Research Paper

Implementation of Quality Control Thermal Bag Using the DMAIC Method (Case Study PT XYZ)

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ABSTRACT

Competition is getting tighter and more competitive, making product quality issues an issue for the company. The company's ability to provide quality products will be a tool or weapon to win the competition and make a brand a market leader and customer satisfaction will be achieved. Therefore, these conditions require companies to process their resources effectively and efficiently. This research aims to analyze product quality problems to avoid and reduce the number of defective products and produce thermal bag that comply with company standards. This study uses a qualitative approach with the DMAIC method (Define, Measure, Analyze, Improve and Control) to analyze the factors that cause defective products and improve the quality of products thermal bag the resulting. This study uses a sample and research population of production data and the number of products thermal bag for defective the period January - December 2019. The results of this study are to identify and define existing problems and what factors cause defective products, then measure CTQ (Critical to Quality) and DPMO, after that perform analysis of the root cause factors causing defects with diagrams fish bone and make improvements using the 5W1H method (When, Why, Who, Where, What and How) then the results are obtained recommending improvement proposals using a check sheet for any documentation in quality control, and changes or updates to company SOPs.

Keywords: DMAIC, CTQ, DPMO, Fish Bone, Thermal Bag, 5W1H

INTRODUCTION

As the progress in the era of competition and increasing activity in the industrial sector will result in intense competition in the business world. The existence of this competition makes the company must be able to manage its resources as effectively and efficiently as possible in order to produce high quality products and according to the standards owned by the company.

Continuous and significant quality improvement is indispensable to win industrial competition and make the company a leader in market share. By using the DMAIC method, a process that does not add value or value in the eyes and minds of consumers can be identified, and variations in the process can be minimized so as to reduce the number of defects in products produced before being marketed and can increase cost efficiency because rework can be reduced.

Table 1. Data Production and Total Reject

Months	Total Production	Total Reject	Percent Reject
January	10,461	421	4.024%
February	9281	567	6.109%
March	8196	420	5.124%
April	8815	1,002	11.367% in
May	8045	531	6.600%
June	7690	446	5.800%
July	12 694	827	6.515%
August	9653	758	7.852%
September	8706	1,057	12.141%
in October	1,079	120	11.121%
November	2432	426	17.516%
in December	1,013	692	68.312%
Total	**88 065**	**7,267**	
Total Reject 2019	**12.118%**		

From the data table 1 can be seen in general how large quantity of products reject and percentage reject every month. Not only that, researchers identified the cause of the reject that occurred at PT XYZ. In the absence of a limit standard reject set by management, researchers also lacked attention to process-based quality control. This causes the quality of products to thermal bag decline and there are a lot of reworks, so the company experiences losses.

LITERATURE REVIEW
Definition of Quality

Quality is essentially the fulfilment of consumer desires, a customer always wants a product with high quality and a satisfactory form of service and is indicated by a smaller error rate (Djoko Adi, 2020). Meanwhile, according to Kotler and Armstrong (2012) defines product quality as the ability of a product to demonstrate its function, including overall durability, reliability, accuracy, ease of operation, and product repair as well as other product attributes.

Quality Control

According to Teny (2018), the purpose of quality control is very important for the company and needs to be realized so that the company can find out if there are deviations in the production process so that the company can minimize the smallest possible damage due to production deviations which will cause large losses, both in terms of quality and quantity.

The factors of quality control (Montgomery, 2009) state that the factors that influence quality control carried out by the company are as follows:

1. **Process Capability:** The limits to be achieved must be adjusted to the existing process capabilities.
2. **Applicable Specifications:** The specifications of the production results to be achieved must be applicable, when viewed from the point of view of process capabilities and consumer wants

or needs to be achieved from the production results.
3. **Acceptable Level of Non-conformity:** The goal of controlling a process is to reduce the product that is below the standard to a minimum.
4. **Quality Costs:** Quality costs greatly affect the level of quality control in producing products where quality costs have a positive relationship with the creation of quality products.

Quality Control Techniques

Control is carried out statistically using SPC and SQC has 7 statistical tools that can be used as aids in quality control (Heizer & Render, 2016) were:
1. Flow chart, is a diagram that shows all the steps in a process and shows how to move it to interact with each other.
2. Pareto chart, is a chart which contains a bar chart and a line chart. Bar charts show data classifications and values, while line charts represent cumulative data totals.
3. Check Sheet, this tool is used to facilitate the process of collecting data for specific purposes and presenting it in a communicative form so that it can be converted into information.
4. Cause and Effect Diagram, is a tool used to identify the relationship between cause and effect in order to find the root cause of the problem, usually called by the name of fish bone diagram.
5. Histogram, which is used to show the distribution of frequencies. A frequency distribution shows how often each different value in a data set occurs.
6. Control Chart, is a chart used to determine whether a process is in-control or out-of-control.
7. Scatter diagram, is a graph showing a pair of numerical data in the Cartesian coordinate system, with one variable on each axis, to look at the relationship of two variables.

Six Sigma (DMAIC)

According to Moore (in Ploytip Jirasukprasert, 2014) six sigma is a statistical term that characterizes quality that has <3.4 defects per million for a given product or process specification. Six sigma has become a methodology for reducing process variability in such a way that the result is better quality and consistency and better performance.

Harmon (2019), most of the projects six sigma are organized based on an approach known as the DMAIC process. DMAIC stands for Define, Measure, Analyze, Improve, Control:

1. Define is the first operational step in the quality improvement program Six Sigma. Define is the phase of determining the problem, establishing customer requirements and building the team. At this stage, what is done is to identify the problem.
2. Measure in this second stage, namely obtaining data to validate and qualify problems and opportunities.
3. Analyze analysis is an unpredictable DMAIC stage because the tools used in implementing the analysis will depend a lot on the problem and the existing process and how to approach the problem.
4. Improve is the stage improve is the stage to make improvements to the work process by first discussing the right ideas based on the results of the analysis carried out in the previous stage.
5. Control is if the implementation has been carried out and the results have seen improvements, then a control stage is needed.

MATERIALS & METHODS
Method of collecting data

Collection methods are carried out using the following:

1. Observation method, namely direct observation of the production process and actual events in the field.
2. Brain storming, namely by interviewing managers, supervisors, QC operators and production tailors.
3. Documentation, which is the historical data collection needed to measure the initial conditions of the implementation process of the six sigma DMAIC that will be carried out.

Population and Research Sample

Population in this study is all the data reject for production as a Thermal Bag result of the QC process carried out by PT XYZ. This study uses a sampling technique for sample saturated with the data of the study population during the period January 2019 to December 2019.

Table 2. Population and Sample Data

Months (2019)	Total Production	Total Reject
January	10,461	421
February	9281	567
March	8196	420
April	8815	1002
May	8,045	531
June	7,690	446
July	12,694	827
August	9,653	758
September	8,706	1,057
October	1,079	120
November	2,432	426
December	1,013	692
Total	**88,065**	**7,267**

RESULT
Define

The data that will be used in this research are production data for 12 months from January to December 2019 in the form of total production and total types reject. This stage is the object identification stage where the researcher determines the object to be used regarding products thermal bag that experience rejects exceeding tolerant limits.

Table 3. Reject Data

Month	Number of Production	Reject Stitches	Reject Dirty	Reject Bad Accessories	Reject Cutting Pattern	Reject Torn Bag	Total Reject
January	10,461	298	7	87	4	25	**421**
February	9,281	289	57	90	78	53	**567**
March	8,196	220	50	50	57	43	**420**
April	8,815	321	229	176	157	119	**1002**
May	8,045	380	51	53	24	23	**531**
June	7,690	220	82	56	56	32	**446**
July	12,694	469	99	106	105	48	**827**
August	9,653	388	208	30	104	28	**758**
September	8,706	576	317	25	89	50	**1057**
October	1,079	33	25	27	20	15	**120**
November	2,432	158	98	70	45	55	**426**
December	1,013	231	230	56	76	99	**692**
Total	**88,065**	**3,583**	**1,453**	**826**	**815**	**590**	**7,267**

Measure

The production process thermal bag plays an important role in quality control and improvement, therefore researchers collect several CTQs that often occur and have the potential to affect the quality of the thermal bag produced in the production process.

Table 4. Frequency Types Reject of Product for Thermal Bag

No	Type of Reject	Frequency
1.	Neat Stitches	3583
2.	Dirty	1453
3.	Bad Accessories	826
4.	Cutting Bad Patterns	815
5.	Torn	590
	Total	**7267**

Table 5. DPMO Measurement Results and Levels Six Sigma

No	Month	Number of Production	Total Rejects	DPMO	Level Sigma
1	January	10,461	421	8048,944	3,9
2	February	9,281	567	12218,51	3,8
3	March	8,196	420	10248,9	3,8
4	April	8,815	1,002	22733.98	3.5
5	May	8,045	531	13200.75	3.7
6	June	7,690	446	11599.48	3.8
7	July	12,694	827	13029.78	3.7
8	August	9,653	758	15704.96	3.7
9	September	8,706	1,057	24282,1	3,5
10	October	1,079	120	22242.82	3,5
11	November	2,432	426	35032.89	3,3
12	December	1,013	692	136623,9	2,6

Size with a good pattern will resulting in DPMO which tends to decrease every month. The DPMO pattern that occurs in PT XYZ tends to be unstable and varies throughout the study time span. This is due to the increasing and decreasing number of defects produced in the production process thermal bag. With DPMO conditions as shown in table 4.5, the company must overcome the work system and routine checks to obtain a decreased DPMO value.

Analyze

Table 6. Analysis the Causes of Stitch Defects

Factors	Sub-Factor	Analysis
Environment	Temperature Room Heat	Limited area and capacity of tailors quite a lot makes the air circulation not good and makes the room work hot enough
Machine	Broken Machine High	Intensity of use makes the machine easily damaged and requires time to replace spare parts, not to mention repairing machine spare parts takes time and repairs are sometimes less than optimal
	Broken	Use needles sewing too often can cause the needle to break, and if there is no replacement needle, sometimes the tailor uses the existing needle if the stock of the needle has not arrived so the stitches are not neat
Manpower	Lack of Concentration	Already with his job, resulting in employees being less enthusiastic about work and paying less attention to the quality of the stitches they are working on.
	Deadline	Employees do their work in a hurry because it is caused by employees meeting deadlines or production targets so they pay less attention to the quality of their work.
	Less Skilled	Employees' unskilled skills are inseparable from the wages they receive, most of the employees recruited are fresh graduates or former home tailors.

Table 7. Analysis the Causes of Dirty Bag

Factor	Sub Factor	Analysis
Manpower	Careless	Indicator usually occurs when negligence causes employee's hands dirty because due to the persistence of the employees who eat and drink while working
Materials	Fabric Reject Of Supplier	On this indicator the causes of the problem that is caused by the fabric congenital dirty or raw material is received that has a stain section specific section
Machine	Dirty Machine	There is an indicator of the cause of the quality problem of the dirty cloth due to exposure to lubricating engine oil. This usually occurs when repairs to machines and machines are carried out directly for the production process

Table 8. Analysis the Causes of Bad Accessories

Factors	Sub Factors of	Analysis
Manpower	Less Accurate when QC	Indicators of negligence usually occur when employees do not focus on their work. The many types and quantities of accessories that will be installed on the bag cause employees to not be able to see or select items that are not suitable for use
Materials	Accessories Reject from Suppliers The	Indicator that causes this error is because the materials and goods sent from suppliers are bad and not suitable for use

Table 9. Analysis the Causes of Cutting Defects Pattern

Factors	Sub Factor	Analysis
Manpower	Careless	Indicators the cause of negligence usually occurs when employees are not focused on their work. The contributing factors are job deadlines and targets to meet production demand. The effect is that employees feel tired and chatting causing negligence in work
Machine	Machine Too Frequently Used	There are indicators that cause cutting quality problems that do not match the pattern is because cutting machines are often used so that several times they have to change blades and if the replacement spare parts have not arrived several times cutting using scissors so that the pattern is not neat.

Table 10. Analysis the Causes of Torn Bags

factor	Sub factor	Analysis
Manpower	Careless	Indicators negligence causes usually occur because of human error when doing repairs products or carelessness when sewing or overturning, and also because of employees who ignore the instructions that have been given.
Material	Fabric Defects	Indicator of the cause of this error is because indeed the materials and goods sent from the supplier are bad and unfit for use or because lack of k Employee research in conducting raw material inspections

Improve

In this stage the researchers used the 5W + 1H method (what, who, where, when, why and how) on each problem.

Table 11. Analysis Table 5W + 1H of Stitch Defects

Time (when)	Reject that occurs (What)	Source of reject (Where)	Root of the problem (Why)		Proposed Repair (How)	PIC (Who)
			Factors Cause	Occurrence Reject		
During the sewing process	Suture defects	Tailor area of bag production process	Environment	Limited space and sufficient capacity of tailors to cause poor air circulation	Will be discussed with management to expand the working area. For the time being will buy a fan and exhaust to facilitate air circulation	Manager, BOD
			Engineering	Intensity high usage makes the machine easily damaged and takes time to replace the spare parts	Perform service repairs the machine regularly and optimally by checking the machine every day	The Head of Production
				Use a sewing needle Too often it can cause the needle to break, and if there is no replacement needle sometimes the tailor uses the existing needle if the stock of the needle hasn't arrived so the stitches are not tidy. There is	An inspection of every raw material that comes by providing a check sheet to the QC team	Head of Production and the QC Team
			Human	Employees feel tired with their work, resulting in employees paying less attention to the quality of the stitches they are working on	Cleaning the work area and machines before and after	Production
				Using employees do their work in a hurry because it is caused by problems. Employees chasing deadlines or production targets	Alternative chosen, namely by providing rewards additional to employees who have high productivity along with good quality work	Manager and Head of Production
				Most of the employees recruited are fresh graduates or former home tailors who	Will be given training or training for old employees and employees who just entered the	Manager and HRD

Table 12. Analysis Table 5W + 1H Reject Dirty Bag

When it occurs (When)	Reject occurs (What)	Source of reject (Where)	Root of the problem (Why)		Proposed Repair (How)	PIC(who)
			Causes	**The cause Reject**		
During the execution of the production process	Materials bag dirty	Occurred in the production process purse	Human	Occurs when the employee's hands dirty because due to the persistence of the employees who eat and drink while working	Inspection during working hours, directing employees to before work better breakfast first, and give strict sanctions if there are employees who violate the	Head of Production
			Material	With cloth or dirty materials or raw materials received have stains in certain parts of	The inspection of each raw material that comes by providing a check sheet to the QC team section	Of the Production Head and QC Team
			Machine	Dirty cloth due to exposure to lubricant engine oil	Cleaned the work area and the machine before and after using it	Production employees

Table 13. Analysis Table 5W + 1H Reject Bad Accessories

Time occurs (When)	Reject occurs (What)	Source of reject (Where)	Root Problem (Why)		Proposed Improvement (How)	PIC (Who)
			Factors Cause	**The cause reject**		
During the production process	Bag accessories / bad	Occurs in the production process and QC of bags	Human	Number of types and quantities of accessories that will be installed on the bag causes employees to not see one by one the goods arrive	Using the check sheet de do not take random sampling and will create a new SOP	QC Team and manager
			Material	Because indeed the materials and goods sent from the supplier are bad and not suitable for use	Doing a deal with the supplier if there is a reject item that exceeds the specified limit it will look for another supplier	Manager

Table 14. Analysis Table 5W + 1H Reject Cutting Patterns

Time occurs (When)	Reject occurs (What)	Sources of reject (Where)	Root of the problem (Why)		Proposed Repair (How)	PIC (Who)
			Factors Cause	**Cause of Reject**		
During the implementation of process cutting	Cutting pattern reject	Occurs in process cutting	Human	Employees do not focus on their work, employees feel bored and chat, causing carelessness in working	Alternatives chosen, namely by providing additional rewards to employees who have high productivity accompanied by good work quality	Manager and Head of Production
			Methods there are	Many patterns for several types of thermal bags so that lack of briefings if there are new patterns. Pattern purse that much is because the bag thermal there are 5 types	Do briefings whenever there is a pattern a new bag for the new season and did groove sampling properly so there was not some issue of production	Head of Production and the team QC
			Machine	Cutting machine is often used so that several times had to replace the blade and if spare a replacement is yet to come several times happen cutting using scissors so as to make a pattern that does not neatly	Perform service repairs the machine regularly and optimally by checking machines daily	Production personnel

Table 15. Table Analysis 5W + 1H Torn Bags

Time occurs (When)	Reject happened (what)	Source of the reject (Where)	The root cause (Rev.)		Proposed Improvements (How)	PIC (who)
			Causes	**The cause reject**		
During the execution of the production process	Bags torn	Occurred in the production process and QC bag	Humans	Usually occur because of human error when doing product repair and careless when performing sewing, and also for their employees who ignore the instructions already given	Using a check sheet to control	Team QC and Head of Production
			Material	Because materials and goods delivered from suppliers ugly and unfit for use	Perform deal with suppliers if any reject goods exceed the specified limit, they will look for other suppliers	Manager

CONCLUSION
Conclusion

Total number of goods reject in 2019 was quite high, amounting to 12,118% of the total number of production thermal bag. This phenomenon indicates a problem that occurs during the production process. The factors causing the reject after the analysis using the fishbone diagram method and 5w1h resulted in the identification of the causes of reject, namely human, machine, material, method and environment factors.

The identification of several factors that cause reject indicates a lack of control in controlling the quality of the goods produced so that they get dpmo and unstable sigma levels and tend to change every month.

Researchers provide recommendations for improvement proposals by improving and designing new sop methods in the work process, designing actions related to material quality by tightening supervision and holding documentation on each procurement by checking using check sheet tools.

Recommendations

Companies can improve quality control by making improvements in terms of raw materials, machines and human resources when the production process is in progress so that control in the process can be implemented. Conduct comprehensive outreach to related divisions as well as provide comprehensive retraining to these divisions and carry out regular control to find out the results. Make work agreements with suppliers to get commitments in the procurement of material goods for production so that employees can be helped when doing QC. And the company should implement the recommendations for improvement given by researchers and consider the results of the proposed improvements.

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