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Quality Improvement for Sleeve Shirt X Using Lean Six Sigma Approach at PT X

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ABSTRACT: PT X, a key player in the garment industry, faces operational challenges, including inefficient motion in packing and product defects. Current state analysis reveals a lead time of 3,424.90 seconds, with a value-added time of 3,054.90 seconds. Direct observations attribute motion wastage during packing to suboptimal hand movements, stemming from inadequate training in motion time measurement. The future state map proposes packing process improvements through motion time measurement, reducing time from 87.27 to 86.32 seconds, with a lead time of 3,423.95. From January to December 2014, total production reached 239,359 units, with 30,702 defective products. The main defect, stitch breakage in short-sleeved shirts 'X,' occurred 15,386 times. Current process capability stands at 3.690 Sigma. Using the 5W+1H method, addressing the root cause of stitch breakage reduced defects to 15,316, with process capability improving to 3.952 Sigma, a 0.262 improvement. Post-improvement analysis estimates an added value in quality costs at Rp1,943,297,372. Lean Six Sigma implementation aims to minimize defects and lead times, enhancing profitability.

KEYWORDS: Lean Six Sigma, DMAIC, Motion Time Measurement, 5W+1H method

INTRODUCTION

The Kaizen word comes from Japan and means improvement. Initially, the Kaizen term was only used within Japanese companies gradually. Kaizen is disseminated globally and exported to continuous improvement standards in ISO 9001: 2015 [1]. Continuous improvement activities are active that mechanical production companies always love the top. Combining the DMAIC cycle in the Lean 6 Sigma method into improvement has been applied with tea a company calls this improvement from Quality Control Story Action or calling by Quality Control Cycle [2]. The clothing industry is labor-intensive and has a relatively low requirement for fixed capital as a result entry into the clothing industry is relatively easy [3]. Among the textile and garment sector, the garment industry is the most labor and material intensive. The cost of production of the garment sector is more dependent on its labor and material consumption. The productivity and success of the garment factory mainly depend on the human factor. An improvement on the human factor in the garment operation process using the lean tool will have a considerable result in the overall performance of the garment [4]. The results of improvement activities provide a competitive advantage for competitors in the joint trading market and improve product quality with continuously improving to grow together with standards of new techniques. The results of improvement activities provide a competitive advantage for competitors in the joint trading market and improve product quality with constantly improving to grow together with standards new technical accompanying. In the current era of globalization, numerous manufacturing industries have emerged, producing similar products. This situation has led to increasingly fierce competition among companies in delivering high-quality products, compelling each company to compete globally in both national and international markets to enhance the marketing of their produced goods. One industry that consistently strives to improve the quality of its products to compete with others in a similar field is PT X. PT X is a company specializing in clothing products, catering to consumer, business, and industrial needs. PT X, within its production process, faces challenges such as wasteful defects and motions in producing short-sleeved shirts 'X'. Based on preliminary observation data obtained from PT X, the production output ranges from 200,000 to 250,000 pieces per period. Focusing on short-sleeved shirts 'X,' production data for January to December 2015 reveals 239,359 pieces, with 30,702 defective pieces, accounting for 12.81%. This can significantly impact the quality of PT X's products when competing with similar companies. In this study, the author employs the Lean Six Sigma methodology, emphasizing the reduction of lead time and production defects during the manufacturing process. Lean emphasizes process streamlining or efficiency, while Six Sigma is defined as a process that produces no more than 3.4 defective products in every one million opportunities (3.4 defects per million). The integration of Lean and Six Sigma aims to enhance performance through increased speed and accuracy (zero defects). Through the Define, Measure, Analyze, Improve, and Control (DMAIC) method within the Lean Six Sigma approach, companies can identify waste along the value stream, such as non-value-added activities like transfer and waiting, as well as the number of production defects. This approach enhances process speed and production quality within the company. The novelty and originality of the present study are: (1) a customized lean and six sigma is proposed for the Indonesia garment manufacturing industry. (2) The customized lean and six sigma implemented using DMAIC problem-solving method in the Indonesia garment manufacturing industry. (3) The efficiency of the customized lean and six sigma in reducing the quality problem and enhancing the productivity is proven through a real case study.

BUSINESS ISSUES

The clothing industry is labor-intensive and has a relatively low requirement for fixed capital as a result entry into the clothing industry is relatively easy [5]. Among the textile and garment sector, the garment industry is the most labor and material intensive. The cost of production of the garment sector is more dependent on its labor and material consumption. The productivity and success of the garment factory mainly depend on the human factor. An improvement on the human factor in the garment operation process using the lean tool will have a considerable result in the overall performance of the garment [6].

Lean manufacturing can be defined as "A systematic approach to identify and eliminate waste through continuous improvement by flowing the product at the demand of the customer" [7]. Lean manufacturing helps to identify productive and nonproductive activities. Productive activities focus on any activity that the customer will pay for value-adding to the product. Non-productive activities describe the customer does not consider as adding value to his product (i.e., waiting time, defective works and reworks, inspection time, wrong motion, improper transportation). Lean manufacturing improves productivity, save manufacturing cost and increase market competency [8] [9]. Six sigma is used to solve the problem of the high rejection of yarn cones in a garment company. It was found that variation in yarn length; yarn count, empty yarn container weight, and yarn moisture content were the root causes for this rejection [10]. Six sigma as a strategy for improvement and problem-solving methodology that can eliminate the root cause of effects [11]. Highlighted the potential of DMAIC six sigma in realizing the cost savings and improving quality by using the case study of a leading manufacturer of tools [12]. The study examined one of the chronic quality issues on the shop floor by utilizing Six Sigma tools. The study showed that the DMAIC Six Sigma process is an effective and novel approach for the machining and fabrication industries to improve the quality of their processes and products and ensuring profitability by driving down manufacturing costs [13]. Six sigma was described as business improvement approach that finds and eliminate defects or causes of mistake in processes. The concept of merging lean and six sigma can be traced back to 1997 when BAE Systems tried to combine lean manufacturing principles with six sigma. The company named their program lean sigma strategy to protect the market share in the aerospace industry [14]. They mixed, the Kaizen team with Black Belts planning at reducing variation within their processes. As a result, BAE systems achieved substantial improvements in productivity, lead time, savings, and reliability. In 1999 an effort to combine Lean manufacturing and six sigma was carried out by Maytag Corporation. The corporation re- engineered one of its production lines making use of the core concepts of lean manufacturing and six sigma by this approach the corporation reduced down manufacturing costs and achieved savings in million dollars [15]. Though six sigma is adept at identifying and eliminating defects, it does not address how to optimize the system by improving process flow. Lean methodologies, on the other hand, lack the statistical analysis required to achieve a truly "lean" system. By combining the lean and six sigma methodologies, aims to achieve total customer satisfaction and improved operational effectiveness and efficiency by removing waste and non-value added activities, decreasing defects, decreasing cycle time, and increasing first-pass yields [16]. However, a separately implementation of lean and six sigma methodologies often fail to lead to results that achieve the dramatic improvements that organizations desire. As a result, the integration of lean and six sigma is important for productivity improvement and to sustain the continuous improvement in manufacturing system [17].

METHODOLGY

In the production process, PT X faces challenges characterized by wasteful defects and inefficient motions in manufacturing short-sleeved shirts 'X.' Preliminary observations at PT X indicate that the produced items range from 200,000 to 250,000 pieces per period. Specifically, data for short-sleeved shirts 'X' in the study period from January to December 2015 reveals a production of 239,359 pieces, with 30,702 defective pieces, equating to 12.81%. This issue has the potential to impact the overall quality of PT X's products, affecting its competitiveness within the industry. This research employs the Lean Six Sigma methodology, focusing on reducing

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lead time and production defects during the manufacturing process. The Lean concept emphasizes streamlining or optimizing processes for efficiency, while Six Sigma is defined as a process that produces no more than 3.4 defective products in every one million opportunities (3.4 defects per million). The integration of Lean and Six Sigma is designed to enhance performance through increased speed and accuracy, aiming for zero defects. Through the Define, Measure, Analyze, Improve, and Control (DMAIC) method within the Lean Six Sigma approach, the company can identify waste along the value stream. This includes non-value- added activities like transfer and waiting, as well as the number of production defects. This comprehensive approach aims to improve process speed and production quality within the company, ultimately ensuring competitiveness in the market.

RESULT AND DISCUSSION

DMAIC Problem-solving Implementation Phases

Figure 1 depicts the procedure of implementation of DMAIC problem-solving methodology phases. The DMAIC implementation phases follows: Define (D), Measure (M), Analyze (A), Improve (I), and control (C) successive steps originated from six sigma concepts

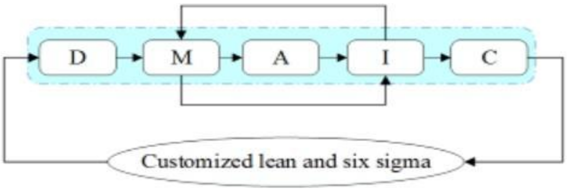

Figure 1. Schematic diagram of DMAIC problem-solving implementation flow chart

Define Phase

In this phase, the goals were defined to improve the current progressive bundle production system product flow in the production line. The most critical goals were acquired using the voice of customer method (i.e., supplier-input-process-output-customer (SIPOC)) as shown in Figure 2. These goals would be helpful for the betterment of the company to easily visualize and mapping of the product flow process from end to end. In addition, the goals also help to the early direct cause of defects and bring down the defect level in order to improve the quality of the product for a given production line.

Project Statement

- **The business case**, involves the prolonged completion time of the production process, attributed to the significant wastage and defects occurring throughout the manufacturing process.
- **Problem Statement**, the core issue in the company lies in wasteful motions during the packaging process and production defects in the cutting process, specifically occurring in the production of short-sleeved shirts 'X.'
- **Project Scope**, the project's scope focuses on resolving issues related to the production of short-sleeved shirts 'X' on Line A. The historical data considered spans from January to December 2014.
- **Goal Statement**, the primary objective is to enhance the quality of shirt 'X' by reducing non-value-added activities and minimizing the number of production defects associated with the product.
- **Project Timeline**, the research project commenced in March 2015, outlining the timeframe for the investigation and implementation of improvements.

Critical to Quality (CTQ

Based on the initial information gathered, the determination of Critical to Quality (CTQ) focuses on the characteristics of short-sleeved shirt 'X' that customers perceive as indicators of quality. The identified CTQs at PT X are as follows broken stitch, skip stitch, puckering, slanted stitch, pleating, stains (dirty/oil stain), holes/cuts, shading, missing label. These CTQs represent the key quality aspects that customers consider essential for the short-sleeved shirt 'X'. Addressing and improving these critical characteristics are crucial for enhancing overall product quality and meeting customer expectations.

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SIPOC(Supplier-Input-Process-Output-Customer)

SIPOC diagram is a diagram that illustrates information about the suppliers, inputs, processes, outputs, and customers involved in the production process. The SIPOC diagram for the production process of short-sleeved shirts x can be seen in Figure 2.

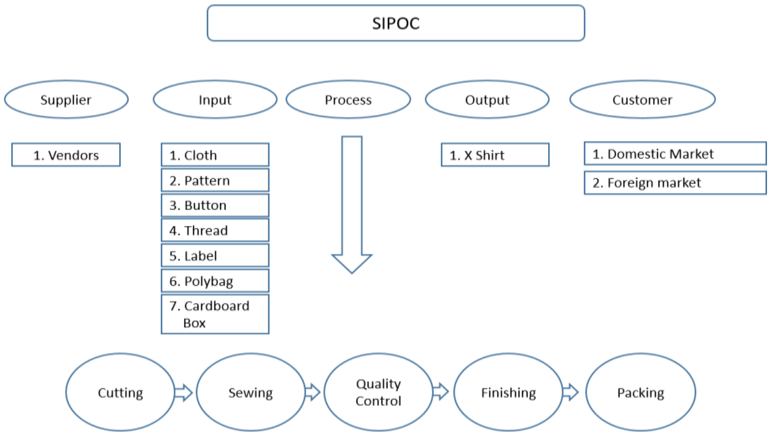

Figure 2. Supplier-Input-Process-Output-Custome

Measure Phase

Calculation of Cycle Time

The normal time calculation involves multiplying the process cycle time by the rating factor (Rf) to adjust the speed among operators, ensuring that the time taken is the operator's normal time. Standard time calculation is the time required for an operator to complete a unit of work with the addition of an allowance factor to the normal time. An example of the normal and standard time calculation in the cutting process, which involves material cutting, is as follows:

Cycle Time = 541.87 seconds Adjustment Factor = 0,8 Allowance = 20%

Normal Time = Cycle Time + (Cycle Time x Adjustment Factor)

= 541,87 + (541,87 x 0.8)

= 520,19 seconds

Standard Time = Normal Time + (Normal Time x Allowance)

= 520,19 + (520,19 x 20%)

= 624,22 seconds

For the summary of normal and standard times for other processes, please refer to Table 1

Table 1: Recapitulation of Standard Time Calculations

Process	Cycle Time	Adjustment Factor	Normal Time	Allowance	Standard Time
Cutting	541,87	0,08	585,22	20.00%	702,26
Sewing	1542.63	0,1	1696,9	19.00%	2019,31
Quality Control	61.36	0,08	66,26	21.50%	80,51
Finishing	121.08	0,13	136,82	21.00%	165,55
Packing	67.36	0,08	72,75	20.50%	87,66

Creating Current State Value Stream Mapping

Value Stream Mapping is a comprehensive depiction of a company's production process. Figure 3 illustrates the Current State Value Stream Mapping for short-sleeved shirt product x.

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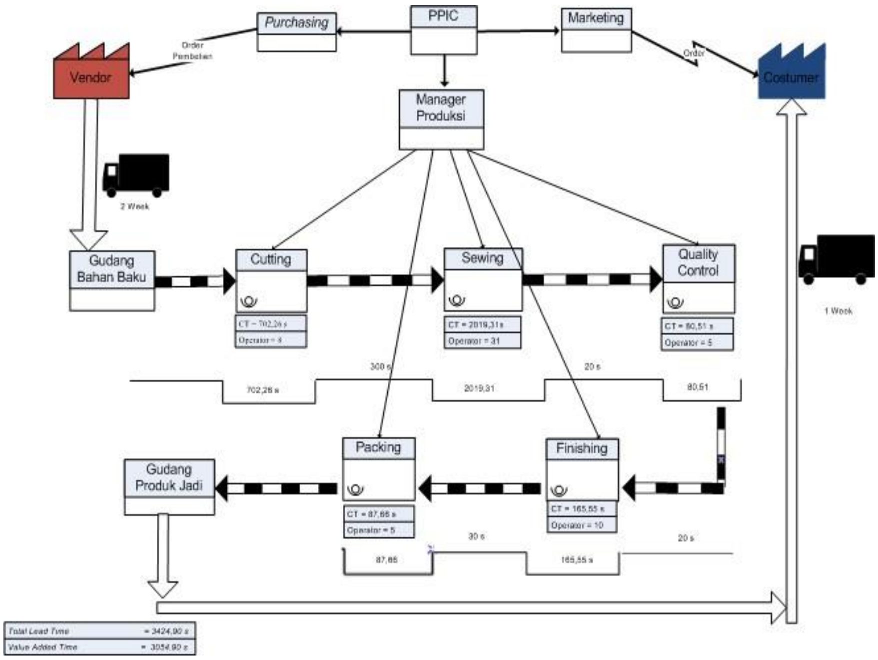

Figure 3. Current State Value Stream Mapping

The Current Value Stream Mapping depicted in Figure 3 explains the company's production process along with the time required for each production step. It is determined that the total lead time is 3.424,90 seconds, with a value-added time of 3.054,90 seconds. Process lead time is commonly utilized as a means to ascertain the duration of the production process for a quantity of goods from initiation to completion. With an average monthly production of 20.000 units, the determined process lead time is approximately 20 days. This figure indicates that, on average, the production process duration for short-sleeved shirt product x is 20 days. The calculated process velocity, representing the overall process speed to fulfill the average demand quantity, is 0,45 processes per day.

Control Chart and Sigma Level Before Improvement

To measure the discrepancies found per unit item from failure modes within the inspected group, a U control chart is employed. The U control chart for defects in the production process can be observed in Figure 4.

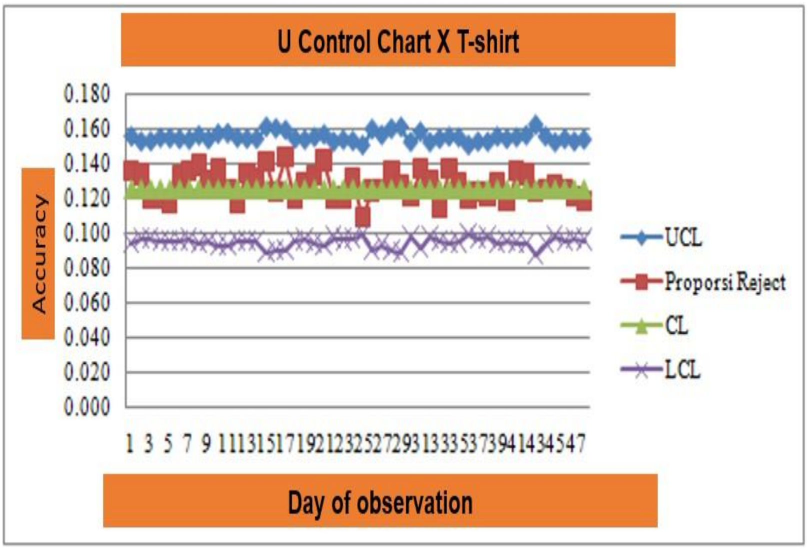

Figure 4. Control Chart for Defective Short Sleeve Shirt X

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Table 2: Sigma Level Calculation Before Improvement

Steps	Action	Equation	Calculation Results
1	What process do you want to assess?		X shirt
2	How many units are being examined?		239.353
3	How many defective units are there?		30.702
4	How many units pass the inspection?	Step 2 - Step 3	208.651
5	Calculate the results for the process defined in step 1	Step 4 / Step 3	0,87
6	Compute the defect rate based on step 5	Step 1 - Step 5	0,13
7	Identify the number of potential Critical to Quality (CTQ) characteristics causing defects.	CTQ Process	9,00
8	Calculate the defect rate per CTQ characteristic.	Step 6 / Step 7	0,01
9	Compute defects per million opportunities (DPMO).	Step 8 x 1 million	14.252,31
10	Convert DPMO into sigma values.		3,69
	Conclusion		Sigma capabilities ais 3,690

Based on Table 4 of the current sigma capability, the sigma capability value for the current production process of short-sleeve shirts, denoted as x, is determined to be 3.690 sigma. The corresponding Defects Per Million Opportunities (DPMO) is calculated to be 14.251,31.

Analyze Phase

The next step in the DMAIC method is Analyze. After measuring the existing process, the next crucial step is to identify any issues that may be occurring within the process. This is essential for making improvements to the existing process. Therefore, to initiate improvements, it is imperative to understand the factors influencing the process and determine which factors are considered most dominant.

Pareto Chart

Based on the data obtained from the production defect report for the period January 2014 to December 2014, it is summarized in Figure 5 as follows.

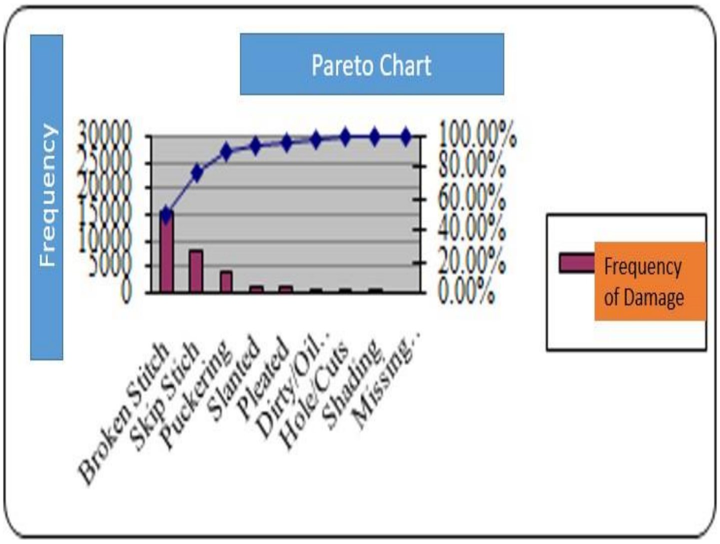

Figure 5. Pareto Diagram of Production Defects for Short Sleeve Shirts X

In Figure 5 it is known that the most dominant defect is the broken stitch defect at 50.11%. Based on Figure 5. it is known that the highest production defect is broken stitch. The factors that cause production defects are human, machine, material, method and environmental factors. Identifying the root of the problem can be done using a cause-and-effect diagram (fishbone diagram) as follows

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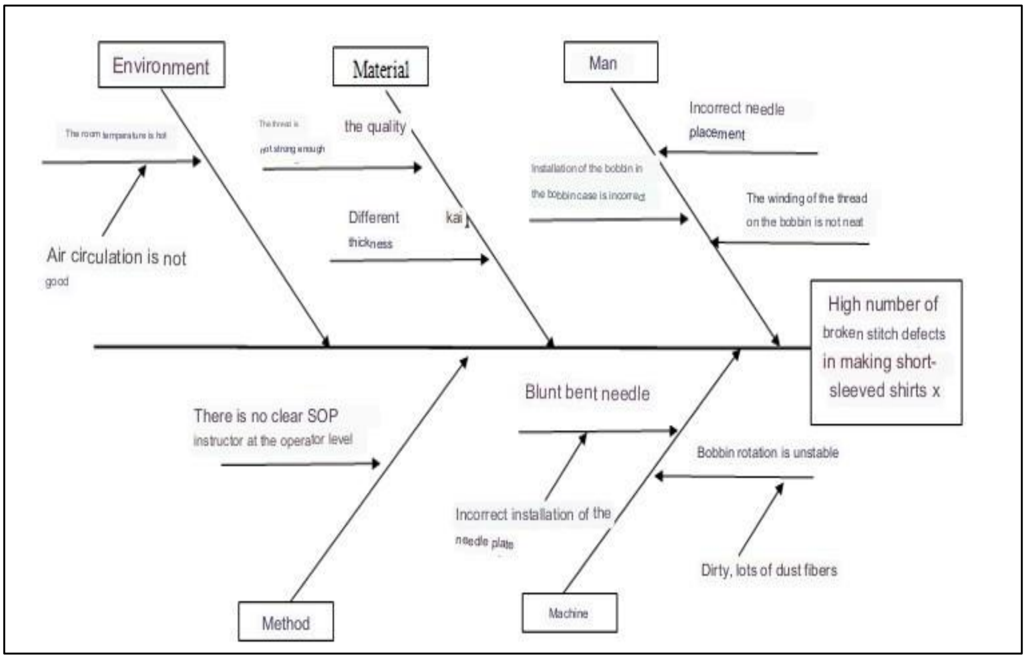

Figure 6. Cause and Effect Diagram of Broken Stitch Defect

Improve Phase

After carrying out the analysis stage, the next stage is to carry out the improvement stage. The improvement stage can be interpreted as continuous or gradual change. At this improvement stage, the tools used are the 5W+1H diagram, targets for achieving sigma capabilities, improvement costs and creating future state mapping.

The main factors that cause production defects are humans, equipment (machines), and methods. Once the factors that cause the production defects are known, repairs are carried out. The dominant factor that causes production defects is the production operator. This happens because the majority of the production process is carried out by humans, therefore it requires tenacity, precision and discipline from each operator by providing supervision. Suggestions for improvements that can be made to reduce product defects that occur due to the machine are by checking and cleaning the machine both periodically and when starting the process. Making a regular schedule needs to be done to help with regular machine maintenance. The method used on the production line is still not appropriate because many operators do not understand how to use needle size for the type of thread and fabric used. Suggestions for improvements that can be given to reduce production defects on the production line are to carry out SOPs correctly. For materials, the Research and Development department should provide standards for the use of yarn so that the production process can run smoothly. In the environment so that the room temperature remains in accordance with standard dining room temperature conditions, air ventilation is created.

Determine targets for achieving Sigma capabilities after improvement

After carrying out improvements regarding the root cause of the product defect problem, it is assumed that the broken stitch defect problem is no longer found, and there has been a decrease in product defects from 30,702 to 15,316, but further measurements are still being carried out to find stable conditions and standard process capabilities in control quality.

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Table 3: Sigma Level Calculation after Repair

Steps	Action	Equation	Calculation Results
1	What process do you want to assess?		X shirt
2	How many units are being examined?		239.353
3	How many defective units are there?		15.316
4	How many units pass the inspection?	Step 2 - Step 3	224.037
5	Calculate the results for the process defined in step 1	Step 4 / Step 3	0,94
6	Compute the defect rate based on step 5	Step 1 - Step 5	0,06
7	Identify the number of potential Critical to Quality (CTQ) characteristics causing defects.	CTQ Process	9
8	Calculate the defect rate per CTQ characteristic.	Step 6 / Step 7	0,01
9	Compute defects per million opportunities (DPMO).	Step 8 x 1 million	7.109,91
10	Convert DPMO into sigma values.		3,95
	Conclusion		Sigma capabilities ais 3,95

Based on Table 5, it is evident that the sigma capability value after improvement is 3.95, whereas before the improvement, the sigma capability only reached 3.69. There has been an increase in sigma capability by 0.262. A better process is achieved after the improvement; however, the Management still needs to continuously enhance the process capability to reach the 6-Sigma level, which produces only 3.4 defects per million opportunities (DPMO).

Estimated Quality Cost Calculation

After improving the quality on line A, the process capability (CP) was 93.6% from the previous process capability of 87.1%, thereby increasing the process capability by 6.5%, thereby reducing quality costs in the process of making sleeved shirts. short x.

Table 4: Comparison of Quality Costs before Repair and After Repair

Quality Costs Before Repair	Quality Costs After Repair
Rp. 3.869.909.334	Rp1.923.250.000,-

Making Future Value Stream Mapping

In initial observations made on the company's work processes, there was waste of movement in the packing process which resulted in longer lead times. This happens when the process of picking up shirts that will be put into a polybag, the operator carries out the process by picking up the shirts one by one, which is a wasteful activity which results in longer process time and results in the operator being less productive. Based on these problems, the process of creating future value stream mapping was carried out using improved left and right hand maps

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PETA TANGAN KIRI DAN TANGAN KANAN SETELAH PERBAIKAN

PETA TANGAN KIRI DAN TANGAN KANAN
Metode Motion Time Measurement

Pekerjaan : Packing
Departemen : -
Nomor Peta : 1
Sekarang : Usulan ☑
Dipetakan Oleh : Albertus Nono Sutrisno
Tanggal Dipetakan : 5-Juli-2015

Km = Kemeja
P = Pola
K = Kantong
B = Box

Meja Kerja
KM 20cm
P 20cm
K 25cm
B 40cm

No.	Elemen	Tangan Kiri			Tangan Kanan			TMU		
		Aktivitas	Notasi	TMU	TMU	Notasi	Aktivitas	Pilihan	Wn	Wb
1	**Packing baju**	**Mengambil Kemeja:**		**21.70**	**21.70**		**Mengambil Pola:**	**21.70**	**0.78**	**0.94**
		* Menjangkau	R5A	7.90	7.90	R5A	* Menjangkau			
		* Memegang	G1A	2.00	2.00	G1A	* Memegang			
		* Membawa	M8C	11.80	11.80	M8C	* Membawa			
		Proses Melipat Kemeja :		**50.00**	**50.00**		**Proses Melipat Kemeja :**	**50.00**	**50.00**	**60.25**
		* Melipat Baju					*Melipat Baju			
		Memegang Kemeja		**0.00**	**27.30**		**Mengambil *Polybag* :**	**27.30**	**0.98**	**1.18**
		* Memegang	G5	0.00	7.90	R10A	* Menjangkau			
					2.00	G1A	* Memegang			
					11.80	M8C	* Membawa			
					5.60	P1S	* Mengarahkan			
		Proses Memasukan Kemeja ke Polybag :		**19.00**	**19.00**		**Proses Memasukan Kemeja ke Polybag :**	**19.00**	**19.00**	**22.90**
		Menganggur			**24.30**		**Membawa Kemeja Jadi ke Box**	**24.30**	**0.87**	**1.05**
					18.70	M16C	* Membawa			
					5.6	P1S	* Mengarahkan			
					2.00	RL1	* Melepaskan			
								Total	**71.64**	**86.32**

Faktor kelonggaran :
* Tenaga yang dikeluarkan (Sangat Ringan) = 6%
* Sikap Kerja (Berdiri diatas dua kaki) = 1%
* Gerakan kerja (Normal) = 0%
* Kelelahan mata (Pandangan yang hampir terus menerus) = 6.5%
* Keadaan temperatur tempat kerja (normal) = 5%
* Keadaan atmosfir (baik) = 0%
* Keadaan lingkungan yang baik (Bersih, cerah, dengan kebisingan rendah) = 0%
* Kelonggaran untuk kebutuhan pribadi (Wanita) = 2% +

20.50%

Wn = Total TMU konversi = 71.64 dtk

Wb = Wn x (1 + N%)
= 71,64 x (1 + 20.5%) = 86.32 dtk

Based on the right hand and left hand map calculations above, it is known that the previous packing process time was 87.27 seconds with a lead time of 3.424,90 seconds. reducing the packing process time to 86,32 seconds with a lead time of 3.423,95 seconds. So, after the improvements were made, there was a time difference of 0.95 seconds.

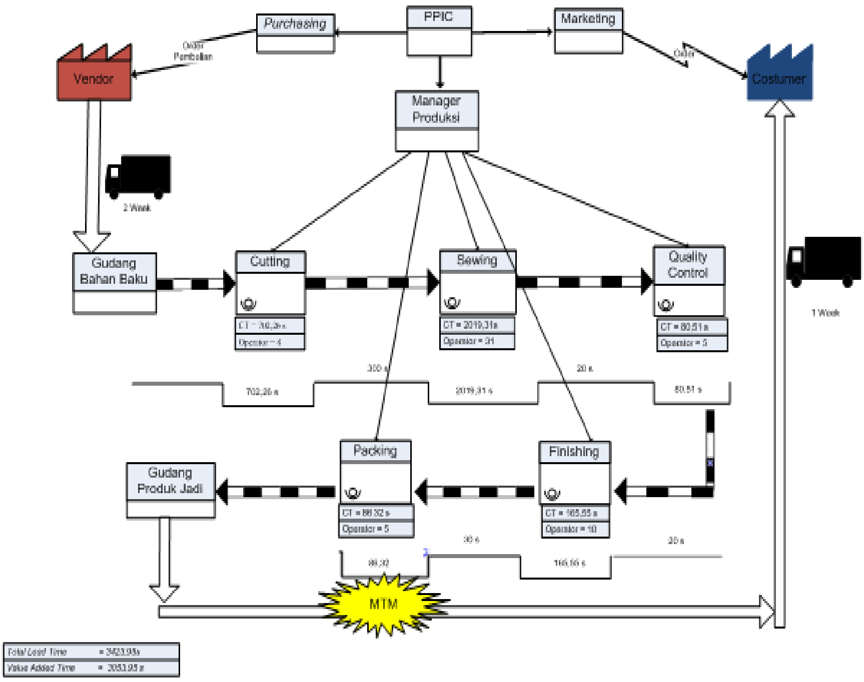

Figure 7. Future State Value Stream Mapping Production Process for Short Sleeve Shirts

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Control Phase

The control stage is the final step in the DMAIC (Define, measure, analyze, improve, control) process. This stage is an activity to ensure that improvements are continuously controlled. This stage requires process supervision and corrective action if necessary to overcome problems and bring the process back to stable performance. The following are the actions taken to carry out control:

- Supervise operator performance by creating Poka Yoke. Poka Yoke or also called an anti- error tool is a tool or mechanism created with the aim of preventing human error or human error by making the possibility of the error aware of before it is made.
- Carry out routine checks in each operational area on control items that have been created including work methods applied by operators, application of cleanliness standards, checking product quality, whether it complies with existing standards.

CONCLUSION

Based on the results of observations, there are nine types of defect classifications that occur in the manufacture of short-sleeved shirt x products at PT X, namely Broken Stitch, Skip Stich, Puckering, Slanted Sewing, Folded Sewing (Pleated), Dirty (Dirty/Oil, Stain), Hole/Cuts, Striped (Shading), Wrong Label (Missing label). It is known that the most dominant defect is Broken Stitch at 15,386. After making improvements by increasing product quality, the result was that there was a reduction in the number of product defects from the current state of 30,702 to 15,316. Capability Process (CP) also increased from the current condition of 3,690 Sigma and after improvements to 3,952 Sigma. After finding waste in the packing process, a proposal for improvement was proposed using motion time measurement. It was found that the previous packing process time was 87,27 seconds with a lead time of 3.424,90 seconds. After the process improvements were made, the packing process time decreased to 86.32 seconds. Seconds with a lead time of 3.423,95 seconds. After making improvements to improve the quality of short- sleeved shirt x products, the result was a reduction in the number of defects in broken sewing products from 30.702 pieces to 15.316 products. It is known that the costs incurred will of course reduce quality costs to Rp1.943.297.372,00.

RECOMMENDATION

Unfortunately, providing specific recommendations requires deeper knowledge of the particular issues identified during the Define and Measure stages of the DMAIC process. However, based on the generic context you've provided, here are some potential areas for improvement:

Fit

1. Optimize size charts: Analyze customer fit feedback and sales data to ensure size charts accurately reflect customer body types. Consider offering more size options or customized sizing solutions.
2. Improve pattern drafting: Evaluate the pattern development process to ensure proper fit across different sizes and body types. Utilize advanced software or collaborate with experienced patternmakers.
3. Invest in adjustable features: Implement design elements like darts, pleats, or adjustable straps to allow for a more personalized fit.

Stitching

1. Standardize sewing parameters: Define optimal stitch length, tension, and type for different fabrics and seam types. Train operators on consistent execution and implement automated sewing machines where feasible.
2. Improve material handling: Ensure proper fabric feeding and tension control during sewing to prevent puckering and distortion. Consider upgrading equipment or implementing tension control devices.
3. Implement stricter quality control: Conduct thorough inspections at key stages of the sewing process and implement clear defect identification and removal procedures.

Material

1. Source consistent materials: Partner with reliable suppliers who offer fabrics with consistent thread count, weight, and shrinkage properties. Conduct pre-production material testing to ensure quality standards.
2. Optimize cutting layouts: Utilize efficient cutting layouts to minimize fabric waste and ensure fabric grain alignment for 0
3. Consistent performance and appearance.
4. Explore alternative materials: Consider using wrinkle-resistant, moisture-wicking, or stretch fabrics to offer additional

functionality and customer appeal.

Process

1. Streamline production flow: Identify and eliminate bottlenecks or non-value-added activities in the production process. Implement lean manufacturing principles for continuous improvement.
2. Invest in equipment maintenance: Develop a preventative maintenance program for sewing machines and other equipment to minimize downtime and ensure consistent quality output.
3. Empower employees: Train and empower operators to identify and address potential quality issues at their workstations. Implement employee engagement initiatives to encourage ownership and proactive problem-solving.

Remember

1. These recommendations are general suggestions and should be adapted to the specific needs and limitations of PT X.
2. The DMAIC process is iterative, so be prepared to refine and adjust your solutions based on ongoing data analysis and feedback.
3. Continuous monitoring and improvement are crucial for sustaining success in quality management.

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