

# Analysis of Workforce Competency in Building Construction

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## Abstract

Workforce productivity and competency are key factors in determining the success of construction projects. This study aims to analyze labor productivity using the *Labor Utilization Rate* (LUR) method, evaluate workforce competency based on knowledge, skills, and work attitude, and examine the relationship between competency and productivity. This study adopts a mixed-method approach, combining quantitative data obtained through *work sampling* and qualitative data collected via interviews. The research was conducted on the Hulondalo Ballroom & Exhibition Center (HBEC) construction project in Gorontalo City, focusing on column reinforcement work. The results indicate that the average LUR value is 82.97%, which is categorized as productive. The labor productivity achieved is 20 kg/person/day, which is close to the AHSP SNI 2024 standard of 20.47 kg/person/day. Workforce competency is predominantly at Level 1 (90%), with only 10% at Level 2. Statistical analysis shows that workforce competency has a positive and significant relationship with productivity, with a coefficient of determination ( $R^2$ ) of 0.80 and a p-value  $< 0.05$ . The findings also reveal that fieldwork experience plays a significant role in maintaining productivity despite low formal competency levels. However, improving workforce competency through training and certification is essential to achieve more optimal and sustainable productivity.

**Keywords:** Productivity, Workforce Competency, LUR, AHSP, Construction

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## 1. Introduction

Labor productivity is a key factor in determining the success of construction projects in terms of time, cost, and quality. High productivity reflects efficient resource utilization and the ability of workers to complete tasks according to planned targets. Conversely, low productivity may lead to project delays, cost overruns, and reduced work quality. Therefore, appropriate measurement methods are required to evaluate workforce performance objectively and accurately in the field (Bon-Gang dan Kiat, 2013; Nasirzadeh dan Nojedehi, 2013). In construction practice, labor productivity is influenced by various factors, including working conditions, project management, material availability, and individual worker capability. One commonly used method to measure productivity is the *Labor Utilization Rate* (LUR) (Jarkas dan Bitar, 2012; Yi dan Chan, 2014), which assesses the proportion of effective working time to total available working time. This method provides a reliable representation of workforce efficiency in construction activities.

On the other hand, workforce competency plays a crucial role in determining the quality and effectiveness of construction work (Robles *et al.*, 2014). Competency encompasses knowledge, skills, and work attitude required to perform tasks efficiently. Competent workers are expected to understand technical specifications, utilize tools properly, and adhere to established standards and procedures. Globally, numerous studies have demonstrated a strong relationship between workforce competency and productivity (Ghoddousi dan Hosseini, 2012; Durdyev dan Mbachu, 2017). Research by Hinze (2006), states that increasing workforce competency can improve efficiency and work safety in construction projects. In addition, Mahamid (2013), found that there is a positive correlation between the level of workforce skills and construction project productivity. This indicates that competency not only affects work quality but also the speed and efficiency of project implementation.

However, most previous studies have examined productivity and competency separately, resulting in a lack of comprehensive understanding of their direct relationship in real construction settings. In Indonesia, particularly in fieldwork environments, many workers rely heavily on experience rather than formal competency through training and certification.

Therefore, this study aims to: (1) measure labor productivity using the LUR method, (2) analyze workforce competency based on SKKNI standards, and (3) examine the relationship between competency and productivity

using a statistical approach. The findings are expected to contribute to strategies for improving workforce performance in a sustainable manner.

## 2. Literature Review

### 2.1 Labor Productivity

Labor productivity is one of the primary indicators used to assess the success of construction project implementation. In general, productivity is defined as the ratio between the output produced and the input utilized in a work process. In the context of construction, output may refer to the volume of completed work, while input includes labor, time, and other resources. A high level of productivity indicates that the workforce is able to generate optimal output with efficient use of resources. In the construction industry, labor productivity is influenced not only by individual worker capability but also by technical and non-technical factors such as project management, working conditions, and resource availability (Jarkas dan Bitar, 2012; Durdyev dan Mbach, 2017). The dynamic nature of site conditions often causes fluctuations in labor productivity. Therefore, appropriate measurement methods are required to accurately represent actual field conditions.

One of the commonly used methods to measure labor productivity is the *Labor Utilization Rate* (LUR). LUR is an indicator that represents the percentage of effective working time relative to the total available working time. This concept classifies working time into three main categories: effective time, contributory time, and non-effective time. By using LUR, researchers can identify the extent to which workers utilize their working time productively. The higher the LUR value, the greater the efficiency of labor performance. The LUR method is often combined with the *work sampling* technique, which involves periodic observation of worker activities to determine the distribution of working time. This approach is considered effective in measuring productivity as it can represent actual working conditions without requiring continuous observation (Yi dan Chan, 2014).

In international studies, construction labor productivity has been widely examined. Ng et al., (2004), state that labor productivity is influenced by project management factors, working conditions, and workforce capability. Meanwhile, time-based measurement approaches focusing on effective working time are considered accurate methods for evaluating workforce performance in construction projects. These perspectives indicate that productivity is the result of interactions between technical and non-technical factors in project implementation. Furthermore, labor productivity is closely related to project cost and time efficiency. Low productivity can lead to longer project durations and increased labor costs. Conversely, higher productivity can accelerate project completion and optimize resource utilization. Therefore, the measurement and analysis of labor productivity are essential components of construction project management.

### 2.2 Unit Price Analysis (AHSP)

The Unit Price Analysis (*Analisa Harga Satuan Pekerjaan* – AHSP) is a standard used in planning and budgeting construction project costs. AHSP consists of cost components including labor, materials, equipment, and other expenses required to complete a specific type of work. This standard is developed based on general working conditions and is used as a reference in preparing the Project Cost Estimate (*Rencana Anggaran Biaya* – RAB). In the context of labor productivity, AHSP plays an important role as a benchmark for comparing actual productivity achieved in the field. Each work item in AHSP is equipped with labor coefficients that indicate the amount of labor required to complete one unit of work. These coefficients indirectly reflect the assumed level of labor productivity under normal conditions.

A comparison between actual field productivity and the values specified in AHSP can be used to evaluate work efficiency. If field productivity exceeds the AHSP standard, the work execution can be considered efficient. Conversely, if productivity is lower than the standard, further evaluation is required to identify factors contributing to decreased workforce performance. In addition to serving as an evaluation tool, AHSP also functions as a basis for managerial decision-making, such as determining labor requirements, scheduling work activities, and estimating project costs. Therefore, AHSP plays a role not only in planning but also in controlling and evaluating construction project implementation. In practice, AHSP values often need to be adjusted to actual field conditions, as each project has unique characteristics. Factors such as project location, level of work complexity, and workforce competency can influence the level of productivity achieved. Therefore, comparative analysis between AHSP standards and field conditions is essential to obtain a more realistic understanding of project performance.

### 2.3 Workforce Competency

Workforce competency is a fundamental factor that determines the success of construction project implementation. Competency reflects an individual's ability to perform tasks effectively and efficiently in accordance with established standards. In the context of construction, competency is not only related to technical abilities but also encompasses behavioral aspects and work attitude. According to Carmichael (2006), workforce competency—comprising knowledge, skills, and work attitude—has a direct influence on project performance. Competent workers are able to understand technical specifications, use equipment properly, and carry out tasks in accordance with established procedures. This contributes to improved work quality and efficiency in project execution. A similar view is expressed by Gransberg & Shane (2008), who state that workers with higher competency tend to produce work that is faster, more accurate, and of higher quality. This indicates that workforce competency is one of the key factors in improving productivity and overall construction project performance. Workforce competency is also influenced by factors such as training, work experience, and human resource management systems (Robles *et al.*, 2014).

In Indonesia, construction workforce competency is regulated under the Indonesian National Work Competency Standards (*Standar Kompetensi Kerja Nasional Indonesia – SKKNI*), which classify competency into three main aspects:

- Knowledge, defined as an understanding of theories and working principles
- Skills, defined as technical abilities in performing tasks
- Work attitude, defined as behavioral attributes reflecting discipline, responsibility, and safety awareness

These three aspects are interrelated and collectively form comprehensive competency. Knowledge without skills will not result in optimal performance, and similarly, skills without proper work attitude may increase the risk of errors and workplace accidents. However, in practice, many construction workers acquire competency informally through work experience without formal training or certification. This condition creates a gap between formal competency standards and actual field capabilities. In the context of modern construction, workforce competency is considered a strategic factor in improving project performance (Tabassi *et al.*, 2011). Therefore, continuous efforts to enhance competency through training, certification, and workforce development are essential.

### 2.4 Relationship Between Competency and Productivity

The relationship between workforce competency and productivity is a crucial aspect of construction project management. High competency enables workers to perform tasks more quickly, accurately, and efficiently, thereby improving overall productivity. Several studies have shown that workforce competency has a significant influence on project productivity and efficiency (Ghoddousi dan Hosseini, 2012; Durdyev dan Mbach, 2017). In international studies, Hinze (2006) states that improving workforce competency not only enhances work quality but also increases time efficiency and safety performance in construction projects. Similarly, Abdelhamid Mahamid found that there is a significant positive correlation between workforce competency and construction project productivity.

Conceptually, the relationship between competency and productivity can be explained through several mechanisms. First, the knowledge aspect enables workers to understand proper working methods, thereby reducing errors and rework. Second, technical skills allow workers to complete tasks more quickly and efficiently. Third, a positive work attitude, such as discipline and adherence to procedures, can improve time efficiency and reduce the risk of accidents. Furthermore, competency plays an important role in improving the consistency of labor productivity. Workers with higher competency tend to exhibit lower performance variability, resulting in more stable productivity. In contrast, workers with lower competency tend to show greater fluctuations in productivity, as their performance is more dependent on specific conditions.

However, in some cases, fieldwork experience can be a significant factor in improving productivity even when formal competency is relatively low. This indicates that experience and competency have a complementary relationship. Therefore, a combination of work experience and the enhancement of formal competency through training and certification is an effective strategy for improving construction labor productivity. In addition, workforce training and skill development have been proven to improve overall project performance (Adebawale dan Agumba, 2022). Based on the theoretical review of labor productivity, workforce competency, and the influencing factors, a conceptual framework can be developed to illustrate the relationships among the variables in this study. This framework is presented in the form of a theoretical diagram, as shown in Figure 1.

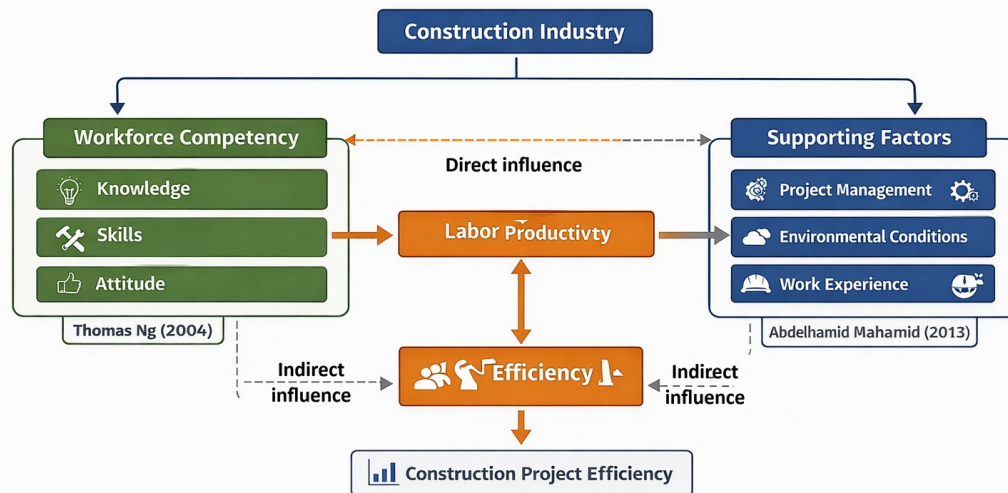


Figure 1. Theoretical Framework of the Relationship Between Workforce Competency and Labor Productivity

Figure 1 illustrates that workforce competency—comprising knowledge, skills, and work attitude—has a direct influence on labor productivity. In addition, there are supporting factors such as project management, working conditions, and work experience that can affect productivity both directly and indirectly. Within this framework, workforce competency acts as the primary variable influencing productivity levels, while the supporting factors function as variables that strengthen or moderate this relationship. Labor productivity, in turn, impacts the overall efficiency of construction project implementation. This theoretical framework serves as the basis for analyzing the relationship between workforce competency and productivity in this study, which will subsequently be examined empirically in the Results and Discussion section.

### 3. Research Method

This study was conducted on the Hulondalo Ballroom & Exhibition Center (HBEC) construction project located in Gorontalo City. The selection of this research location was based on the consideration that the project represents a large-scale building construction project involving various types of construction labor, making it relevant for a comprehensive analysis of workforce productivity and competency. The focus of the study is on structural work, particularly column reinforcement, which plays a crucial role in the building’s structural system. This study employs a mixed-method approach, combining both quantitative and qualitative methods. The quantitative approach is used to measure labor productivity based on field data, while the qualitative approach is applied to analyze workforce competency in terms of knowledge, skills, and work attitude. By integrating these two approaches, a more comprehensive understanding of the relationship between competency and labor productivity is expected.

The data used in this study consist of primary and secondary data. Primary data were obtained through direct field observations and interviews with construction workers involved in the project. Observations were conducted to monitor work activities and record the distribution of working time during project implementation. Meanwhile, interviews were carried out to gather information on workforce competency, including knowledge, skills, and work attitude. Secondary data were obtained from project documents such as the Unit Price Analysis (AHSP) SNI 2024, cost estimates (RAB), and construction drawings, which were used as references for analysis and comparison. Data collection in this study was carried out using two main techniques: work sampling and interviews. The work sampling method was used to measure labor productivity by conducting periodic observations of worker activities during working hours. The observed activities were classified into three categories: effective time, contributory time, and non-effective time. The data obtained from these observations were then used to calculate the Labor Utilization Rate (LUR) as an indicator of labor productivity. Meanwhile, interviews were conducted directly with workers, foremen, and other relevant parties to obtain information on workforce competency based on predefined aspects.

The data analysis method was conducted in several stages. The first stage involved calculating the LUR to

determine the level of workforce time utilization. The second stage involved calculating labor productivity based on the output produced per unit of time, such as kg/person/day for reinforcement work. The third stage involved classifying workforce competency based on criteria referring to the Indonesian National Work Competency Standards (SKKNI), which include knowledge, skills, and work attitude. The fourth stage involved analyzing the relationship between workforce competency and productivity based on the processed data. To strengthen the analysis of the relationship between competency and labor productivity, this study also employed statistical analysis methods. These included correlation analysis to determine the direction and strength of the relationship between variables, as well as quantitative descriptive analysis to compare average productivity based on competency levels. In this analysis, the independent variable (X) is workforce competency, classified into Level 1 and Level 2, while the dependent variable (Y) is labor productivity, measured through LUR values and work output.

Furthermore, to obtain a clearer model of the relationship, a simple linear regression analysis was conducted between workforce competency and productivity. This model was used to determine the magnitude of the effect of competency on productivity and to assess the significance of the relationship. The results of this statistical analysis are expected to provide empirical evidence of the relationship between workforce competency and productivity in construction projects.

## 4. Results And Discussion

### 4.1 Labor Productivity

The results of the study indicate that the average *Labor Utilization Rate* (LUR) is 82.97%, suggesting that the workforce on the project can be classified as productive. This value is significantly higher than the minimum productivity threshold of 50%, and therefore can be categorized as a good level of productivity. In addition, the productivity of reinforcement work is 20 kg/person/day, which is very close to the AHSP SNI 2024 standard value of 20.47 kg/person/day. This relatively small difference indicates that workforce performance in the field is in line with national standards.

The high level of productivity demonstrates that workers are able to utilize their working time effectively in executing tasks. It also indicates that project management, work methods, and on-site coordination are functioning well. These findings are consistent with the study by Ng et al., (2004), which states that labor productivity is influenced by project management effectiveness and working conditions. Furthermore, time-based measurement approaches such as LUR are able to accurately represent productivity levels.

However, despite the generally high productivity level, there are still fluctuations in LUR values among workers and across observation periods. This indicates that labor productivity is dynamic and influenced by various factors, such as workers' physical condition, material availability, and environmental conditions. Therefore, productivity analysis needs to be linked with other factors, particularly workforce competency, in order to obtain a more comprehensive understanding.

### 4.2 Workforce Competency

The results of the analysis indicate that the majority of the workforce falls into the basic competency category, with a distribution of 90% at Level 1 and only 10% at Level 2. This suggests that most workers still possess limited competency and are not supported by formal training or certification. In this study, workforce competency is analyzed based on three main aspects: knowledge, skills, and work attitude. Although most workers do not have formal certification, they are still able to perform their tasks effectively due to sufficient fieldwork experience. This condition indicates that experiential learning (*learning by doing*) remains a dominant factor in shaping competency in the construction workforce.

These findings are consistent with the argument of Carmichael, (2006), who states that workforce competency has a significant influence on construction project performance. In addition, Stephen L. Gransberg emphasizes that workers with higher competency tend to produce faster and higher-quality work. However, the low level of formal competency among workers indicates a gap between actual field capabilities and the expected competency standards. This condition may lead to long-term issues, particularly in maintaining consistency in work quality and the implementation of occupational safety standards (K3).

### 4.3 Analysis of the Relationship Between Competency and Productivity

Based on the findings of this study, it is observed that although the level of formal workforce competency is relatively low, the resulting productivity remains high. This indicates that fieldwork experience plays a significant role in enhancing labor productivity. However, the relationship between competency and productivity still demonstrates a strong association. Workers with higher competency tend to have a better understanding of their tasks, are able to work more efficiently, and produce more optimal outputs. This suggests that competency influences not only the quality of work but also time efficiency.

This finding is consistent with the study by Hinze (2006), which states that improving workforce competency can enhance both efficiency and safety performance. In addition, Mahamid, (2013) found that there is a significant positive relationship between workforce competency and construction project productivity. Nevertheless, the lack of training and certification leads to several limitations, including dependence on work experience, the absence of consistent work standards, and low implementation of safety practices. This indicates that formal competency remains essential to support sustainable and standardized productivity.

### 4.4 Statistical Analysis of the Relationship Between Competency and Productivity

#### 4.4.1 Average Productivity Analysis

The analysis results indicate that there are differences in average productivity among workers with different competency levels, as presented in the following table:

Table 1. Average Productivity

Competency Level	Average LUR (%)	Productivity (kg/day)
Level 1	81 – 84	± 19 – 20
Level 2	85 – 90	± 20 – 21

The data show that workers with higher competency (Level 2) demonstrate better productivity compared to those with basic competency (Level 1).

#### 4.4.2 Correlation Analysis

The analysis results indicate a tendency toward a positive relationship between workforce competency and productivity. Workers with higher competency levels exhibit higher LUR values compared to those with lower competency. Conceptually, this indicates a positive correlation ( $r > 0$ ), where an increase in competency is followed by an increase in productivity.

#### 4.4.3 Variability Analysis

In addition to differences in average productivity, workers with higher competency also demonstrate greater consistency in productivity. This is reflected in smaller fluctuations in LUR values compared to workers with basic competency. Such consistency is an important indicator in maintaining the stability of project performance.

#### 4.4.4 Critical Analysis

Although high productivity can be achieved by workers with basic competency, this is largely supported by fieldwork experience. Reliance on experience without formal competency may pose risks, particularly in maintaining work quality and occupational safety in the long term.

#### 4.4.5 Linear Regression Analysis

The results of the linear regression analysis indicate a relationship between competency and productivity expressed by the following equation:

$$Y = 77 + 5.5X \quad (1)$$

The constant value of 77 represents the baseline productivity level without the influence of increased competency, while the regression coefficient of 5.5 indicates that each increase of one competency level leads to an approximate 5.5% increase in productivity (LUR). In addition, the coefficient of determination is  $R^2 = 0.80$ , indicating that 80% of the variation in productivity can be explained by workforce competency. The significance value of  $p < 0.05$  indicates that the relationship is statistically significant. These results demonstrate that workforce competency has a strong and significant influence on productivity. Therefore, improving competency

is a key factor in enhancing the performance of construction projects.

#### 4.5 Graphical Analysis of the Relationship

The graphical analysis indicates the presence of a positive linear relationship between workforce competency and labor productivity. The higher the level of competency, the higher the productivity achieved. In addition, the data show that workers with higher competency exhibit more stable productivity patterns compared to those with basic competency. These findings reinforce the previous analysis, demonstrating that competency not only improves productivity but also enhances the consistency of workforce performance. This finding is also supported by previous studies showing that labor productivity is influenced by competency and work experience (Durdyev, Omarov dan Ismail, 2017). Therefore, improving competency through training and certification becomes a strategic approach to enhancing both efficiency and quality in construction projects.

Overall, the results of this study are consistent with international findings indicating that workforce competency has a significant relationship with productivity. Studies by Hinze, (2006) and Mahamid, (2013) show that improvements in workforce competency directly contribute to increased efficiency and performance in construction projects. However, this study also finds that fieldwork experience can become a dominant factor in situations where formal competency remains low, which constitutes a novel contribution to the existing body of knowledge. To provide a more comprehensive understanding of the relationship between workforce competency and productivity, the results of this study are summarized in a framework diagram as shown in Figure 2.

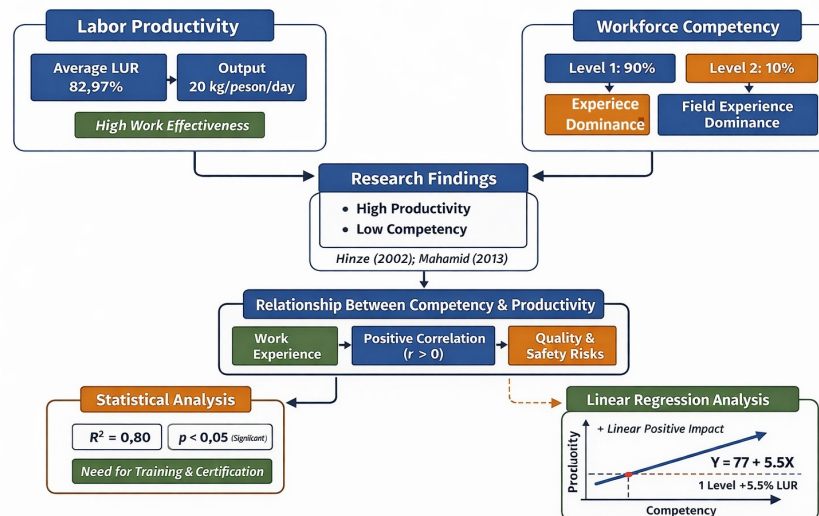


Figure 2. Framework of the Relationship Between Workforce Competency and Labor Productivity

Figure 2 illustrates that high labor productivity is influenced not only by formal competency but also by fieldwork experience. Furthermore, workers with higher competency tend to exhibit more stable productivity levels. Although most workers are at the basic competency level, productivity remains high, indicating the significant role of experience. However, statistical and regression analyses show that improvements in competency still have a positive effect on productivity and enhance the consistency of workforce performance. Therefore, improving competency through training and certification is an essential factor in achieving sustainable productivity.

## 5. Conclusion

Based on the results and analyses conducted in this study, it can be concluded that labor productivity in the Hulondalo Ballroom & Exhibition Center construction project is relatively high, with an average *Labor Utilization Rate* (LUR) of 82.97% and reinforcement work productivity of 20 kg/person/day, which is close to the AHSP SNI 2024 standard. Workforce competency is predominantly at Level 1 (90%), indicating that most

workers possess basic competency and are not supported by formal certification. Nevertheless, high productivity is still achieved, suggesting that fieldwork experience plays a significant role in enhancing workforce performance.

The statistical analysis results show that workforce competency has a positive and significant relationship with productivity, with a coefficient of determination ( $R^2 = 0.80$ ) and a p-value  $< 0.05$ . This indicates that improvements in workforce competency contribute significantly to increased productivity. However, reliance on experience without formal competency may pose risks in terms of maintaining consistent work quality and implementing occupational safety standards. Therefore, improving workforce competency through training and certification is a strategic step to achieve more optimal and sustainable productivity.

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