



ANALYSIS OF PRODUCTION CYCLE ACTIVITIES ON THE ASM-AS CABLE PROJECT USING MANUFACTURING CYCLE EFFICIENCY IN THE WIRE HARNESS INDUSTRY

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ABSTRACT

PT ABC is a company that produces various types of wire harnesses to produce cable assemblies. Wire harnesses are used in a wide variety of electronic products, such as motor vehicles, airplanes, industrial machines and household appliances. In this study the product that will be the object of this research is the wire harness assembly PN 03230462-0101 which is included in the ASM-AS cable project which has a long assembling lead time, this is because this PN is composed of several small PNs, namely PN 03218291- 01, 03218572- 01, 03218569-01, 03222900-01, 03218576-01, 03218574-01, 03223128-01, 03230390-01, 03230391-01. Small PN must be assembled first, so the time required will be longer and the process is quite complicated, there is still no clear work instruction in the cable assembly process, another problem is production efficiency which is still lacking based on company data from each operator's actual production line that works is greater than the allocation of operators that should be. So that conditions like this cause a decrease in productivity and profits earned by the company. Project cable ASM-AS PN 03230462-0101 is one of the processes that will be improved using a manufacturing cycle efficiency approach. The number of value-added activities is 2,384 seconds, while non-value-added activities are 2,565 seconds, impacting productivity and MCE by 48%. The act of reducing non-value added activities to 987.30 seconds increases MCE to 68% with production flow optimization, automation and stock management.

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1. INTRODUCTION

In the era of technological advances where access to information can rotate quickly, consumer behavior patterns can change (Litardiansyah and Hariyanto, 2022). The tendency to buy is no longer based on need but because of other factors. Companies are required to understand this through product quality adjustments (Ahmad-Shushami and Abdul-Karim, 2020). The quality of the resulting product must be superior to competitors' products. Product quality must be supported by the level of productivity to meet demand. Good productivity is one that is able to allocate various kinds of resources to produce products of appropriate quality (Mendes *et al.*, 2022). Through the productivity carried out, it can be measured the level of use of inputs for results or products that have profit value (Wyrwicka and Mrugalska, 2017). Based on this, each company is required to measure the extent to which the productivity that has been achieved is then compared with the productivity target that was determined at the beginning.

The wire harness industry is one of the most important industries in the manufacturing sector (Bentaha, Voisin and Marangé, 2020). PT ABC is a company that produces various types of wire harnesses to produce cable assemblies (Nanda, Sahai and Das, 2022). Wire harness is a cable consisting of several wires that are specially arranged and connected to form one integrated electrical system (Navas-Reascos, Romero, Stahre, *et al.*, 2022). Wire harness is used in a wide variety of electronic products, such as motor vehicles, airplanes, industrial machines and household appliances (Navas-Reascos, Romero, Rodriguez, *et al.*, 2022). In this study the product that will be the object of this research is the wire harness assembly PN 03230462-0101 which is included in the ASM-AS cable project which has a long production process assembling lead time, this is because this PN is composed of several

small PNs namely PN 03218291-01, 03218572-01, 03218569-01, 03222900-01, 03218576-01, 03218574-01, 03223128-01, 03230390-01, 03230391-01. Small PN must be assembled first, so the time required will be longer and the process is quite complicated and there is still no clear work instruction in the cable assembly process, another problem is production efficiency which is still lacking based on company data from each actual operator production line that works more than the allocation of operators that should be (Putri, Utary and Nadir, 2016). So that conditions like this cause a decrease in productivity and profits earned by the company.

In this study, the process of repairing the wire harness production line will be carried out by analyzing the production cycle on the ASM cable project by reducing cycle time and eliminating non-value-added processes (Nguyen, Kuhn and Franke, 2020). In addition, research on wire harnesses can also help find solutions to problems that occur in the production of wire harnesses from various projects and other types, such as problems with limited resources and company technical problems (Suyanto, Sugiarti and Setyaningrum, 2021). With proper research, these problems can be solved and improve production efficiency and product quality (Heisler *et al.*, 2020). In the era of industry 4.0 and digitalization, research on wire harness needs to be developed to increase automation and use of technology in wire harness production (Jovanovic, Milanovic and Djukic, 2014). With more advanced technology, wire harness production can become more efficient, accurate and predictable.

2. METHODS

The research method consists of steps in achieving the research objectives. As for this research, the approach used is Manufacturing Cycle Efficiency by measuring several PN 03230462-0101 processes by calculating

processing time, inspection time, waiting time, moving time and storage time for each small partial PN, the data obtained will be improvement is carried out by reducing the time for non-value added activities. For details of the research stages can be seen in Figure 1 below:

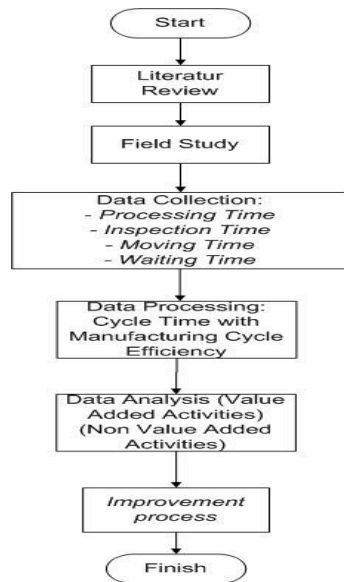


Figure 1. Flow Chart

The data that has been obtained will be processed using the Manufacturing Cycle Efficiency method approach, data from each work element time PN 03230462-0101 (processing time, waiting time, moving time, inspection time, and storage time) will be processed and improvements will be made to reduce time and processes that are not value added (non value added activities). For data processing steps as follows:

- Determine the production cycle time for the production process to be measured PN 03218291-01, 03218572-01, 03218569-01, 03222900-01, 03218576-01, 03218574-01, 03223128-01, 03230390-01, 03230391-01 (each PN work element will be taken 10 measurement samples).
- Calculating value added time (processing time)
- Calculating non-value added time (waiting time, moving time, inspection time, and storage time) Calculating MCE with the data obtained when the value

added activities are divided by the time for non value added activities. The higher the MCE value, the more efficient the production process and the less time spent on unproductive activities.

- Calculating the average productivity level achieved by the company. Obtained from the amount of production divided by the production time.

3. FINDINGS AND DISCUSSION

3.1. Findings

Activities in the production stages of manufacturing companies include processing time, inspection time, transfer time, waiting time, and storage time. From the results of observations at PT ABC, the following table is obtained:

Tabel 1. Processing Time

PN	Processing Time (s)
03218291-01	214.20
03218572-01	351.70
03218569-01	440.05
03222900-01	258.20
03218576-01	175.45
03218574-01	256.40
03223128-01	199.20
03230390-01	251.40
03230391-01	237.80
Total	2.384,40

The entire calculation of company activities in the table above will be categorized into two groups, namely activities that provide added value (value added activities) and activities that do not provide added value (non value added activities).

Tabel 2. Value Added Activities

No	Value Added activities	Processing Time (s)
1	Processing Time	2,384.40

Tabel 3. Non Value Added Activities

No	Non Value Added Activities	Waktu Proses (s)
1	Inspection Time (Visual Insert, Visual Crimping, Visual FG)	525.30
2	Waiting Time	720
3	Moving Time	420

4	Storage time	900
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The table given illustrates that value added activities can be described in terms of time duration related to various stages in the production process chain, with an aggregated total duration of value added activities reaching 2.384 seconds or 0.66 hours. Activities that do not add value (non value added activities) are divided into segments of inspection time, waiting time and moving time. The total time spent carrying out non-value added activities is 2.565 seconds or 0.71 hours. Through the evaluation of production activities, calculations can be made to determine the value of Manufacturing Cycle Efficiency (MCE) as follows:

Cycle Time = Processing Time +Waiting Time +Moving Time +Inspection Time + Storage Time (1)

$$\text{Cycle Time} = 2384,40 + 525,30 + 720 + 420 + 900 = 4949,70 \text{ s} = 1,37 \text{ hour}$$

$$\text{MCE} = \frac{\text{Processing Time}}{\text{Cycle Time}} \times 100\% \quad (2)$$

$$\text{MCE} = \frac{0,66 \text{ hour}}{1,37 \text{ hour}} \times 100\% = 48\%$$

The proposed improvement suggestions to increase the value of Manufacturing Cycle Efficiency (MCE), productivity involves Redesigning the production flow to reduce unnecessary shifts and minimize waiting time between stages and Reduce waiting time by managing production schedules effectively and avoiding overproduction.

Tabel 4. PN (Suggestion)

PN	Processing Time (s)
03218291-01	191.60
03218572-01	326.23
03218569-01	409.15
03222900-01	252.90
03218576-01	164.35
03218574-01	228.73
03223128-01	108.39
03230390-01	235.67
03230391-01	210.90
Total	2,127.92

Changes in processing time have an impact on the time requirements for value added

activities and non-value added activities as shown in the table below:

Tabel 4. Value Added Activities (Suggestion)

No	Value Added activities	Waktu Proses (s)
1	Processing Time	2127.92

Tabel 5. Non-Value Added Activities (Suggestion)

N o	Non Value Added Activities	Waktu Proses (s)
1	Inspection Time (Visual Insert, Visual Crimping, Visual FG)	525.30
2	Waiting Time	116
3	Moving Time	134
4	Storage time	212

A number of activities have been eliminated, calculations can be carried out to measure the increase in the value of Manufacturing Cycle Efficiency (MCE), the level of productivity and efficiency in the production process as follows:

Cycle Time = Processing Time +Waiting Time +Moving Time +Inspection Time + Storage Time (1)

$$\text{Cycle Time} = 2127,92 + 525,30 + 116 + 134 + 212 = 3115,22 \text{ s} = 0,87 \text{ hour}$$

$$\text{MCE} = \frac{\text{Processing Time}}{\text{Cycle Time}} \times 100\% \quad (2)$$

$$\text{MCE} = \frac{0,59 \text{ hour}}{0,87 \text{ hour}} \times 100\% = 68\%$$

3.2. Discussion

At PT ABC there is a series of important stages that begin with the journey of raw materials from the initial entry stage to producing the final product. As a result of the calculation analysis, an estimate of the time needed to run the entire process at PT ABC is obtained. Timing checks, which are also known as monitoring or checking activities, are actions carried out to ensure proper execution in the production process. The inspection time required for the wire harness process is as much as 525.30 seconds.

Waiting time includes the period during which raw materials and products in process use up resources and time in waiting for processing to continue. In the operational context, the waiting time is 720 seconds. Material moving time refers to actions that require the allocation of resources and time to move raw materials, products in process, and finished products from one division or part to another part or division within a company. This situation is also found at PT ABC where the material transfer takes as much as 420 seconds. Activities that involve the allocation of resources and a certain duration during the storage period of products and raw materials are interpreted as terms in the industrial context. What's more, in the warehousing aspect, the time dimension does not have an individual focal point, due to its direct relationship with the waiting time mandated by company SOPs. Where at PT ABC the storage time requirement takes 900 seconds.

The accumulation of time for value added activities is 2,384 seconds or 0.66 hours. As for activities that do not add value as much as 2,565 seconds or 0.71 hours. Through this calculation it can be seen that in the production activities of the wire harness there are a number of activities that do not have added value but involve a longer time than the processing time. If left unchecked, it can cause losses for the company such as decreased productivity in the wire harness process. this is in line with the value of MCE or Manufacturing Cycle Efficiency which is only 48%.

To improve the situation that occurred, a number of activities were carried out which could reduce non-value added activities to 987.30 seconds or 0.27 hours. So that there is an increase in value added activities to 2127.92 seconds or 0.59 hours. The MCE value also increased to 68% from the previous 48%. This can be achieved through optimizing production flow activities, using automation for repetitive tasks, reducing waiting times and managing stocks of raw materials and components properly to avoid buildup and waste.

4.CONCLUSION AND SUGGESTION

In PT ABC, important stages guide the journey of raw materials to final products with estimated time. Inspection time reaches 525.30 seconds. Waiting time and material transfer are 720 and 420 seconds. Storage time is estimated at

900 seconds. The number of value-added activities is 2,384 seconds, while non-value-added activities are 2,565 seconds, impacting productivity and MCE by 48%. The act of reducing non-value added activities to 987.30 seconds increases MCE to 68% with production flow optimization, automation and stock management. To get maximum results, continuous improvement is necessary

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