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Original Article

Measuring Workers' Productivity in the Rural Infrastructure Construction Project Using the Historical Experience Method

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Abstract *- The success of a construction project as a whole depends on the success of each job in the project, while one of the factors that influences the success of a job is the productivity of its workforce. This is because work in a construction project is labor-intensive, which means using a lot of labor, and the majority of the work is done manually. Lack of attention to worker productivity in a construction project can hinder construction work. The purpose of this study is to determine the value of worker productivity in Check Dam work using the Historical Experience method. The results of this study indicate that in the reinforcement work, the average productivity value in the field is 17.0630 kg/ hour, in the formwork 2.44 m²/ hour, in the casting work 0.30 m³/ hour, in the formwork dismantling work 5.30 m²/ hour. While the average productivity coefficient value in the field in the reinforcement work is 2.40 OH, in the formwork 0.33 OH, in the casting work 1.88 OH, and in the formwork dismantling work 0.33 OH.*

Keywords *- Productivity, Human resources, Rural infrastructure, Historical experience, Coefficient value.*

1. Introduction

Labor or workers are all people who can do work to produce goods and/or services either to meet their own needs or for the community [1-3]. Labor is an important factor in the implementation of construction projects. This is because work on construction projects is labor-intensive work, which means using a lot of labor, and the majority of the work is done manually [4-7]. Neglecting worker productivity in a construction project can hinder progress [8]. Several factors can affect productivity in a construction project, one of which is the labor factor, which is directly related to construction development in the field [8-12].

In some developing regions, one of which is Indonesia, infrastructure construction is being carried out massively to support economic growth, from the center to rural areas [13]. One of the supporting factors of project success includes good project management and the availability of adequate human resources in accordance with needs [10]. If human resources are adequate, the project will run smoothly, and the company will continue to grow and gain a good profit orientation. Many things need to be considered for each workforce in order to support and meet the achievement of organizational goals. These aspects are competence, motivation, loyalty, and work discipline. If these four aspects are achieved, performance will increase, and productivity will also increase [8-11].

Performance can be measured if the individual can carry out his/her duties well. However, in project implementation, sometimes service providers pay less attention to this aspect because service providers want to gain more profit and reduce operational costs to a minimum. With quality resources, it is expected that all management performance activities of the project can be implemented as planned [10, 14, 15].

Management is a science of the art of leading an organization, which consists of planning, organizing, implementing, and controlling limited resources in an effort to achieve effective and efficient goals and objectives. So that the process and use of project management can be achieved, while a project is an activity that is carried out with limited time and resources to achieve the specified final result. So, in achieving the final result, project activities are limited by budget, schedule, and quality, known as three constraints (triple constraints). So it can be interpreted that project management is all the planning, implementation,

control and coordination of a project from the beginning (idea) to the end of the project to ensure the implementation of the project on time, at the right cost, and with the right quality [16-18].

One of the functions of project management is to lead and direct all resources in the project to achieve project goals. The most important resource in the system is human resources. Resource management is a considerable management process; human resources are objects even though they are subjects. This is because decisions regarding quantity and quality must be carefully considered so that resources remain of adequate quality. In determining the allocation of resources, what needs to be considered includes: 1). The amount of resources available for project needs, 2). Financial conditions that will be used to pay for resources, 3). Resource productivity, 4). Ability and capacity of resources, 5). Effectiveness of resource efficiency. For this reason, human resources in a project are categorized as labor [6, 10, 15].

Effectiveness is the result of the use of resources and activities in accordance with its goals, which include quality, cost, time, and others. So, efficiency can be interpreted as the appropriate use of resources and the selection of sub-activities, which includes the number and type when using other resources. Therefore, management in a project is something that cannot be ignored. Because without this, it will be difficult for the project to run according to expectations both for project productivity in terms of cost, time and quality [19, 20].

Productivity is how to produce or increase the yield of goods or services as high as possible by utilizing resources efficiently. In other words, it can be said that the definition of productivity has two dimensions, namely effectiveness and efficiency which can be measured based on certain measurements. The spirit of productivity has existed since human civilization because the meaning, in essence, is the desire and effort of human beings to improve the quality of all fields. Broadly speaking, productivity has the meaning of a comparison between the results achieved and the overall resources used [21-23].

2. Materials and Methods

The object of this study is worker productivity in rural infrastructure work. In this study, the researcher used a descriptive method, namely by collecting primary and secondary data. Primary data is obtained by direct observation (observation) in the field to obtain data on the volume of realization, in this case, ironing, form work, casting and dismantling of begisting. While secondary data is obtained from existing data sources, from related agencies, books, reports, journals or other relevant sources. Then, the productivity data will be analyzed using the historical experience method.

3. Results and Discussion

3.1. Reinforcement Work

This construction work uses iron with a size of D10 and a nominal weight coefficient of 0.617 kg/m. The overall calculation results obtained from the data are shown in Table 1.

Table 1. Recapitulation of the results of the analysis of the reinforcement work

Observation days	Volume (kg)
1	125,98
2	139,98
3	97,99
4	29,43
5	76,36
6	74,63
7	66,02
8	108,41
9	49,05
10	110,57
11	98,72
12	39,24
13	118,22
14	110,57
15	98,72

3.2. Formwork Installation Work

The method of installing the formwork used in this work is semipermanent. The calculation of the formwork volume is in m^2 units. The calculation results are shown in Table 2.

Table 2. Recapitulation of the results of the analysis of the formwork installation work

Observation days	Volume (m^2)
1	2,76
2	10,9
3	9,92
4	3,82
5	30,94
6	3,82
7	30,94

Table 3. Recapitulation of casting work analysis results

Observation days	Volume (m^3)
1	0,85
2	0,41
3	1,66
4	2,04
5	1,41
6	0,02
7	2,48
8	3,05
9	1,41
10	0,62
11	2,48
12	3,06

3.3. Casting Work

The casting work on this infrastructure project uses the help of a mixer with concrete quality Fc = 14.5 MPa (K175). The volume unit in casting work is m³. The results of the casting work analysis are shown in the following Table 3.

3.4. Formwork Dismantling Work

The process of dismantling the formwork begins after the concrete is considered hardened. The unit of volume in the demolition work begins is m². So, the calculation of the volume of the demolition begins can be seen in Table 4.

Table 4. Recapitulation of the results of the analysis of the formwork dismantling work

Observation days	Volume (m^2)
1	2,76
2	20,82
3	30,94
4	3,82
5	3,82
6	30,9

After obtaining observation data in the form of the number of workers, volume of work and time of work implementation, worker productivity can be calculated, and the results can be seen in Tables 5 to 8.

Table 5. Results of the analysis of the productivity of ironworkers using the historical experience method

Observation Days	Volume (kg)	Observation time (hour)	Observed Worker (People)	Productivity (kg/ hour)
1	125,98	6	2	20,99
2	139,98	6	2	23,33
3	97,99	6	1	16,33
4	29,43	3	2	9,81
5	76,36	5	2	15,27
6	74,63	4	2	18,66
7	66,02	6	1	11,00
8	108,41	6	2	18,07
9	49,05	4	1	12,26
10	110,57	5	2	22,11
11	98,72	6	2	16,45
12	39,24	5	2	7,85
13	118,22	6	2	19,70
14	110,57	4	2	27,64
15	98,72	6	2	16,45
Average				17,06

After conducting the analysis of the calculation of productivity values on the ironwork, the average worker productivity value was obtained at 17.06 kg/hour. Furthermore, conducting the analysis of the calculation of productivity coefficients on the ironwork, the average worker productivity coefficient was obtained at 2.40 OH.

Table 6. Results of Worker Productivity Analysis Using the Historical Experience Method

Observation days	Volume (kg)	Observation time (hour)	Observed Worker (People)	Productivity (kg/ hour)
1	2,76	3	2	0,92
2	10,9	6	2	1,82
3	9,92	6	2	1,65
4	3,82	2	2	1,91
5	30,94	7	2	4,42
6	3,82	2	2	1,91
7	30,94	7	3	4,42
Average				2,44

After conducting the analysis of the calculation of productivity values on the formwork work, the average worker productivity value was obtained at 2.44 m²/hour. Furthermore, conducting the analysis of the calculation of the productivity coefficient on the formwork work, the average worker productivity coefficient was obtained at 0.33 OH.

Table 7. Results of the analysis of the productivity of foundry workers using the historical experience method

Observation days	Volume (kg)	Observation time (hour)	Observed Worker (People)	Productivity (kg/ hour)
1	0,85	4	2	0,21
2	0,41	2	2	0,21
3	1,66	7	2	0,27
4	2,04	7	3	0,29
5	1,41	4	2	0,35
6	0,02	3	1	0,21
7	2,48	7	3	0,35
8	3,05	7	4	0,44
9	1,41	4	2	0,35
10	0,62	2	2	0,31
11	2,48	7	3	0,35
12	3,06	7	4	0,44
Average				0,31

After conducting the analysis of the calculation of productivity values in the casting work, the average worker productivity value was obtained at 0.31 m³/hour.

Furthermore, conducting the analysis of the calculation of productivity coefficients in the casting work, the average worker productivity coefficient was obtained at 1.89 OH.

Table 8. Results of productivity analysis of formwork dismantling workers using historical experience method

Observation days	Volume (kg)	observation time (hour)	Observed Worker (People)	Productivity (kg/ hour)
1	2,76	1	2	2,76
2	20,82	2	2	10,41
3	30,94	4	1	7,736
4	3,82	2	2	1,91
5	3,82	1	2	3,82
6	30,9	6	2	5,1
Average				5,30

After conducting the analysis of the calculation of productivity values in the work of dismantling the formwork, the average value of worker productivity was obtained at 5.30 m²/hour. After conducting the analysis of the calculation of productivity coefficients in the work of dismantling the formwork, the average coefficient of worker productivity was obtained at 0.33 OH.

4. Conclusion

Based on the results of the calculation analysis carried out, it was concluded that in the reinforcement work, the average productivity value in the field was 17.06 kg/hour; in the formwork, the average productivity value in the field was 2.44 m²/hour, in the casting work the average productivity value in the field was 0.30 m³/hour, in the formwork dismantling work the average productivity value in the field was 5.30 m²/hour. In the reinforcement work, the average productivity coefficient value in the field was 2.40 OH. In the formwork, the average productivity coefficient value in the field was 0.33 OH; in the casting work, the average productivity coefficient value in the field was 1.88 OH; in the formwork dismantling work, the average productivity coefficient value in the field was 0.33 OH.

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