THE IMPLEMENTATION OF LEAN SIX SIGMA METHOD IN PRODUCTION PROCESS OF UNDERWEAR RIDER R333B AT PT. XYZ

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ABSTRACT

PT. XYZ is a company which engages in textile and garment sectors and produces man underwears and clothes. Based on the company history records, the average percentage of defect Underwear Rider R333B products for the period of June - August 2011 is 5,05%. Furthermore, the output of these products have not reached the company's target, that is only 60-70%. It is due to the fact that there is a lot of waste in the production process of Underwear Rider R333B such as waiting, defect, inventories, etc. Therefore, it needs an improvement by using Lean Six Sigma Method with DMAIC (Define, Measure, Analyze, Improve, and Control) in minimizing defects and eliminating waste in production process of Underwear Rider R333B.

Based on the measurement's results, Process Cycle Efficiency for the production process of Underwear Rider R333B is 28,55% with Process Velocity 8,641 process/hour and sigma level of the product's quality is 4,09 sigma. Measurement's result shows that the production process of Underwear Rider R333B is still far from lean condition and six sigma quality. Therefore, it needs an improvement by using Lean Six Sigma Method.

There are some improvement suggestions for the problems, such as combination and elimination of some processes, utilizing Standard Operation Procedure (SOP), adding the number of operator, using the same material handling, changing the company's layout, organizing administration procedures, machine scheduling, training and controlling, checking, cleaning, and giving oil to every machine, and also adding more ventilation.

Implementation is done for some improvement suggestions according to the company's regulation. The results of the implementation are Process Cycle Efficiency increase to 31,87% with Process Velocity 9,679 process/hour and sigma level of the product's quality is 4,33 sigma.

***Key words**: lean six sigma, DMAIC, process cycle efficiency, sigma, standard operation procedure*

1. INTRODUCTION

PT XYZ is a company which engages is textile and garment sectors and produces man underwears and clothes, which various type among others things, R310, R316, R333B, R325. While in three months period June-August 2011.The percentage of defect are for product with R310 type are as big as 3,46 %,R 316 as big as 3,07 %, R333B as big as 5,05 % and R325 as big as 4,06 %. Therefore what becoming concentration in this research are product with R333B type as product the first order with level percentage of defect wich is as big as 5,05 %. The disability that is happened is one of waste, wich is found in underwear rider R333B production process,with the wasting will caused a time that is needed to produce underwears increasing the length. So it will resulted a limited output and not reached production target that already set.With the low of the resulted output caused the low of target aim percentage, which is just 60-70 %, it is a major issue is XYZ company facing. Therefore it is necessary to do improvement with using Lean Six Sigma method.Lean six Sigma is a combination between Lean and Six Sigma, Lean is method to reduce the complexity and smoothen with identified and eliminated the wasting source in procees to increase the efficiency. While six sigma is focusing to minimize defects in a process so thus it is expected the production process work efficiency and defect level is lower,which is can improve the company profit, meanwhile the purpose of this research as the following:

1. Lower the defect level and eliminated the wasted that was happened is production process
2. Do the implementation for the proposal for improvement.
3. Comparing result between before and after implementation

2. THEORETICAL BACKGROUND

2.1.Lean Six Sigma

Over the past century, various quality methodologies have come and gone but some basic principles have endured. In 1913, Henry Ford developed his assembly-line system, he focused on standardization and taking out of the car manufacturing process. Over the years, the world of quality has ultimately converged on the principles that are known todays as Lean and Six Sigma. According to (Sheila Shaffie, 2012), Lean, its simple approach that focuses on improving the speed and efficiency of process, provides breadth in problem solving. On other hand, Six Sigma is more sophisticated and offers a method drilling deep into complex issues. Six Sigma also has a very structured approach to problem solving that is absent in Lean. By definition, Six Sigma is about enhancing the quality and accuracy of processes by reducing variation while Lean focuses on achieving faster response times by eliminating waste. As result, these two methodologies offer complementary tools kit; they help address the root cause of different business challenges. For example; if the goal is reducing account opening cycle time ,Lean principles can help identify areas of waste to be eliminated. On other hand, if the goal is to reduce credit card losses, Six Sigma tools provide the better fit with understanding root couses.

2.2 Methodologies of Lean Six Sigma (DMAIC)

2.2.1 DEFINE

The define phase is the starting for all Lean Six Sigma projects. Regardless of whether the project will rely more on Lean tools and principles or those from Six Sigma,the deliverables for this phase are the same. There are four major steps in the Define phase, each with designated tools :

Step 1: Define the project Critical To Quality (CTQ) or the item or area in need of improvement.
Step 2: Outline the business case
Step 3: Develop a high level process map
Step 4: Define and excute a change management strategy.

2.2.2 MEASURE

During the Measure phase, you will develop a deep understanding of what your customer wants from you. Futhermore, you will focus on the type of data needed and ensure that you have the correct mechanism for gathering these dat a if you not already have in your possession. The main step in the Measure phase are :

Step 1:Define characteristics data of CTQ
Step 2:Outline performance standards
Step 3:Develop a data collection plan
Step 4:Validate the measurement system

2.2.3 ANALYZE

The end goal of this phase is to take all the collected information and data identify the root cause of the problem. The Analyze is divided into three steps:

Step 1: Baseline the process's current capability, how good is our process ?
Step 2: Define the performance objective for the process, how good do we need to be?
Step 3: Identify source of variation, what are the key drivers of the problem

2.2.4.IMPROVE

The Improve phase is focused on selecting the improvement ideas that were either identified by team or determined through data analysis. It also in this phase that the implementation plan is develop. There is only one step in this phase :

Step 1: Identify the vital problem and Implementable solution.

2.2.5.CONTROL

The last phase of Lean Six Sigma is Control. This phase focused on successfully passing the project to a functional owner and ensuring long term sustainability of the improvements. There are three steps in the Control phase:

Step 1: Validate measurement system analysis on the problem

Step 2: Determine the process capability

Step 3: Implement process control.

3. RESEARCH METHODOLOGY

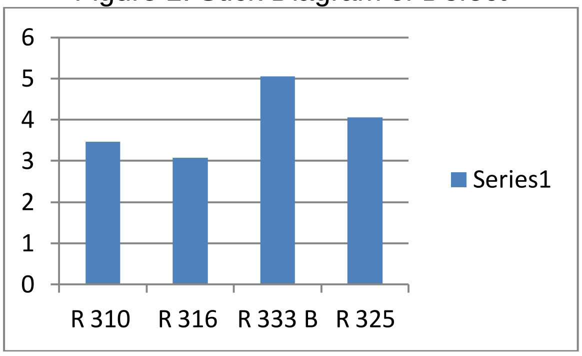
Research methodology that is done in this research is with collecting history datas and direct observation company, with the stage as following :

1. Define the product that is going research as research object.
2. Do diagram Supplier Input Process Output (SIPOC)
3. Do the measurement with the process both Value Added and Non Value Added
4. Count Process Cycle Efficiency
5. Count DPMO and Sigma Level
6. Compare between PCE, DPMO and Sigma Level before and after implementation
7. Giving suggestion to the company.

4. RESULT AND DISCUSSION

The product becoming concentrate of this research is based on history data obtained from June to August 2011 shown in stick diagram as follow:

Figure 1. Stick Diagram of Defect



Therefore the elected product to research is underwear with type R333B, and after thirty days observation from September 19 to October 28, 2011, with the number of sample 600 pcs that becomes critical to quality are :

- Perforated : is a defect atribute shaped perforated on a fabric
- Needle : is a defect atribute shaped a gap on a fabric
- Dirty : is a defect shaped a stain on fabric
- Thread : is a defect shaped a colour on a fabric
- Oil : is a defect atribute which is found on a fabric shaped oil stain.
- Connect the bottom : is a defect shaped connect it the bottom of the untidy ,furrowed or not symmetrical
- Attach the rubber : is a detect shaped rubber mounthing in compatible with supposed.
- Bis T : is a detect shaped tailoring untidy on a bis T or forrowed or not symmetrical.
- Wray size : is a detect shaped inexpediency between fabric pattern and the existing standard
- Bis P : is a detect shaped tailoring untidy, furrowed or not symmetrical on bis P
- Pairs of brand :is a defect shaped mismatch pairs of grand with the position has been determined.

From the calculation obtained $\bar{p} = 0{,}0487$ which means defect proportion from rider R333B underwear based on samples taken is as big as 0,0487 or 4,87 from total production as for result it can be seen on figure 2.

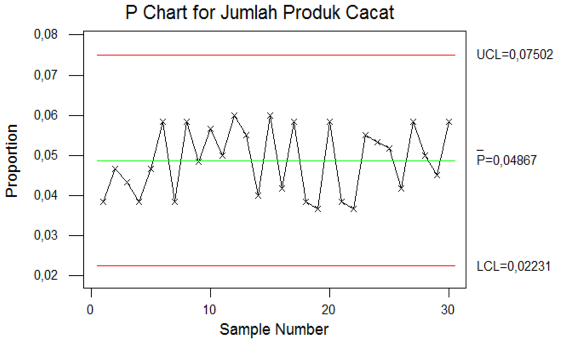


Figure 2. Control Chart of p

Based on figure 2, known that defect proportion for rider R333B underwear still are in control because of the data points don't cross the line that has been established.To find out defect type which most dominant use Pareto Diagram, it can be seen on figure 3.

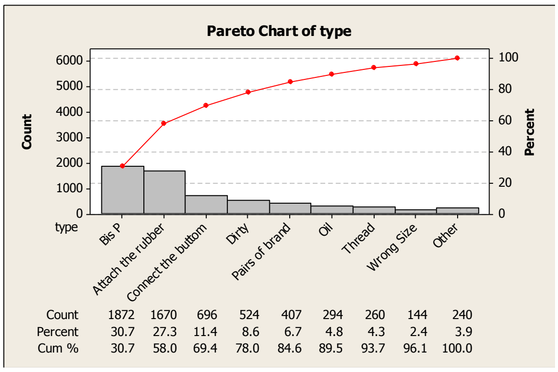


Figure 3:Pareto Chart of defect

It turns out the greatest disability is a bis P defect, as big as 24,9% while most small with these types of disabilities perforated as big as 5,5 %, because of that what become priority in handling problems is a bis p defect. To reduce bis p defect number the first thing to do used Iskhawa diagram then continued with Why-Why diagram.

After analyze is done with Why Why Diagram:

Then it can be drag conclusion as follow

- Human Factor because lack of the careful and less skilled in handling the job
- Method Factor is an appropriate way of tailoring , this caused by tailoring standard made by company
- Machine Factor, engine misfire often caused less engine maintenance
- Environment Factor, hot and noisy because air of silencers in productor floor .

The improvement on the bis p will be doing with doing standard operating procedure for the employee and this expected to reduce the defect quantity. Meanwhile the possibility with DPMO and its done with steps as follow :

1. The number of units that are cheked = 600x30=18.000 units
2. The amount of disability that accurs = 937
3. $DPU = \frac{D}{U} = \frac{937}{1800} = 0{,}0521$
4. Defect characteristic that could potentially to be defect is eleven
5. $DPO = \frac{D}{UxOP} = \frac{937}{1800x11} = 0{,}004732$
6. DPMO =4.732 or equivalent with 4.09 sigma

And for lean process is done with identified working elemen ,then separated becoming those activities are value added or non value added. From table 1, known that total value added is as big as 2854,0107 second and total non value added time is as big as 7142,9518 second. Total manufacturing lead time is as big as 9996,9625 second. Therefore the caunting for process cycle efficiency for rider R333B underwear product is as follow :

$$PCE = \frac{ValueAdded\ Time}{TotalManufacturingLeadTime}$$

$$= \frac{2854{,}0107}{9996{,}9625} = 28{,}55\%$$

From counting result obtained the value of process cycle efficiency as big as 28,55 %, this means that R333B underwear production process not running well because Process Cycle Efficiency still under 30 %. Because of that it is necessary to do on production process improvement.

4.1 Counting process lead time and process velocity

Counting process lead time it aims to find out the time it takes to process one product from the beginning to the end.And this caunting the longest time complation in processing work element from one product. In this research the longest time of work completion is working element 24th ,whis is sewing process bis P as big as 407,3664 second .as for the details as follow :

1. Work in process = 180 batch
2. Time completion persecond $= \frac{180}{407{,}3664} = 0{,}44$ batch
3. Total Work in process = 8100 batch
4. Lead time process $= \frac{8100}{0{,}44} = 18.331{,}488$ second = 5,092 hours
5. The number of activities in process = 44 activities
6. Therefore Process Velocity $= \frac{44}{5{,}092} = 8{,}641\, process/hour$ is meaning in every one hour completion 8,641 process

4.2 Connection between Six Sigma and Lean

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Based on pareto diagram that the biggest defects is bis P defect as big as 24,9 % and this found on bis P process and longest time completion to finishing process, also found at bis P process as big as 407,3664 second. Because of that it is need for improvement in this process. As we know Lean Six Sigma is concept how we together lower defect level and process can work be slim or Lean.from lean side the activity on bis P process is have the quality on non value added therefore need to eliminate. Meanwhile from concept six sigma how the process variation can be smaller to increase sigma level. As the proposed improvements done is making SOP with the step as follow.

1. Prepare the sewing machine and scissor, check and needle condition, install bis P on track.
2. Take one batch underwear product place the patter work table with a distance of within easy reach and remove the cards.
3. Take one underwear product from that batch, place on sewing machine with position staright up on pattern part.
4. Make sure that the bis fabric on track
5. Start sewing part of the thigh from up to the buttom with hand relief to push and pull the fabric.
6. Repeat step 2-4 until the whole pants in one batch finished sewn
7. Take the fabric that has been sewn, cut the bis fabric that still connected between one pants and the other
8. Make sure there is no underwear the seam lined, sideways, thread jump
9. If the stitching is not completed, open seam back
10. Arrange the returns and tie underwear in one batch
11. Do labeling on wrapping batch

After implementation is done in research from April 12 th 2012 until April 21 2012 obtained result as follow (see table 2):

Table 2. indicator of product type R 333 B

No	INDICATOR	IMPLEMENTATION	
		Before	After
1	DPMO	4.732	2.363
2	Sigma Level	4.09	4.33
3	Process Cycle Efficiency	28,55 %	31,87%
4	Process Lead Time	5,092	3,823

5. CONCLUSION

After research satage is done above ,then in this research the conclusion can be drawn as follow :

1. The biggest defect level that can be found in R 333 B type underwear is bis P as big as 24,9 % and the lowest is perforated defect as big as 5,05 %.
2. Working elemen be found on production process type R 333 B underwear is as big as 44 element and the longest time completion is on working element at bis P process as big as 407,3664 second.
3. Defect Per Million Opportunity before implementation is as big as 4.732 and after iimplementation is as big as 2.373
4. Process Cycle Efficiency increase from 28,55 % become 31,87 %
5. Lead Time Process decrease from 5,092 become 3,823

6. REFERENCES

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Attachment

Table 1. Work element product type R333B

No	Work Elemen	*Non-Value-Added-Time* (sec)	*Business-Value-Added-Time* (sec)	*Value-Added-Time* (sec)
1	Early administrattion			
2	Movement (Transportation with handpa*llet*)	3,2053		
3	Inspection of raw material	10,7729		
4	Movement(manual transportation)		51,3424	
5	The process of deploying fabric	52,6254		
6	The movement of the operator brings the patterns		13,9984	
7	The process of making patterns	59,2833		
8	The movements of the operator			5,181
9	The process of cutting the fabric shape box	2,89 .T		
10	Movement(Transportation with small trolley to cutting pattern area)	77,8368		
11	The process of cutting the fabric match the pattern			12,8364
12	Manual transportation to banding area	137,7368		
13	Binding Process		35,2589	13
14	Movement (Transportation with small trolley to sewing area)	315,9025		14
15	Moving to the front of the sewing machine	179,6003		
16	Front sewing process			242,0509
17	Movement (Transportation)	159,9123		
18	The process of overwriting the front			161,6295
19	Movement (Transportation)	302,8052		
20	The coonect process agency			288,0954
21	Movement (Transportation)	128,7428		
22	Bis T sewing process			231,1043
23	Movement (Transportation)	367,1848		
24	Bis P sewing process			407,3664
25	Movement (Transportation)	274,8127		
26	The installation process of rubber			393,1803
27	Movement (Transportation)	201,7281		
28	The process down to connect			173,332
29	Movement (Transportation)	137,3526		
30	Bartek Process			124,663
31	Movement (Transportation)	333,7907		
32	Brand installation process			312,7279
33	Movement (Transportation)	875,0393		
34	Thread cutting process			276,9581
35	Movement (Transportation)	1763,4539		
36	Final Inspection		167,5797	
37	Movement (Transportation)	772,2589		
38	Mika packing process			183,4359
39	Operator movement	387,1421		
40	Plastic Packing Process			35,125
41	Operator movement	155,0184		
42	Packing process cardboard			6,3239
43	Movement (Transportation to finished good warehouse	93,9673		
44	Final Inspection	3,5898		
Total Time		6874,7724	268,1794	2854,0107
		7142,9518		
		9996,9625		