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Research Paper

Implementation of Lean Six Sigma Method in Cross Circuit in Sub Assy Area to Improve Product Quality

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Abstract

The purpose of this study is to identify activities that are not value added (waste) and know the level of disability of cross circuit products. The method used in this research is quantitative with lean six sigma concept approach. The result of this research is the highest waste type is the waste defect with the value of 4.7, and the level of disability is found on a cross circuit of 870 DPMO (Defect per Million Opportunity) or 4,653 sigmas. It shows that the sigma value found in cross circuit product in sub assy area can be said good because DPMO value is close to sigma number. Based on these results, then for further research can identify potential interference in the process of a cross circuit in sub assy area by using FMECA (Failure Mode Effect Critically Analysis) method and develop an operational standard procedure to reduce variation in doing the job

Keywords: *Cross Circuit, Defect, Lean Six Sigma, Waste*

1. Introduction

In the competition in the global era only good quality products that will always be in demand, because the quality is the fulfillment of services to consumers[1]. This can be a guideline that quality control is part of the production process that is very influential in improving product quality. Quality of product is a collection of features and sharp brand product characteristic which have the contribution to the ability to fulfilling specific demand [2], [3].
So that the fulfillment of services to consumers can be achieved. Company PT XYZ is a company engaged in the automotive field of a cable assembly for the car (wiring harness). If product defects and passes to customer or defect are not detected, it can cause damage to the car, and the car can burn. In the process of making wiring harness, there is a lot of waste of activities that are not valued (waste) and the resulting product is also a lot of defects is about 6% per day (output per day 5000 pcs circuit into the connector, 15 pcs per day defects). To solve this problem, one way or method used is to use lean six sigma approach. Application lean six sigma (LSS) for establishing continuous quality improvement especially in the manufacturing subsector, is recently on the increase in the advanced countries and to a large extent seems to have become a permanent approach adopted by organizations that want compete globally and have financial stability [4], [5]. Lean Six Sigma is a methodology that focuses on the elimination of waste and variation, following the DMAIC structure, to achieve customer satisfaction with regards to quality, delivery, and cost [6]. Lean six sigma concept is the integration of two (2) quality management concept which is Lean Manufacturing and Six Sigma whereby it attempts to increase the scope and size of improvements achieved by either concept alone [7]. Based on the above problem, so the purpose of this research is to identify the activity that is not value added (waste) and to know the level of disability of cross circuit product based on lean six sigma method.

2. Literature Review

Lean Manufacturing is a systematic approach to eliminate waste and change processes [8]. Lean Manufacturing seeks to create a production flow throughout the value stream by eliminating all forms of waste and improve value-added products to customers[9]. By identifying and reducing waste with continuous improvement [10]. The Six Sigma method is a project-driven management approach to improve the organization's products, services, and a process by continually reducing defects in the organization [11]. Furthermore, the six sigma is a business strategy that focuses on improving customer requirements understanding, business systems, productivity, and financial performance[11]. Six Sigma uses different theories and tools to improve the processes of a specific business[12]. Six Sigma is a formal and highly disciplined methodology for reducing process variation to ensure customer satisfaction, cost reduction and profitability of the organization [13] Lean six sigma has become a business model, a symbol of excellence, with the goal of eliminating waste and reducing the defect and variation in organization's process[14]. The most important step of the Lean Six Sigma project aims to detect the critical-to Quality process factors (CTQs), considering the customer's opinion[15].

3. Methodology Research

The methods used are quantitative with Lean Six Sigma (LSS) approach. There are several steps using this method, namely: (1). Identification waste with lean method approach; (2). Determination of Critical to Quality; (3). A measure of Process capability

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with six sigma method; (4). Analysis of highly waste and capability process.

The production process at PT XYZ consists of two parts, namely Pre assy and Final Assy. Pre assy is the process by which all product materials are first processed. Among them are wire cutting, wire exfoliation, installation of wire terminals, rubber coatings, copper union (bonder), and then checks. In the Pre Assy area, every finished process should end with a check. This is done to prevent the occurrence of defects that pass to the customer. While Final Assy is processed after Pre Assy is wire wrapping with isolate, insert circuit into the connector (Sub Assy), electrical check, offline, visual, then packaging. Field observation is done to know the production process found in the sub assy especially in the insert circuit process. PT. XXX is a company engaged in automotive. Based on data from Quality Assurance Department average defect per day for MAZDA J53C carline in February 2014 is 13 defect.

The highest number of rejects that occurred on the J53C carline. Reject because the cross circuit is the highest reject with a total reject of 279. Then reject because others (reject due to various small errors - sort) with the amount of 141 times. After that in the next position is rejected due to damage connector, then reject due to damage insulation with the number 28.

3.1 Identification Waste

Based on the observation of the quality of the connector product that has a cross circuit, can be identified waste that occurs in the insert circuit process. The types of waste contained in this process are:

a. Overproduction
   Excess process and operator unnecessary. The production process of insert circuits classified as overproduction is: the circuit is mounted excessively, exceeds the production target
b. Defect
   Defect or non-compliance contained in the product with the specified specifications. Which include waste defect is: Incorrectly insert the circuit into the connector
c. Transportation
   It is a waste that occurs in the process experienced by the operator. There are have two type, namely: a. the remote operator puts the result of the process (product) into the trolley; b. Remote circuit or material.
d. Waiting
   An empty time that does not have acted so, it does not produce anything like Operator Layout (process after insert circuit) waiting for a connector which has attached circuit.
e. Inappropriate Processing
   In the waste (waste) this happens processing is an excessive process, such as the wrong process insert into the connector.
f. Unnecessary inventory
   In waste (waste) this happens excess inventory. This inventory can be material, work order, which includes waste (waste) unnecessary inventory is Order material excessive so long useless or even unused.
g. Unnecessary motion
   In waste (waste) this happens unnecessary motion is the movement of operators that are not productive (e.g., move, put a defective product).

Based on table 1. Shown that it can be seen that the defect is the highest waste experienced by PT XXX in February 2014 that is ranked 1, the number of 15,275, the weight of 4.7 and the frequency of 3.25.

Table.1: Waste Ranking

No	Waste Type	Freq Rate	Weight	Sum	Ranking
1	Overproduction	2.7	3	8.1	7
2	Defect	3.25	4.7	15.275	1
3	Unnecessery inventory	3.05	4.4	13.42	3
4	Inapropriate inventory	3	4.2	12.6	4
5	Excessive transportation	2.95	4.25	12.5375	5
6	Waiting	3.3	4.55	15.015	2
7	Unnecessery motion	3	4.2	12.6	6

3.2 Determination of Critical to Quality

Identification of critical to quality (CTQ) is based on the results of the highest importance (highest weight), and the frequency is found that the type of waste that occurs in the Sub Assy process is the type of waste defect. This type of waste provides an opportunity for consumer dissatisfaction. Here is a description of critical to quality (CTQ) based on prioritized waste to improve. Wastes that occur in products in Sub Assy areas that include defects based on the type of waste include:

a. Cross circuit (No interruption code)
   Critical to quality (CTQ) that affects the interference of cross-circuit navigation lights
b. Damage connector (No interruption code)
   Critical to quality (CTQ) that affects the damaged connector is the material of the connector
c. Damage insulation (No interruption codes)
   Critical to quality (CTQ) which affects damage insulation damage is wire material

The highest defect type that occurred during February 2014 was across the circuit with a total of 279 cross circuit.

3.3 Measure of Process Capability with Six Sigma

Six Sigma as a measurement system using Defect per Million Opportunities (DPMO) as the unit of measurement. DPMO is a good measure of product quality or process because it correlates directly with defects, costs and time wasted. Based on table 2. Shown that the value of capability process is 4.63 sigma.

Table.2: Calculation of Cross Circuit Process Capability

Step	Action	Formula	Calculation Result
1	What process you want to know the quality	-	The process of insert the circuit into the connector
2	Number of product output per day	-	5000
3	Number of defect products per day	-	13
4	Determining the level of disability based on step number 3	= (Step No.3) / (Step No.2)	0,0026
5	Determining the number of potential CTQs that can lead to complaints or disabilities	= The large number of CTQ characteristics	3
6	Calculate the short chance of complaint / disability per characteristic CTQ	= (Step 4) / (Step 5)	0.00087
7	Calculate the short chance of complaints / disabilities per million opportunities (DPMO)	= (Step 6) X 1,000,000 870	870
8	DPMO Conversion (Step 7) in sigma value	-	4.635
9	Make a conclusion	-	The DPMO conversion value is 4.635

4. Results and Discussion

Based on the type of waste and disability that occurs in the process of insert circuit into the connector then Critical to Quality is often the case is incorrect to enter the circuit into the connector contained in the waste process.

The first Critical to Quality (CTQ) is a cross circuit. Cross circuit is a mistake made by the operator in entering the circuit into the whole (Cavity) connector. As in the data Figure, 4.7 on the number of a cross circuit that occurred in February 2014 is as much as 279 pcs. The second Critical to Quality (CTQ) is a damaged connector. Damage connector is a defect that occurs on the connector such as a broken connector, connector perforated, connector break and connector cracks. In this case, the error is not entirely from the operator, but many factors cause. The third Critical to Quality (CTQ) is damage insulation. Damage insulation is a defect that occurs in wire protective rubber such as insulation (peeling rubber) peeling, and insulation (rubber protector) is scratched. In this case, the error is not entirely from the operator, but many factors cause.

The result of this research can identify the type of waste and measurement of process capability. The research conducted by Indrawati and Ridwansyah under the title "Manufacturing Continuous Improvement Using Lean Six Sigma: An Iron Ores Industry Case Application"[7]. The result of research showed that the highly waste type is a defect with value 30.68 and the process capability is at the level of 2.96 sigmas[7].

The Suggestions for further research can identify potential interference in the process of the cross circuit in sub assy area by using FMECA (Failure Mode Effect Critically Analysis) method and develop an operational standard procedure to reduce variation in doing the job.

5. Conclusion

Based on the research conducted, the following conclusions can be drawn: (1). the highest waste type is a waste defect with the value of 4.7, and the level of disability is found on a cross circuit of 870 DPMO (Defect per Million Opportunity) or 4,653 sigmas. The Suggestions for further research can identify potential interference in the process of a cross circuit in sub assy area by using FMECA (Failure Mode Effect Critically Analysis) method and develop the operational standard procedure to reduce variation in doing the job.

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