IMPROVE CAPABILITY PROCESS TO OPTIMIZING PRODUCTIVITY: CASE STUDY LINE PROCESS PACKING ASSEMBLY IN ELECTRONIC MANUFACTURING COMPANY

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Abstract

Six sigma is a method for improving processes that focus on reducing process variations using statistical approaches and effective problem solving. The purpose of this method is calculating the impact of six sigma applications to company productivity. Six sigma not only aims to achieve zero defect, with the Six Sigma method optimizing production (Productivity), Six sigma, supporting the proper procedures in line with business goals both system and process. With the DMAIC method, we get as much information as possible and as soon with the smallest sample unit of the experiment. From the results of the paper, Takt Time reduce, 9.2s → 8.5s proved by DMAIC analysis to get effective and efficient improvement that ultimately can improve the company's efficiency.

Keywords: *control, define, improve, measure, optimizing, six sigma.*

1 Introduction

The industrial revolution has grown rapidly and has spread around the world (Ashworth, 2014). This has resulted in more competition to ensure the position of market leaders. The company is expected to take advantage of this free competition challenge as a chance to succeed. In many manufacturing companies there is a waste (Mehta, et al., 2012), so the companies must be able to minimize the things that can be threated to survive in today's free competition. Therefore, it is necessary to improve all process paths through the six sigma approach. Six sigma is regarded as a powerful engine for innovation management in this modern era (Belfo, et al., 2015), six sigma is a method for improving processes that focus on reducing process variations using statistical approaches and effective problem solving. The purpose of this research is calculating the impact of six sigma applications to company productivity.

The company that is the object of research in this research is the one of the global companies with the title of "Top 5 largest Exporter in Indonesia" (Kemenperin.go.id), which is engaged in manufacturing producing electronic equipment with a production scale of 1.5-2.0 million products per year, with a total employee of 1000-1500 employees. In order to meet customer satisfaction, the company places a customer's position as a King, in which the company must maintain the credibility of QDC (Quality, Delivery, and Cost) to promote increased company competitive advantage (Gosh, et al., 2016).

2 Literature Review

In order to increase productivity, the company must have good planning (Jonsson et al., 2016), the company have to set production targets and estimate the resources needed to achieve those objectives, efficient and on time (Kim et al., 2012). Planning production can predict every step in the production process (Sivakumar et al., 2012), as well as to predict the possible problems of production processes to eliminate the cause of waste. One of the most important requirements to gain trust from customers is to deliver products/services within an agreed timeframe (Boon-itt, 2011), since delivery must be one of the priorities for every business. For the theory is quite easy, namely; orders must be delivered accurately and arrive on time. However, many companies have difficulty in overcoming the problems that exist at their upstream level (Thunberg, et al., 2017). OTD are performance indicators that have a greater impact on customers (Van Looy, 2016). Problems that often occur with OTD often affect many areas of the company's supply chain (Danese et al,

2012). Some examples include delays in production due to material shortages, shipping costs accelerated so production costs will be increased.

Each company has different ways of measuring OTD (Ting, 2010). Basically OTD is the calculation of the amount of shipment that is sent on time to the customer in accordance with the number of orders. To improve the service of OTD (Wang, 2015), the company has several alternative strategies (Bodislav, 2014), among others; 1. Chase Strategy, 2. Level strategy.

The ability of production lines to produce products/services within a certain time, to keep the OTD well, the company strives to increase its production capacity (Tamas, et al., 2017), by means of; speed up production time or takt time reduce, as well as new machine investment with better capability. Strategies aimed at making production lines flexible enough to absorb external and internal deviations (Modrak, et al., 2017). There are two types of line of balancing, which are; 1. Static balance, 2. Dynamic balance.

Six Sigma's practical thinking method that refers to results, both practitioners and management (Bititci, et al., 2011). Six Sigma Management philosophies can be explained; Six Sigma is a smart and efficient way of working (Barjaktarovic, et al., 2011). Six Sigma is top down Management and focuses on the real situation in the field (Schiele, et al., 2011). Six Sigma is a language/easy communication for the organization (Yazdani, et al., 2015). The Six Sigma method is the basis for clear understanding and precise action under real circumstances (Yu, et al., 2010).

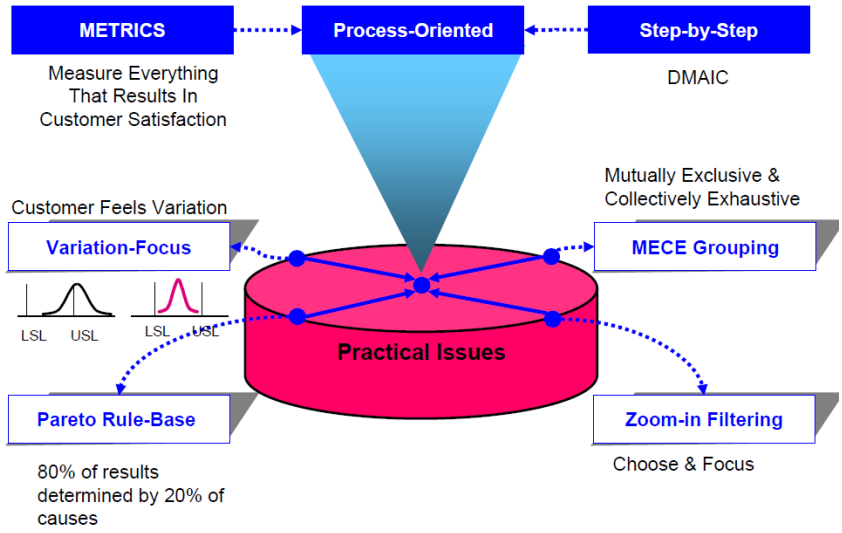

Figure 1 Basic Six Sigma Principle Method.

Source: Training module "Global Standard Six Sigma Training 2005" electronic manufacturing company

The process is a set of actions or operations that transfer materials or resources to products and services based on customer needs. Examples of MECE mergers;

- SWOT: Strong, Weak, Opportunity, Threats
- 4C: Customers, Participants, Companies, Channels
- 4P: Products, Prices, Places, Promotions.

There are two ways to calculate sigma level based on the data used, among others;

- Continues data → measured / distributed data, length, weight, time
- Attribute data → calculated data / proportion, number of defects, number of products.

In general, σ (Sigma) -level is calculated using attribute data, that is, at the statistical measurement stage for process acquisition, the defect rate decreases when the level sigma increases (Jose, et al., 2017). But the sigma level can also be calculated using measured data (Continues data), namely by calculating the Z-Bench (ST-LT) value, Z-shift (LG Electronics, 2005).

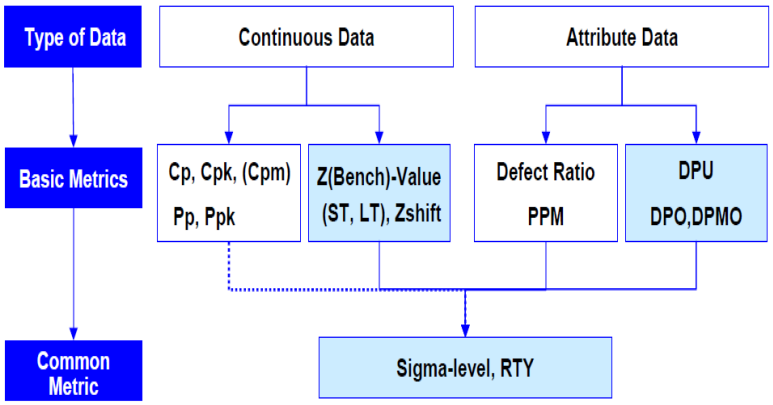

Figure 2 Calculation of sigma level based on data used.
Source: "Global Standard Six Sigma Training 2005" training module for electronic manufacturing companies

3 Method

Six Sigma supports the proper procedures in line with the business objectives of both systems and processes. DMAIC can be explained through the following drawings/schemes;

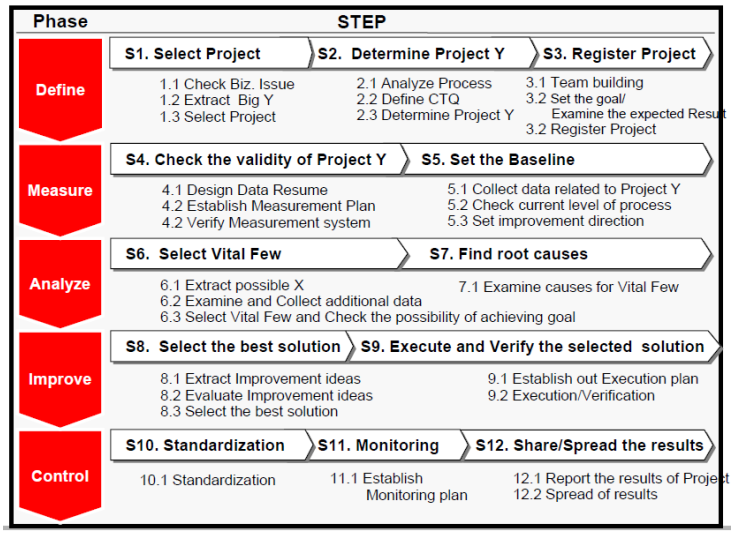

Figure 3 Six Sigma Project Direction Plan.
Source: Training module "Global Standard Six Sigma Training 2005" electronic manufacturing company

From the above scheme, we can simplify DMAIC steps or steps as follows;

- ✓ **Define**
  - Choose an important project theme in the Customer's side and also have a huge business impact
  - Clarify the achievements and resources of the project successfully completed
- ✓ **Measure**
  - Check the validity of the measurements for Selected Y Project, Set the Baseline after measuring the current level of project Y, and then determine the objective and direction of the improvement.
- ✓ **Analysis**
  - Extract the possible X factor for the Project Y repair from the Investigation Stage, then select the Vital view factor based on factor X. Find the main cause of each of several important factors.
- ✓ **Improve**
  - Lower design improvements to processes based on several important factors and / or roots are selected from the Analysis phase, and then choose the best solution between them.
  - The selected repair solution should be performed in practice.

✓ **Controls**

- Prepare a standardized management plan to continue to maintain the best results from the Upgrade Stage. : Create a basis for sharing results and / or certified methods to other areas of the organization
- Set up a standard management plan to keep the best results from the improvement phase.
- Create a base for sharing verified results / methods to other areas.

4 Result and Discussion

1. Define

- Background: Production target increases 10% for next year.
- Big Y Extracting;

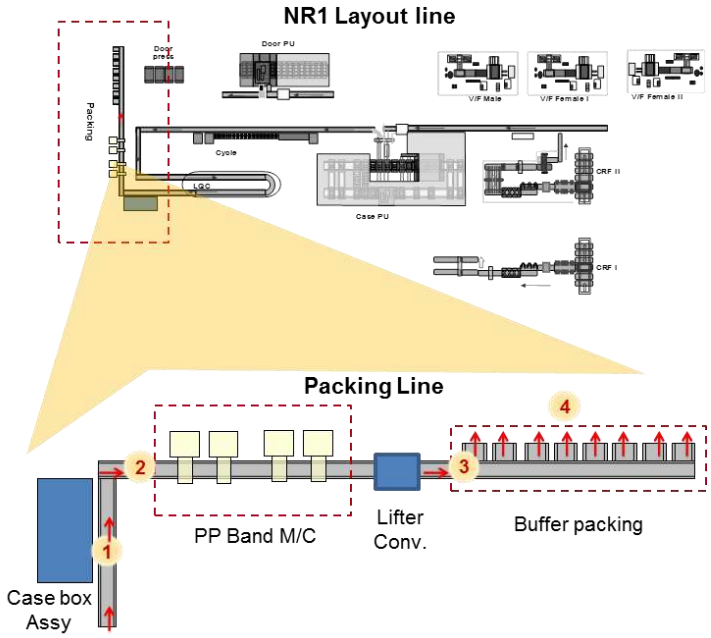

Figure 4. Process Mapping

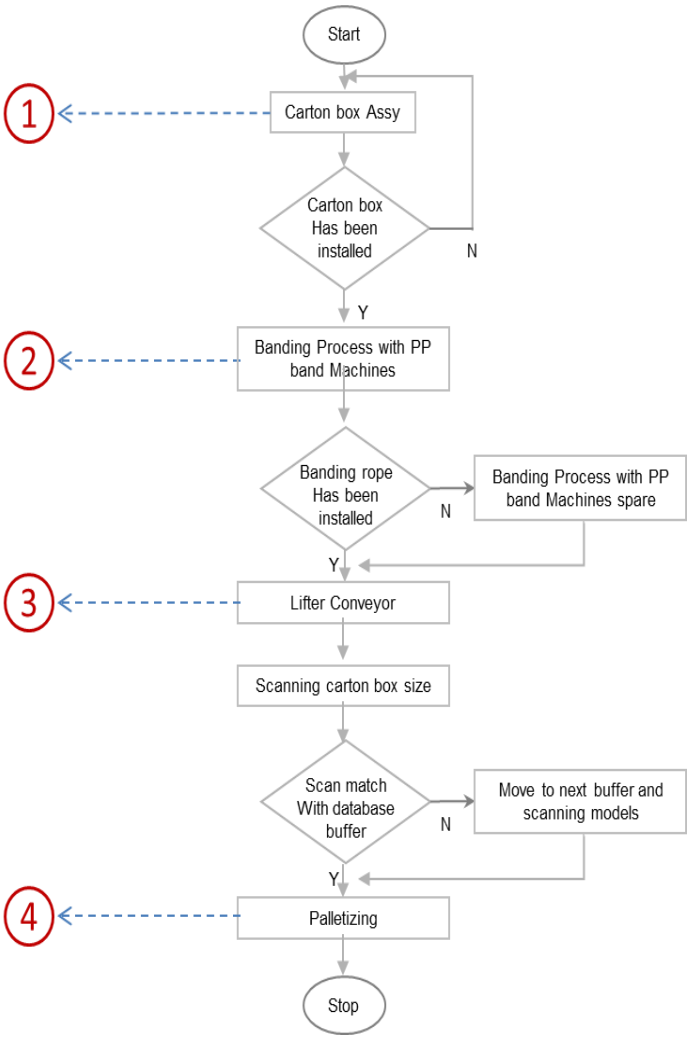

Figure 5 Takt Time Status Packing Line Machine

* Problem Analysis

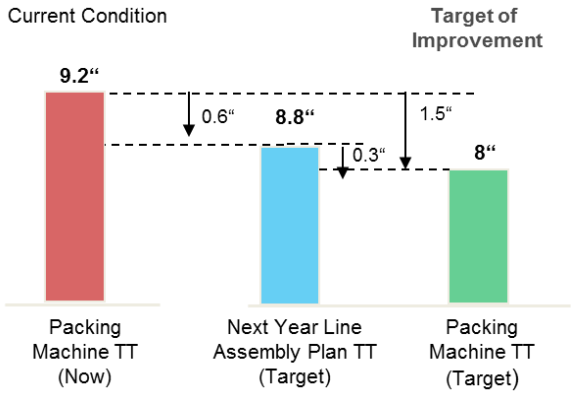

Figure 6 Takt Time Status Packing Line Machine

- **Problem Statement:** Unbalance takt time packing line between machines and line process assembly.

2. Measure

- Validity Project Y:

Data Resume	Measure	Takt Time
	Type Of Measure	Continue data
	Measurement Test	Visual Test Instrument
	Data Collection Meth	Manual
Measurement Plan	What	Time process
	Who	Bambang
	When	April
	How Many	60
Measurement Tools		Stop watch

The characteristic of Y is Takt time

Gage R&R is Taken by 3 Operator an 2 times replication.

Source	Study Var StdDev (SD)	%Study Var (6 * SD)	%Tolerance (%SV)	(SV/Toler)
Total Gage R&R	0.0168819	0.101292	17.20	1.27
Repeatability	0.0148885	0.089331	15.17	1.12
Reproducibility	0.0079582	0.047749	8.11	0.60
operator	0.0027722	0.016633	2.82	0.21
operator*Machine	0.0074598	0.044759	7.60	0.56
Part-To-Part	0.0966863	0.580118	98.51	7.25
Total Variation	0.0981491	0.588894	100.00	7.36

% Tolerance < 20%
% Std Variance < 20%
N.D.C > 5
Number of Distinct Categories = 8
Acceptable

Figure 7 Gage R&R Test

From gage R&R analysis result above, we may conclude that gage R&R analysis is acceptable.

3. Analysis

- **Vital Few Defining**

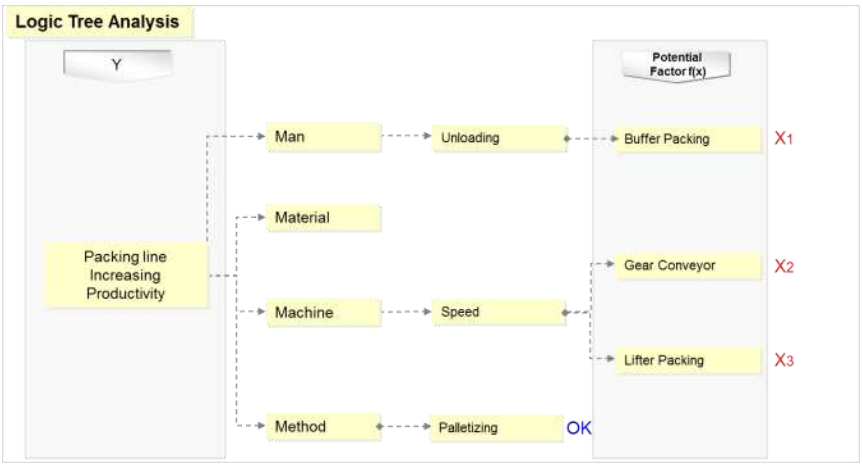

Figure 8. Logic Tree Analysis

- **Vital Factor Selecting (Hypothesis)**

The logical analysis is generated through brainstorming from operators, technicians and personnel maintenance, to obtain vital factor, among others; packing buffer, gear conveyor speed, lifter packing.

- **Vital Factor Defining**

The few key factors that have been gained through the brainstorming above, we will test each factor, to prove whether it is some of the key factors or not.

- **Vital Factor Selecting (After Test)**

  From the test results, we can conclude Conveyor is an important Vital Factor that needs to be improved to improve the sigma level.

4. IMPROVEMENT

- **Solution :** Increase speed Conveyor by changing Conveyor gear (21 pin → 14 pin).
- **Verification & Result**

  After we do improvement, we will do the testing of capability analysis to know result after improvement. We can get significant decrease of takt time 9.2s → 8.5s.

5. CONTROL

- **Standardize**

  Increase speed Conveyor by changing Conveyor gear (21 pin → 14 pin).
- **Monitoring**

  Collect some takt time data's after improvement and making control chart to monitoring the result of improvement that is stable or not.

5 Conclusion

The research result got the decreasing takt time 9.2sec → 8.5 sec, proved by DMAIC method obtained by effective and efficient improvement that impact to efficiency of the company.

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