185. This figure is greater than the required sample size, so the data obtained satisfies the quality requirements.

The results of the survey were synthesized by the author and evaluated the impact of 43 factors, which are divided into seven groups of factors affecting the labour productivity of construction workers on sites in Hanoi as follows.

Group 1: Factors relevant to construction workers themselves

Table 2. Ranking of factors on workers themselves

Factors	RII	Impact	Ranking
Experiences of workers	4.31	Very high	1
labour discipline	4.28	Very high	2
Physical ability	4.20	Very high	3
Psychophysiology ability	3.74	High	4
Labour intensity	3.53	High	5
Age	3.52	High	6
Gender	3.22	Moderate	7
Level of training	3.08	Moderate	8

According to the interviewed participants (Table 2), the experience of construction workers was the leading factor among the influencing factors in the group of factors of the workers themselves, with RII = 4.31. The results coincide with previous studies [35, 36], which found that workers' experience greatly influenced labour productivity. Labour discipline was ranked second with RII = 4.28, physical ability with RII = 4.20 was ranked third in this group.

Factors such as physiological ability, labour intensity, and age were in the greatly influential factors, with RIIs of 3.74, 3.53 and 3.52 respectively. This result is somewhat predictable because high professional qualifications correspond to skilled workers or high ranks should increase productivity. The lower the labour intensity, the lower the labour productivity, the physiological psychological problems of people will affect the efficiency of work thus affecting the labour productivity. The higher the age, the more accumulated experience, but the physical strength can be reduced, thus greatly affecting labour productivity.

Gender and level of training are two factors ranked 8th and 9th with RIIs of 3.22 and 3.08 respectively, which means that the moderate influence. This proves that although the job of construction workers is strenuous, this does not significantly affect the increase or decrease labour productivity. Education, likewise, has the low impact on productivity of construction workers on sites in Hanoi.

Group 2: Factors relevant to operation and management on construction site

This is the group with the highest number of influencing factors, ranked as follows:

Table 3. Ranking of operational and managerial factors

Factors	RII	Impact	Ranking
Ability to organize production	4.25	Very high	1
Construction supervision	4.23	Very high	2
Application of technology	3.95	High	3
Workers' arrangement	3.74	High	4

The results in Table 3 show that the ability to organize production is the leading factor in the group affecting labour productivity with RII = 4.25, ranking second is the organization of construction supervision with RII = 4.23. It can be seen that the ability to organize and supervise the construction of contractors, especially the site manager will decide the management and organization, manufacture and direct construction on the site. These have a direct impact and greatly affect the increase or decrease of labour productivity. With RIIs being 3.74 and 3.95, the factors to be assessed with a high degree of influence are the application of technology and worker's arrangement. That is to say, under workers' perspective, technology and labour's arrangement significantly contribute to their performance.

Group 3: Factors relevant to motivation

Table 4. Ranking of factors that motivate employees

Factors	RII	Impact	Ranking
Types of salary payment	4.28	Very high	1
Staff support	4.08	High	2
Reward mechanism	3.96	High	3
Spiritual life	3.82	High	4
Training and improving skills	3.38	Moderate	5
Initiative at work	3.19	Moderate	6

According to research results (Table 4), the form of salary payment is a factor that has a very high impact on labour productivity ranked first with RII = 4.28. Income is the legitimate purpose. Monetary incentive therefore is the goal that every construction worker aiming for. High levels of welfare were the welfare, incentive, and spiritual well-being factors that RII is 4.08, 3.96 and 3.82 respectively. These factors will directly affect the motivation of employees, good motivation will relieve unnecessary stress, enhance the attractiveness of pay, bonus. The workers will be eager to work, stick with the organization, willing to devote themselves for the organization.

Professional training, skills upgrading and innovations in labour are factors that have high impact on labour productivity. These factors directly influence the motivation of employees, bring satisfaction and sense of responsibility of construction workers to the work.

Group 4: Factors relevant to tools and objects of labour

Table 5 shows the impact of these factors of working tools and objects on variation in labour productivity. Quality of building materials is the leading factor with RII = 4.26, ranked second factor

is quality of working tools with RII = 4.25. It can be seen that if good bricklayers do not have built-in tools, the quality of bricks or mortar is poor, so the performance of building walls can not be high.

Table 5. Ranking of factors of working tools and objects

Factors	RII	Impact	Ranking
Quality of building materials	4.26	Very high	1
Quality of working tools	4.25	Very high	2
Complexity of works	3.89	High	3
Material transport methods	3.27	Moderate	4

High-impact factor is the complexity of the work with RII = 3.89 and factor of material transport methods with RII = 3.27. These factors affect the performance of the work that will also affect labour productivity as reported by [37]. In order to ensure the achievement and growth of labour productivity, organisations need to utilise machines, equipments and tools which must be suitable with products and technologies; ensure routine readiness and operation throughout the working shift; ensure raw materials, semi-finished products putting into production must have evident origin and qualification.

Group 5: Factors relevant to working time

Table 6. Ranking of factors that motivate employees

Factors	RII	Impact	Ranking
Operating time	3.90	High	1
Number of working hours	3.78	High	2
Break time	3.71	High	3
Preparing and finalizing time	3.53	High	4
Delay time	3.50	High	5
Working mode	3.29	Moderate	6

According to Table 6, he total working time and finishing product time of construction workers will determine their productivity is high or low. Operating time; working hours in shift; preparing and finishing time; Break time and delaying time are factors that have a high impact on labour productivity. In which, the operating time is the leading factor in the group with RII = 3.90, secondly the factor of working hours with RII = 3.78.

The working mode factor is the factor with moderate impact and ranked at the bottom of the group with RII = 3.29. In order to increase labour productivity, construction firms should take measures to reduce wasted time and increase value-added time, thereby increasing the efficiency of the squad of workers.

Group 6: Factors relevant to labour condition

Research results show that with RII = 4.20, the factor of height has a great influence on labour productivity and ranked first in this group (Table 7). This is perfectly suited to the fact that the higher the level of construction work, the more likely it is that the construction worker will suffer the effects of natural factors and the more difficult work done for the type of work. At civil construction having high elevation, this factor has a greater affect on labour productivity, so the system of norms in Vietnam is currently according to the heights, i.e. ≤ 4 m; ≤ 16 m; ≤ 50 m and > 50 m.

Table 7. Ranking of factors of working tools and objects

Factors	RII	Impact	Ranking
Height of working place	4.20	Very high	1
Working in hazardous areas	4.13	High	2
Exposure to toxic substances	3.80	High	3
Noise	3.74	High	4
Intensity of lighting, ventilation	3.16	Moderate	5

The second highest risk factor is working in hazardous areas with RII = 4.13, which has the same high impact with exposure to toxic substances and noise levels having 3.80 and 3.74, respectively. The factor having a moderate impact is the intensity of lighting, ventilation with RII = 3.16. Places with poor working conditions such as too bright or too dark will affect the eyes and vision of the workers, reducing their working capacity as a result. The contaminated and unsafe workplaces, without a doubt, have possibility to affect the health of workers. Moreover, it makes workers feel not assured, so they do not concentrate on work, thereby reducing labour productivity.

Group 7: Factors relevant to labour safety

Not only the construction industry, but for all kinds of occupations, the safety of people, safety of machinery, safety of products are placed on top of priority. According to the survey results (Table 8), the factor of occupational safety equipment has the highest effect on the construction workers with RII = 4.23. Construction workers often work in dangerous environment, so that the firms having adequate protection and safety equipment is essential to prevent occupational accidents and help the workers peace of mind. On that basis, increasing productivity is achievable.

Table 8. Ranking of factors of occupational safety

Factors	RII	Impact	Ranking
Safety equipment	4.23	Very high	1
The sense of observance of regulations by labourers	3.81	High	2
Safety signs	3.79	High	3
Occupational accidents	3.78	High	4
Regulations on labour safety	3.62	High	5
Arrangement of safety staff	3.58	High	6
Training on labour safety	3.31	Moderate	7

Factors of RII from 3.54 to 3.81 are rated as having a high impact including employees' sense of compliance; safety signs; occupational accidents; regulations on labour safety and arrangement of safety staff. According to [37], accidents have a significant impact on occupational accidents with three types comprising fatal accidents will cause the construction process to interrupt for a number of days; accidents causing injured construction workers to be hospitalized for at least 24 hours will adversely affect the performance of such work; the remaining minor accidents affect the labour productivity in certain cases.

However, the respondents propose that the factor of training on occupational safety has a moderate impact on labour productivity with RII = 3.24. These factors affect the worker's psychology and working processes that affect labour productivity, in order to ensure occupational safety and reduce occupational accidents and diseases during the construction process.

Group 8: Factor relevant to natural enviroment and society

Table 9. Ranking of natural environmental factors

Factors	RII	Impact	Ranking
Weather conditions	3.84	High	1
Regulations, laws on construction	3.52	High	2
Geological and hydrological conditions	3.39	High	3

According to Table 9, weather factor is a factor that has a high impact on labour productivity and is ranked first with RII of 3.84. Most construction works are built in natural spaces, where are affected directly by the weather. The weather not supporting or sometimes becoming severe has a not small impact on labour productivity. The role of natural conditions for labour productivity is objective and unavoidable. Therefore, to ensure the achievement and increase productivity, construction firms need to anticipate the difficulties arising due to natural environment conditions to mitigate risks in the production process. The second most influential factor is the factor of regulations on construction with RII = 3.52. Regulations and national policies that influence the goals and direction of the production of the construction firms, affecting the organisational policies for workers on wages, investment in science and technology, so on, thus affecting productivity.

Rank the impact of factor groups

Table 10. Ranking of groups of factor

Factors	RII	Impact	Ranking
The construction workers themselves	4.32	Very high	1
Motivating for construction workers	4.03	High	2
Working tools and objects of labour	3.91	High	3
Organization and management of production on site	3.86	High	4
Labour safety	3.72	High	5
Working time	3.61	High	6
Working condition	3.58	High	7
Natural environment and society	3.49	High	8

According to the research results (Table 10), the construction workers themselves are the most influential factor in labour productivity of construction workers with RII = 4.32. This result is consistent with the fact that labour is the first and most important factor affecting labour productivity. Ranking second with RII = 4.03 is the motivating factor for construction workers, so construction workers argue that when the firm has motivational policies, the workers will try their best to work to increase productivity. Furthermore, thanks to it, workers will stick together and ready to dedicate themselves to the organization. The group of natural-social environment factors is highly influenced but ranked in groups with RII = 3.49 only.

Summary of ranking factors affecting labour productivity

The results show in Table 11 that the factor of experience of the employees is the highest impact factor among 43 factors that affect the labour productivity of the construction workers. There are ten factors that are highly influential: employee experience; labour discipline; pay forms; quality

Table 11. Summary of ranking factors affecting labour productivity

Factors	RII	Impact	Ranking
Experiences of workers	4.31	Very high	1
Labour discipline	4.28	Very high	2
Types of salary payment	4.28	Very high	3
Quality of building materials	4.26	Very high	4
Ability to organize production	4.25	Very high	5
Quality of working tools	4.25	Very high	6
Construction supervision	4.23	Very high	7
Safety equipment	4.23	Very high	8
Physical ability	4.20	Very high	9
Height of working place	4.20	Very high	10
Working in hazardous areas	4.13	High	11
Staff support	4.08	High	12
Reward mechanism	3.96	High	13
Application of technology	3.95	High	14
Operating time	3.90	High	15
Complexity of works	3.89	High	16
Weather conditions	3.84	High	17
Spiritual life	3.82	High	18
The sense of observance of regulations by labourers	3.81	High	19
Exposure to toxic substances	3.80	High	20
Safety signs	3.79	High	21
Number of working hours	3.78	High	22
Occupational accidents	3.78	High	23
Psychophysiology ability	3.74	High	24
Workers' arrangement	3.74	High	25
Noise	3.74	High	26
Break time	3.71	High	27
Regulations on labour safety	3.62	High	28
Arrangement of safety staff	3.58	High	29
Labour intensity	3.53	High	30
Preparing and finalizing time	3.53	High	31
Age	3.52	High	32
Regulations, laws on construction	3.52	High	33
Delay time	3.50	High	34
Geological and hydrological conditions	3.39	High	35
Training and improving skills	3.38	Moderate	36
Training on labour safety	3.31	Moderate	37
Working mode	3.29	Moderate	38
Material transport methods	3.27	Moderate	39

of construction materials; ability to organize production; quality of tools and tools; organization of construction supervision; strength and heights. At the same time, 25 factors have high impact and 8

Factors	RII	Impact	Ranking
Gender	3.22	Moderate	40
Initiative at work	3.19	Moderate	41
Intensity of lighting, ventilation	3.16	Moderate	42
Level of training	3.08	Moderate	43

factors have a moderate impact on the labour productivity of construction workers at the construction sites in Hanoi. As a result, construction firms wishing to increase labour productivity must offer solutions that address the most influential factors or the ten factors identified by the study.

5. Conclusions

Labour productivity plays an absolutely important role in economic growth and improving the competitiveness of each business as well as in each country. The research has identified 43 factors that are classified into 8 groups affecting the labour productivity of construction workers on site in Hanoi. Through the survey responded by construction workers who are working on site in Hanoi, the author has used the RII relative importance index method to evaluate and rank the impact of these 43 factors. The top ten most influential factors have been determined that will provide the basis for the construction firms to provide effective solutions to achieve and increase the productivity of construction workers.

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