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FIBRES & TEXTILES in Eastern Europe
Research Article • DOI: 10.2478/ftee-2022-0005 FTEE • 151(2) • 2022 • 35–46

Prioritisation and Analysis of Faults in Shirt Production by the A3 Technique

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Abstract

In this study, it was aimed to solve the problems occurring in a clothing company's shirt manufacturing line. For this Pareto charts and A3 reporting philosophy were used to organise the process in the best way. In line with the examinations and analyses made, an apparatus was developed to shorten the unit time and standardise the quality for the collar preparation process, which is the fault with the highest frequency. Afterward, the collar preparation process was compared according to the situation with the apparatus, manual and automat. As a result of the implementation of the Pareto charts and A3 reporting technique, it can be seen that while the total time spent on the process with the automat is 24.6 seconds, this time is 87% quicker than the apparatus developed, which is 46.2 seconds; however, it needs 95% more investment.

Keywords

New collar preparation technique, shirt production, Pareto chart, A3 technique, productivity, standard times.

1. Introduction

The A3 problem-solving technique, which is the core of the lean management system, provides a guide to find answers to the questions of "who, what, when?" for dealing with the current situation, finding the root causes of the issues, and finding various solutions to these root causes as a process and a mindset. While in the traditional management approach, simple solutions are brought to problems encountered to save the day. Within the A3 technique, permanent solutions are obtained through more profound insight into the problem or systems created to prevent problems by taking pre-measures and precautions. This thinking approach ensures that everyone in the organisation proceeds in the same direction by gaining the support and understanding of the individuals in the organisation. It is widely known that today's product life curves have been shortened, and product diversity has increased. Lean thinking has become even more critical to cope with today's competitive environment. In order to ensure the permanence of the practices, this philosophy must become a part of corporate culture in the managerial sense.

This study aims to solve the problems that occur in apparel production with the aid of Pareto charts and A3 reporting philosophy, as mentioned above, and to organise the process in the best way. The following studies can be given as examples of comparative studies carried out until today.

In a study conducted by Şeker in 2019, the advantageous and disadvantageous aspects of the A3 reporting technique compared to the Obeya and SMED techniques were discussed within a theoretical-based approach [1]. In a book review conducted by Morgan and Liker (2006), the importance of the A3 reporting technique in the Toyota production system was mentioned. According to the study, the essential features were cited as follows: the A3 technique gets to the bottom of identified faults and eliminates problems completely [2]. Akay, Tiryaki, and Çelebi discussed lubrication and packaging processes in the metal industry. In this study, the faults encountered in lubrication and packaging processes were handled and evaluated through the A3 technique [3]. In a study conducted by Kara in 2018, the problems encountered in an aircraft assembly area were discussed. Pareto analysis was used to prioritise the problems identified [4]. In a master's thesis undertaken by Gülsün in 2006, the ERP-enterprise resource planning installation in companies operating at the international level was examined, and problems encountered in the installation of this system were analysed statistically [5]. In a study conducted by Çakırkaya and Acar in 2016, the significance of the faults encountered in a production line was determined by Pareto charts, which is one of the statistical process control techniques [6]. In a study by Ala and İkiz in 2014, Pareto charts was used again in determining the prioritisation of fabric defects that occurred during the weaving production process [7].

In this study, the production lines of a clothing company were studied, and faults encountered during the production were determined. Analyses were conducted with the help of Pareto charts considering the frequencies of these faults and the faults that needed prior consideration were identified. The root causes of the most common fault were determined within the A3 technique. Based on these analyses, a manufacturing apparatus was developed to make it easier to eliminate the fault mentioned in the processes. The effects of these apparatuses on the manufacturing processes were examined in terms of time, quality and cost. Moreover, necessary investigations were conducted accordingly.

2. Material-Method

2.1. Material

The material of this study consisted of the shirt production line of an apparel company that is engaged in export-oriented production activities. 6 different shirt sewing lines were observed to collect data during one month (22 working days). All the faults and their effects encountered during this monitoring were recorded.

2.2. Method

The types of faults occurring during the investigations were prioritised through Pareto analysis, which is one of the statistical process control techniques. Afterward, the most important one was addressed through the A3 problem-solving technique, and improvements were generated to handle and solve the problem accordingly.

2.2.1. Pareto Analysis

Pareto analysis was revealed by Vilfredo Pareto (1848-1923) in the 19th century, claiming that 20% of the population in the country where he lived possessed 80% of all income, where the remaining 20% of the income was shared by 80% of the population [4]. Today, this method is used to classify alternatives according to their importance and to make decisions in this direction. In other words, it is a method that enumerates alternatives from the most common to the rarest one.

Therefore, the method provides the possibility of statistical analysis of data and presents relevant data in turn; it is widely used today by planning engineers and managers. In this study, Pareto analysis was used to draw attention to the most crucial alternative in a batch of multiple alternatives.

2.2.2. A3 Technique

After determining the most common fault type, the A3 technique was used for the minimisation or elimination of it. As stated above, this is a problem-solving technique that results from the lean manufacturing process. A3 thinking deals with the root of the problem by providing deeper insight into the current situation, and determining the root cause of the problem. Accordingly, this method prepares an implementation plan meticulously and then repeats this cycle.

The report developed within the aforementioned method's scope describes the current and also improved situation in the enterprise, resulting from the measures taken for the improvements. In general, An A3 report should follow from the top left to the bottom right to tell a story that anyone will understand. Reports do not simply specify a target or define a problem in a static or isolated manner. Like any story, an A3 shares the whole story. There is a beginning, development, and end where the specific elements are sequentially linked. Therefore, a completed A3 follows a path from the general situation and definition to a solution, leading to a conclusion [8]. An A3 report includes the following elements.

Title: Defines the name of the problem, theme, or topic.
Owner/Date: Determines the "owner of the problem or subject and the date of the last revision.
Current Status: Explains what the person already knows about the problem or topic.
Current Status Map: Describes the process of the operation.
Definition of the Problem: The problem is defined.
Analysis: Analyses the situation and the underlying causes that make up the difference between the current state and the desired output.
Aims / Objectives: Defines the desired output.

Suggested Countermeasures: Suggests corrective actions or countermeasures to solve the problem, close the gap, or achieve the goal.

Plan: Indicates an action plan on who, what, and when to achieve the goal.

Monitoring: Creates a review/learning follow-up process and anticipates remaining issues.

These A3 elements follow each other in a natural and logical sequence. The connections within the problem, the root causes of the problem, the purpose, the activities proposed to achieve the goal, and the means for assessing success should be clear and easy to understand [8].

3. Findings

Faults detected resulting from the examinations, the explanation of them, and their effects are shown in the following Table 1.

The faults encountered are handled on a line basis. These faults are sorted within the machine and human factors, shown in the following figure in terms of daily checked quantity, number of working days, the total number of controls, total number of faults encountered, and common fault types.

While determining the faults to be examined, the above data were taken into consideration, and detailed analysis of the lines were conducted accordingly. These analyses and the fault rates are explained in detail between figures 1-6 with related data. 6 different production lines were examined for 22 days, and, as a result, the faults and fault frequencies indicated in Table 2 were obtained.

As can be seen from the Pareto analysis (Figure 7), the collar tip form (28,21%), stain (25,08), cuff form (12,99%) and button (10,02) faults have a 76,3% fault ratio among 17 fault classes. As a result of the investigations on shirt production, it was found that if 4 of the 17 faults were prevented only, 76,3% of the total faults could have been reduced.

In this study, the collar tip form fault, which is the most common and most important one, is discussed. The collar tip form fault, which constitutes 28,21% of the total faults, means that the collar is not symmetrical, the tips not sharpened

	FAULT	EXPLANATION	EFFECT
1.	Size difference	A difference in the size of the pieces	Repetition of the spreading-cutting processes
2.	Barcode	The attached barcode does not belong to the product.	The delivery of the product to a different warehouse
3.	Fabric Fault	Defects on the fabric affect the quality of the product	Disassemble process, repetition of the spreading-cutting processes
4.	Button	Broken, incorrect, unsewn or improper positioning of the buttons	Disassemble process or re-sewing, productivity loss
5.	Label	Incorrect, defected or incorrect positioning	Disassemble process and re-sewing, productivity loss
6.	Needle	Unsuitable needle for the fabric or the yarn	Damage to the product, re-cutting and re-sewing processes, fabric waste, cost increase
7.	Button hole	Unsuitable position, number or type	Damage to the product, re-cutting and re-sewing processes, fabric waste, cost increase
8.	Yarn	Yarn knitting, knotting or fringing	Loss of productivity and quality
9.	Seam Fault	Seam faults, such as skipping or disassembling	Re-sewing, loss of productivity and time
10.	Stain	Colour changes occurred on the product due to various reasons	Loss of productivity and time
11.	Cuff form	Position, sewing, ironing or size-related defects	Labour, time and productivity loss
12.	Position	Not settling the product pieces at specified lines or levels	Labour, time and productivity loss
13.	Colour difference	Colour mismatch between product parts	Productivity loss, re-cutting and re-sewing processes, fabric waste, cost increase
14.	Disassembly	Stitch defect between parts, button, buttonhole and hemline	Labour, time and productivity loss
15.	Fibre flies	Adhesion of fly fibers on the products	Productivity loss
16.	Interlining resin traces on fabric surface	Non-sticking or -tracing the interlining resin on the fabric surface	Labour, time and productivity loss
17.	Collar tip form	Wrong positioning of the collar and visible seam allowance	Productivity loss

Table 1. The faults and effects

➔ **Data obtained from Line-1**
- Daily average checked quantity: 504
- Number of working days: 22
- Total number of controls during the working time: 11.088
- Total number of faults encountered: 640
- Fault type and frequency
    - Stain à 224
    - Collar Tip Form à 151
    - Cuff Form à 122
    - Button hole à113
    - Other à 30

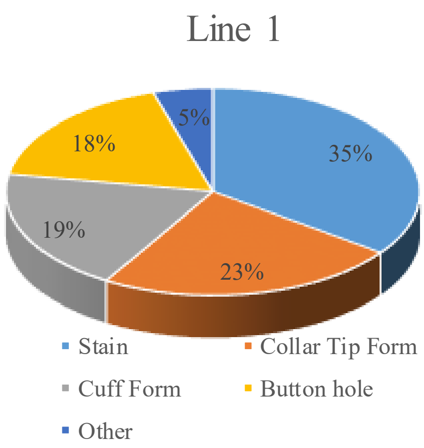

Fig. 1. Faults of line-1

➔ **Data obtained from Line-2**
- Daily average checked quantity: 1000
- Number of working days: 22
- Total number of controls during the working time: 22.000
- Total number of faults encountered: 1536
- Fault type and frequency
    - Stain à 547
    - Collar Tip Form à 430
    - Button à 354
    - Cuff Form à 185
    - Other à20

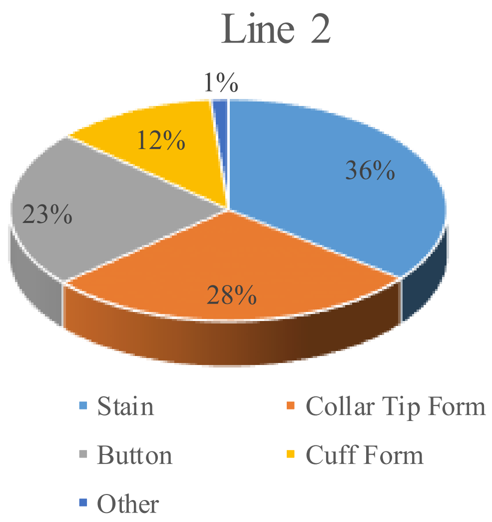

Fig 2. Faults of line-2

➔ **Data obtained from Line-3**
- Daily average checked quantity: 1200
- Number of working days: 22
- Total number of controls during the working time: 26.400
- Total number of faults encountered: 2115
- Fault type and frequency
    - Collar Tip Form à 570
    - Stitch fault à 468
    - Button à 348
    - Cuff Form à 274
    - Position à 204
    - Other à 251

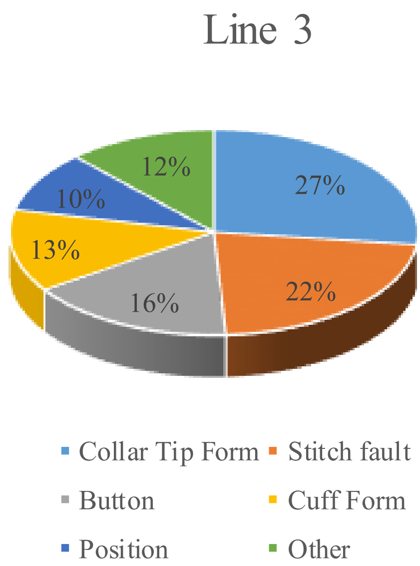

Fig. 3. Faults of line-3

➔ **Data obtained from Line-4**
- Daily average checked quantity: 950
- Number of working days: 22
- Total number of controls during the working time: 20.900
- Total number of faults encountered: 1210
- Fault type and frequency
    - Stain à 374
    - Collar Tip Form à 371
    - Cuff Form à 258
    - Interlining Resin à 177
    - Other à 30

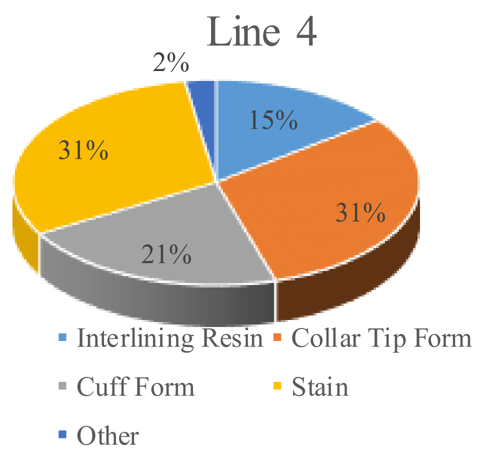

Fig. 4. Faults of line-4

➔ **Data obtained from Line-5**
- Daily average checked quantity: 1000
- Number of working days: 22
- Total number of controls during the working time: 22.000
- Total number of faults encountered: 1974
- Fault type and frequency
  - Collar Tip Form à 681
  - Stain à 678
  - Cuff Form à 289
  - Button à138
  - Fiber Flies à 101
  - Other à 87

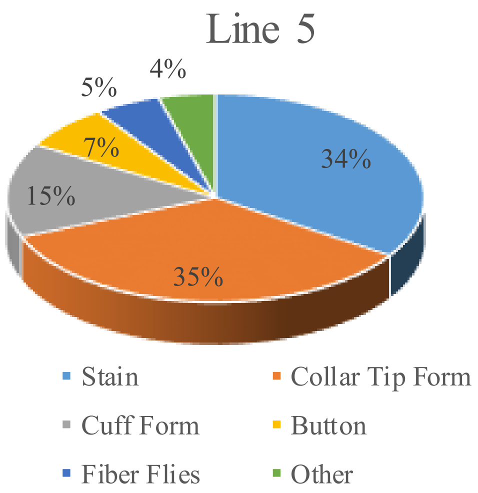

Fig. 5. Faults of line-5

➔ **Data obtained from Line-6**
- Daily average checked quantity: 1150
- Number of working days: 22
- Total number of controls during the working time: 25.300
- Total number of faults encountered: 1210
- Fault type and frequency
  - Stain à 355
  - Collar Tip Form à 247
  - Colour Difference à 231
  - Needle à 188
  - Other à 189

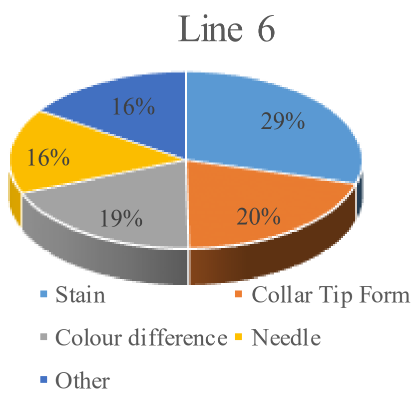

Fig. 6. Faults of line-6

	Fault	Fault quantity	Fault percentage (%)	Cumulative percentage (%)
1.	Collar Tip form	2450	28,21	28,21
2.	Stain	2178	25,08	53,29
3.	Cuff Form	1128	12,99	66,28
4.	Button	870	10,02	76,30
5.	Seam Fault	468	5,39	81,69
6.	Needle	248	2,86	84,55
7.	Color Difference	231	2,66	87,21
8.	Position	206	2,37	89,58
9.	Interlining Resin	177	2,04	91,62
10.	Fiber Flies	152	1,75	93,37
11.	Button Hole	113	1,30	94,67
12.	Yarn	103	1,19	95,86
13.	Size Difference	100	1,15	97,01
14.	Fabric Fault	89	1,02	98,03
15.	Label	87	1,00	99,03
16.	Barcode	45	0,52	99,55
17.	Disassembly	40	0,46	100

Table 2. Faults and their frequency

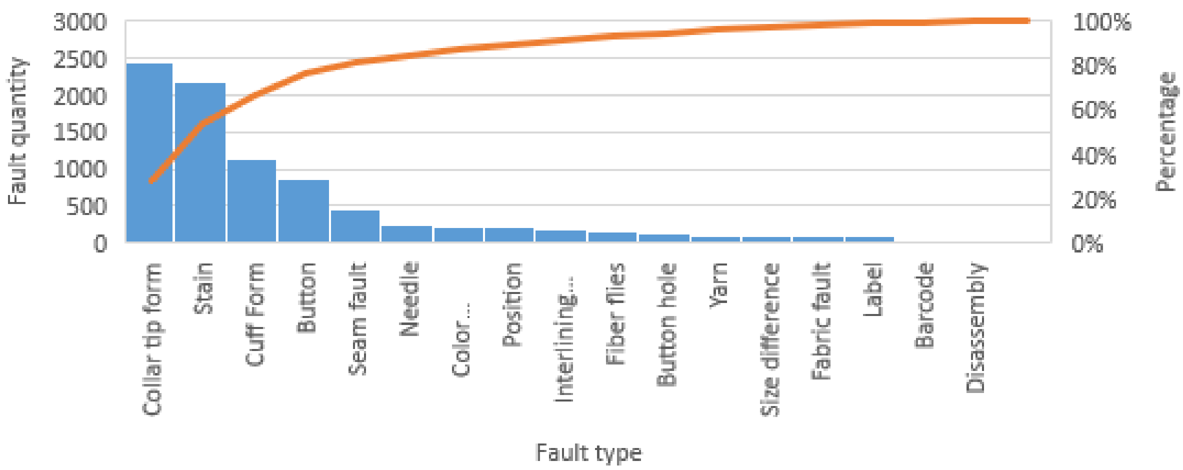

Fig. 7. Pareto diagram of the faults

Fig. 8. Samples of 2nd quality collars

properly, or the shadings that have occurred in the inside seam allowance are not cut properly. If the collar, which is the first point of attention of a shirt, is not produced symmetrically and adequately, it means a great loss in terms of quality. Figure 8 highlights an example of some poor quality related to the collar part.

The A3 reporting technique was used to prevent this fault. In this context, the A3 report was obtained from the application of the technique to the collar tip fault, shown in ANNEX-1.

Based on the analyses stated above, to eliminate the collar tip fault by the A3 technique, a collar cutting and everting apparatus was developed to obtain more standardised and symmetrical collars. By utilising this apparatus, the seam allowances of the collar tips could be cut more uniformly and symmetrically to prepare the collar in a shorter time. Details of this apparatus are shown in ANNEX-1. Examples of the collar tips formed by cutting and everting with the apparatus developed are shown in Figure 9 below.

3.1. Application of A3 Technique to the Problem

Resulting from the investigations carried out in a shirt manufacturing company, the faults and their frequencies were recorded. The Pareto analysis revealed that the most common fault among them was the "collar tip form". Accordingly, the A3 technique was used to eliminate it. Data obtained from this technique are as follows.

*- **Roadmap of Current Status***

In this technique, firstly, the collar preparation and everting process applied within the current system is defined. A map of the current process was prepared. The following steps were performed within the current system for collar preparation and everting.

1. Preparation of collar patterns
2. Placing the pattern on the spreading plan (CAD)
3. Drawing and cutting the pattern
4. Arrival of the cut pieces to the production line

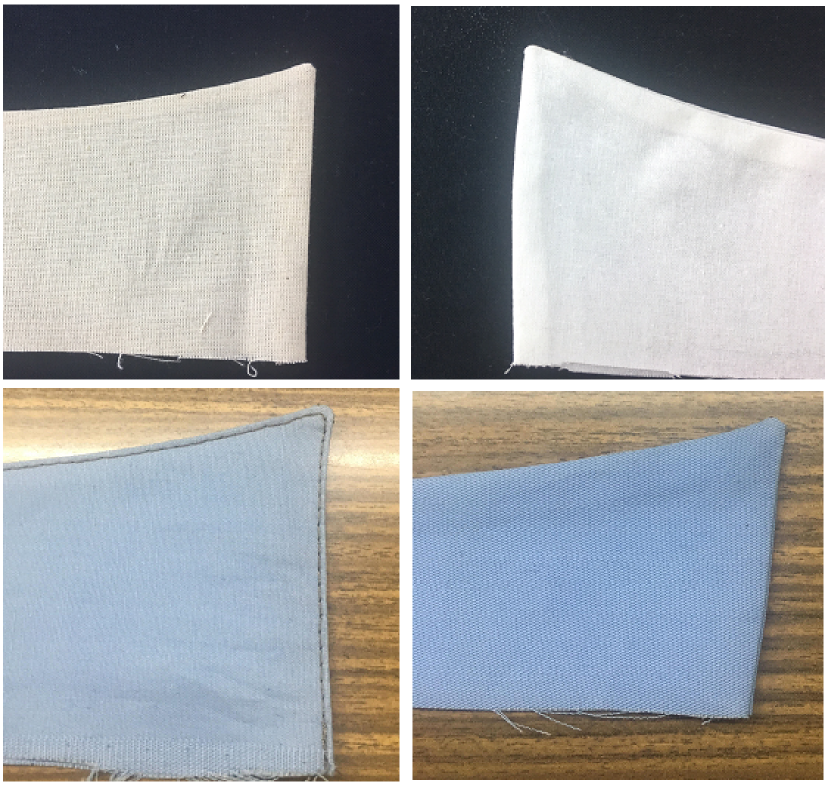

Fig. 9. Collars manufactured with the apparatus

5. Marking the collar pieces and interlining process
6. Assembling the pieces
7. Cutting the seam allowance surpluses
8. Everting the collar and sharpening the collar ends with a sharp tool such as a pencil, cloth scissors, etc.
9. Symmetry control of the collar and giving it the final form

- Process Times of the Current Situation

The calculated standard times for collar preparation and everting process are stated as follows through the examinations of these steps.

Based on the time studies conducted, 14 seconds was spent on even cutting of the seam allowance parts, while the collar form and turning took 29.1 seconds. The standard time of the collar preparation and turning was calculated as 65.2 seconds in total.

	Collar Forming Records									
	Manually									
	Taking a piece - putting under the needle		Sewing		Cutting (the seam allowance)		Turn inside out - Forming the edges (manually) (2 Edges)		Putting the piece away - taking another one	
	Sec	R	Sec	R	Sec	R	Sec	R	Sec	R
Sample-1	3,8	100	10,2	100	13	105	30,4	95	1	100
Sample-2	4,2	95	11	95	15	90	31	90	1	100
Sample-3	5	95	10,6	100	14,5	100	29,4	100	2	90
Sample-4	3,66	100	10,8	100	13,4	100	29	100	2,5	90
Sample-5	3	105	12	90	13,9	100	30	100	2	90
Sample-6	3,7	100	10,7	100	14	100	30,7	95	2	90
Sample-7	2,9	110	11	100	14	100	29,8	100	1	100
Sample-8	3,5	100	11	100	13,6	105	30	95	1	100
Sample-9	3,7	100	10,2	100	15	90	32	90	1	100
Sample-10	3,1	100	10	95	14,8	105	29,1	100	1	100
Averages	3,7	100,5	10,8	98,0	14,1	99,5	30,1	96,5	1,5	96,0
Basic Time= Avg Time x Avg Rating 100	3,7		10,5		14,0		29,1		1,4	
Total Basic Time	58,7									
Relaxation Allowance (%4)	2,35									
Unavoidable Delays (%7)	4,11									
STANDARD TIME (sec)	65,2									

Table 3. Records obtained by manual processes

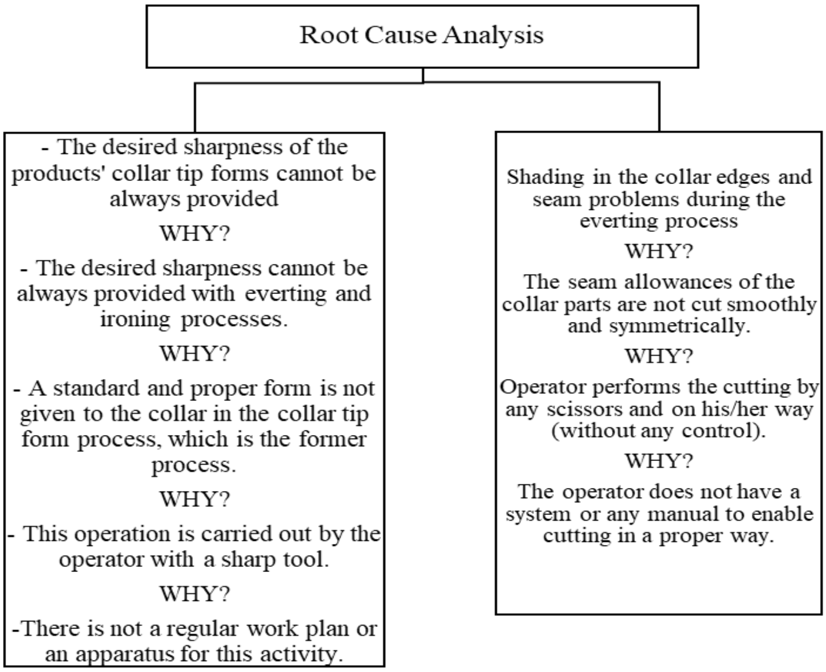

Fig. 10. Root cause analysis

- ***Definition of the Problem***

Activities that cause poor quality in the current process are listed as follows:

- Asymmetry of the collar ends
- Collar end forms not being at the desired sharpness
- Everting process and preparing the collar end forms evenly should be accelerated depending on the workflow.
- Since the seam allowance of the collar parts are not cut properly, this may cause shading or seam problems.

- ***Analyses***

Root-cause analyses, shown in the following diagram, were carried out in order to eliminate the processes that lead to poor quality.

	Collar Forming Records									
	With the Apparatus									
	Taking a piece - putting under the needle		**Sewing**		**Cutting (the seam allowance)**		**Turn inside out - Forming the edges (with the apparatus) (2 Edges)**		**Putting the piece away - taking another one**	
	Sec	**R**	**Sec**	**R**	**Sec**	**R**	**Sec**	**R**	**Sec**	**R**
Sample-1	3,6	95	11	100	8,1	105	18,4	100	1,2	100
Sample-2	3,2	100	11,2	110	7,5	105	18	100	1	100
Sample-3	3,5	100	10,8	105	9	100	17,5	100	1,5	95
Sample-4	3,6	95	10,9	105	7,3	100	17,7	95	1	100
Sample-5	3,4	95	11,5	100	8,7	90	18,2	100	1,5	95
Sample-6	3,4	100	11	100	9	90	18	100	1,4	95
Sample-7	2,6	115	10,7	100	9	100	17,9	95	1,3	100
Sample-8	4,2	90	10,8	100	8,7	90	17	95	1,2	100
Sample-9	3,7	100	11,5	95	8,8	100	17,8	95	1,4	95
Sample-10	3,9	100	10	110	9	100	19	90	1	100
Averages	3,5	99,0	10,9	102,5	8,5	98,0	18,0	97,0	1,3	98,0
Basic Time= Avg Time x Avg Rating 100	3,5		11,2		8,3		17,4		1,2	
Total Basic Time	41,7									
Relaxation Allowance (%4)	1,67									
Unavoidable Delays (%7)	2,92									
STANDARD TIME (sec)	46,2									

Table 4. Records obtained by processes with the apparatus

Fig. 11. Cutting apparatus

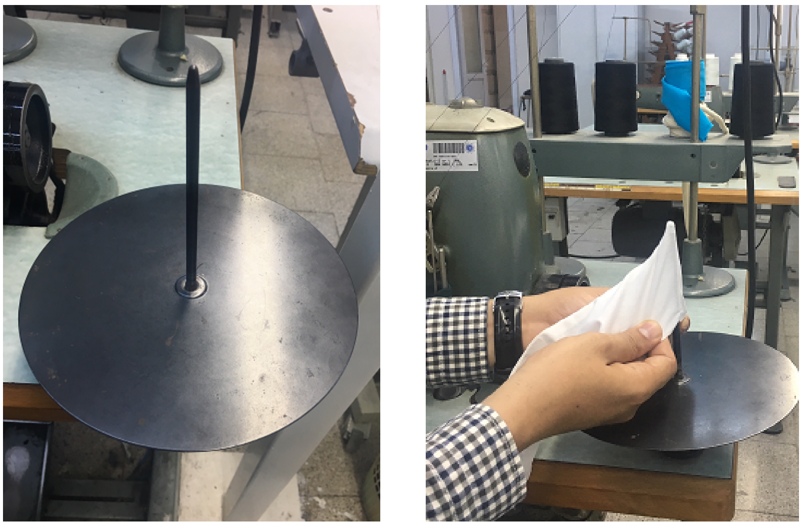

Fig. 12. Everting apparatus

- ***Goals***

Based on the root cause analyses and the A3 technique, the desired developments, in other words, the goals, are as stated below:

- Standardisation of the operation
- Eliminating the problem of shading in the collar edges
- Smoothing the sharpness in the collar tips
- Increasing productivity
- Developing an apparatus suitable for the process that can be used by operators
- Using the workforce more effectively

- ***Precautions (Improvements)***

Precautions (improvements) recommended to the company are as follows;

- First of all, the operator should be checking the cut collar parts in terms of the cut quality.
- After sewing the collar parts, the operator should cut the remaining seam excess with the developed apparatus (Figure 9).
- The operator should perform the reversal of the collar with the "collar cutting and everting apparatus" developed within this study.
- The operator should check the symmetry of the collar tips in a quicker way.

- ***Collar Cutting and Everting Apparatus***

The apparatus developed consists of two different parts: the first enables to cut the seam allowances clearly (Figure 11), and the second helps operators to evert the collars evenly (Figure 12). This apparatus can be placed on different parts of the machine table in accordance with the hand side of the operator most used. The apparatus developed is shown below in Figure 11.

- ***Improved Time Plan***

Time study data of the process steps belonging to the collar everting and giving the desired form with the apparatus developed are shown in Table 4.

According to the calculations, while cutting the seam allowances of the collar tips took 8.3 seconds, the standard time for collar everting and sharpening of the tips took 17.4 seconds with the apparatus developed. The total standard time of this process was calculated as 46.2 sec.

	Std time-cutting process (sec)	Total std time (sec)	Price ($)
Manually	14,0	65,2	-
Developed Apparatus	8,3	46,2	84
Automat	7,9	24,6	2050

Table 5. Comparison of the techniques

Fig. 13. Collar automat [9]

3.2. Evaluations

As can be understood from the visuals of the collars prepared with the improved collar apparatus, it is now possible to obtain collars in a more uniform form with standard quality. Thanks to the apparatus developed, the following advantages could be gained:

- The shirt collar tip form can be adequately prepared, and it is thought that the quality level can be standardised.
- The asymmetry problem between the two ends of the collar forms was eliminated due to the advantage of the new apparatus. The sharpening and shadowing problem of the collar tips was prevented.
- The collar everting process was realised faster and more smoothly thanks to the improved collar apparatus.

Thanks to the time studies carried out, the time spent on cutting the seam allowances after collar circumference sewing and that spent on the process of everting the collar and obtaining the sharp form at the tips of the collar were compared. Accordingly, while cutting the seam allowances at both ends of the collar took 14 seconds manually, it was completed in 8.3 seconds with the cutting apparatus developed. This apparatus shows that the process is completed in 40.7% less time. Similarly, the reversal of the collar and the sharpening of the two collar ends lasted 29.1 seconds when performed manually, and this process was completed in 17.4 seconds thanks to the collar everting apparatus developed. Owing to this apparatus, a time saving of approximately 40.2% was achieved.

Collar automats (Figure 13), which are preferred by a specific section of companies, operate only on shirts on the market, and provide superiority in terms of speed and quality in all operations performed on the collar. An image of a collar automat is shown in Figure 13.

In studies and investigations carried out in companies using this automat, it was seen that while the cutting of the seam allowance of a collar and giving the desired tip form by turning takes 7.9 seconds, the standard time of collar preparation and the turning process is determined as 24.6 seconds. Another critical point is the sales price of the system, which is $2050 as the market price (25.04.2020).

4. Conclusion

In this study, firstly, faults encountered in a shirt manufacturing company and their frequencies were determined. Afterwards, these faults were listed according to their percentages and frequencies by means of Pareto Analysis . Based on the examinations carried out using A3 diagrams on the most common faults, the reasons for the poor quality of the shirt collar were determined. Accordingly, developed apparatuses were used to eliminate these reasons.

Although there is an existing collar automat currently in use in the market, investment decisions that need to be made for an automat should be well considered in today's difficult economic conditions. A price-time comparison of the operations performed on a collar manually, with the apparatus developed and by automats available on the market, is listed as follows.

As a result of the examinations, data belonging to the three different methods were calculated, shown above (Table 5). Based on the data, the time spent on cutting the collar seam allowance was determined as the highest when the activity was performed manually. The duration of the activity performed with the apparatus developed and with the automat were close. When the collar preparation activity durations were examined in total, it can be seen that while the total time spent for the process with the automat was 24.6 seconds, this time is 87% faster than for the developed apparatus - 46.2 seconds, and 165% faster than the activity performed manually - 65.2 seconds.

In today's demanding economic conditions, which require deep analysis of investment decisions, it is possible to achieve similar quality with the apparatus developed in this study with a cost of only $ 84, instead of investing $ 2050 only for a collar operation. Nowadays, companies are designing their production lines to produce various products instead of specialising in a single product type to keep up with the different product demands of their customers. Therefore, they may be hesitant to invest in an automat that can only be used for collar production. This study demonstrates the importance of this decision by emphasising the advantages of the apparatus developed over its rivals.

Another advantage of the apparatus developed is the possibility of adding it to the working area of each operator working with collars, given its lower costs. However, since automats are comparatively expensive, there are only 1 or 2 plants in factories.

Regarding this study's method, A3 reporting is one of the essential methods used to address and solve the problems encountered in companies. At this point, the A3 reporting method is becoming quite useful in solving issues because it has a simple and effective nature. Since the problem-solving process needs to be continuously handled, different statistical process control techniques supporting this method will provide more concrete benefits to companies, which will be dealt with in future studies.

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ANNEX 1

A3 REPORT

CURRENT STATUS;

- Collar pieces are prepared by an operator.
- After being the collar pieces sewn, the seam allowances are cut and everted.
- Collar tips are sharpened by a sharp tool such as pencil, cloth scissors and etc.
- Collars are controlled after all the preparation processes.

DEFINITION OF THE PROBLEM;

- Asymmetry of the collar ends
- Collar end forms are not always at the desired sharpness.
- Everting process and preparing the collar end forms evenly should be accelerated depending on the workflow.
- Since the seam allowance of the collar parts are not cut properly, this may cause to shading or seam problems.

PRECAUTIONS (IMPROVEMENTS);

- First of all, operator should be checking the cut collar parts in terms of the cut quality.
- After sewing the collar parts, the operator should cut the remaining seam excess with the developed apparatus (figure 9).
- Operator should perform the reversal of the collar with the developed "collar cutting and everting apparatus".
- Operator should the check the symmetry of the collar tips in a quick way.

ROADMAP OF THE CURRENT STATUS;

Preparation of the collar patterns
↓
Placing the pattern on the spreading plan (CAD)
↓
Drawing and cutting the pattern
↓
Arrival of the cut pieces to the production line
↓
Marking the collar pieces and interlining process
↑
Assembling the pieces
↑
Cutting the seam allowance surpluses
↑
Everting the collar and sharpening the collar tips by a sharp tool such as pencil, cloth scissors and etc.
↑
Symmetry control of the collar and giving it the final form

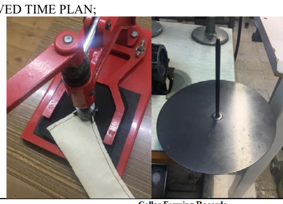
ANALYSES;

Root Cause Analysis

- The desired sharpness of the products' collar tip forms can not be always provided
WHY?
- The desired sharpness can not be always provided with everting and ironing processes.
WHY?
- A standart and a proper form is not given to the collar in the collar tip form process which is the former process.
WHY?
- This operation is carried out by the operator with a sharp tool.
WHY?
-There is not a regular work plan or an apparatus for this activity.

Shading in the collar edges and seam problems during the everting process
WHY?
The seam allowances of the collar parts are not cut smoothly and symmetrically.
WHY?
Operator performs the cutting by any scissors and on his/her way (without any control).
WHY?
The operator does not have a system or any manual enable cutting in a proper way.

COLLAR CUTTING-EVERTING APPARATUS AND IMPROVED TIME PLAN;



	Collar Forming Records									
	With the Apparatus									
	Taking a piece - putting under the needle		Sewing		Cutting (the inside surpluses)		Turn inside out - Forming the edges (with the apparatus) (2 Edges)		Putting the piece away - taking another one	
	Sec	R	Sec	R	Sec	R	Sec	R	Sec	R
Sample-1	3,6	95	11	100	8,1	105	18,4	100	1,2	100
Sample-2	3,2	100	11,2	110	7,5	105	18	100	1	100
Sample-3	3,5	100	10,8	105	9	100	17,5	100	1,5	95
Sample-4	3,6	95	10,9	105	7,3	100	17,7	95	1	100
Sample-5	3,4	95	11,5	100	8,7	90	18,2	100	1,5	95
	⋮									
STANDARD TIME (sec)	46,2									

THE PROCESS TIMES OF THE CURRENT STATUS;

	Collar Forming Records									
	Manually									
	Taking a piece - putting under the needle		Sewing		Cutting (the inside surpluses)		Turn inside out - Forming the edges (manually) (2 Edges)		Putting the piece away - taking another one	
	Sec	R	Sec	R	Sec	R	Sec	R	Sec	R
Sample-1	3,8	100	10,2	100	13	105	30,4	95	1	100
Sample-2	4,2	95	11	95	15	90	31	90	1	100
Sample-3	5	95	10,6	100	14,5	100	29,4	100	2	90
Sample-4	3,66	100	10,8	100	13,4	100	29	100	2,5	90
Sample-5	3	105	12	90	13,9	100	30	100	2	90
	⋮									
STANDARD TIME (sec)	65,2									

GOALS;

- Standardization of the operation
- Eliminating the problem of shading in the collar edges
- Smoothing the sharpness in the collar tips
- Increasing productivity
- Developing an apparatus can be used by the operators suitable for the process
- Using the work force more effectively

EVALUATIONS;

- Shirt collar tip form can be prepared properly and the quality level is standardized.
- Asymmetry problem between the two ends of the collar forms is eliminated given to the advantage of the new apparatus and the sharpening and shadowing problem of the collar tips is prevented.
- Collar everting process has been realized faster and more smoothly thanks to the improved collar apparatus.