International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Labor Producivity Analysis on Summarecon Mall Bandung Construction Project

Madaliatul Islahiyah[1], Sakinata Zhahrina Ramadhani E[2], Genta Putra Adietama[3]

[1,2,3]Student, Civil Engineering, Bandung Institute of Technology

Abstract

Located in the East Bandung area Indonesia, in Gedebage, Summarecon Bandung want to develop the first independent city in the city of Bandung. The progress of project work is at 52.44%, still 0.13% higher than 52.31% for the planned sub-structural work in the following weeks. 21. This study will discuss the analysis of productivity values in reinforcing work to provide information regarding the causes of delays that cause project progress to be delayed, worker performance, and the amount of productivity produced. The method used for data collection includes direct observation, using the Five Minutes-Rating and direct interviews using the Foreman Delay Survey (FDS) in the form of questions that will be given to field supervisors in order to obtain valid and actual data. The results of the research through observation for 20 minutes with the Five Minutes- Rating is 85% with comparison the results of productivity analysis by Foreman A and B are 33% and 17%. As for the results of the Foreman Delay Survey, it shows that the factors that affect the productivity value with the top three rankings are construction equipment damage, waiting for materials (vendor delay), and changes / rework (design errors).

Keywords: Foreman Delay Surveys, Five-minutes ratings, Bandung, Summarecon, Construction

1. Introduction

Located in the eastern Bandung area precisely in Gedebage, Summarecon Bandung is an effort to develop the first independent city in Bandung City in order to provide decent housing and provide facilities such as, shop houses, and office areas, shopping centres, educational facilities, etc. PT Summarecon Agung Tbk, itself has a vision to provide economic value in a sustainable manner. In its implementation, the development of an area that is comfortable to live in and familiar with the community is the starting point for Summarecon to innovate.

The Summarecon Mall Bandung project has a land area of ±100,504 m2 and a building area of ±64,061 m2, with structural and architectural scopes of work. The assumed duration of the overall construction work is 14 months (420 Days) starting in June 2022 until completion in July 2023. The project work progress is at 52.44%, still 0.13% higher than the 52.31% planned for sub structure works in week 21. This means that many workers and material mobilisations are moving on the project. So this can affect the value of labour productivity in the field.

Productivity is the efficient and effective use of production resources to achieve, optimally, set organisational goals [1]. [2] Mbachu (2008) also asserts that productivity increases are highly correlated with increased profitability, competitiveness, achievement of key stakeholder value and long-term growth and sustainability of an organisation, industry or economy (nation). The reasons put forward for low productivity levels and those related to the peculiarities of the construction industry include the characteristics of the workforce, the variety of project work conditions and the environment as well as inherent non-productive activities [3].

This study will discuss the analysis of productivity in formwork with the aim of providing information related to the causes of delays that cause project progress to be delayed, worker performance, and the amount of productivity produced. Hopefully, the results of this analysis can be used as a reference in an effort to increase the value of productivity on the Summarecon Bandung project.

2. Study Literature

A. Man Power

Human resources are the most strategic element in the organisation. Increased productivity can only be done by humans. Conversely, human resources can also cause waste and inefficiency in various forms.
There are so many methods that can be used to measure labour productivity in the field. However, accurate measurement of labour productivity is difficult. Data collection methods including five-minutes rating and foreman delay survey are approaches that can be used for productivity measurement. One of the approaches to determine the level of labour productivity is to use a method that classifies worker activities. Idle work or corruption of working hours is not conducive to development, but hinders the progress that should be achieved. On the other hand, the effective work according to the number of hours that should be worked and work in accordance with the job description of each worker, it will be able to support progress and encourage the smooth running of the business both individually and as a whole [4].

B. The Understanding of Productivity

Productivity has a different definition for each individual. In general, productivity can be defined as the ratio between input and output. Output is a real physical result that has value and benefits for society. Meanwhile, inputs are resources that can be in the form of materials or services. Productivity itself can be a measure of production efficiency

C. The Factors that Affeting Productivity

According to [5]variables that influence labor productivity field can grouped become several things. Following is a number of the factor :

1. Physical condition of the field and auxiliary facilities
2. Seasonal climate and weather conditions
3. Physical condition of the field
4. Auxiliary facilities
5. Work group composition
6. Project size
7. Learning curve
8. Labour density

D. Foreman Delay Surveys (FDS)

The Foreman Delay Survey (FDS) relies on a questionnaire to be completed by job foremen at the end of the working day according to a specific survey schedule, for example, one working week in every month. This questionnaire is mainly intended to identify the number of man-hours lost due to delays. Most FDSs are divided into rework and and delay categories.

Once the form is filled out, information is extracted in the form of a percentage and actions are taken to ensure that the source of delay is properly addressed. FDS is a relatively low cost method to analyse sources of delay during construction. It can be easily compiled and implemented.

E. Five-Minutes Ratings

Five-Minutes Rating, unlike work sampling, is not based on statistical sampling theory. It is a simple method of observing operations for a short period of time. Such observations do not produce a large enough sample to support work sampling. It does however provide some insight into crew effectiveness and can identify areas where further observation is required. The following procedure can be used to implement the 5-minute rating technique:

1. Identify the crew members to be observed and organise a form
2. Observe the crew as they work. For example observation intervals equal to 5 minutes, determine if the crew member has been active for more than half of the interval. If so mark the cell observation with "ü"; otherwise, leave the cell blank.
3. Add the "ü" observations for the entire table and divide the sum by the total number of observationsto get the effectiveness value of the job.

3. Method

In this research, the methodology used is arranged systematically to facilitate the productivity calculation process. The stages of research preparation in the form of a flow chart can be seen in Figure 3.1.

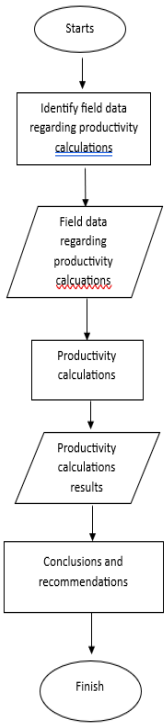

Figure 3.1. Flow Chart

The research began by identifying work and field data to determine productivity calculations carried out in a field visit container. The data obtained was in the form of a series of labour productivity with labour groups in structure work. Then a literature study was conducted on productivity calculations. The next objective is to provide conclusions and determine recommendations for implementation based on productivity calculations.

A. General Project Data

The following is the general data of the project reviewed in this study.

Table 3.1. Data General Project

No	Details	Information
1	Project Name	Summarecon Mall Bandung
2	Land Area	100,504 m^2
3	Building Area	64,061 m^2
4	Work Scope	Structural and Architecture
5	Owner	PT. Mahakarya Buana Damai
6	QS Consultant	PT. Rekagriya Mitra Buana
7	Construction Management	-
8	Architect Consultant	Cadiz International Middle East FZLLC and PT. Anggara Architeam
9	Structure Consultant	PT. Arsini PRIma Cipta
10	MEP Consultant	PT. Arnan Pratama Consultants

Source: Document PT. Jagat Construction

B. Method And Instrument Collection Data

1. Data Collection Method

In this study, researchers used the Quantitative Descriptive method, namely direct observation (observation) and direct interviews in the field. This method was taken because the data source used was the field supervisor who worked in the field, in order to obtain valid and actual data from the field.

Methods used for data collection include direct observation, time taking of production activities using five-minutes rating. Direct observation was used to assess worker effectiveness based on Activity Sampling.

In the FDS (Foreman Delay Survey), field supervisors are questioned on the extent and type of delays affecting worker performance. Considering their close contact with workers and management, foreman are considered more competent in identifying the cause of any delays and providing accurate estimates of their duration. Only delays that are out of control are recorded in terms of source, length of time lost and number of workers affected.

2. Data Collection Instruments

Data collection instruments are tools selected and used by researchers in their activities to collect data so that these activities are systematic and productivity calculations can be made. To determine data collection instruments, researchers must first determine the data sources and data collection methods used. The following is a picture of determining the research data collection instrument contained in Figure 3.2 below:

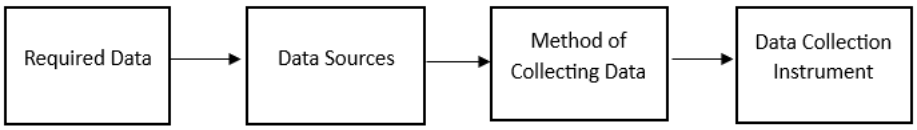

Figure 3.2 Step Determination Instrument Collection Data Study

In addition to the above, the constraints on the researcher are also important factors that must be considered by the researcher in choosing the data collection instrument, including: ability, namely the master of knowledge, methodology, energy and time available. In accordance with the data collection method used in this study, the author used interview guidelines and observation guides as instruments to collect data, while also considering the author's own abilities.

4. Data Analysis

A. Five-Minutes Rating

There are four workers who are working on the iron work, therefore the minimum length of observation for the 5-minute rating is 5 minutes per worker, so the total length of observation is 20 minutes because there are four workers.

Tabel 4.1 5-Minutes Rating Iron Work

	Iron Work			
Time	Worke r 1	Worker 2	Worker 3	Worker 4
03.00 PM	✓	✓	✓	✓
03.05 PM	✓	✓	✓	✓
03.10 PM	✓	✓	✓	
03.15 PM		✓	✓	✓
03.20 PM		✓	✓	✓
Effective Observa-tion	3	5	5	4
I. Total Observation = 20 II. Effective Observation = 17 III. Effectiveness = 17/22 IV. 5-Minutes Rating = 85%				

From the observation data above, it was found that the 5-minutes rating of the 20-minute iron work was 85%. At 03:10 PM, worker 4 was transporting from his previous workplace to his new workplace. At 03:15 PM, worker 1 left the workplace and did not return until the observation time was over. The value of the 5-minutes rating reaching 85% can be classified as effective because workers do more than 50%

of the work without any delay. Although the observed data is not the overall value of the project, this value is the value that took place in the field during the observation.

B. FDS (*Foreman Delay Survey)*

The following data is obtained through the FDS method regarding the amount of production lost per week through the influence of 11 factors. The following is a table of sorted FDS results that have been adjusted by the level of production.

Tabel 4.3 Construction Site Delay Factors by Foreman Delay Survey (FDS)

Date :	Name :		
Total Crew :	General Foreman		
	Foreman's name :		
Problems that cause Delay	Manhours Lost		
	Number Of Hours	Number of Workers	Labour Hours
Change / rework (Design error)	14	3	42
Change/rework (Prefabrication error)	14	2	28
Changes/Rework (Field Errors/Damage)	-	-	-
Waiting for Material (Warehouse)	-	-	
Waiting for Material (Vendor Delay)	24	2	48
Waiting for Equipment	15	2	30
Construction Equipment Damage	21	15	315
Waiting for Information	730,000	10	7.300.000
Waiting for the rest of the crew	7	3	21
Unnecessary/unexplained movements	8	3	21
Machine Damage	14	1	14

Tabel 4.4 Factors and Levels of Construction Site Delay by Foreman Delay Survey (FDS)

S/N	Factors	Lost Man Hrs	%	Rank
1	Change / rework (Design error)	42	8.09%	3
2	Change/rework (Prefabrication error)	28	5.39%	5

3	Changes/Rework (Field Errors/Damage)	0	0.00%	9
4	Waiting for Material (Warehouse)	0	0.00%	9
5	Waiting for Material (Vendor Delay)	48	9.25%	2
6	Waiting for Equipment	30	5.78%	4
7	Construction Equipment Damage	315	60.69%	1
8	Waiting for Information	7,300,000		
9	Waiting for the rest of the crew	21	4.05%	6
10	Unnecessary/unexplained movements	21	4.05%	6
11	Machine Damage	14	2.70%	8
Total		519		

Tabel 4.5 Factors and Levels of Sequential Delay on Construction Sites by Foreman Delay Survey (FDS)

S/N	Factors	Lost Man Hrs	%	Rank
7	Construction Equipment Damage	315	60.69%	1
5	Waiting for Material (Vendor Delay)	48	9.25%	2
1	Change / rework (Design error)	42	8.09%	3
6	Waiting for Equipment	30	5.78%	4
2	Change/rework (Prefabrication error)	28	5.39%	5
9	Waiting for the rest of the crew	21	4.05%	6
10	Unnecessary/unexplained movements	21	4.05%	6
11	Machine Damage	14	2.70%	8
3	Changes/Rework (Field Errors/Damage)	0	0.00%	9
4	Waiting for Material (Warehouse)	0	0.00%	9
8	Waiting for Information	7,300,000		
Total		519		

From the results of Table 4.3, Waiting for information is the main factor that gives the most influence on the value of productivity. However, based on our data, we did not include it in the ranking because it has a very high value if included in the percentage category compared to other jobs. The factor of

waiting for information is very high because if there is a change in design but there is no decision yet, then the work in the field will be held because it must be consulted and coordinated in advance by other parties related to each specialist in accordance with their respective work and field, for example in the pit lift work the dimensions required for the elevator are 2m x 3m then the field also needs to work larger than the dimensions of the pit lift so that the elevator can be used properly and the change must be consulted by the party related to the pit lift specialist.

The next rank with the second rank, is in the work of construction equipment damage, especially for bar cutters and bending bars because the tools used in the field amount to 10 units of bar bending and 5 units of bar cutter, so there is a high probability of damage. The two tools are complementary tools used in iron work. Of course, both tools have equally important functions. If the bar cutter is used for cutting then the bending bar is used for bending. When choosing a bar cutter, you must also pay attention to the engine power. This is very important because engine power has a big influence on the strength and torque released when the tool is used which will affect the damage to the cutter bar.

The next rank with the third rank, is waiting for materials (vendor delay), in the Summarecon Mall Bandung Project the materials used are ordering materials by the owner. Therefore, coordination must be carried out regularly by the contractor to the owner for the availability of materials and there is also negligence from suppliers (vendors) in handling the delivery of goods. For this reason, so far, the contractor PT. Jagat has anticipated with material requests in advance and once a week (every Tuesday) monitoring the available iron. When the fixings are available in the field, PT. Jagat also needs to check and control the delivery from the supplier (vendor). The assignor also provides dispensation if the delay is caused by the owner.

Some other factors that affect the value of productivity that give a fairly low value are changes / rework (design errors) with a percentage value of 8.09%, waiting for equipment with a percentage value of 5.78%, changes / rework (Prefabrication errors) with a percentage value of 5.39%, waiting for other crews with a percentage value of 4.05%, unnecessary / unexplained movements with a percentage value of 4.05%, machine damage with a percentage value of 2.70), waiting for materials (warehouse) with a percentage value of 0% which means it does not affect the delay because PT. Jagat and the stakeholders involved are meant to anticipate in advance for the materials in the warehouse and finally for changes / rework (errors in the field / damage) directly done by the contractor PT. Jagat and does not affect the delay because the work does not affect other work.

C. Comparison between Field Results and PT Jagat Results

Table 4.6 Productivity values obtained from PT. Jagat

Observation	Volume (Kg)	Duration (Days)	Number of Workers	Worker Productivity / per 20 minutes	Worker Productivity/per Person	Worker Effectiveness/ per minute
Foreman A	80,929.92	20	19	56.20	212.97	30%

Foreman B	31,605.95	14	12	31.36	188.13	17%
Foreman C	99,392.91	14	35	98.60	202.84	53%
Total	211,928.48	48	66	186.16	603.94	100%

From the data obtained from PT Jagat that the total productivity of workers per 20 minutes is 186.16, this value is assumed to be the maximum value for worker productivity per 20 minutes per foreman. It was found that for the comparison between the observation of the 5-minutes rating and the results of the report from PT Jagat that the value of effectiveness was still below the value of observations in the field. The average value of the PT Jagat report is still below 50%, which is 33%. From the value of each foreman, Foreman A and Foreman B are still below 50%, which is still not effective, but for Foreman C has exceeded 50%, which means that Foreman C has worked effectively, but this value is still below the observation value of the data in the field.

D. Recommendations

From the previous discussion, the recommendation that can be given to PT Jagat in increasing productivity is to improve the damage factor of the tool, this can be done by doing maintenance on the tool regularly, with this the risk of damage to construction equipment is minimal. Next is to increase the productivity of the concreting work to reach the value of the field observation, which is 85%. The performance of Foreman A and Foreman B workers needs to be improved by at least reaching the effective value because the results of PT Jagat are not far from the effective value.

Improve coordination and communication between each stakeholder related to pembesian work. This can avoid misinformation if there are changes to the design, so as to minimize errors in the drilling work and the amount of iron needed according to the amount needed during the initial planning.

5. Conclusions

From the results of the five-minutes rating, it is found that the value of worker effectiveness at the observation time of 20 minutes is 85%, it can be seen in PT. Jagat's results that the resulting productivity does not reach the value of the five-minutes rating from field observations. The highest value of PT Jagat's results is 53% for Foreman C. This result can already be considered effective if using the assumption that the maximum productivity value that can be achieved is the total of the three foremen. The value of Foreman A and Foreman B is still far from the effective number with a value of 33% and 17%. Although the value of Foreman C is still effective, this result is still below the value of the five-minutes rating observation. This means that the three foremen are still not maximally achieving the value of the five-minutes rating observations made in the field.

From the results of the Foreman Delay Survey, it is found that the top three values of factors affecting work productivity in order from the top rank are construction equipment damage, waiting for materials (vendor delay), and changes / rework (design errors). The construction equipment damage factor is the highest factor in causing delay in the concreting work. This factor needs to be explored further because, if the construction equipment damage factor can be reduced, the delay that occurs in the concreting work

will be significantly reduced. The second top factor and the third top factor cause delay, but the resulting percentage value is much smaller than the first factor. All factors causing delay need to be addressed, but the most important one to prioritize is the first factor, which is construction equipment damage. This is obtained by excluding the factor of waiting for information in the calculation, because if it is included in the calculation, the Foreman Delay Survey calculation is not good, because the number of factors waiting for information is so large that the calculation results are not good.

6. References

1. S. I. S. a. A. B. N. Durdyev, "Factors Causing Cost Overruns in Construction of Residential Projects; Case Study of Turkey," *International Journal of Science and Management, 1*, pp. 3-12, 2012.
2. J. Mbachu, "Conceptual framework for the assessment of subcontractors' eligibility and performance in the construction industry," *Construction Management and Economics, Taylor & Francis Journals, vol. 26(5),* pp. 471-484, 2008.
3. G. C. S. a. L. M. Jerges, "ConstructionProductivity: A Survey of Industry Practices," *ACCE InternationalTransactions,* p. PM 06.01, 2000.
4. M. Sinungan, Produktivitas Apa dan Bagaimana, Bumi Aksara, 2003.
5. I. Soeharto, Manajemen Proyek, Jakarta: Erlangga, 1997.