PROPOSING BEST SOLUTION FOR IDEAL CYCLE TIME TO ACHIEVE THE DAILY TARGET OF PRODUCTION PIN D375-5 AT PT. ARYA GLOBAL DINAMIKA

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ABSTRACT

Many people think that takt time and cycle time are the same two parameters. But in reality it is very different. When viewed from the definition of both, takt time is the time required by the production line to be able to meet the number of units requested by the customer. While the cycle time is the time required to produce one unit of product from the initial process to the final process. Cycle time which is higher than takt time causes various problems, such as not achieving the company's production target. The purpose of this research is to determine the cycle time on pin D375-5 which includes the longest time to the shortest time, find out the cause of not achieving takt time, provide solutions for takt time to be achieved and cycle time to be ideal. This research was conducted using the DMAIC method, starting with an investigation of not achieving takt time until solutions for the ideal cycle time can be achieved in order to fulfil orders from customers. Based on the results of the research, the longest cycle time of pin D375-5 production is in the OP 1 stage with a cycle time of 4,28 minutes, and the shortest cycle time is at the cutting stage with a cycle time of 1,00 minute. And from the calculation results, the ideal cycle time for pin D375-5 is 3,31 minutes. From the results of the analysis, it is known that the method chosen by the company is one of the causes of the high cycle time. For that, one of the right recommendations to overcome this cycle time problem is to do overtime. Therefore, with this solution it is hoped that the daily production target can be achieved.

Keywords: Cycle Time, Takt Time, DMAIC, Pin D375-5, Overtime

OBJECTIVE

This research is focused on how to define the best cycle time for production pin D375-5 and be able to maintain in the future. This research aims to solve a problem in PT. Arya Global Dinamika , there was a problem based on the cycle time of pin D-375 cannot achieve the order of PT. Komatsu Undercarriage Indonesia. PT. Komatsu Undercarriage Indonesia ordered PT. Arya Global Dinamika to product 250 pins per day but in fact PT. Arya Global Dinamika has not achieved that. In order to achieve that, a solution will be provided for the company. The solution is for optimal system to maximize the cycle time of production process.

INTRODUCTION

Along with the increasing demand for heavy equipment throughout 2021, several heavy equipment manufacturing companies were competing to become number one in the heavy equipment industry market. High market demand for heavy equipment due to rising commodity prices in various sectors such as mining, construction, agro, and forestry. Another influencing factor is the recovery in economic conditions affected by the COVID-19 pandemic. This phenomenon is also a special concern of PT. Komatsu Undercarriage Indonesia which is a subsidiary of PT. Komatsu Indonesia, which is one of the heavy equipment manufacturers in Indonesia. PT. Arya Global Dinamika which is a supplier (based on job order) of PT. Komatsu Undercarriage Indonesia also experienced the same thing as experienced by PT. Komatsu Undercarriage Indonesia. The increase in demand is certainly in line with the increase in sales and revenue for the company, but with the high revenue and sales figures production activities are not necessarily perfect. There are factors such as man, process and machine which are inefficiency and become an internal problem for the company, especially in PT. Arya Global Dinamika.

Figure 1. Pin D375-5 for Komatsu Heavy Machinery

LITERATURE REVIEW

a. Cycle Time

For service organisation or industry cycle time can be defined or expounded in relation to the time a customer states his or her needs (or wants) and the total time should it take to complete the requested service. This view is supported by Khan and Sharma (2014) who writes that cycle time can be circumscribed as the entire time to move and process a workpiece from the beginning until the end of the evidently resolute physical manufacturing process. Patel and Shah (2014) define Cycle Time as the time necessary to accomplish a certain task or activity at each well-defined station.

b. Takt Time

Takt is a German word for rhythm. Takt time deal with how frequently the product or part is obligatory needed usually by the buyer (Kumar, 2014). Again, Takt Time is defined as a "total cycle time in which the product must be produced to meet the customer demand" (Prashar, 2018). Takt time (time/piece), can be calculated using either equation (1) (Kumbhar et al., 2014b; Saraswat et al., 2015) or by using equation (2) (Prashar, 2018).

Takt Time = Available Operating time / Daily Demand……(1)

Takt Time = Available Time / Customer demand……...……...(2)

c. DMAIC (Define, Measure, Analyse, Improve and Control)

Define, Measure, Analyse, Improve, Control (DMAIC) is a structured problem solving procedure that is widely used in the field of process and quality improvement. DMAIC is often associated with the Six Sigma method, and almost all implementations of Six Sigma use the DMAIC process. However, DMAIC itself is not formally tied to Six Sigma and can be used by companies independently. DMAIC has 5 stages which can be used in a structured way to solve root problems related to quality and processes and also find the best way that can be permanently applied in related business operations. In addition, DMAIC can also be useful for increasing creativity in thinking about a problem and its solution that comes from products, processes, or services

d. Production

According to (Vincent Gaspersz, 2004; 3), "Production is the main function in every organization, which includes activities that are responsible for creating value-added products which are the output of each industrial organization." From the definition by Vincent Gaspersz above, it can be concluded that a task or activity is said to have added value if the addition of several inputs to the task will provide added value to the product (goods and/or services). The process of transforming value added from inputs to outputs in modern production systems always involves structural and functional components.

METHODOLOGY

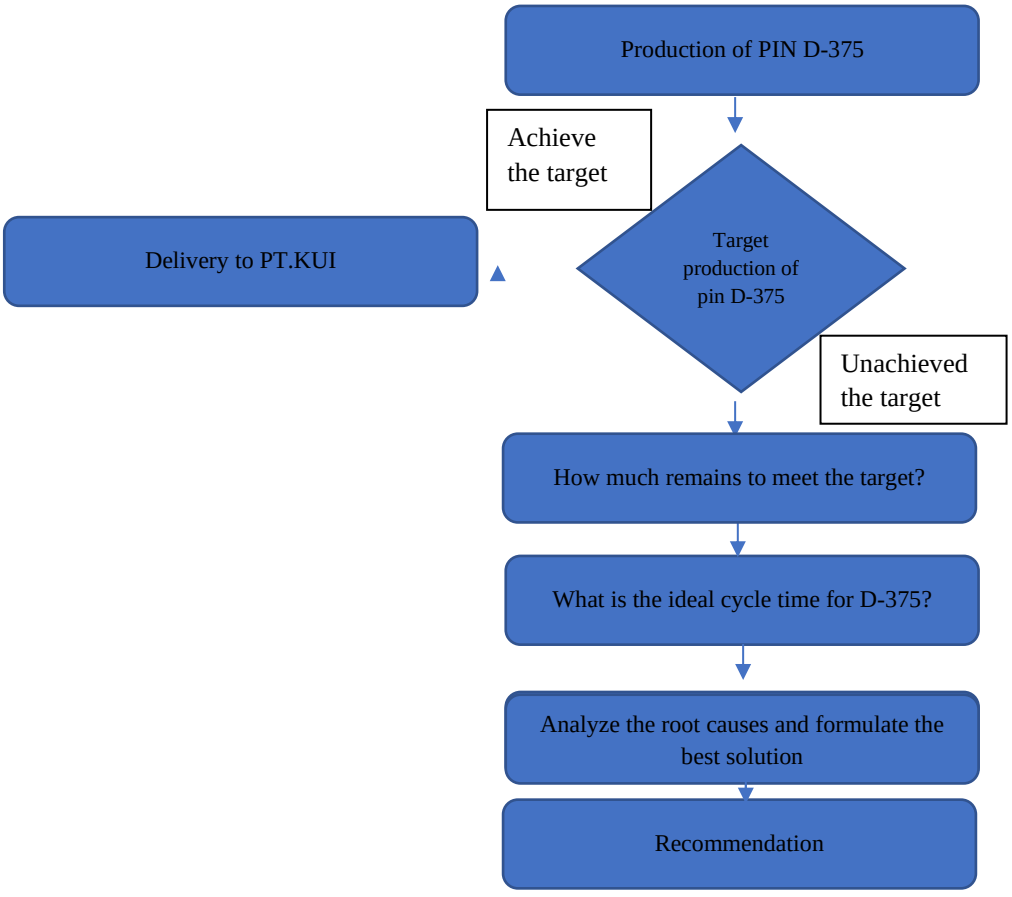

Figure 2. Conceptual Framework

Methodologies that author used was quantitative and qualitative methods. Type of data that used was primary data which obtained from PT. Arya Global Dinamika during January 2022 through observation around CNC lathes, this is also classified as a quantitative data. Besides that, this research also used the secondary data from several references such as journal and literatures. Also qualitative data obtained from questionnaire interview with the management of PT. Arya Global Dinamika. According to the types of Gitosudarmo (2009), the type of production process basically consists of two types;

- **Continuous Production Process Type (Mass-pro)**

This type of continuous production process is standardized. All products made are the same, the production process can be carried out on a large scale. This type of continuous production process allow the company to reduce the cost of production. Because in this type, the resulting product can be standardized as well as the production process, thus mass production can be carried out on a large scale. This mass production will make it possible to obtain the most economical scale of production, the lowest cost of goods.

- **Intermittent Production Process (Job- Order)**

The fundamental difference between the intermittent production type and the continuous production type lies in the nature of product that must be produced. Basically, the intermittent process makes goods in small (limited) quantities and is highly dependent on individual consumer (subscription) desires. In this type, it is necessary to control each order, both on the total cost, the use of materials, labour, and manufacturing costs that are specifically charged to that particular order. In addition, this type is required to be able to monitor the progress of the level of completion of each order so that it can guarantee the accuracy of different completions. This type of production is equal with the conditions of PT. Arya Global Dinamika.

According to the methods above, the main steps that are the focus of this research are:

- **Cycle Time Observation**

Measurements made by author is to measure the cycle time of each process of pin D 375-5 and match it with the literature and also match it with the production target requested by PT. Komatsu Undercarriage Indonesia, then that any discrepancies that occur can be resolved. In the first stage the first process is cutting pin D 375-5, and then followed by the stage of OP1, OP2, OP 3 and OP 4, the following is the cycle time of each process carried out.

- **Analyze The Cycle Time**

The cycle time result is obtained from the observations and matched it with the takt time formula whether it meets the target or not. If the cycle time is greater than the takt time, then the production target is not achieved. And the result of takt time is the ideal cycle time for production.

- **Do an Interview with Management of PT. Arya Global Dinamika**

Interviews were conducted for brainstorming between the author and management in order to overcome the problem of the D375-5 pin production target which was not achieved. Respondents was the management of PT. Arya Global Dinamika consist of (Operational Manager, Head of Production, and Head of HRD).

- **Proposing Best Solution**

The result of the interview are several solutions from management and author for pin D375-5 production target, and the chosen one is the most suitable with the conditions of the company.

RESULT AND ANALYSIS

Measurements made by author is to measure the cycle time of each process of pin D375-5 and match it with the literature and also match it with the production target requested by PT. Komatsu Undercarriage Indonesia, then that any discrepancies that occur can be resolved. In the first stage the first process is cutting pin D375-5, and then followed by the stage of OP1, OP2, OP 3 and OP 4, the following is the cycle time of each process carried out.

a. Cycle Time Observation

1. Cycle time Cutting Process

Table 1.1 Cycle Time Cutting Process

Operator	Ilham Ibnu Khafifi
Machine	Mieux Cut
Time / Place	January 17th, 2022 / PT. Arya Global Dinamika
1st observation	1 minutes
2nd observation	1 minutes, 10 seconds
3rd observation	1 minutes
4th observation	1 minutes, 5 seconds
5th observation	1 minutes, 7 seconds

2. Cycle time OP 1 (Facing and Center Drill)

Table 1.2 Cycle Time OP 1 Process

Operator	Supriyono
Machine	Okuma LB-15
Time / Place	January 17th, 2022 / PT. Arya Global Dinamika
1st observation	4 mins, 14 seconds
2nd observation	4 mins, 17 seconds
3rd observation	4 mins, 15 seconds
4th observation	4 mins, 17 seconds
5th observation	4 mins, 16 seconds

3. Cycle time OP 2 (Gundrill and Center Drill)

Table 1.3 Cycle Time OP 2 Process

Operator	Nasrullah
Machine	Okuma LB-25
Time / Place	January 18th, 2022 / PT. Arya Global Dinamika
1st observation	3 mins, 46 seconds
2nd observation	3 mins, 40 seconds
3rd observation	3 mins, 49 seconds
4th observation	3 mins, 50 seconds
5th observation	3 mins, 41 seconds

4. Cycle time OP 3 (LNC 1)

Table 1.4 Cycle Time OP 3 Process

Operator	Lukman
Machine	Hitachi Seiki
Time / Place	January 19th, 2022 / PT. Arya Global Dinamika
1st observation	2 mins, 6 seconds
2nd observation	2 mins, 9 seconds
3rd observation	2 mins, 10 seconds
4th observation	2 mins, 8 seconds
5th observation	2 mins, 7 seconds

5. Cycle time OP 4 (LNC 2)

Table 1.5 Cycle Time OP 4 Process

Operator	Nurohman
Machine	Okuma LB-15 (Orange)
Time / Place	January 19th, 2022 / PT. Arya Global Dinamika
1st observation	1 mins, 24 seconds
2nd observation	1 mins, 20 seconds
3rd observation	1 mins, 23 seconds
4th observation	1 mins, 22 seconds
5th observation	1 mins, 21 seconds

b. Analyze the Cycle Time and Takt Time

According to the case in PT. Arya Global Dinamika, the condition can be described below;

Current Condition

Available Operating Time = 2 Shift = 18 hours – (2 hours break+40 minutes coffee break)
= 18 hours -2,66 hours
= 15,34 hours = 920,4 minutes

Longest phase of production = 4 mins 17 seconds or 4,28 minutes (OP 1)

Calculation output in 1 hour = $\frac{90\% \; x \; 60 \; minutes}{4{,}28 \; minutes}$
= 12 pins per hour

In 1 day (2 shift) the output is = (15,34x12 pins per hour) = 184 pins per day

Current condition PT. Arya Global Dinamika can only process **184 pins per day**, whereas the order from PT. Komatsu Undercarriage Indonesiais **250 pins per day.**

*1 shift = 9 hours with (1 hours break+20 minutes coffee break) = 7,66 hours
*Idle time = 10% (time for setting, operator go to toilet, etc)

Calculation using Takt Time

Idle Time = 10% (time for setting, operator go to toilet, etc)
Customer need = 250 pcs
Takt Time = $\frac{90\%x920,4}{250}$ = 3,31 minutes

Meanwhile in PT. Arya Global Dinamika there are bottlenecks in OP 1 and OP 2. In OP 1 has 4 mins 17 seconds for the longest cycle time. And OP 2 has 3 mins 50 seconds for the longest cycle time. This calculation above figure out that the existing cycle time in PT. Arya Global Dinamika has not achieve the target of PT. Komatsu Undercarriage Indonesia.

According to the calculation above author concluded using Ishikawa Fishbone Diagram which factors that make the cycle time did not achieve the target, with this following figure

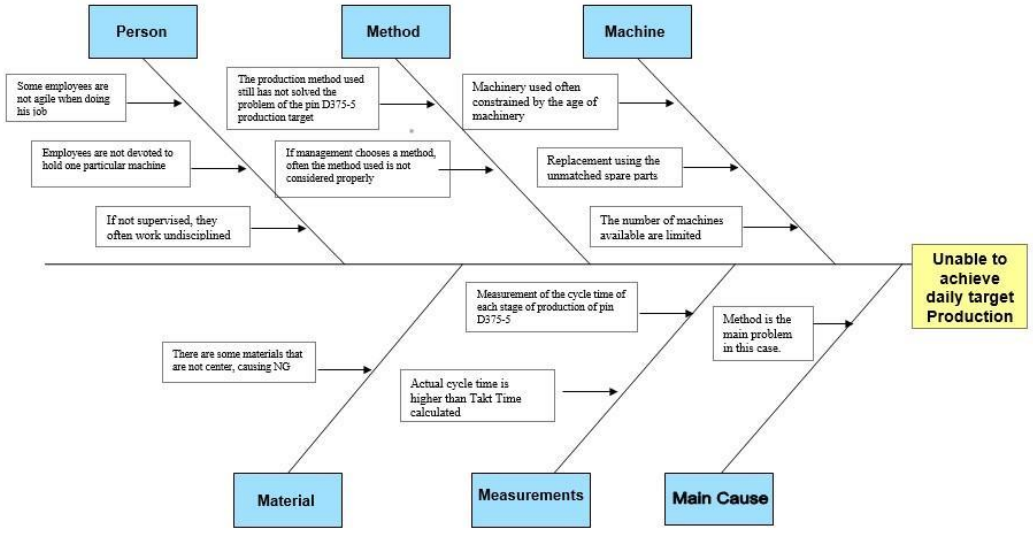

Figure 3 Fishbone Analysis

Based on the figure above it can be summarized that the most impactful causes that make the target production did not achieve the target is the "Methods" that have been using in PT. Arya Global Dinamika.

c. Interview with Management of PT. Arya Global Dinamika

Framework of Interview Questions from author to management of PT. Arya Global Dinamika (Operational Manager, Head of Production, and Head of HRD). The questions addressed to each respondent differ according to their duties in the company.

- First interview with Operational Manager of PT. Arya Global Dinamika, will be explained in more detail in the table below

Table 1.6 Interview Questions with Operational Manager.

Number of Questions	Questions	Objective of the Questions	Correlations to the research questions
1.	In your opinion, how to overcome the production target that is not achieved?	Knowing how the company's Operational Manager provides solutions to this problem	Propose best solution in order to achieve the daily target of PT. Komatsu Undercarriage Indonesia
2.	How if the author proposes to increase the working time of employees for the production of pin D375-5?	As a consideration for Operational Manager, would the author's suggestion be used as a solution?	Propose best solution in order to achieve the daily target of PT. Komatsu Undercarriage Indonesia

3	How if the author proposes adding machines for the production process of pin D375-5?	As a consideration for Operational Manager, would the author's suggestion be used as a solution?	Propose best solution in order to achieve the daily target of PT. Komatsu Undercarriage Indonesia
4	How if the author proposes to increase the number of employees for the pin D375-5 production process?	As a consideration for Operational Manager, would the author's suggestion be used as a solution?	Propose best solution in order to achieve the daily target of PT. Komatsu Undercarriage Indonesia
5.	How if the author proposes to do the substitution using a non-running machine?	As a consideration for Operational Manager, would the author's suggestion be used as a solution?	Propose best solution in order to achieve the daily target of PT. Komatsu Undercarriage Indonesia
6	How if the author proposes to do subcontracting with the third party?	As a consideration for Operational Manager, would the author's suggestion be used as a solution?	Propose best solution in order to achieve the daily target of PT. Komatsu Undercarriage Indonesia

- Second interview, respondents: Head of Production PT. Arya Global Dinamika, will be explained in more detail in the table below

Table 1.7 Interview Questions with Head of Production

Number of Questions	Questions	Objective of the Questions	Correlations to the research questions
1.	How if the author proposes adding machines for the production process of pin D375-5?	Knowing how the company's Operational Manager provides solutions to this problem	Propose best solution in order to achieve the daily target of PT. Komatsu Undercarriage Indonesia
2.	How if the author proposes to increase the number of employees for the pin D375-5 production process?	As a consideration for Operational Manager, would the author's suggestion be used as a solution?	Propose best solution in order to achieve the daily target of PT. Komatsu Undercarriage Indonesia
3	How if the author proposes to increase the working time of employees for the production of pin D375-5?	As a consideration for Operational Manager, would the author's suggestion be used as a solution?	Propose best solution in order to achieve the daily target of PT. Komatsu Undercarriage Indonesia
4	How if the author proposes to do the substitution using a non-running machine?	As a consideration for Operational Manager, would the author's suggestion be used as a solution?	Propose best solution in order to achieve the daily target of PT. Komatsu Undercarriage Indonesia

- Third Interview, respondents: Head of HRD PT. Arya Global Dinamika, will be explained in more detail in the table below

Table 1.8 Interview Questions with Head of HRD

Number of Questions	Questions	Objective of the Questions	Correlations to the research questions
1.	How if the author proposes to increase the number of employees for the pin D375-5 production process?	Asking for advice from the Head of HRD whether the author's suggestion is appropriate or not	Propose best solution in order to achieve the daily target of PT. Komatsu Undercarriage Indonesia

2.	How if the author proposes to increase the working time of employees for the production of pin D375-5?	Asking for advice from the Head of HRD whether the author's suggestion is appropriate or not	Propose best solution in order to achieve the daily target of PT. Komatsu Undercarriage Indonesia

d. Solution to Achieve Ideal Cycle Time

According to the condition in PT. Arya Global Dinamika that the cycle time unachieved the target order, then based on the interview there are several alternative solutions as follows:

1. **Overtime for the Production of Pin D375-5**

Based on the results of interviews conducted with the leadership of PT. Arya Global Dinamika the choice of increasing working time is the best choice because considering the work carried out by PT. Arya Global Dinamika is a job order and there is no long term contract with PT. Komatsu Undercarriage Indonesia. Then if at someday there is no order from PT. Komatsu Undercarriage Indonesia PT. Arya Global Dinamika already has a strategy to deal with it. With the following cost calculation, overtime pay for the production of pin D-375 for 10 employees in 1 month is Rp. 26,000,000 based on data obtained from the HRD department. PT. Arya Global Dinamika

2. Add New Machine for Pin D-375 Production

PT. Arya Global Dinamika with PT. Komatsu Undercarriage Indonesia did not have long term contract for produce pin D375-5, the type of production from PT. Komatsu Undercarriage Indonesia to PT. Arya Global Dinamika is job order not mass pro, so in the future if PT. Komatsu Undercarriage Indonesia is no longer needed this item PT. Arya Global Dinamika will face big problems. Moreover, the considerations that must be considered other than the price of CNC lathe is quite expensive, around 2.2 billion rupiah. It is very different if the company chooses overtime which only spends 26 million rupiah per month without any big risk.

3. Add More Employees

Adding employees means adding various supporting facilities such as BPJS, Allowances, Bonuses, and THR. In the case of the production of the D375-5 pin, the Operations Manager and Head of HR said that adding employees only for the production of the D375-5 pin was a very risky and inefficient action. The calculation if the company adding employees is as follows: means adding 1 shift (5 people), then the money spent per month is Rp. 4,500,000 x 5 = Rp. 24,000,000 for salary, and other facilities that must be paid such as BPJS, THR (around Rp. 20,000,000 to Rp. 25,000,000 per year), and bonuses. When compared to overtime, overtime is cheaper and safer to use overtime.

4. **Doing Substitutions with not Running Machine**

Based on the results of interviews conducted to Operational Manager and Head of Production PT. Arya Global Dinamika, the production process for OP 1 is the process that takes the longest time with a cycle time of 4 minutes 17 seconds, because of this there is a "waiting" for OP 2 due to too long material in OP 1. Therefore, author proposes to use another machine, the machine used to process pin PC200-7 due the material for the pin PC200-7 has run out so the machine is idle, in this substitution the idle machine will be produced phase OP1 of pin D375-5 but this proposal can only be done if the machine used for other processes is idle and not operating. In this proposed solution the company no need to add additional costs.

5. Do Subcontracting with the Third Party

Based on the results of the interview with the Operational Manager, he said that PT. Komatsu Undercarriage Indonesia does not allow if the goods made by the supplier are sub-contended to other parties, there are several reasons that he cannot explain related to company privacy. So it is clear that this subcontracting solution cannot be carried out, therefore PT. Arya Global Dinamika can only maximize its internal strengths.

CONCLUSION

Based on the production results from January 17, 2022, the production target achieved per day is 184 pcs while the request from PT. Komatsu Undercarriage Indonesia is 250 pcs per day. The longest cycle time that has been going on so far is the OP 1 phase with a time of 4 mins 17 seconds, after calculating the takt time formula finally the ideal time that must be achieved by PT. Arya Global Dinamika is 3,31 mins to reach the target of 250 pins per day. In order to achieve the target of cycle time PT. Arya Global Dinamika should determine the best way. There is an alternative that can be taken by PT. Arya Global Dinamika in tackling the non-achievement of the pin D375-5 production target, based on the results of the interview questions with the management of PT. Arya Global Dinamika, the best solution is to increase the working time of employees through overtime in order to catch up to the shortage of production targets, this method is the best way because the costs incurred by the company are not too large and in accordance with company conditions.

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