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# Analysis of The Line Balancing Assembly Implementation to Increase Productivity

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A B S T R A C T
This research was conducted at PT. TRIN which produces automotive spare parts. The Line Balancing Assembly method is used to minimize the time needed to complete one unit of product. This research was conducted by collecting primary data and conducting interviews with workers at each work station. The results of the study show that the application of the Line Balancing Assembly method can increase productivity at PT. TRIN on the X30 production process originally the number of production reached 26 pcs/hour , after the Line Balancing Assembly method was applied it became 28 pcs/hour or an increase of 7.70%. This study provides recommendations for other companies wishing to increase productivity by applying similar methods to their processes.



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## INTRODUCTION

Competition in the automotive world is fierce, with many large automotive companies competing for a larger market share. This competition occurs at various levels, including in terms of price, quality, technological innovation, car design, and marketing.

Some of the world's largest automakers include Toyota, General Motors, Ford, Volkswagen, Honda and Nissan. Each of these companies has a different strategy to face competition in the global automotive market. Some strategies that are commonly used are to develop cars that are more fuel efficient, reduce production costs, improve quality, and develop more sophisticated technology. Not only car manufacturers, but also the automotive parts and accessories industry is also competing fiercely. Automotive parts and accessories companies continue to innovate to create new products that are more efficient and affordable, with the aim of increasing competitiveness and expanding the market. In an effort to increase the competitiveness of companies, one thing that is very much pursued by every company is to increase productivity.

Productivity is a measure or index that regulates output in the form of goods or services relative to inputs, which consist of labor, materials, energy and other resources, which are used to produce product (sofian 2016: 19).

Productivity is formulated in:

PRODUKTIVITAS = PRODUKSI : WAKTU = OUTPUT : INPUT

Productivity is often measured in terms of economic inputs and outputs. However, human and social resource inputs and outputs are also important factors. If organizational behavior is better, it can improve job satisfaction resulting in an increase in human resource outcomes.

Increasing productivity is one of the main goals for companies and organizations in various sectors. Productivity is a measure of efficiency in producing goods or services using available resources. Productivity improvements can help companies improve operational efficiency and effectiveness, increase profits, reduce production costs, and strengthen competitiveness in the market.

In today's highly competitive business environment, increased productivity is critical to achieving long-term success. This requires companies to pay attention to factors that affect productivity such as technology, human resource management, and operational efficiency.Increased productivity can also benefit employees and society as a whole, as it can create new jobs, increase wages and benefits, and improve social welfare.

However, increasing productivity is not an easy task and requires continuous effort. Therefore, companies must be committed to continuously increasing productivity by making improvements to business processes, adopting new technologies, and training employees to improve skills and work efficiency. One method that can be used to increase productivity is the Line Balancing method.

Assembling is the process of assembling or assembling the components or parts of a product into a complete and ready-to-use product. The assembling process usually involves several stages, such as assembling parts, tightening bolts and screws, installing cables or electrical connections, and functional testing of the assembled product. The assembling part is very important in the production process because it can affect the quality and performance of the final product.

Line balancing assembly is a technique used in manufacturing to create efficiency in the production process. This technique involves arranging tasks and activities in an assembly line in an organized and coordinated way to result in production at lower costs and in less time.

Line balancing assembly is carried out by allocating tasks and activities among operators in a balanced way to minimize waiting time and ensure that all operators work with similar intensity. The goal is to strike a balance between the time it takes to complete the different tasks in the Line Assembly.

In the manufacturing industry, assembly line balancing can help increase productivity, reduce production costs and improve product quality. As an illustration of the implementation of the Line Balancing Assembly method in this study, the researcher presents a case that occurred at PT. TRIN.

## THEORETICAL REVIEW

The definition of productivity is philosophical, and according to the National Productivity Council productivity is a mental attitude that always tries and has the view that today 's life is better than yesterday and tomorrow is better than today. Technically productivity is a comparison between the results achieved and the overall resources used , by comparing the amount produced with each source used, productivity is a measure that shows consideration between input and output issued (Sunyoto, 2012: 41).

PT TRIN is a company engaged in the automotive manufacturing sector. PT TRIN produces one of the automotive components in the form of motorcycle radiators, car radiators, intercoolers and oil coolers. The resulting achievements For maximizing the production of PT TRIN , if the total productivity increases each time production and has added value in each activity and can reduce excess activity each time the production process is carried out. In intercooler production activities, the activity is not balanced between parts where there is a different cycle *time* in the production process, both in assembling or in the process of changing the model every time it is done. PT TRIN needs to do equity in the production process so as to make production activities more balanced in each the process.

## METHODOLOGY

This type of research is descriptive qualitative research. According to Narbuko and Achmadi (2013), descriptive qualitative research is research that seeks to explain the current problem solving based on data, so it also presents data, analyzes and interprets it. So that this research will finally solve the

existing problems in accordance with the data that has been processed starting from presenting the data, analyzing the data that has been obtained and then interpret it.

The type of data used is primary data (data obtained directly from the field). The technique of collecting research data is in the following way:

a. Preliminary study by understanding the production process flow in the assembly line and understanding the instructions Work.
b. See how the operator works and conduct interviews with the operator.
c. Adjusting the cycle time balance in the assembly process by making improvements, adjusting process activities.

**DISCUSSION**

Increasing productivity in this study was carried out by the Line Balancing method. Line balancing is the process of regulating and balancing production activities on a production line or assembly line. The goal of line balancing is to achieve production efficiency and maximize the use of available resources.

In line balancing, different production activities are arranged in a logical and efficient sequence to minimize waiting time or idle time, and ensure that each station on the production line works optimally and is balanced in workload. This process involves organizing production activities in a logical and efficient sequence to minimize waiting time or idle time, and ensures that each station on the production line is working optimally and in a balanced workload.

Line balancing can help companies increase productivity, reduce production costs, speed up production cycle times, improve product quality, and better meet customer needs. However, the line balancing process can also be difficult if there are many product variations or different customer needs, thus requiring the right strategy in managing production activities in order to balance the workload at each station.

In practice, Line Balancing Assembly involves several steps, that is:

1. Identify the activities and tasks to be performed in the assembly line.
2. Estimate the time needed to complete each task.
3.Organize tasks and activities within the assembly line so that the time required to complete each task is balanced among operators.
4. Evaluate the Line Balancing Assembly to ensure effectiveness and efficiency in the production process

The subject of this research is PT TRIN precisely in the I/C line on the X30 product. This research was conducted by means of field observations, namely conducting *cycle time* and *trial and error* .

The following is the result of the cycle time of the X30 production process at PT. TRIN

Table 1. Activity each Station and Cycle Time

| Activity each Station and Time | | |
|---|---|---|
| Station Fin Forming 125,17 sec /pcs | Station Jig Assy 136,09 sec/pcs | Station Final Assy 128,38 sec/pcs |
| Activities each station | | |
| | Install C/S Lower | |
| | Tank Cleaning | Put Core to palet |
| Tube Expand | Flux Spray | Install Tank Band |
| Core Assy 2 | Dry Off | Install Core Band |
| Install H/P | Air Blow | Repair |
| Core Assy 1 | Flux Dipping | Checking |
| Fin Assy | Install Core | Cleaning |
| Tube Assy | Install C/S | Take Core |

Based on the results of the analysis that has been carried out, the improvements made are changing the work method in accordance with the improvements that have been made, so there are several things that must be proposed for corrective action to get maximum productivity.

So the improvement made is by changing the pallet waiting sensor from 261 seconds to 220 seconds thereby reducing the distance between pallets which makes more capacity.

Figure 1. Fixing the spacing between palettes

In the jig assy process, repairs are carried out by repairing the worn tipper nail jig assy so that the h/p nails can lock properly and there is no more time for the tightening process to be carried out.

Figure 2. Repair jig assy

Change The resulting cycle *time* after this repair is:

a. in the fin forming process cycle time results remain 125.17 seconds / pcs,
b. Station jig assy down to 131.29 seconds/pcs and
c. final check fixed: 128, 38 seconds / pcs.

improvement is balancing the workload in the following way :
Initial conditions : :

Operator 1 with *a cycle time* of 125.17 seconds Operator 2 with *a cycle time of* 131.29 seconds Operator 3 with *a cycle time* of 128.38 seconds Judging from the existing cycle *time,* operator 1 has a cycle time of 3.4 seconds less than the Final Assy time (128.38 sec/pcs) , while operator 2 has a cycle time of 2.72 more than the Final Assy time (128.38 sec/pcs) . if calculated from the equal distribution of workload there will be an addition productivity.

The next step is to move one work process from the jig assy operator to the job of the fin forming operator because the jig assy is the longest cycle time and fin forming is the fastest cycle time.

Table 4. Balancing Work time

| Activity each Station and Time | | |
|---|---|---|
| Station Fin Forming 128,15 sec /pcs | Station Jig Assy 128,15 sec/pcs | Station Final Assy 128,38 sec/pcs |
| Activities each station | | |
| | | |
| Install C/S Lower | Tank Cleaning | Put Core to palet |
| Tube Expand | Flux Spray | Install Tank Band |
| Core Assy 2 | Dry Off | Install Core Band |
| Install H/P | Air Blow | Repair |
| Core Assy 1 | Flux Dipping | Checking |
| Fin Assy | Install Core | Cleaning |
| Tube Assy | Install C/S | Take Core |

Balancing work time is done by moving process installation of c/s lower which was originally the task of the jig assy operator became a task operator fin forming so that the cycle time be balanced.

## CONCLUSION AND RECOMMENDATION

The conclusions that can be drawn from the research that has been carried out regarding the application of the Line Balancing Assembly method as an effort to increase the productivity of the X30, namely the management of the X30 production process, are as follows:

The Line Balancing Assembly method has helped increase productivity from initially only being able to reach 26 pcs/hour to 28 pcs/hour or an increase of 7.70%. This is supported by improvements in several processes, namely :

A. Changed the pallet sensor waiting time from 261 seconds with a distance between pallets of 151.69 mm to 220 seconds which making there is no space between pallets, and the brazed capacity can accommodate 28 pcs/hour.
B. Replacing the worn *jig assy* by repairing it by maintenance so that there is no more perfect process. Initially, the cycle time obtained before the repair was 136.09 seconds and after the repair, the cycle time without tapping was reduced by 5 seconds to 131.29 seconds.
C. Balancing work time in the *fin forming, jig assy* and *final processes check* . Equalization is done by moving the initial core support installation process done by the *jig assy operator* it is the job of the *fin forming* operator so that each process has the same workload and time and is able to increase productivity by 0.67 pcs/hour and makes all processes capable of reaching 28 pcs/hour.

## ADVANCED RESEARCH

Given the limitations of time, facilities and knowledge of the authors, this research is very limited to one line in this company, we suggest companies to continue on other lines in this company, also to other researchers to continue research in other companies, with the same method as cases are of course different.

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