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January 2005

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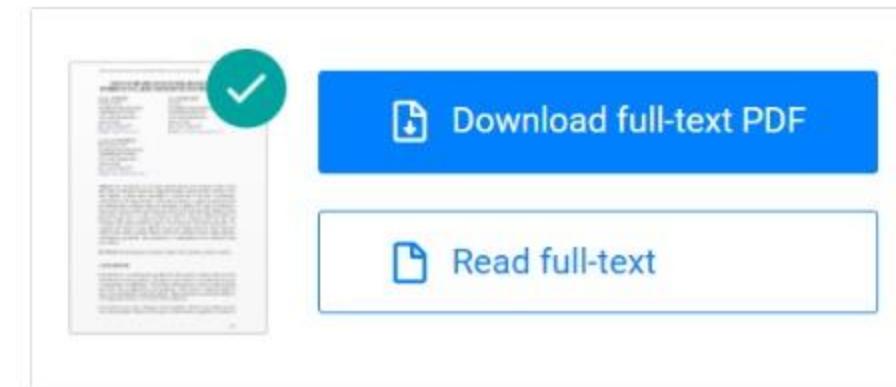
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STUDY OF THE INFLUENCE OF THE LENGTH OF WORK EXPERIENCE ON LABOR COEFFICIENT IN UNIT PRICE ANALYSIS

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Abstract: The construction cost is usually calculated based on the unit price analysis using three major coefficients for materials, equipment and labor. Among the three, the labor cost is more difficult to obtain where uncertainty is occurred due to the lack of performance standardization. This paper describes a study with the purpose to acquire an approach model in estimating labor coefficient where the uncertainty is applied. The study is conducted to labor involved in the industry and based on length of work experience that influences labor performance. Reference of labor coefficient is gathered from the National Standard of Indonesia (NSI) and is examined toward the range of coefficient from the data. The correlation and equation between length of work experience and labor performance are computed. By doing so, testing NSI on average time obtained from the study, regression analysis output and its equation could be used as the correlation between length experience and manpower productivity. This productivity is a transformation of the coefficient in unit price analysis.

Key Words: labor performance, uncertainty, length of work experience, unit price analysis

1. BACKGROUND

Labor intensive is a common practice in Indonesia. This practice is employed due to the fact that Indonesia has large population. The purpose of this method is to accommodate the needs of opportunities for employment. The benefit of labor intensive is that the method absorbs more labor; thus unemployment can be minimized. This method is commonly applied in most sectors including the construction industry. While technology in construction industry is developing, labor intensive is used more widely in Indonesia.

Labor intensive gives many advantages for the population. However, this method can also cause some problems. Firstly, the consequence of labor-intensive application is variation of

labor performance. The variation is caused by the fact that labor involved in the industry possibly will not have any training before he starts to perform a certain construction work. Mostly, labor is learning how to perform the work by doing it. In addition to it, labor experience in a construction work influence the variation. From all labors that involve in construction project, only some of them have experience to perform a particular work. The skilled labors have their experience because they already carry out the work for a certain time, while others are unskilled at the work. Other factor that influence variation of labor performance are geographic area. Indonesia is stretching over 5,000 kilometers along equator with an area of about 1,904,000 km². The large area and its diversity in many ways of life lead to a deviation of labor performance throughout the country.

Labor-intensive program also results in difficulty in determining labor performance standardization. The lack of standard is also occurs due to the variation of labor performance. Furthermore, when labor performance standard is not acknowledged, it leads to a problem in project cost estimation. Generally known that construction cost is influenced by some items as cost of material, labor, equipment, overhead and profit allocation. Labor cost can be calculated if certain labor performance is established.

Calculation of all cost items is conducted using unit price analysis. In unit price analysis, the requirement of labor to perform a work is computed using labor coefficient and work volume. The coefficient is gathered from labor performance. When certain standard of labor performance is not available, the coefficient of labor becomes difficult to formulate. This condition leads to a problem in construction project estimation.

The Ministry of Settlements and Regional Infrastructure has been formulated the Indonesian National Standard (NSI) for unit price analysis of housing. However, some problems occur in the implementation of NSI. Many parties that are involved in the construction industry have not employed the standard accordingly. Each party has its own coefficient for project cost estimation. Another problem of NSI implementation is the source of data utilized to formulate the coefficient in the NSI. Data is gathered from two sources, secondary and primary data. The primary data is collected from several housing projects around Bandung city, Indonesia. The secondary data is gained from some housing contractors. Consequently, the NSI will not possibly be applied through out Indonesia.

As stated before, cost estimation will be difficult where the uncertainty occurs in determining labor performance. For that reason, the need to define labor performance based on uncertainty becomes necessary. The uncertainty occurred is caused by several influence variables that affects the labor performance as geographic, experience, training, age, education level etc. Each factor has its own influence characteristic to be considered. This study objective is to obtain the characteristic of length of experience, as one of influence factors, on labor performance for calculation of labor coefficient for unit price analysis. Research of this study is concentrated on labor of brick masonry, carpentry and reinforced works.

2. LITERATURE STUDY

Productivity means comparison between effective and efficiency. Effective toward manpower performance in maximizes quality, quantity and time. In other hand, efficiency means comparison between input and the result from the input (Umar, 1998).

In this study, to know efficiency labor performance, each activity of certain work duration from observation is established. Total duration from each work is calculated using Eqn.1.

$$T = \sum_1^n te \quad (1)$$

te = Duration for each work item activity in 1 unit volume

T = Total duration in 1 unit volume per labor

Based on Eqn. 1, to know productivity of each labor performance, 1 unit volume is used to measure labor performance effective. From that assumption, productivity can be calculated using Eqn.2.

$$Productivity = \frac{I}{T} \quad (2)$$

Since uncertainty condition occurs in developing country due to the lack of standardization, qualitatively, any variable, either single or multiple variables, can influence labor productivity. Length of experience, as one of those variables, has a specific characteristic. In a normal condition, it related with age. In an uncertainty condition, labor experience is not directly related with variable age due the uncertainty condition. Skill, underage restricted regulation performance, geographic culture and others factor influence the characteristic of labor productivity and conduct the uncertainty itself. Based on those conditions, the study has to be separated length of experience from age. In other words, there is a need to conduct a different study to find the influence of age toward labor productivity. Logically, the model cannot be drawn in linear shape and has to accommodate flexibility of human characteristics. Using quantitative method, influence characteristic of variable length of experience to productivity can be predicted. Quantitative method used in this approach is regression which will shows its correlation. A polynomial regression approach applied as the basic concept because there will be no human with a linear characteristic. The best fit of non-linear characteristic curve should be chosen as a representative equation. In this study, second degree of non-linear is will be used as shown in Eqn.3 below.

$$Y = a + bX + cX^2 \quad (3)$$

Y = dependent variable, for this study is productivity

X = independent variable, for this study is length of experience

a,b,c = integers

In order to understanding the correlation between X and Y, the equation is analyzed. The correlation between X and Y is defined as correlation coefficient (r). If the value of r more than zero the correlation is positive, in the contrary, the correlation is negative. The correlation determination is shown as below:

- If $r \leq 0.5$ shows poor correlation
- If $0.5 < r < 0.7$ shows fair correlation
- If $r > 0.7$ shows good correlation
- If $r > 0.9$ shows excellent correlation

3. METHODOLOGY

Based on the theory above, systematic steps is design as a methodology to determine correlation between length of experience and labour productivity. All the steps performed are:

1. Determine study area and its available standarization.
Study area should be determined as limitation of the study with a standard that exist in those area to ensure the population.
2. Establish construction method to obtain work breakdown.
Determining work breakdown provides work items to be observed.
3. Collect data
 - i. The duration (te) is obtained through observation. The output should be turned into productivity form.
 - ii. The length of work experience is obtained through questioner.
 - iii. Available standardization is obtained from choosen standard in certain area.
4. Test the standard that used in the study.
Test is using a common quantitaive method hypothesa testing on normal distribution. The output has shown that the standard being used is larger than the mean of datas, as hypothetic assumption.
5. Analyze data
Analysis of the data is used the Eqn 3 for each type of labor. The output is a curve that describes the correlation of length of experience and productivity.
6. Draw conclusion
Conclusion is made by compare r output of correlation equation as the result from the analysis with the range of correlation determination as shown above.

4. ANALYSIS

1. Study area and standard applied

Study Area : Jakarta and around.
Standard Used : NSI number 03-2495-1991, 03-3434-1994 and 03-94-03

Table 1. Coefficient NSI

No	Activity	NSI coefficient
1	Door Frame	18.00
2	Brick Mansory	1.6
3	Reinforced Bar	0.033

2. Work breakdown

Broken down work activity for each activity can be shown in table 2 below.

Table 2. Activities Sequence

No	Door Frame	Reinforced Bar	Brick Masonry
1	Cutting	Cutting	Thread setting
2	Planing	Cross bar preparation	Paste placing
3	Beveling	Reinforced bending	Brick positioning
4	Molding	Reinforced assembling	
5	Pegs making		
6	Holes making		
7	Assembling		

3. Data collecting

Data gathered from observation and interview will be shown later in curve later.

The mean of labor productivity in coefficient is:

- Brick Mansory = 1.49768
- Reinforced Bar = 0.07243
- Door Frame = 15.744

4. Testing data observation to NSI

Table 3. Output data testing

Confidence interval = 95%

No	Type of Labor	Prod. Mean Data	SD	NSI	t_α	Z	Accepted the hypothesis
1	Brick Mansory	1.49768	0.196	1.6	2.101	2.27	OK
2	Reinforced Bar	0.07243	0.00616	0.033	1.64	6.4	OK
3	Door Frame	15.744	4.55	18	2.052	12	OK

5. Correlation characteristic

A. Brick Masonry

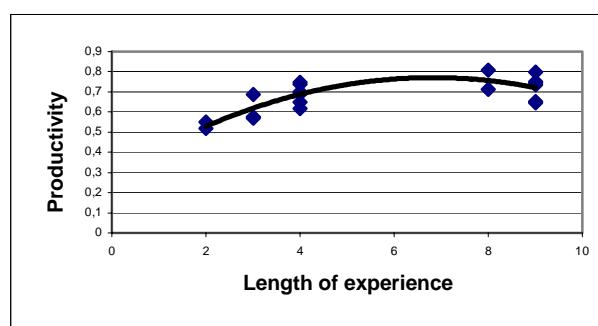


Figure 1. Correlation Length of Experience vs Productivity for Brick Mansory

Result: $Y = -0.0104X^2 + 0.1424X + 0.2854$
 $r = 0.799$

B. Reinforced Bar

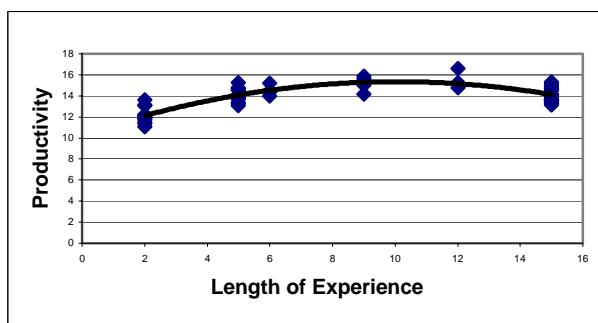


Figure 2. Correlation Length of Experience vs Productivity for Reinforced Bar

Result: $Y = -0.0499X^2 + 1.0033X + 10.309$
 $r = 0.805$

C. Door Frame

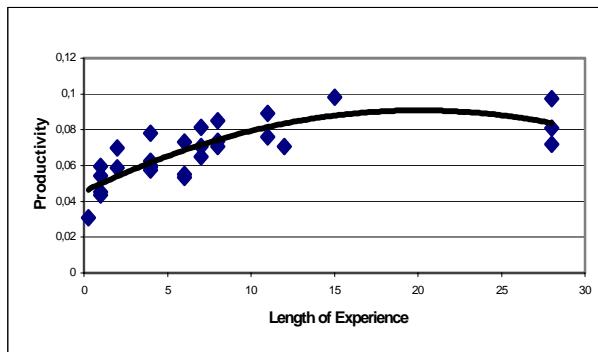


Figure 3. Correlation Length of Experience vs Productivity for Door Frame

Result:

$$Y = 0.0001X^2 + 0.045X + 0.0454$$

$$r = 0.8013$$

5. CONCLUSION

- 1) The characteristic of labor productivity, in general, is positive curve as shown in figure 1, 2 and 3.
- 2) The correlation is good enough, it proves that there is a correlation between the two variables.
- 3) The NSI coefficient is too large relatively. Study output shows that there is a need to consider an improving coefficient in unit price analysis for construction project in Jakarta and around
- 4) Length of experience gives an increase productivity up to a certain value, before it started decrease. This is a natural characteristic of human being, where age should influence the productivity, even it has a mean of longer experience.

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