International Journal of Scientific Engineering and Science
Volume 3, Issue 10, pp. 66-69, 2019. ISSN (Online): 2456-7361

Analysis of the Productivity of a Mason in the Work of the Red Brick Wall in the St.Thomas Aquinas Chapel Development Project

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Abstract*— When talking about project productivity in developing countries, including Indonesia, can not be separated from labor productivity. This is because the characteristics of projects in Indonesia that are still labor-oriented are the dominant factors in implementing a project. Productivity is used as a measure of whether the project is carried out effectively and efficiently or not. Productivity is very important in completing a job. Lack of awareness of productivity is the cause of the low quality of jobs produced.*

This study aims to determine the productivity of workers in bricklaying work and to know the comparison of the coefficient of worker productivity in the research location with SNI and to know the daily effects of the craftsman. The method used in this research is MPDM (Method Productivity Delay Model).

From the results of data analysis, it is known that the ideal productivity of masons on brickwork in the Chapel Building project St. Tomas Aquinas National Institute of Technology Malang is an average of 1.4544 m2 / Hour and the average productivity of overall workers is 1.704 m2 / Hour. From the MPDM analysis (Productivity Delay Model Method), the average productivity coefficient of workers for masonry is 0.1110 OH while the SNI standard is 0.1 OH so that labor productivity in the St. Chapel. Tomas Aquinas Malang National Institute of Technology does not meet the SNI requirements or is smaller than the specified standard.

Keywords*— Productivity, Brick Wall, SNI.*

I. INTRODUCTION

Nowadays development in the field of construction continues to develop rapidly, this is marked by the existence of development projects both roads, irrigation, and also buildings. In a project, the role of human resources is very important because the implementation and control are the full authority of the project actors. For that reason, it can be said that the success of a project is inseparable from the role of human resources as the driving force.

In a construction project, the productivity ratio is the value measured during the construction process which can be separated into labor, material, money, method and tool costs. The success and failure of the construction process depends on the effectiveness of resource management. One of the resources is the human factor, namely labor (workers and workers) becomes a determinant to achieve an effective and efficient level of productivity [1].

There are several things that affect the decline in labor productivity, such as wages that are not in accordance with the workload, discomfort at work, or lack of tools provided to help with work. From some of these constraints factors, it is necessary to do research on worker productivity in the St. chapel construction project. Thomas Aquinas used the Productivity Delay Model (MPDM) method which is expected to be able to answer the problems that occur at the project location and provide strategies in solving existing problems.

II. LITERATURE REVIEW

A. Productivity

In general, productivity is defined as the relationship between tangible and physical results (goods or services) and actual entry. Productivity is also defined as the level of efficiency in producing goods or services [2].

To increase productivity can be achieved by reducing all kinds of costs including the utilization of human resources and increasing output as much as possible. This means that productivity is a picture of overall work efficiency and effectiveness. [3].

Productivity is defined as the ratio between output and input, or between production output and the total resources used. In construction projects, the productivity ratio is the value measured during the construction process, can be separated into labor, material, money, method and tool costs [4].

Factors that influence labor productivity include the following [5]:

1. Wage rates
   Equitable labor costs will encourage workers to work even harder because they feel their participation in the production process in the project is valued by the company.
2. Worker experience and skills
   Workers' experience and skills will increase if the worker is doing the same work more frequently or repeatedly so that the productivity of the work can increase in doing the same work.
3. Education and expertise
   Workers who have attended special training or have attended a special education (STM) will have abilities that can be used directly so they can work more effectively when compared to workers who have not take special education.
4. Age of workers

Younger workers have relatively higher productivity when compared to older workers (elderly) because younger workers have more energy that is needed in construction work.

5. Procurement of goods
   When the material (cement, reinforcement, and brick) comes to the location, workers will be stopped for a moment because the workers must transport and move the material goods to the place provided (such as a warehouse). Or if at the time the work is in progress and the required materials are not available at the project site, then the work productivity will be stopped because it will await the supply of goods or materials.
6. Weather
   In the dry season the air temperature will increase (hotter) which causes productivity will decrease, while in the rainy season work involving the foundation and excavation of the soil will be hampered due to muddy soil conditions and cannot be foundry during rainy conditions because it will cause the quality of concrete results casting is reduced.
7. Material distance
   The existence of a large distance of material will reduce work productivity, because with the great distance between the material and the place where the work is done, it requires extra labor to transport the material.
8. Cooperation relations between workers
   The existence of a good and harmonious relationship between fellow workers and the foreman will facilitate work communication so that the desired goals will be easily achieved.
9. Managerial factors
   Managerial factors influence the enthusiasm and passion of workers through leadership style, tact, and company (contractor) regulations. Because with the quality of management as a driving force in production, it is expected that the level of productivity, achievement and operational performance will be achieved as desired.
10. Effectiveness of working hours
    Working hours that are used optimally will produce optimal productivity as well so it is necessary to pay attention to the effectiveness of working hours, such as the determination of start and end hours of work and proper rest hours.

B. Measurement of Labor Productivity

In general, productivity can be measured by calculating the ratio of output to input. The following is an equation to calculate productivity, namely: [6]:

$$\text{Produktivitas kerja} = \frac{\text{Hasil dalam Jam-Jam standar}}{\text{Masukan Dalam Jam-jam waktu}} \qquad (1)$$

Source: (Muchdarsyah Sinungan, 2003: 25)

Based on the Method Productivity Delay Model (MPDM), known approaches to productivity calculation are as follows [6]:

- Overall Productivity

$$= \frac{1}{rata-rata\ waktu\ siklus\ keseluruhan} \qquad (2)$$

- Ideal Productivity

$$= \frac{1}{rata-rata\ waktu\ siklus\ tak\ tertunda} \qquad (3)$$

- Production cycle is not delayed

$$= \frac{waktu\ siklus\ rata-rata\ waktu\ tak\ tertunda}{n} \qquad (4)$$

- Overall Production Cycle

$$= \frac{waktu\ siklus\ produksi\ rata-rata\ waktu\ tak\ tertunda}{n} \qquad (5)$$

Where:
Een = estimated delay due to the environment
Eeq = estimated delay due to equipment.
Ela = estimated delay due to labor.
Emt = estimated delay due to material.
Emm = estimated delay due to management.
All productivity units are in m2 / hour.

C. Wall

The wall is one of the important components in construction, in general people still use conventional methods in wall construction, namely by using bricks and concrete blocks as the main material [7].

In the construction project in this case the wall work, several materials can be used, namely bricks, concrete blocks, lightweight concrete, pre-cast concrete, and various other alternative materials. The main functions of the wall are as follows:

1. As a separator between rooms.
2. As a room divider that is private and public.
3. As a barrier to light, wind, rain, flood, etc. originating from nature.
4. As a barrier and anchoring the structure (for certain functions such as elevator walls, reservoir, and others).
5. As a noise barrier for spaces that require certain soundproofing thresholds such as broadcast studios.
6. As a barrier to light radiation or certain substances such as the radiology room, operating room, laboratory, and others.
7. As a particular artistic function and storage of securities such as safes in banks and others.

III. Research Methodology

A. Type of Research

This study uses the Method of Productivity Delay Model (MPDM) analysis method in which the data obtained are recorded in the form of data collection sheets in accordance with the method used. The research data is the result of the time the work of masonry bricks performed by 27 masons. Production units taken 1 m^2 for each cycle. Observation data will be taken in the form of activity time in the wall work cycle consisting of taking bricks, leveling mortar, laying bricks and

Volume 3, Issue 10, pp. 66-69, 2019. ISSN (Online): 2456-7361

others while the preparatory activities are not included or recorded.

B. Research Location

The research location is in the area of campus II of the National Institute of Technology Malang with the object of research being the construction of the Chapel of St. Thomas Aquinas.

C. Research Data

This research data consists of two namely:

- Primary data

Primer data in this study is data obtained directly from the study site, which records the behavior of workers or masons in the brickwork installation cycle.

- Secondary data

Secondary data in this study were obtained from books or journals that are relevant to this type of research.

D. Timing of Research

The time of this research is divided into two (2) stages, namely:

- The first stage:
  April 12 - April 17 2019 (8:00 AM - 4:00 PM WIB)
- Second stage:
  May 19 - May 23, 2019 (8:00 AM - 4:00 PM WIB)

IV. ANALYSIS AND DISCUSSION

A. The Result of the Calculation of the Productivity of a Mason

The following calculation to represent the entire calculation will be presented in the following table;

Known Artisan 1:

Total time of 3 cycles = 6456 seconds

Non effective time (delay) = 38 + 21 = 59 seconds

Effective time = 6456 - 59 = 6397 seconds and Area of 3 cycles = 3 $m2$

Overall Productivity $= \frac{1 jam}{waktu\ efektif}$ area of 3 cycles

Overall Productivity $= \frac{\frac{60\ menit}{jam} x\ 60\ detik/menit}{6397\ detik}$ x 3 m^2

$= 1{,}6883\ m^2/hour$

Ideal Productivity $= \frac{Produktivitas\ Keseluruhan}{(1 - Een - Eeq - Ela - Emt - Emm)}$

Ideal Productivity $= \frac{1{,}6883\ m^2/jam}{1 - 0 - 0 - 0{,}0138 - 0 - 0)}$ = 1,7118 m^2/ hour

Average Time for 1 Cycle $= \frac{Waktu\ efektif}{3\ siklus}$

$= \frac{6397\ detik}{3}$

= 2132,3333 seconds

= 35,5389 menutes

Based on SNI, the effective working time is 5 hours per day and in SNI the bricklayer coefficient for 1 m^2 = 0.1 OH. This means that 1 mason for 1 day of production is 1 $m2$ So to find the coefficient of bricklayers for the extent of work 1 m^2 in the field the following formula is used:

Artisan productivity coefficient 1 (1m2)

$= \frac{Waktu\ efektif\ Jumlah\ Tukang}{Produktivitas\ Tukang\ perhari}$

$= \frac{1m^2}{1{,}6729 m^2/hari}$

$= \frac{0{,}10x35{,}5389}{30\ menit}$

= 0,1185 OH

TABLE I. Overall Productivity of Bricklayers

handyman	The overall productivity of the craftsman (m2 / hour)	Ideal Productivity (m2 / hour)	Average time 1 cycle = 1 m2 (minutes)	The coefficient of artisan productivity
1	1,6729	1,6592	35,5389	0,1185
2	1,5347	1,4346	37,789	0,1260
3	2,3535	2,3535	25,49	0,0850
4	1,5248	1,3779	37,25	0,1242
5	1,5684	1,4300	36,33	0,1211
6	1,7341	1,7124	34,35	0,1145
7	1,6739	1,6632	35,589	0,1186
8	1,7656	1,7545	33,733	0,1124
9	1,9200	1,8986	31,017	0,1034
10	1,8342	1,8235	32,594	0,1086
11	1,6620	1,5713	33,917	0,1131
12	1,6716	0,7797	35,194	0,1173
13	1,5967	1,5869	37,456	0,1249
14	1,7863	1,6208	33,278	0,1109
15	2,0108	1,9713	29,05	0,0968
16	1,6952	1,6710	35,16	0,1172
17	1,5684	0,6167	37,11	0,1237
18	1,6569	1,0463	30,37	0,1012
19	1,6202	1,2332	34,03	0,1134
20	1,5575	1,4944	37,71	0,1257
21	1,6364	1,1118	32,81	0,1094
22	1,6984	0,9183	30,85	0,1028
23	1,7705	0,3801	30,783	0,1026
24	1,8944	1,8339	30,578	0,1019
25	2,2118	2,1792	26,833	0,0894
26	1,6912	1,1391	31,939	0,1065
27	1,6791	1,0077	32,039	0,1068
Total	46,9894	39,268974	898,79	2,9960
Average	1,7403	1,4544	33,2883	0,1110

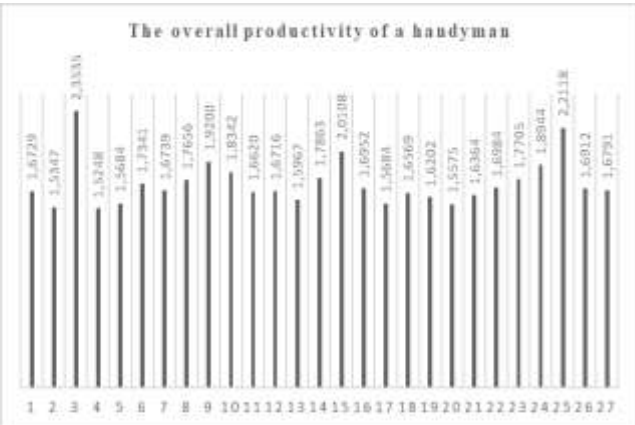

Figure 1. Overall Productivity Graph of the handyman

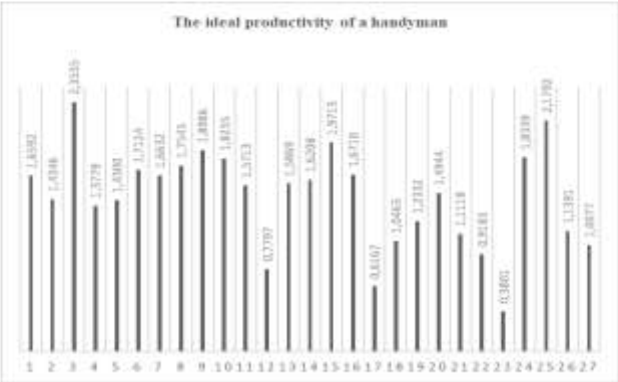

Figure 2. Graph of ideal worker productivity

Figure 3. Graphic coefficient of handyman productivity

TABLE II. Comparison of the Overall Productivity Coefficient of the handyman for 1 m^2 with SNI

Handyman	Coefficient of Brick Mason in the Field for 1 m^2 (OH)	the coefficient standard for masons according to SNI for 1m^2 (OH)
1	0,1185	
2	0,1260	
3	0,0850	
4	0,1242	
5	0,1211	
6	0,1145	
7	0,1186	
8	0,1124	
9	0,1034	
10	0,1086	
11	0,1131	
12	0,1173	
13	0,1249	
14	0,1109	0,1
15	0,0968	
16	0,1172	
17	0,1237	
18	0,1012	
19	0,1134	
20	0,1257	
21	0,1094	
22	0,1028	
23	0,1026	
24	0,1019	
25	0,0894	
26	0,1065	
27	0,1068	
Average	0,1110	

B. Discussion of Research Results

The results of this study indicate that the productivity of workers who do brickwork on the chapel construction project Thomas Aquinas is smaller than the productivity provisions contained in SNI (Indonesian National Standard) for construction work units, so a more stringent supervision is needed so workers do not use work time to do other activities or not work.

V. CONCLUSIONS AND SUGGESTION

A. Conclusions

Based on the research that has been done and the results of the analysis and discussion in the previous chapter, it can be concluded that the average productivity of the mason ideal for the work of masonry in the St. Chapel Chapel Development Project. Tomas Aquinas Malang National Institute of Technology is 1,544 m^2 / hour.

The Overall Productivity Rate of the masons on the St. Chapel Chapel Project Tomas Aquinas Malang National Institute of Technology is 1.7403 m^2 / hour and the average value of the coefficient of productivity of masonry masons is 0.1110 OH while the SNI is 0.1 OH.

B. Suggestion

In observing and analyzing data in the field it is necessary to pay attention to details in order to get accurate results and to carry out this data acquisition at the same time when the work of the masonry has entered the top floor so that the material mobilization is also not too smooth and also at the same time during the rainy season, so that the work must be postponed, tried at the time of data collection at the time of the work of the wall downstairs and when there is no rain.

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