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**OPTIMIZATION OF MANPOWER IN SEAMLESS PIPE THREADING
MANUFACTURE BATAM**

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Abstract
The objective of manpower optimization is to have the right number of workers with the right capabilities in the right production areas. In this research, a model was developed for optimizing manpower allocation coupling threading area. Total initial manpower allocation is 26 manpower. Improvement executed which consider to customer demand and production capability. Evaluation result indicates there is unbalance work load distribution of each manpower. Improvement planned such as balancing the work load of each manpower, machine replacement, and re-Layout the production area. The implementation based on Direct Productivity formula resulted manpower saving cost about 50%, from 26 manpower to 16 manpower. Standardized work did as well as the control item in order to stabilize the improvement process. The next step is the analysis of production capability to face the increasing of customer demand. This analysis concluded that production needed additional overtime and additional work shift in order to fulfill the customer demand

Keywords : optimization, manpower, threading manufacture

1. INTRODUCTION
Manpower planning is about ensuring that the right types of employees are available at the right place at the right time. The success of the manpower planning is paramount to the survival of the organization and the complexities associated with the planning process and production. Productivity is measured in pcs per man hour, means the amount of goods that can be generated in one hour by several manpower. Productivity thus depends on production output and input in the form of the total number of man power times the hours worked per man power. Total number of manpower allocated in the usual production process measured by man power efficiency. This shows that the man power efficiency value doesn't just have an impact on Manpower wage costs, but also related to productivity.
The threading company has several production areas, one of the area is coupling shop. Coupling shop produce threaded coupling which designated as per API (American Petroleum Institute) standard and other licenses. Amount of man power in threading area currently is 26 MP. Improvement studies were carried out to find out whether the current Manpower is still efficient enough compared real working hours and whether the results of improvement is feasible in term of increasing demand.

2. IMPLEMENTATION METHOD
Improvement studies were carried out using several concepts and methods. DMAIC is used as steps in doing improvement. The reference method used is The Toyota Production System, which is related to the use of the Takt time as a reference for improvement and elimination of seven types of Muda in the production process. Repair ones done using the concept direct productivity and overall equipment effectiveness. Standardization of work done for process control. (Takahashi, 1992)

1. Toyota Production System (TPS)
Toyota Motor Corporation (2006) stated that TPS is an activity at the overall level company, based on the awareness to eliminates waste completely, seeking the rationality of manufacturing means, and develop good manufacturing techniques. Core of the TPS concept itself is the cost reduction or reduction in costs through removal waste thoroughly.

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1. Toyota Production System (TPS)

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Figure 1. The TPS Framework

Two main pillars in the TPS framework is Just In Time (JIT) and Jidouka or autonomy. The JIT concepts aims to produce and deliver the right parts, in the right amount, at the right time using the minimum necessary resources. This system reduces inventory, and strives to prevents both early and over production. Producing in a JIT exposes problems quickly. With less inventory in a system the “rocks” are quickly exposed in production that are disrupting flow. (Moden,2000)

Jidoka (Build in quality) is the second pillar of the system. There are two parts to Jidoka– 1) Building in quality at the process and 2) Enabling separation of man from machine in work environments. The goal is not to run continuously but in other words to stop running automatically when trouble arises. In other words it is better to stop a machine at the first sign of trouble than to keep on producing the problem which only generates more waste. (Elsayes,1994)

2. OEE

The OEE (Overall Equipment Effectiveness) is a global indicator for the effectiveness of an equipment. That means that a machine individually or as part of a subsystem must be operating as designed (V.Thebault. 2018). Based on the Opening Time, OEE scrutinizes all type of losses, with the goal of reducing or eliminating them. If it happens however, to have an unscheduled downtime, this downtime must be at very minimum (Yang, 2010). The practical calculation to be used is:

$$OEE = \frac{\text{Good products} \times \text{Standard cycle time}}{\text{Opening time}}$$

3. Direct productivity

The Direct Productivity is the quantity of direct men.hours needed to produce 1 equivalent product. It can be measured for a line or a workshop. (V.Thebault. 2018)

The Direct Productivity is given by:

$$\text{Direct productivity} = \frac{\text{Total paid hours of direct manpower}}{\text{Total Equivalent Production}}$$

The paid hours of manpower includes all paid hours without exception (and including training). Temporary workers shall also be included in the perimeter because they also add value to the product. The Total Equivalent Production is determined using the Cycle Time table. Hours and equivalent products shall be calculated for the same period. (D.H. Stamatis, 2011)

4. Seven types of Muda

A job can be divided into three namely valuable work or giving core work added value, non-valuable work but necessary to do, work that does not provide value added but still required such a process put the part on the machine. The third type of work namely non valuable work and not needed this work is referred to as Muda or extravagance in TPS. Muda is always endeavored to be eliminated in the TPS. (PT Astra Otoparts. 2008)

5. Standardization of Work

Standardization of work is necessary made as a reference in the production process. To be nominal, variabilities must be identified and eliminated. Standard work make the work defined precisely and clearly in order to understand, share, and apply what is nominal. Standardization work is an effective way as tools in kaizen or continuous improvement. (PT Astra Otoparts, 2008)

3. RESULTS AND DISCUSSION

Analysis of the discussion will be carried out sequential from initial conditions analysis, Muda potential analysis, improvement plans, and evaluation of improvements to analyze whether the results of improvement is feasible in term of increasing demand.

Initial Situation

Currently coupling threading line have a total 26 manpower. For one threading machine is placed 2 personnel. One threading machine operator is for handling activities; and the other is production controller or gauging inspector for inspection activities. Production process starts with the operator begin the tooling preparation, material preparation and until machining process. After first output finished, gauging inspector begin the inspection activities.

Table 1. Handling Activities

No.	Handling Activities	Time (s)
1	Loading material into CNC	20
2	Loading material into waiting material rack	25
3	Loading material into waiting material rack	25
4	Checking ID	30
5	Chcecking ID and Swap Side	85
6	Loading material into waiting material rack	20
7	Checking ID	35
8	Checking ID clean chip from thread, loading out	60
Total Handling Activities Duration/ 1pcs coupling		300

Table 2. Inspection Activities

No.	Inspection Activities	Time (s)
1	Cleaning using vacuum cleaner	47
2	Manual Deburring	45
3	Coupling no. record to report	5
4	Gauging Inspection activity	365

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5	Final cleaning and touch up	120
6	Loading into basket	30
Total Inspection Activities Duration/ 1pcs coupling		150

Table 3. Activities Comparison

Type of Activity	Time (minute)
Machining Time	15
Handling Time	5
Inspection Time	10.2

The total working time to produce one output is the total working time of the machining which include handling activities, and the inspection activities. Based on table. 3 shows that there is no workload balance shown through unbalanced manpower uptime between handling and gauging. Total time needed for one output becomes 15 minutes during machining and another 10 minutes to inspection. The steps got to do is to balance workload by eliminating some work elements or can be replaced by other operations as well with combine several elements of work into one work station.

Muda Potencial

Direct observations into the workshop indicate there are several Muda potenciales or waste such as waste of processes, waste of time, waste of movement, and waste of transportation. Those waste need to be minimized or eliminated. Muda potencies is analized using 5-Why Analysis as a basis of reference to plan on some production area imporvements.

Table 4. Muda potenciales

Root Cause	Action
Some operators didn't train as gauging inspector yet	Operators will follow MUSO (Multi Skill Operator) Program to complete their gauging inspection qualification.
Current gauging inspection table position not facing CNC machine	New gauging inspection tables and workstation layout are needed and will be arranged properly.
Operator should walk to input area then output area after inspection by himself	Chain hoist will be relocated according to new workstation layout design

The result of Muda potency shows that a few improvements can be done, such as machine replacement, additional equipment for handling and transportation, layout modification, also personnel training and qualification.

Improvement Plan

Improvement plan for several problems that have been analyzed in the analysis of Muda potential is created and analyzed its possibilities of implementation and related impact.

1. Re-layout Threading Area

The first improvement is the re-layout of the work area using the C-round layout concept. The aim is to narrow the distance between machines to inspection area so as to reduce the movement time of the manpower operating machines and doing the inspection. This improvement

needs to be done to facilitate the C Formation to be achieved due to the reduced material transportation time from one work area to another.

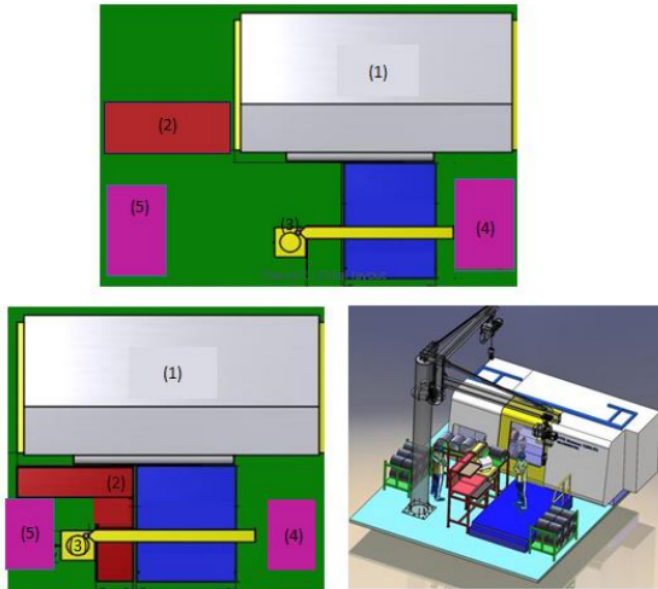


Figure 3. Layout after improvement

Note:

- (1) Machine area
- (2) Inspection area
- (3) Crane
- (4) Incoming material
- (5) Output material

2. Modification of handling tools and machine replacement

The second improvement is to modify the handling tools and to replace the threading machine with the latest improved technology. Modification of handling tools is to combine the material moving access and their placement position, so that when the threading machine operating, the personnel can do the handling and inspection material.

Modification of handling tools is to reduce Muda process which happened before such as operator should walk to input area and then to output area after inspection by himself. Those element can be reduced by move the jig crane position for more area cover, to install proper gauge placement, to install roller for threading inspection, to install conveyor for coupling transportation, and to make optimum height for work floor to improve the ergonomic factor of personnel.

3. Workload balancing

The result of layout and handling tool improvements make manpower optimization possible to do. Direct productivity formula can be used to check if the production will be more effective with 1 personnel. With the old version machine, total work hour of one machine is 15 minutes and work hours of inspection is 10.2 minutes. Number of machines in coupling workshop area is 13 machines, each machine placed 2 personnel. These results can be concluded that the C Formation is better to implement.

Improvement Evaluation

Improvement evaluation is done by recalculating average output unit per hour, activities time, and cost saving in manpower optimization. These results will be compared with the initial conditions.

Table below is the after improvement condition which using new machine and other handling improvement with only one personnel in charge.

Table 5. Handling activities after improvement

No.	Handling Activities	Time (s)
1	Loading material into CNC	20
2	Loading material into waiting material rack	25
3	Loading material into waiting material rack	25
4	Chcecking ID and Swap Side	85
5	Loading material into waiting material rack	20
6	Checking ID clean chip from thread, loading out	60
Total Handling Activities Duration/ 1pcs coupling		235

Table 6. Inspection activities after improvement

No.	Inspection Activities	Time (s)
1	Cleaning using vacuum cleaner	47
2	Manual Deburring	45
3	Coupling no. record to report	5
4	Gauging Inspection activity	365
5	Final cleaning and touch up	120
6	Loading into basket	30
Total Inspection Activities Duration/ 1pcs coupling		612

Table 7. Activities comparation after improvement

Type of Activity	Time (minute)
Machining Time	15
Handling Time	3.9
Inspection Time	10.2

The result of time needed shows in table.7 that the total time needed to produce one output is the same with the previous condition which has 2 personnel involved.

Table 8. Comparison of final result and initial situation

	Initial	Improved	Unit
Time consume	15	15	minute
Machine capacity	2.77	3.86	pcs/hour
Total manpower	28	16	person
Direct productivity	1.32	0.66	point

Achievement of improved results shows an increase in machine capacity by 71%. By operating and doing inspection at once it will be decreasing a half of manpower cost which shown in the decrease of direct productivity point by 50%. The results of these improvements do not stop with the implementation process, but are also standardized using several standardized TPS work tools. The standardization process is needed so that the improvement results do not decrease back to the initial conditions.

Production Capability Facing Increasing Demand

The results of the improvements show that the production capacity to meet the demand needs until October 2020 is enough by using only 1 manpower per machine. However, the amount of consumer demand for products for years ahead has the possibility to increase from the previous months, causing the overall equipment efficiency needs to be reviewed.

The strategy analysis that companies should take related to this issue will be discussed further, namely the selection of strategic options that can be taken between over time (OT) or additional work shifts. The analysis will be determined based on the amount of total salary costs to be paid for each given plan. The summary of the calculation results shows the plan to allocate overtime working hours and shift arrangements with the smallest total salary.

4. CONCLUSION

Improvements to the coupling threading area have been carried out by resulting in savings in the number of manpower by 13 manpower. The results of these improvements also resulted an increase in machine capacity by 71%, an increase in manpower efficiency by 50% and a decrease in direct production by 50%. The results of the analysis of production capability in the face of rising demand also showed that production was still capable of up to end of 2020. An increase in demand in next years can be anticipated with additional OT and additional work shifts based on the analysis results.

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