Work Elements Analysis for Optimization Operator Productivity in Warehouse

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Abstract. Warehouse PT Astra Otoparts Tbk Cibitung is a company that deals with the process of warehousing, distribution and product sales motor spare parts 2W (motorcycle). The process in each work unit needs to be addressed and done with the standardization or the determination of ideal duration workmanship by work element analysis. The purpose of Toyota Production System is to get a good quality with minimize processing time. One of methodology that is used in the Toyota Production System is Just In Time (JIT) and Jidoka that focus on standardization of work element duration. Work element analysis that performed on each work unit is needed for optimization operator productivity. In Work element analysis the authors observe that there is movement that should not be done and it will be eliminated to increase productivity. There is five work element that will be optimize that is Receiving, House-Keeping, Picking Check Pack and Shipping. From the results of optimization operator productivity that productivity can be increased in the receiving work unit by 0.04%; house-keeping 23% and 30%; picking of 47.11% and shipping 1% through the elimination of waste duration of work element.

1. Introduction
Warehouse PT Astra Otoparts is located in Cibitung West Java, Indonesia. The Warehouse deal with the process of warehousing, distribution and product sales motor spare parts 2W (motorcycle spare parts). Activities undertaken in this company start from inbound process until outbound process. The inbound process is the receipt of goods from the supplier (Receiving) to the allocation of goods to storage (HouseKeeping) and Outbound Process includes taking goods according to customer order (Picking), check out / pack to delivery of goods (Shipping) to various regions and retail that become customer PT Astra Otoparts. In addition to Inbound and Outbound processes, in the warehouse PT Astra Otoparts Cibitung there is a process called local process. Local process is the process of packaging goods and label attachment process PT Astra Otoparts that come from suppliers so that the goods are ready to be sent to the customer.

Work elements in each work unit needs to be measure and standardized in order to develop the business that is run in the fulfillment of consumer needs. Until now, the standardization of work duration in PT Astra Otoparts Cibitung has not been established. For that we need to analyze and optimize the duration of work for each work element.

The results of optimization work elements will be reference in creating the standardization of work duration. Standardization of work duration is an activity that minimize the cause of problem in each work process so that the productivity can be increased. Increased productivity will increase company profits and business target can be achieved [4].
2. Research Method

This research was conducted in warehouse PT Astra Otoparts Tbk Cibitung. The data used are grouped into primary data in July- August 2017. The stages of research can be seen in Figure 1.

![Figure 1. Research stages](image1)

As a division engaged in warehouse PT Astra Otoparts Tbk Cibitung which doing inbound process to the outbound process. Every process from inbound to outbound must go through several stages that have been structured. The stages can be seen in Figure 2.

![Figure 2. Inbound-Outbound process in Warehouse PT Astra Otoparts Tbk. Cibitung.](image2)

A. Receiving

The flow of goods receiving process is a description of the flow of goods process incoming from the supplier to enter the stage of inventory not put away. Products received by Warehouse PT Astra Otoparts Tbk will be checked by quality control operators to see the suitability of goods with the order and conformity of quality and standards set by Warehouse PT Astra Otoparts Tbk. Goods that meet the standards will be processed to the next stage, and for non-standard products will be returned to the
supplier by providing a description of the troubled goods and details of the goods problem. After finished the quality control then the goods will proceed to the next stage. The ready-made products will be forwarded to the house keeping process and the unpacked products will be forwarded to the packaging process in the local process.

B. Housekeeping

Ready-made items from suppliers and products that have been packaged local parts of the process will be located to the storage area. In the process of allocation there are 3 (three) types of activities that become the work of the operator that is inventory not put away, replenish, and grouping / pressing.

C. Picking

The picking process can be defined as the activity where a small quantity of goods is taken from the warehousing system to meet a number of independent customer orders. Orders will be received by the dispatcher work unit after it will be printed a list of pick (picking) list by the admin who will be delivered to the picking inspector.

D. Check Pack/Out

The process of inspection of goods is a process of checking goods according to received orders. This process aims to see the condition and quantity of goods have been in accordance with the data received and for inspection of goods based on the store or booking area.

E. Shipping

Shipping is the process of preparing ready-to-send items to be loaded and then delivered to the consumer in accordance with the order received. Flow process of delivery begins when the items to be delivered are prepared in the freight area. Expedition will enter the shipping area. Goods that have been prepared in the shipping area will be checked again by the checker in the shipping area. Each item will be stamped OK if it is in accordance with the order and seen directly by the driver. Furthermore the goods will be loaded by helper or freight forwarding team into the truck until the truck is full and/or according to customer’s order. After the loading process then the helper will do the calculations and adjust the check sheet. Check sheet will be given to delivery admin. Admin delivery of goods will check the description of orders in WMOS and will be printed invoices and mail delivery of goods to be delivered to consumers. The last process is the driver will receive the invoice and mail the way and then out of the area of warehouse PT Astra Otoparts Tbk. Cibitung.

3. Research Algorithm

Toyota Production System (TPS) is a philosophy used by Toyota to organize raw materials[3]. TPS is also often known with the name of Lean Manufacturing.

The purpose of the Toyota Production System is to get a good quality with a cheap price for a short time process and efficient. The system that is used in the TPS is Just In Time (JIT) and also Jidoka that is done with the standardize of work duration, perform equity of work (Heijunka) and make continuous improvement efforts (kaizen) [3].

Just In Time is a concept whereby raw material for production are shipped from supplier just when the material is needed by production so that will save the cost of inventory Jidoka in Japanese is the control and early detection part defects automatically [2]. The principle of Jidoka is automation equipment that work in harmony with the operator (machinehuman automation). Jidoka has purpose to:

1. Ensure the quality of production close to 100%.
2. Simplify man power work.
3. Prevent down time due to the abnormalities in the production operational process.

There are philosophy that support the implementation of Jidoka that is Andon, Fixed Positions Stop System and Pokayoke. Andon means of lights that shows the location where the problem occurred. Fixed Positions Stop System is an indication if the abnormal condition[6]. Pokayoke is a system that be
able to prevent the abnormal condition[3]. Kaizen is defined as an effort to make continuous improvement[7]. Standardization of work element duration is the actualization of production system to implement the basic principles of the TPS and the standard for measuring quality, cost reduction and safety [6]. The cycle times (cycle time) is also need to be addressed to create a working time standard [5]. Cycle time is the period required to complete one operation. The formulation to optimize the cycle time can be seen below:

\[ W_s = \frac{\sum X_i}{N} \]

Where:

- \( W_s \): Cycle Times
- \( \sum X_i \): Total time to complete each work element
- \( N \): the quantity of goods processed
- \( i \): 1,2,3,…,N

Measurement of working time are performed to get the standard time to complete a single work element, that is the time required by a workers to complete a job performed in the best working ways[9]. In general, time measurements can be grouped into two major groups that is direct time measurement and indirect time measurement[8]. Direct time measurement is performed with different time observers in location where the measurement object is being observed. Meanwhile, indirect time measurements are made using time series data that has been available before, so the observer is not directly in the measurement location. This this study uses direct time measurement. Normal Time for a single element of work indicates that a professional operator will work and complete the work at normal speed. Nevertheless in practice that is impossible that the operator will be able to do work continuously without any interruptions at all. In this case the operator will frequently doing other thing that are not include in the working system. This is require a special time for a purposes such as personal needs and other reason beyond the operator’s control. There are several factors that need to be considered in order to obtain appropriate time for the job as ot relates to working condition, environment and time measurement.

**Table 1. Terminology for Calculation**

| Variable | Information |
|----------|-------------|
| \( W_s \) | Average time required to work / produce one product within a certain time (hours, minutes, seconds / seconds) |
| \( W_{s1} \) | Total cycle time of work elements performed during observation on the preparatory work process |
| \( W_{s2} \) | Total cycle time of work elements performed during observation on core work processes |
| \( W_{s3} \) | Total cycle time of work elements performed during observation on the work process of completion |
| \( W_v \) | Total time that should normally be done for an activity |
| \( W_{w} \) | Total waste of time that occurs during the activity |
| \( W_{b} \) | Total cycle time (Ev+Env) which is conducted |
| \( W_{a} \) | Total cycle time without any waste (Ev) |
| \( CBI \) | Total quantity of product that can be produced / done by operator in one working day (in pieces, pallet, koli, etc) Per CTB |
| \( CAI \) | Total Quantity of product that can be done by one operator per CTA |
4. Experiment Result

Optimization of working time is a measurement to get the duration standardization in completion work [9]. Measurement time can be grouped on two major groups that is direct time measurement and indirect time measurement. The formulation can be seen below:

Min $W_B = W_v + W_{nv}$

Subject to :

$W_v = (W_s(1) + W_s(2) + W_s(3) + ... + W_s(n))_{valuable}$

$W_v = (W_s(1) + W_s(2) + W_s(3) + ... + W_s(n))_{nonvaluable}$

$W_v + W_{nv} \geq W_V$

Data processing is done by using a program so that the calculation can be automatically connected from one stage to others stage. As for the data and calculation results from the process of warehousing inbound until outbound obtained as follows:

A. The Result for Receiving Work Element

| Element   | Valuable | Non Valuable | Total    |
|-----------|----------|--------------|----------|
| Element 1 | 6.03     | 0.13         | 6.03     |
| Element 2 | 341.36   | 0.13         | 341.49   |
| Element 3 | 3.99     | 0.13         | 3.99     |
| Total     | 351.38   | 0.13         | 351.51   |

| Process               | Receiving |
|-----------------------|-----------|
| Location/Pallet       | Slow      |
| Cycle Time (Second)   | Before    |
|                       | After     |
| Man Power             | 1         |
| Productivity Up       | 0.04%     |
| Capacity/day          | Before    |
|                       | After     |
| Capacity/hour         | 10.24     |

B. The Result for House-Keeping Work Element

| Element   | Valuable | Non Valuable | Total    |
|-----------|----------|--------------|----------|
| Element 1 | 21.355   |              | 21.355   |
| Element 2 | 142.9    | 49.92        | 192.87   |
| Total     | 164.304  | 49.92        | 2144.22  |
Table 5. Result of Calculation cycle Time and Capacity of Housekeeping Process

| Process | Location/Pallet | Cycle Time | Before | 214.22 | After | 164.30 | Man Power | 1 | Productivity Up | 30% |
|---------|----------------|------------|--------|--------|--------|--------|-----------|---|----------------|-----|
|         |                |            | Inventory Not Put Away |        |        |        |           |   |                 |     |
|         |                |             | Capacity/day | Before | 101 |      | 131 |    |                 |     |
|         |                |             | Capacity/hour |        | 17  |      |      |    |                 |     |

C. The Result for Picking Work Element

Table 6. Picking Work elements Data

| Element | Valuable | Non Valuable | Total |
|---------|---------|--------------|-------|
| Element 1 | 21.355 | 21.355 |
| Element 2 | 142.9 | 49.92 | 192.87 |
| Total | 164.304 | 49.92 | 2144.22 |

Table 7. Result of Calculation cycle Time and Capacity of Picking Process

| Process | Location/Pallet | Cycle Time | Before | 296.27 | After | 201.40 | Man Power | 1 | Productivity Up | 47.11% |
|---------|----------------|------------|--------|--------|--------|--------|-----------|---|----------------|--------|
|         |                |            | Spareparts |        |        |        |           |   |                 |        |
|         |                |             | Capacity/day | Before | 73 |      | 107 |    |                 |        |
|         |                |             | Capacity/hour |        | 12  |      |      |    |                 |        |

D. The Result for Check Pack Work Element

Table 8. Check Pack/Out Work elements Data

| Element | Valuable | Non Valuable | Total |
|---------|---------|--------------|-------|
| Element 1 | 0.08 |              | 0.08  |
| Element 2 | 42.55 |              | 42.55 |
| Element 3 | 5.92  |              | 5.92  |
| Total | 48.54 |              | 48.54 |
Table 9. Result of Calculation cycle Time and Capacity of Check Pack/Out Process

| Process                  | Check Out          |
|--------------------------|--------------------|
| Location/Pallet          | Main Dealer        |
| Cycle Time (Second)      | Before 48.54       |
|                          | After 48.54        |
|                          | Man Power 1        |
| Productivity Up          | 0%                 |
| Capacity/day             | Before 445         |
|                          | After 445          |
| Capacity/hour            | 74                 |

E. The Result for Shipping Work Element

Table 10. Shipping Work elements Data

| Element   | Valuable | Non Valuable | Total |
|-----------|----------|--------------|-------|
| Element 1 | 6.03     | 0.40         | 0.40  |
| Element 2 | 341.36   | 0.13         | 56.81 |
| Element 3 | 3.99     | 44.87        | 44.87 |
| Total     | 351.38   | 0.13         | 102.08|

Table 11. Result of Calculation cycle Time and Capacity of Shipping Process

| Process                  | Shipping |
|--------------------------|----------|
| Location/Pallet          | Main Dealer |
| Cycle Time (Second)      | Before 102.08 |
|                          | After 80.496 |
|                          | Man Power 1 |
| Productivity Up          | 27%       |
| Capacity/day             | Before 212 |
|                          | After 268 |
| Capacity/hour            | 35        |

5. Conclusions

From observation, interview and the measurement process is done then there are some things that still need to be addressed by the company Warehouse PT Astra Otoparts Tbk. Cibitung so that companies can be more advanced and can achieve the vision by measurement of work element that obtained the fact that productivity can be enhanced on the work unit receiving of 0.04% ; house-keeping 23% and 30% ; picking of 47.11 percent and shipping 1 percent through disappearances squandering the duration of the work element. Educate the operator about the types of waste in the production process is one of solution in order to challenge the operator for participate in improvement of a work element methods. The implementation of standardize of work duration will show the consistency of the work element analysis and productivity. The expected outcome from the implementation of the SOP execution a work is all of the workers can do their work with clear, regularly, consistent and responsible.
Acknowledgments
This work was supported by PT. Astra Otoparts

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