Analysis of Labour Productivity in the Work of Light Steel Roof Frame Structure (Case Study: Construction Project of the Catholic Church of St. Maria Bunda Pengharapan Bunut Sanggau)

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**ABSTRACT**
Project performance is greatly influenced by labor productivity. The productivity of each worker is different and is influenced by several factors such as work experience, age, education level, wages, site conditions, weather, coordination and planning, and leadership skills. This study examines the value and level of labor productivity, the variables that influence productivity, and the efforts to improve labor productivity. Observations in this study were conducted using the construction sampling method to observe the work scope, construction time, number of workers, adequate time, contribution time, ineffective time of lightweight steel-roof frame construction work, and direct on-site observation. Next, the level of labor productivity must be analyzed using the Labor Utilization Rate (LUR) approach. The analysis shows that the average productivity values for horse labor were 2,581 m²/OH for ironworkers and 5,197 m²/OH for manual workers. The productivity value for ironworkers in lath construction is 5,256 m²/OH. From the analysis of the average level of labor productivity (results are more than 50% of her), it can be concluded that the level of labor productivity in the construction project of the catholic church of St. Maria Bunda Pengharapan Bunut Sanggau is satisfactory. The most significant variables affecting labor productivity are control variables. As a result of interviews with stakeholders, it was found that ways to increase labor productivity include effectively using time, creating a working system that is easy to work in, ensuring that workers have specialized knowledge, and ensuring thorough on-site supervision. Improvements are needed to create a good working environment.

**Keywords:** Labour Productivity, Variables Influencing Productivity, Construction Sampling Method, Labor Utilization Rate (LUR), Effective Time Management
1. Introduction

Productivity is a factor that influences the competitiveness of construction projects (Alghbari et al., 2019; Hidayah et al., 2023). The productivity of each worker is different and is influenced by several factors such as work experience, age, education level, wages, site conditions, weather, coordination and planning, and leadership skills (Al-Abbadi et al., 2023). Low productivity affects the amount of time it takes to complete a task. Increased productivity is necessary to reduce working time and indirectly affects the cost (Vara-Horna et al., 2023). Project delays are often caused by workers needing to be used more efficiently, such as chatting, doing nothing, eating, drinking, or smoking outside of their breaks (Young et al., 2018). Therefore, productivity is essential to get the job done.

Lack of awareness of productivity leads to poor work performance. A light steel roof structure is one of the construction projects in which productivity should be emphasized (Barbosa et al., 2017). It is now becoming increasingly common to use lightweight steel as roof frames. CE and Quickandy are essential when choosing this lightweight steel roof frame role.

In this study, observations were made using the working sampling method. This method is carried out using the productivity evaluation approach, which classifies the activities of workers into three categories: practical work, work of significant contribution, and inefficient work. After conducting the observations, the number of workers in each type of activity was calculated. The Labor Utilization Rate (LUR) approach calculates labor productivity. (Andi, 2004).

2. Materials and Methods

2.1. Study Area/ Research Location

![Figure 1. Research Location](image)

This study was conducted as part of a construction project in the catholic church of St. Maria Bunda Pengharapan on Jl: Sabang Merah, Kapuas district, Sanggau Regency. Observations will begin on November 14, 2022, and continue until November 17, 2022. Observations will be conducted seven hours a day during regular working hours, from 8 a.m. to 11 a.m. and from 1 p.m. to 5 p.m. We inspected truss construction and lath construction. The study was conducted by observing each worker for two days.

2.2. Data

The data collection techniques used in this phase are primary and secondary data collection. Primary data was obtained from direct observations in the field (observation and work sampling), response data from questionnaire results and interviews with related parties, and secondary data such as construction drawings that support the research.
2.3. Analysis Method

Data processing in this study includes calculating productivity values using existing formulas and labor productivity levels using the LUR method. Data testing was conducted using validity and reliability tests with 18 respondents. Afterward, normality tests, regression analyses, t-tests, and f-tests were used for data analysis.

1. Productivity Value

Labor productivity refers to the comparison between the output achieved per unit of time and the participation of the workforce. Because the nature and intensity of project activities can change rapidly throughout a project cycle, the number of employees, types of skills, and deployment of expertise must match the requirements of ongoing activity changes. This requires a critical parameter: labor productivity, which is used to measure labor efficiency. According to Soeharto (1997), the definition of productivity index can be formulated as follows:

$$\text{Produktivitas} = \frac{\text{Volume Pekerjaan}}{\frac{\text{Durasi}}{60} \times \text{Jumlah Pekerja}}$$ .................................................................(1)

2. Parts of the Roof Frame Structure

The roof frame structure consists of several parts.

a. Truss

The lightweight steel truss structure on the roof forms a frame that supports the roof loads and gives the building its shape. The volume of a roof truss can be calculated as follows:

$$V = \frac{(p+o+o) \times l}{a}$$ .................................................................(2)

Information:

\(V\): truss volume (m²)
\(p\): truss length (m)
\(l\): truss width (m)
\(o\): roof overhang (m)
\(a\): degree of inclination (°)

b. Batten

Roofing battens are the most minor roof components in shape and size. Roofing battens act as supports for roofing materials (such as tiles). No zinc or shingles are used on roofs covered with asbestos. Roofing battens are used for tiled roofs. Battens are installed perpendicular to the ribs. The batten volume can be calculated as follows:

$$V = \Sigma La$$ .................................................................(3)

$$\Sigma La = \frac{p \times l}{a}$$

Information:

\(V\): batten volume (m²)
\(\Sigma La\): total roof area (m²)
\(p\): batten length (m)
\(l\): batten width (m)
\(a\): degree of inclination (°)

3. Labour Utilization Rate (LUR)

Labour utilization rate (LUR) is the percentage obtained by adding effective work, summing \(\frac{1}{4}\) essential contributory work, and dividing that sum by the total observed values. For clarity, it can be seen in the following equation:

$$\text{LUR} = \frac{\text{effective work} + \frac{1}{4} \text{essential contributory work}}{\text{total observations}}$$ .................................................................(4)
When measuring the level of productivity, the time variable is one of the most used inputs for comparing the results (output) of the activities performed.

4. Labor Coefficient Analysis

The number of working hours is the labor factor or the number of working hours per unit of measurement. This factor indicates how long it takes to complete a unit of work. The number of workers (time units per labor volume unit (m²)) is used to determine the labor coefficient. To determine the work coefficient, the following formula is usually used:

Production/day:
Qt = Tk x Q1; m² .........................................................................................................................(5)

Worker:
Coefficient = (Tk x P) / Qt..................................................................................................................(6)

Information
 Qt : daily work results (m²)
 Q1 : The large production capacity of the equipment determines the workforce (m²/jam)
P : Number of workers required (orang)
Tk : Number of daily working hours (jam)

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Figure 2. Flow Diagram
3. Result and Discussion
   
   a. Productivity Value Analysis

   Productivity values are determined by the amount of work, number of workers, and effective working hours. From the observation results, we determined the number of rolls, number of workers, and number of working hours. The analysis of the value of labour productivity in the work of lightweight steel roof frame structures begins with the calculation of the amount of work. The results are then compared to the amount of effort and time required to complete the work. The analysis results of productivity values for light steel roof truss construction are shown in Table 1 for roof truss construction and Table 2 for roof batten construction.

   
   b. Analysis Of Productivity Rate

   Work sampling methods are used along with productivity assessment approaches to observe productivity rating. From these observations, the effective working time, contributed time, ineffective time, and total observation time of each worker while working on the lightweight steel roof frame structure were determined. Analyses your productivity levels using LUR
(Work Utilization Rating) techniques. Table 3 shows the results of analysing the productivity rating of each worker in lightweight steel roof framework.

Table 3. Productivity Rate

<table>
<thead>
<tr>
<th>Day</th>
<th>Worker</th>
<th>Total Observation (minutes)</th>
<th>LUR (%)</th>
<th>Average LUR (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Wahid</td>
<td>420</td>
<td>67,8</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Antoni</td>
<td>420</td>
<td>68,15</td>
<td>68,33</td>
</tr>
<tr>
<td>3</td>
<td>Saputra</td>
<td>420</td>
<td>69,05</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Wahid</td>
<td>420</td>
<td>86,25</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Antoni</td>
<td>420</td>
<td>85,24</td>
<td>86,87</td>
</tr>
<tr>
<td>3</td>
<td>Saputra</td>
<td>420</td>
<td>89,11</td>
<td></td>
</tr>
</tbody>
</table>

From this table, we can see that the average LUR value on day 1 was 68.33% and on day 2 it was 86.87%. The average LUR value is more than 50%, so theoretically this is a very satisfactory result.

c. Labor Coefficient Analysis

Labor factor analysis is performed to determine the labour time required to complete a unit amount of work. Labor coefficients are calculated based on working hours, number of employees, and work performance. The results of the work coefficient analysis are shown in Table 4.

Table 4. Coefficient Analysis Results

<table>
<thead>
<tr>
<th>Day</th>
<th>Work</th>
<th>Work Result (m²)</th>
<th>Blacksmith (OH)</th>
<th>Worker (OH)</th>
<th>Foreman (OH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Truss</td>
<td>38,536</td>
<td>0,545</td>
<td>0,727</td>
<td>0,112</td>
</tr>
<tr>
<td></td>
<td>Bitten</td>
<td>15,143</td>
<td>0,858</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Truss</td>
<td>19,268</td>
<td>1,072</td>
<td>1,429</td>
<td>0,288</td>
</tr>
<tr>
<td></td>
<td>Bitten</td>
<td>45,428</td>
<td>0,367</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5. Comparison of Coefficients with SNI 2022

<table>
<thead>
<tr>
<th>Day</th>
<th>Work</th>
<th>Blacksmith (OH)</th>
<th>Worker (OH)</th>
<th>Foreman (OH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Truss</td>
<td>0,545</td>
<td>0,734</td>
<td>0,112</td>
</tr>
<tr>
<td></td>
<td>Bitten</td>
<td>0,858</td>
<td>0,734</td>
<td>0,073</td>
</tr>
<tr>
<td>2</td>
<td>Truss</td>
<td>1,072</td>
<td>0,734</td>
<td>0,288</td>
</tr>
<tr>
<td></td>
<td>Bitten</td>
<td>0,367</td>
<td>0,734</td>
<td>0,073</td>
</tr>
</tbody>
</table>

Based on the above comparison, the coefficient value in the construction project of the catholic church of St. Maria Bunda Pengharapan Bunut Sanggau is lower and higher than the SNI value. Therefore, based on existing data, the coefficient value will be greater than her SNI 2022 value; this means that the time required for a field worker to complete a unit of work is longer than the time required by his SNI (reducing field productivity) and vice versa. Although the adequate time used on the second day was longer than his first day due to poor weather on the first day, he concluded that the first day was more productive than his second day.
d. Variables that Influence Work Productivity

The labor productivity variables in this study use eight variables: work history, age, education, wages, field conditions, weather, coordination and planning, and management of people. The research instrument used in this study was a questionnaire. We then analyze the survey data to determine whether these variables influence labor productivity. The analysis showed that work experience, age, education, wages, field conditions, weather, coordination and planning, and managerialism partially or simultaneously influenced labor productivity. In the Catholic Church construction project, control variables have the most significant impact on labor productivity in the construction project of the catholic church of St. Maria Bunda Pengharapan Bunut Sanggau.

4. Conclusion

From the analysis of the research that has been done, it can be concluded that the average productivity value for stance work is 3,874 m²/OH on day 1 and 3,720 m²/OH on day 2. The productivity value for batten work is 4,659 m²/hour on day 1 and 4,327 m²/hour on day 2. The average productivity value of workers was 68.33% on the first day and 86.87% on the second day.

The productivity value (LUR) of each worker on roof truss construction is more than 50%; this shows that labor productivity in roof truss construction work is very productive and satisfactory. From the analysis, the variables of work experience, age, education, wages, site conditions, weather, coordination and planning, and control partially or simultaneously significantly affect labor productivity.

In the construction project of the Catholic church of St. Maria Bunda Pengharapan Bunut Sanggau, the control variable has the most significant influence on labor productivity, so the steps to improve labor productivity in the project are to use time efficiently so as not to waste too much time on things that are not related to work, and organize the work system so that each employee can work without any problems, employees need to have and develop specialized knowledge in their field of work, besides that project supervision of workers in this sector needs to be improved.

5. Acknowledgement

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6. Author’s Note

This journal was created based on research results in collaboration with Mrs. Dr. Lusiana, S.T., M.T. and Mr. Ir. Saffaruddin M. Nuh, M.T. as guide. The author states that this journal is an original work and not plagiarism, as he passed the Bachelor of Engineering Examination at the Faculty of Engineering, Tanjungpura University on June 21, 2023.

7. References


Peter F Drucker. (2002). Professionals’ Productivity. (ProOuest Company), h. 50.


Yulianto, E. (2020). *Productivity Analysis Level of Steel Roof Truss Installation (Case Study: Faculty of Science Building Construction Project Islamic Religion, Indonesian Islamic University)*. Yogyakarta: Indonesian Islamic University