Analysis and evaluation of factors affecting the motivation of construction workers

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Abstract: The characteristics of the construction works are the participation of many fields and many jobs with different requirements. Therefore, in construction projects, even when applying science, technology and automation, the construction workers also play an important role. The construction workers are the main force and directly perform the tasks of creating construction products. For desiring to improve the labor productivity in the construction industry, research on the construction workers is focused increasingly. This paper learns about the factors which affect the motivation of the construction workers. Analytical Hierarchy Process (AHP) method is used to analyze and evaluate the affecting factors the work motivation of the construction workers. The ranking results of the factors show that the factors which are from the employer, have a strong impact on their work motivation. These factors are such as salary, bonus and welfare, labor management method, work discipline, regular job guarantee. They are factors with high weight and making decisive to the work motivation of the construction workers. Meanwhile, factors which are from employees, have less impact on their work motivation. This result is consistent with current reality.

Keywords: Affecting Factors, Construction Workers, Motivation, Analytical Hierarchy Process (AHP), Labor productivity.

1. Introduction

From 2021 to now, the construction industry has effectively implemented many long-term development strategies and plans in the field of construction such as: Orientation of the master plan for the development of Vietnamese cities; Housing development strategy to 2020, vision to 2030; Planning for the construction of key economic regions, provincial areas and urban areas; Master plan for development of construction materials. The result has changed the face from urban to rural areas. The system of cities is expanding, developing both in size and quality. The technical infrastructure system is invested centrally, gradually improving quality to meet the development requirements of society. Housing problems in urban areas are being improved significantly. In 2023, the construction industry achieved a growth rate of 6.5-7% [1] and continues to have the positive changes in housing, water supply and drainage, waste collection, transportation,.... It can be said that construction enterprises have a lot of potential and development opportunities in the coming time.

Estimating about 7 million of the workers working in the construction industry, the demand for human resources of the construction industry can increase by about 400,000 – 500,000 workers per year. According the current development rate, the number of the workers working in the construction industry by 2030 may reach about 12-13 million people [2]. However, the human resources of the construction industry still do not meet the requirements of the market. There are a lot of large projects which have a shortage of manpower in both quantity and quality.

The capacity and professionalism of the construction workers are also considered to be limited. The number of the workers with their college and vocational secondary degrees only accounts for 11.8%; the number of the high-education level workers (6.7) accounts for only about 7% of the construction industry [2]. The number of manual labor, untrained agricultural labor is still high. They remain their proficiency, professionalism, and professional skills which is not improved.

The construction speed is taking place quickly in big cities such as Ho Chi Minh, Hanoi, Da Nang, etc. The number of the construction workers coming from neighboring provinces to the big cities is very large. They face many difficulties in living conditions, working conditions, and social evils. The workers are forced to adapt and accept the difficult conditions. The quetion is how to improve the working efficiency of the construction workers. Shahriyar Mojahed et al [3] and Bon-Gang Hwang et al [4] argued that influencing the motivation of the construction workers to can improve their work efficiency quickly. Within the scope of the study, the authors learn in more detail about the factors affecting the work motivation of the construction workers. The research results are the basis for developing the feasible solutions to improve the labor productivity of the construction workers.

2. Literature Reviews

The construction workers are the main force and perform the task of creating construction products directly. Labor costs account for a significant portion of the total cost of the construction project. Thus, the labor productivity of the construction workers is also given comprehensive attention. Many studies have been conducted around the world to understand the labor productivity. Scientists had acknowledged that the construction industry recorded the labor productivity levels lower than other economic sectors [5]. In particular, developing countries had the labor productivity levels much lower than developed countries [6]. But in general, the poor labor productivity has been being a long-term problem for the construction industry worldwide.

Research results by Richard L. Tucker (1986) shown that about 20% of construction workers' working hours in general are actually productive [7]. Peter F. Kaming et al (1997) found that the workers in Indonesia were productive on average 75% of the working time [8]. Besides, Awad S. Hanna et al (2005) found an interrelationship between the labor productivity and overtime of the construction workers in the United States [9]. Overtime was counted as time exceeding 40 hours per week. As a result, the labor productivity had decline as the number of extra ovetime of the construction workers increased.

Another study by Peter F. Kaming et al (1997) conducted in 07 regions in Indonesia, that showed that the labor productivity has large differences between regions and they wewe related to the following factors: Time, skills, workers' abilities and motivation, the supervision and responsibilities of supervisors [8]. Richard Fulford and Craig Standing et al (2014) believed that the project management forms contributed to reducing the labor productivity and competitiveness in the construction sector [10].

In Vietnam, Nguyen Manh Hung (2015) compared the labor productivity in Vietnam with other constries. The results showed a quite large difference [5]. The labor productivity in developed countries was much higher than Vietnam's labor productivity. At the same time, the growth rate of the countries around the world was also faster than Vietnam. Trinh Quoc Thang (2005) shown that there were many factors affecting the labor productivity, in which people are the key factor in improving the abor productivity [11]. There needs to be an impact on the motivation of the construction workers to improve the labor productivity of the construction workers in Vietnam to approach the labor productivity level developed countries.

"Motivation" according to the Vietnamese dictionary is to make development. Motivation can be understood as a process of initiating, leading, and maintaining purposeful behaviors at work. Donn E. Handier (1985) has divided into two groups of factors that affect the motivation of construction workers: financial motivation and non-financial motivation [12]. Typical of financial motivation is wages, typical of non-financial motivation is recognition. Dinh Tuan Hai and Nguyen Van Tam (2019)

point out a number of factors stemming from workers that directly affect their work performance such as age, gender, work discipline, physical, psychophysiology [13]. Kazaz, A., MIanisali, E. & Ulubeyli, S (2008) identified 4 groups of factors affecting the motivation of the construction workers: the group of factors related to organization, the group of factors related to economics, the group related to physical and the group related to psychosocial relations [14]. The authors' studies also clarify the issue of factors affecting the motivation of construction workers [15-18]. A summary of the affecting factors the motivation of the construction workers is as shown in Table 1 below.

Table 1.
Factors affecting the motivation of construction workers

Symbol	Influencing factors	Sources
A1	Age, gender, psychophysiology	[14]
A2	Personal development	[14, 17]
A3	Salary, bonus and benefits	[14, 15, 17, 19]
A4	Recognition of the organization	[15, 17]
A5	Methods of labor management, work discipline	[14, 16]
A6	Guaranteed regular work	[16]
A7	Working conditions	[15, 16, 19]
A8	Allow rest	[15]
A9	The push for progress	[15]
A10	Teamwork	[15, 17]

3. Research Methodology

3.1. Analytical Hierarchy Process

AHP (Analytical Hierarchy Process) method is also known as hierarchical analysis method. The AHP method is used to solve unstructured problems in economic, social and managerial science. The AHP methodology helps to handle complex multi-standard decision-making problems. AHP allows decision makers to gather the knowledge of research experts, combining objective and subjective data in a logical hierarchical framework. AHP helps to classify the relative priority for options, problems are given based on a proportional level. This ratio is based on the judgment of the decision maker and how important those judgments are, as well as the consistency in comparing options in the decision-making process. AHP combines both qualitative and quantitative human thinking. Qualitative through hierarchical arrangement and quantitative through the results of the weighting set for each hierarchical factor. Three principles when implementing the AHP method: (1) Analysis of decision-making problems (building a hierarchical structure); (2) Comparative evaluation of components (pairing comparison between factors); and (3) Synthesis of priorities (determination of weighted matrices).

There have been a number of studies applying AHP to solve problems in different aspects of the construction industry in Vietnam such as: Vu Quyet Thang, Nguyen The Quan (2015) have applied hierarchical analysis method (AHP) to select the type of project contract used in the project implementation in the form of public-private partnership [19]. Nguyen The Quan (2015) applies hierarchical analysis (AHP) to select construction technology options [20]. Pham Quang Thanh (2019) applies hierarchical analysis method (AHP) to select the method of implementing construction investment projects [21]. Nguyen Quoc Toan, Nguyen Thi My Hanh (2020) apply AHP (Analytic hierarchy process) method to selectmaterial suppliers for construction contractors [22]. However, in applying the AHP method to analyze and evaluate the factors affecting the motivation of construction workers in Vietnam, there are no studies.

In this study, the authors will use the AHP method to compare, evaluate and rank the factors affecting the motivation of construction workers.

3.2. The Research Steps

The steps are as follows:

- Step 1: Identifying and analyzing the research contents and objectives. In the paper, the authors aims to compare, evaluate and rank the factors affecting the motivation of the construction workers.

- Step 2: Building a hierarchy for the factors in Table 1.

- Step 3: Surveying and collecting data.

+ Survey sample sizing: To simplify the process and still ensure reliability, the authors used the sample size determination accoring to Hair (2014) [23]. A ratio of observations to an analytical variable of 5:1 guarantees 95% of confidence. The number of variables is 10 variables corresponding to the 10 factors under consideration. Thus, the number of questionaries must be greater than or equal to 50 votes to be reliable enough for analysis.

+ The authors investigates the survey according to the random method.

- Step 4: Building the pairs comparison matrices using the scale according to the table below.

Table-2.
Pair comparison scale

Priority level	Definition	Explain
1	Equal priority	Two factors have the same priority
3	Moderate priority	Experience and judgment are slightly inclined to one factor over another
5	Slightly preferential	Experience and judgment are strongly inclined towards one factor over the other
7	Very priority	A factor takes precedence over the other and is manifested in practice
9	Extremely priority	The overwhelming preference of an element above possible
1/3; 1/5; 1/7; 1/9	The negative levels correspond to level 3; 5; 7; 9	

Source: [24]

– Step 5: Weighted matrix

Table3.
Illustration of the weighted matrix

Symbol	A1	A2	A3	...	An
A1	a_{11}	a_{12}	a_{13}	a_{14}	a_{1n}
A2	a_{21}	a_{22}	a_{23}	a_{24}	a_{2n}
A3	a_{31}	a_{32}	a_{33}	a_{34}	a_{3n}
...	...	...	...	...	....
An	a_{n1}	a_{n2}	a_{n3}	a_{n4}	a_{nn}

Source: [24]

- Step 6: Checking the CR coefficient. CR ratio of 10% is satisfactory, if CR > 10%, it is necessary to redo the 3rd, 4th, and 5th step. Determining CR coefficient according to the formulas below:

$$(J - \lambda I). W = 0 \quad (1)$$

$$\Sigma W = 1 \qquad (2)$$

$$CI = \frac{\lambda \max - n}{n-1} \qquad (3)$$

$$CR = \frac{CI}{RI} \qquad (4)$$

Where: CI is a consistent indicator;

n is the matrix dimension;

λmax = Max (n);

RI is a stochastic index;

CR is the coefficient of consistency.

Table 4.
Value of stochastic index (RI).

| N	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.52	0.89	1.11	1.25	1.35	1.4	1.45	1.49

Source: [24]

- Step 7: Calculation of aggregate weighting, using calculated aggregate weights for options to make decisions.
+ Sum the columns.
+ Divide each value in the matrix by the sum of the column corresponding to that value, then sum the rows.
+ The calculated value divided by the total number of criteria of the matrix is the weight of the criteria to be found.

4. Analysis and Evaluation of Factors Affecting the Motivation of Construction Workers

### 4.1. Results of Surveying

Completing of the survey, there were 98 questionnaires that satisfied the determined sample size. Considering of age, the number of workers aged 15-29 years accounts for the largest proportion (62.24%), 32.65% of respondents were 30-40 years old, accounting for 5.10% of of respondents were 40-45 years old. It can be seen that the construction workers who participated in the survey, were of working age, especially there were many wokers of young working age.
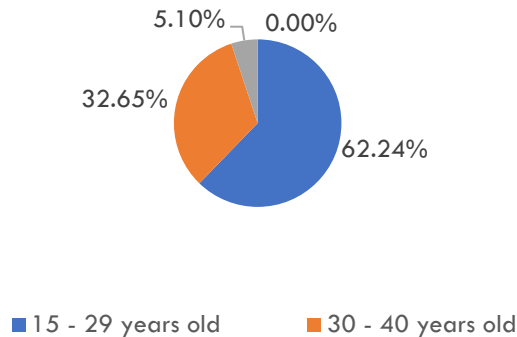
Figure-1.
Age of survey participants

Considering the level of education, a very large proportion of survey participants (accounting for 90.82%) have not undergone vocational training, they have just completed high school or lower levels of education. The number of workers who have undergone vocational training accounts for only 9.18%.

Considering by region, 54.08% of the construction workers came from the Red River Delta provinces, concentrated mainly in Nam Dinh, Thai Binh, and Ninh Binh provinces. Accounting for 43.88% of the construction workers from the Northern Mountainous provinces and accounting for the smallest proportion of the workers from the North Central provinces (accounting for 2.04%).
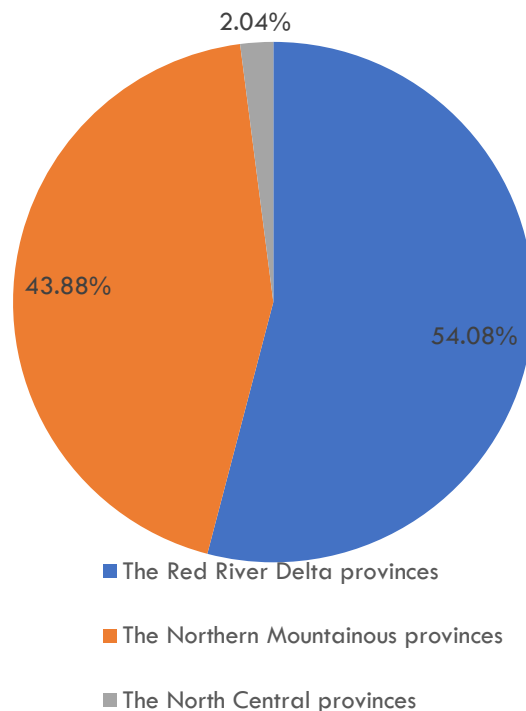
Figure 2.
Classification of the survey participants by region

4.2. APH analysis results

Applying the 7 steps of the AHP method, the results obtained are as detailed as follows:

(1) Identifying and analyzing the research contents and objectives

In the paper, the authors aims to compare, evaluate and rank the factors affecting the motivation of the construction workers.

(2) Building a hierarchy for factors

The factors in Table 1 are coded, creating pairs of comparative factors.

(3) Collecting data

Surveying the construction wokers on the priority of the factors. The authors conducted the survey of 98 the construction workers who are working on the construction sites.

(4) Pair comparison matrix

Building the pair comparison matrices using the scale according to Table 2. Each pair of factors is compared with each other.

(5) Weighted matrix

Table 5.
Weighted matrix.

Symbol	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
A1	1.00	0.30	0.19	0.33	0.19	0.33	0.22	0.43	0.33	1.18
A2	3.37	1.00	0.15	0.31	0.33	0.18	0.31	3.00	5.00	5.00
A3	5.13	6.62	1.00	6.18	7.92	5.03	2.97	4.97	6.18	8.66
A4	3.03	3.18	0.16	1.00	6.18	1.37	3.00	0.20	0.14	0.20
A5	5.22	3.00	0.13	0.16	1.00	1.00	3.18	5.03	5.00	6.71
A6	3.00	5.62	0.20	0.73	1.00	1.00	3.00	4.68	3.00	5.03
A7	4.61	3.18	0.34	0.33	0.31	0.33	1.00	5.03	3.03	5.08
A8	2.33	0.33	0.20	4.88	0.20	0.21	0.20	1.00	0.21	0.29
A9	3.00	0.20	0.16	7.00	0.20	0.33	0.33	4.72	1.00	4.74
A10	0.84	0.20	0.12	4.90	0.15	0.20	0.20	3.47	0.21	1.00

(6) Checking the CR Coefficient

The CR index = -0.61 < 0.1 indicates that the data obtained ensures the calculation of the respondent. Therefore, the results are transferred to the weighting calculation of factors affecting the motivation of the construction workers.

Table 6.
CR consistency index results.

Symbol	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	Weighted sum value	Criteria Weights	Consisten cy vector	Lamda max	CI	RI	CR
A1	0.02	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.02	2.34				
A2	0.08	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.14	0.07	1.95				
A3	0.13	0.02	0.11	0.03	0.06	0.06	0.02	0.01	0.02	0.01	0.46	0.29	1.59				
A4	0.08	0.01	0.02	0.00	0.04	0.02	0.02	0.00	0.00	0.00	0.19	0.10	1.80				
A5	0.13	0.01	0.01	0.00	0.01	0.01	0.02	0.01	0.02	0.01	0.23	0.13	1.78	1.86	-0.90	1.49	-0.61
A6	0.07	0.02	0.02	0.00	0.01	0.01	0.02	0.01	0.01	0.01	0.18	0.12	1.48				
A7	0.11	0.01	0.04	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.20	0.10	2.07				
A8	0.06	0.00	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.04	2.42				
A9	0.07	0.00	0.02	0.03	0.00	0.00	0.00	0.01	0.00	0.01	0.14	0.08	1.77				
A10	0.02	0.00	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.05	1.44				

(7) Calculation of aggregate weighting

Table 7.
Composite weighted matrix.

Symbol	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	Weighting
A1	0.03	0.01	0.07	0.01	0.01	0.03	0.02	0.01	0.01	0.03	0.02
A2	0.11	0.04	0.06	0.01	0.02	0.02	0.02	0.09	0.21	0.13	0.07
A3	0.16	0.28	0.38	0.24	0.45	0.50	0.21	0.15	0.26	0.23	0.29
A4	0.10	0.13	0.06	0.04	0.35	0.14	0.21	0.01	0.01	0.01	0.10
A5	0.17	0.13	0.05	0.01	0.06	0.10	0.22	0.15	0.21	0.18	0.13
A6	0.10	0.24	0.08	0.03	0.06	0.10	0.21	0.14	0.12	0.13	0.12
A7	0.15	0.13	0.13	0.01	0.02	0.03	0.07	0.15	0.13	0.13	0.10
A8	0.07	0.01	0.08	0.19	0.01	0.02	0.01	0.03	0.01	0.01	0.04
A9	0.10	0.01	0.06	0.27	0.01	0.03	0.02	0.15	0.04	0.13	0.08
A10	0.03	0.01	0.04	0.19	0.01	0.02	0.01	0.11	0.01	0.03	0.05

4.3. Discussion The Factors Affecting the Motivation of Construction Workers
From the weighted calculation results, the factors are ranked in Table 8.

Table 8.
Ranking the factors affecting the motivation of the construction workers

Symbol	Influencing factors	Weighting	Rank
A1	Age, gender, psychophysiology	0.02	10
A2	Personal development	0.07	7
A3	Salary, bonus and benefits	0.29	1
A4	Recognition of the organization	0.10	5
A5	Methods of labor management, working discipline	0.13	2
A6	Guaranteeing the job regular	0.12	3
A7	Working conditions	0.10	4
A8	Allowing rest	0.04	9
A9	Pushing for the progress	0.08	6
A10	Teamwork	0.05	8

The results of Table 8 show that wages, bonuses and benefits have the greatest influence on the motivation of the construction workers. The purpose of the construction workers is to make a living and create a family gathering. 79.12% of the construction workers surveyed acted as breadwinners. The pressure to earn money to improve their lives has motivated them to work in big cities, where there are many the construction projects. However, according to the assessment of the construction workers who surveyed, the current salary and bonus regime has not met their desires as well as commensurate with their labor. Salary is mostly calculated on a daily basis with the rate of 300,000 - 500,000 VND/day, but not stable monthly. The bonus is either low or none. The reward in the construction projects is not based on the effort at work. It only aims to support visiting their family regularly and bonus for holidays. The construction workers consider the stability of salaries, bonuses and benefits at construction enterprises is the best way to retain them, while getting them excited about the job.

Labor management methods and working discipline are factors which affect the motivation of the construction workers. Results of the survey show that if providing good management and assigning teams of workers, it will take full advantage of the line construction method on the construction sites.

The construction workers account for over 90% of out-of-province workers, initially they work and comply with regulations and discipline on the construction site passively. When the construction workers understand the management methods and applying them skillfully, the workers to improve their working ability. The opinions of the workers show that the management method and the working discipline helps them to recognize their tasks clearly and they try and desire to achieve the good work results.

Factor "Guaranteeing the job regular" is the 3rd factor that affects the motivation of the construction workers. There are many construction investment projects in big cities. Therefore, it brings many job opportunities for the construction workers. Statistics from the survey indicate that 56.57% of the construction workers identify with their long-term employment and 43.42% of the workers work seasonally in searching of better, more stable job opportunities. But the reflection of the construction workers say that they are mostly not entered into by the formal employment contracts. The labor contract, if any, is only procedural to be created due to the request of the investor or state management agency. In fact, they work according to the human resource needs of the construction projects. Employers are not considered for the job stability but it depends on the team manager. These causes have led to the strong desire of the construction workers for their job stability and regularity.

"Working conditions" are also rated as having a high impact on the motivation of the construction workers. It reflects the current situation at the construction sites. It is easy to see at the construction sites labor insecurity, the construction workers are not equipped with labor protective gear fully . According to statistics of the Ministry of Labor, War Invalids and Social Affairs, the construction industry is the sector with the most fatal labor accidents, accounting for 14.73% of the total number of labor accidents and 15.26% of the total number of deaths due to labor accidents in 2022 [25]. Hygiene issues, environmental pollution are not concerned in the construction projects. But it is also worth looking back at one issue gathered from the survey that the construction workers have a subjective attitude to their own safety issues on the construction sites. They don't ask managers for full levels when they're missing or don't have workwear and it's easy to overlook them in the process.

The recognition of construction organizations and enterprises also helps the construction workers have more motivation in their work. Providing encouragement and encouragement timely, the construction enterprises help the workers have more confidence in the business and dedication at work. However, the recognition also needs to materialize to maintain the motivation to work in a sustainable way.

Factor "pushing for the progress" is a frequent factor in the construction sites. Many projects are accelerated, forcing the workers to work overtime regularly. Construction activities such as pouring concrete, transporting materials,... sometimes done at night. However, there is almost young and healthy workforce on the construction sites, the requirements of intensity and work progress, although influential, are only assessed as medium influences.

Factors "Allowing rest", "Teamwork" are factors that are rated low impact. Teams of out-of-province workers at the construction sites often come from the same locality, sometimes with each related relationship, so they have respect and understanding for each other. Some conflicting issues that occur in construction projects such as quarrels, fights, disputes are usually handled quickly to ensure the operation of the project. Some opinions also reflect that construction teams often perform various professional tasks such as formwork nests, steel nests, concrete nests, aluminum and glass nests,.... With such a division of work also helps to better connect in the matter of teamwork. This makes the teamwork factor have a low impact on the work motivation of construction workers. Besides, the rest of workers on the construction site also reflects well and is suitable for the working rhythm of workers. Therefore, this factor receives a low score or low impact on the motivation of construction workers.

Factors "Age, gender, psychophysiology" and "Personal development" are subjective factors of the construction workers. Both factors are rated as having a low impact on workers' motivation. This reflects the fact that workers do not have much expectation in the development of their own work in the

construction sector. For them construction work is merely work to earn income to feed themselves and their families.

It can be seen that the construction workers who participated in the survey, were of working age, especially there were many wokers of young working age (62.24% of the workers aged 15-29 years, 32.65% ofthe workers aged 30-40 years, 5.10% the workers aged 40-45 years). For young people, health and mental capacity are an available advantage. Therefore, this factor is not highly appreciated when considered in relation to the motivation of the construction workers.

5. Conclusions

The construction industry is one of the industries with growthing contineuos in the human resource index. In the coming time, the demand of the human resources will continue to increase to meet the rapid development of the construction industry. The construction workers are the main force that creates construction products. Therefore, it is necessary to have a correct and clear view of this labor force to take appropriate attraction measures. In this paper, the authors explore the factors that influence the motivation of the construction workers. The results show that the factors derived from the construction enterprises have a strong impact on the motivation of the workers. In which, salary, bonus and benefits, labor management methods, work discipline, ensuring regular work are the factors that determine their motivation to work. Factors derived from the workers themselves have a low impact on motivation to work. This also hints at solutions to improve the working efficiency of construction workers that need to start from construction enterprises.

Improving the labor productivity is a national goal in general and the construction industry in particular. Researching on the motivation of the construction workers is only one aspect of the labor productivity problem. Solving the labor productivity mater, there needs to be more comprehensive research on many issues such as: Barriers faced by the construction workers, social housing for the workers, and supporting the policies of local authorities, from the state for the workers from other provinces when working long-term in big cities,....

One finding is suggested in this study is: Regional differences may affect the motivation of the construction workers. Peter F. Kaming (1997) conducted research in 07 regions in Indonesia and showed that the labor productivity has large differences between the regions [8]. Combining with the results of Peter F. Kaming, one can see the difficulty and excitement in the study of the labor productivity.

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Copyright:

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