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Enhance Productivity in Garment Industry Through VSM and FMEA Approaches

Rithanya.D[1], Nirmala Varghese [2]

[1] Student, Department of Apparel and Fashion Design, PSG College Of Technology, Peelamedu, Coimbatore,India
[2]Associate Professor, Department of Apparel and Fashion Design, PSG College Of Technology, Peelamedu, Coimbatore,India

ABSTRACT
In this study, Value stream mapping approach and Failure mode effect analysis approaches were used as trigger to enhance the production. Data were collected from production and industrial engineering department. Data included two hand process chart, Risk priority number chart, and Time study chart. Data‘s are arranged and line charts were plotted to visualize the results. Results indicated that the line capacity, operator training, inspection, and machines were optimized with the help of VSM approach non-value-added time is identified and layout changes are made. Inspection and training of operators were improved with the help of FMEA approach. Whenever it is importantly to enhance productivity, little changes play a major role in enhancing productivity.

Keywords: Garments, lean manufacturing, VSM approach, FMEA approach, Risk priority number, Non value added time.

1.INTRODUCTION

Many companies implement lean production systems to increase productivity and compete better. Among other techniques, Value stream mapping(VSM) is highly favored because of its application suitability to optimize line layout. VSM is based on a principle of lean manufacturing that utilizes increased productivity with the use of available resources [1]. It would be important to indicate the need for results and show the application of VSM in creating future maps within the textile and garment export industries. With input costs increasing and production rates dropping due to poor management of firms, the garment industry always thrives for the continuous improvement tools in identifying production flow problems and highlighting improvement opportunities to boost competitiveness. Hence, the approach for the use of the VSM tool in the objective of increasing competitiveness will be formulated in this research study [2]. The Failure Mode and Effects Analysis is another fruitful tool in the prevention, identification, control, and elimination of possible errors in the garment industry. As an activity that can be comprehended on the production floor or the production line, VSM can be used to demonstrate how well the production line is working operationally, identifying activities that are not value-added or wastes, and showing potential improvements by different strategies of improvement. In addition to that, VSM is also useful for a clear articulation of the entire manufacturing system from raw material sourcing up to finished goods delivery [3]. The activities are classified in three types :Non-value adding (NVA), Necessary but non-value adding (NNVA), and Value-adding (VA). This techniques can be used for first getting data from the apparel industry and FMEA followed by optimizing production efficiency improvement using simulation-based optimization techniques. These techniques bear significant reductions in defects, rework, and overall costs of production in the garment industry [4]. On FMEA, defects are known and their causes determined, and a risk priority number is calculated; this is on the basis of severity, occurrence, and detection, and these are rated between 1 and 10, thus making easy defect detection. A smart inspection system is introduced for the textile industry with a smart hanger, stitching-workmanship defect classification unit, and shade variation detection unit [4]. Similarly, operators are trained to enhance productivity further. FMEA is an industry-wide technique for ensuring systems, services, and projects for safety and reliability, which can be a preventive evaluation tool for the design and manufacturing phases of the product [5].Quality concepts are increasingly recognized, and today they have become imperative in today's competitive landscape. This calls for full utilization of customers' satisfaction through service delivery being flawless yet reliable. To this end, a proven mechanism is Failure Modes and Effects Analysis (FMEA) that identifies the types of risks that may lead to failure.

Through FMEA, the cause and the effects of those failures can be systematically categorized in such a way that provides an allowance for the introduction of specific improvement techniques into organizations. The underlying goal of every FMEA is to predict errors at design time or implementation, whether a flaw in design or development. Through the structured approach, FMEA helps an organization assess such risks as well as measure them by their impacts. It deals with issues such as the needs of quality assurance, problem-solving techniques, team leadership, and auditor training Finally, FMEA is an all-around procedure for failure identification and classification, which in turn provides opportunity to improve product development services systems and ultimately quality of process[5][6]. The failure probabilities should be updated as the system matures. More actual criticality numbers should be generated using the quantitative approach along with the support of part configuration and failure rate information.[7]

2.LITERATURE REVIEW

A value stream is all the actions which are both value-added and non-value-added necessary for bringing a product or class of products from raw materials stage to the customer. Value stream mapping aims at unveiling all types of waste in value streams and eliminating them. Although so many tools have been developed in improving individual operations of a supply chain, most fail to link and visualize the flow of information flow throughout the company's entire supply chain. VSM, however is a pencil and paper visualization tool, which depicts the flow of material and information as a product goes along the stream. In order to create a future state map with improved techniques and performance ,VSM maps the flow of information and methods. It makes visualization of station cycle times, inventories at each stage or WIPs, manpower and information flow across the supply chain through use of VSM. They identified the applicability of VSM for the apparel industry, revealing that VSM could be applied to mass production apparel industries to make positive results such as a decrease in inventory and defects. VSM helped the company managers to see the wastes produced by the organization and the possibilities of the future elimination of reducing the wastes[8]. There is a case study on VSM in an Indian garment export industry to aid in the development and testing of strategies aimed at elimination of wastes for enhancing productivity.

Using the VSM current factory floor was altered to enhance the process of identifying waste and its causes while developing substantially reduced setup times. These are the characteristics that any product or process should have. Failure to meet these characteristics may prevent a product or process from functioning as expected and could culminate in total failure. At this point, customer needs cannot be satisfied, and it may cause problems such as losing competitive power and losses in profits. Failure is an inability of a product or process to perform its intended function. Based on functions, modes of failure may be classified. Multiple factors may cause failure, and the root causes should be studied during the FMEA study. The effect of failure discusses the consequences of failure on the final product in case the failure modes have not been suppressed or removed. It examines what the customer will perceive or feel. When performing this, consider similar products, and previous failure modes. The existing controls are used to assess if final or semi-product performs it task as intended. The existing controls are aimed at detecting or eliminating failure before it happens rather than finding it in the final product errors with higher intensity and deviation should be fixed first if two or more of them have the same RPN value,Changes to the production process, material selection, quality control, and quality inspection standards are based on information gathered from FMEA. The approach method can serve as a decision-making tool. Types of errors are systematically reviewed to prevent even minor damage to the product, process, or service [5][6] Each potential failure mode is classified according to its impact on mission success and personnel/equipment safety. The FMECA is composed of two separate analyses, the Failure Mode and Effects Analysis (FMEA) and the Criticality Analysis (CA)[9].
RPN = Occurrence × Severity × Detection
The three questions regarding the faults are addressed in this evaluation:
a. Has the situation improved since then?
b. Has the issue gotten worse?
c. Is everything the same as it was before?[10]

The FMEA elements, steps, and data that are evaluated in the FMEA process. By comparing the risk analysis result with these measurements, critical numbers can be found, and it aims to prevent the occurrence of critical events. Criticality is defined as the "relative measure of the consequences of the error type and its frequency of occurrence." RPN values measure criticality. The RPN number itself holds no inherent value; it is used to rank and compare errors based on their criticality and relative importance. It provides the system overview, with the corrective action to be taken based on the values of RPN. The value of RPN is calculated by examining the causes of errors and ranking critical points, where they then address the highest causes of error. The RPN should be between 1 and 1000. The more crucial it is, the higher the value of RPN. The ranges of decision-making the Ford Motor Company has are as follows:

- RPN < 40: No treatment
- 40 ≤ RPN ≤ 100: be cautious
- RPN > 100: Caution in use if necessary

3.OBJECTIVES

a. To identify idle resources and optimize resource utilization for maximum efficiency.
b. To enhance the productivity with the help of VSM approach.
c. To enhance the quality of garments by reducing the defects.

4.METHODOLOGY

The Value stream mapping (VSM) is a tool for lean management that aids to eliminate waste through process visualization by illustrating the flow of materials and information. To improve the productivity of steps, the following have been put in place:

a. Understanding the current state
b. Analysis of the current state
c. Designing the future state
d. An implementation plan should be developed
e. Implementation of changes
f. Evaluation and sustaining improvements

Table 1: Machine data in use

MACHINERIES	PERCENTAGE	IN USE
Flatlock	72.9	58
Overlock	91.6	156
Single needle lockstitch	91.6	366
Flat seamer	68.7	27
Button attach machine	35.4	32
Bartack	62.5	31
HT label fusing	70.8	49
Neck folding machine	29.1	14
Topstitch machine	66.6	100
Rib attach machine	43.75	44
Auto trimmer	11.11	2

This Table1 shows the machines currently in use, serving as a first step in identifying active machinery. The percentage usage of each machine is calculated, providing the industry with valuable insights into machine statistics. With this information, idle resources can be identified and managed more effectively.From the table it can be seen that the auto trimmers are kept idle The trimming time for the garments is rather long when using manual trimmers. As automatic trimmers were available, they remained unused because the operators preferred manual trimming. In addition to this, automatic trimmers do not suit higher GSM garments

Table 2:SAM value

S.N0	PARTICULARS	SAM VALUE FOR TRIMMING
1	Kids dress	0.55
2	Men’s crew neck	0.76
3	Shorts	0.52
4	V Neck	0.72
5	Pocket t-shirt	0.68
6	Leggin	0.52
7	Bikni	0.55
8	Bloomer brief	0.52

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The Table 2 shows the SAM value calculated for trimming, it would be noted that the time taken for trimming every garment is more than one minute and the non-value added time to every garment ranges between 20 and 40 seconds.

Table 3:Tank top

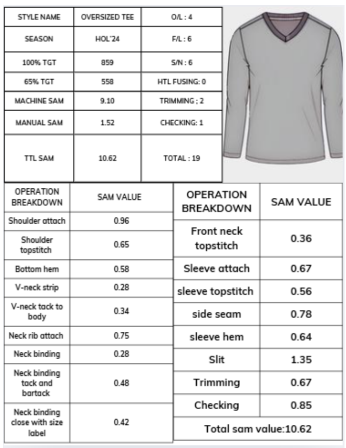
TYPE OF OPERATION	M/C TYPE	SAM	65%
Bottom hem	F/L	0.35	110
Armhole binding	F/L	0.75	53
Armhole binding	F/L	0.71	55
shoulder attach	O/L	0.40	98
Neck binding	F/L	0.35	112
2nd shoulder attach	O/L	0.34	116
Bottom label	S/N	0.40	99
Peack tak	S/N	0.44	89
Print size label	H/T	0.44	89
Trimming	Table	0.84	47
Checking	Table	0.40	98
Working minutes:480		Target:673	

The table 3 shows the time study chart for tank top in which the 65% target for every operation is given. It displays that the minimum hourly target has trimming. Using the stopwatch, the time taken for the trimming operation is recorded to be 1.33 minutes for undergarment, and 2.40 minutes for t-shirt, both above the SAM value for the respective operation.

Table 4:Trimming data

Date	Tank top	Bikni
29.7.24	200	389
30.7.24	210	400
31.7.24	198	397
1.8.24	200	390
2.8.24	206	399
3.8.24	194	385

This Table 4 shows cutting data for five days, with the graph showing that average number pieces is 200 for tank tops, and 393 for bikinis, which is pretty low.



STYLE NAME	OVERSIZED TEE	O/L : 4
SEASON	HOL'24	F/L : 6
100% TGT	859	S/N : 6
65% TGT	558	HTL FUSING: 0
MACHINE SAM	9.10	TRIMMING ; 2
MANUAL SAM	1.52	CHECKING: 1
TTL SAM	10.62	TOTAL : 19

OPERATION BREAKDOWN	SAM VALUE	OPERATION BREAKDOWN	SAM VALUE
Shoulder attach	0.96	Front neck topstitch	0.36
Shoulder topstitch	0.65	Sleeve attach	0.67
Bottom hem	0.58	sleeve topstitch	0.56
V-neck strip	0.28	side seam	0.78
V-neck tack to body	0.34	sleeve hem	0.64
Neck rib attach	0.75	Slit	1.35
Neck binding	0.28	Trimming	0.67
Neck binding tack and bartack	0.48	Checking	0.85
Neck binding close with size label	0.42	Total sam value:10.62	

Fig.1 Operation chart

The Fig.1 operation chart shows line layout planning provides a detailed overview of the SAM (Standard Allowed Minutes) value for each operation, along with the utilization of each machine involved in production. This plan is based on the layout from a prior style of the garment to streamline processes and enhance efficiency. An article like T-shirt is analyzed by using VSM approach with two hand process technique.

Table 5: Two hand process chart for shoulder attach

ACTIVITY:SHOULDER ATTACH								COMMENTS:						
S.NO	ACTIVITY OF LEFT HAND	●	□	→	▼	D	TIME	ACTIVITY OF RIGHT HAND	●	□	→	▼	D	TIME
1	Pick up the bodice	●					7	Pick up the bodice						7
2	Pick up the yoke	●					5	pick up the yoke						5
3	Attach	●					10	attach	●					10
4	Pick the yoke and bodice	●					10	Pick the yoke and bodice	●					10
5	Sew the yoke	●					10	Sew the yoke	●					10
6	Pass the bodice	●					2	Pass the bodice	●					2
Total:140 seconds														

Table 6: Two hand process chart for shoulder Topstitch

ACTIVITY:SHOULDER TOPSTITCH								COMMENTS:						
S.NO	ACTIVITY OF LEFT HAND	●	□	→	▼	D	TIME	ACTIVITY OF RIGHT HAND	●	□	→	▼	D	TIME
1	Pick up bodice			●			2	Pick up bodice						2
2	Topstich	●					45	Topstich	●					45
3	Trim	●					10	Trim	●					10
4	Pass the bodice						5	Pass the bodice			●			5
5	Idle time					●	60	Idle time					●	60
Total: 122 seconds														

Table 7: Two hand process chart for shoulder Bottom hem

ACTIVITY:BOTTOM HEM								COMMENTS:						
S.NO	ACTIVITY OF LEFT HAND	●	□	→	▼	D	TIME	ACTIVITY OF RIGHT HAND	●	□	→	▼	D	TIME
1	Pick up bodice			●			5	Pick up bodice						5
2	Sew hem	●					30	Sew the hem	●					30
3	Inspect it		●				5	Inspect it		●				5
4	Delay b/c of machine					●	30	Delay b/c of machine					●	30
Total: 70 seconds														

Table 8: Two hand process chart for V neck strip

ACTIVITY:V NECK STRIP								COMMENTS:						
S.NO	ACTIVITY OF LEFT HAND	●	□	→	▼	D	TIME	ACTIVITY OF RIGHT HAND	●	□	→	▼	D	TIME
1	Sew edges	●					15	Sew edges	●					15
2	Cut in center	●					10	cut in center	●					10
3	Fold it	●					5	Fold it	●					5
4	Sew it in shape	●					20	Sew it in shape	●					20
5	Idle time					●	15	Idle time					●	15
Total: 65 seconds														

Table 9: Two hand process chart for V neck tack to body

ACTIVITY:V-NECK TACK TO BODY								COMMENTS:						
S.NO	ACTIVITY OF LEFT HAND	●	■	→	▼	■	TIME	ACTIVITY OF RIGHT HAND	●	■	→	▼	■	TIME
1	Pick up the bodice			●			5	Pick up the v neck			●			5
2	Align	●					10	Align	●					10
3	Attach in center	●					20	Attach in center	●					20
4	Pass it						5	Pass it	●					5
Total: 40 seconds														

Table 10: Two hand process chart for Neck rib attach

ACTIVITY:NECK RIB ATTACH								COMMENTS:						
S.NO	**ACTIVITY OF LEFT HAND**	●	◘	→	▼	D	**TIME**	**ACTIVITY OF RIGHT HAND**	●	◘	→	▼	D	**TIME**
1	Pick up bodice	●					5	Pick up bodice						5
2	Attach neck	●					65	Attach neck	●					65
3	Pass to the next operator						5	Pass it to the nextoperator			●			5
Total: 75 seconds														

Table 11: Two hand process chart for Neck Binding

ACTIVITY:NECK BINDING								COMMENTS:						
S.NO	**ACTIVITY OF LEFT HAND**	●	◘	→	▼	D	**TIME**	**ACTIVITY OF RIGHT HAND**	●	◘	→	▼	D	**TIME**
1	Idle time					●	46	Idle time					●	46
2	Pick up the bodice	●					3	pick up the bodice						3
3	Align the neck rib	●					2	Align the neck rib						2
4	Sew the neck rib	●					20	Sew the neck rib	●					20
5	Pass the bodice						4	Pass the bodice			●			4
Total: 75 seconds														

Table 12: Two hand process chart for Neck label

ACTIVITY:NECK LABEL								COMMENTS:						
S.NO	**ACTIVITY OF LEFT HAND**	●	◘	→	▼	D	**TIME**	**ACTIVITY OF RIGHT HAND**	●	◘	→	▼	D	**TIME**
1	Pick the bodice	●					10	Pick the bodice						10
2	Sew till center	●					25	Sew till center	●					25
3	Take label						3	Take label						3
4	Align it						5	Align it	●					5
5	Sew the label						30	Sew the label	●					30
6	Mark the center	●					10	Mark the center	●					10
Total: 83 seconds														

Table 13: Two hand process chart for Front neck Topstitch

ACTIVITY:FRONT NECK TOPSTITCH								COMMENTS:						
S.NO	**ACTIVITY OF LEFT HAND**	●	◘	→	▼	D	**TIME**	**ACTIVITY OF RIGHT HAND**	●	◘	→	▼	D	**TIME**
2	Pick up bodice					●	5	Pick up bodice					●	5
3	Trim	●					10	Trim						10
4	Topstich	●					40	Topstich	●					40
5	Pass it	●					5	Pass it	●					5
Total: 60 seconds														

Table 14: Two hand process chart for Sleeve attach

ACTIVITY:SLEEVE ATTACH								COMMENTS:						
S.NO	**ACTIVITY OF LEFT HAND**	●	◘	→	▼	D	**TIME**	**ACTIVITY OF RIGHT HAND**	●	◘	→	▼	D	**TIME**
1	Pick up the bodice	●					9	Pick up bodice						9
2	Pick up sleeve	●					9	Pick up sleeve						9
3	Sew it	●					57	Sew it	●					57
4	Pass it to next operator			●			2	Pass it to next operator						2
Total: 73 seconds														

Table 15: Two hand process chart for Sleeve Topstitch

ACTIVITY:SLEEVE TOPSTICH								COMMENTS:						
S.NO	ACTIVITY OF LEFT HAND	●	□	→	▼	D	TIME	ACTIVITY OF RIGHT HAND	●	□	→	▼	D	TIME
1	Idle time					●	20	Idle time					●	20
2	Pick up bodice	●					2	Pick up bodice						2
3	Trim	●					10	Trim	●					10
4	Topstich	●					40	Topstich	●					40
5	Pass it	●					5	Pass it	●					5
Total: 77 seconds														

Table 16: Two hand process chart for Side Seam

ACTIVITY:SIDE SEAM								COMMENTS:						
S.NO	ACTIVITY OF LEFT HAND	●	□	→	▼	D	TIME	ACTIVITY OF RIGHT HAND	●	□	→	▼	D	TIME
1	Pick the bodice	●					2	Pick up the bodice						2
2	Align	●					5	Align	●					5
3	Sew side seam	●					42	Sew side seam	●					42
4	Hold side slit						10	Hold side slit						10
5	Align	●					5	Align				●		5
6	Sew other side seam	●					37	Sew other side seam	●					37
7	Take label	●					2	Take label						2
8	Attach it	●					10	Attach it	●					10
9	Hold Slit		●				5	Hold slit						5
10	Pass it to next operator						2	Pass it to next operator	●					2
Total: 120 seconds														

Table 17: Two hand process chart for Slit

ACTIVITY:SLIT								COMMENTS:						
S.NO	ACTIVITY OF LEFT HAND	●	□	→	▼	D	TIME	ACTIVITY OF RIGHT HAND	●	□	→	▼	D	TIME
1	Pick the tshirt						5	Pick the tshirt	●					5
2	Align the slit	●					5	Align the slit	●					5
3	Sew the slit	●					45	Sew the slit	●					45
4	Inspect it						5	Inspect it		●				5
5	Trim it	●					10	Trim it	●					10
6	Pass it						5	Pass it	●					5
Total: 75 seconds														

Table 18: Two hand process chart for Sleeve hem

ACTIVITY:SLEEVE HEM								COMMENTS:						
S.NO	ACTIVITY OF LEFT HAND	●	□	→	▼	D	TIME	ACTIVITY OF RIGHT HAND	●	□	→	▼	D	TIME
1	Idle time					●	60	Idle time					●	60
2	Pick the garment						2	Pick the garment	●					2
3	Fold	●					4	Fold	●					4
4	Overlock	●					29	Overlock	●					29
5	Inspect						5	Inspect		●				5
Total: 100 seconds														

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The Table 6-18 shows two-hand process chart, it can be seen how both hands are used at each task and all the time it takes for each hand movement is captured, so it's easier and quicker to see where the non-value-added time occurs. The operations are broken down, and each operation is developed into steps for both hands.

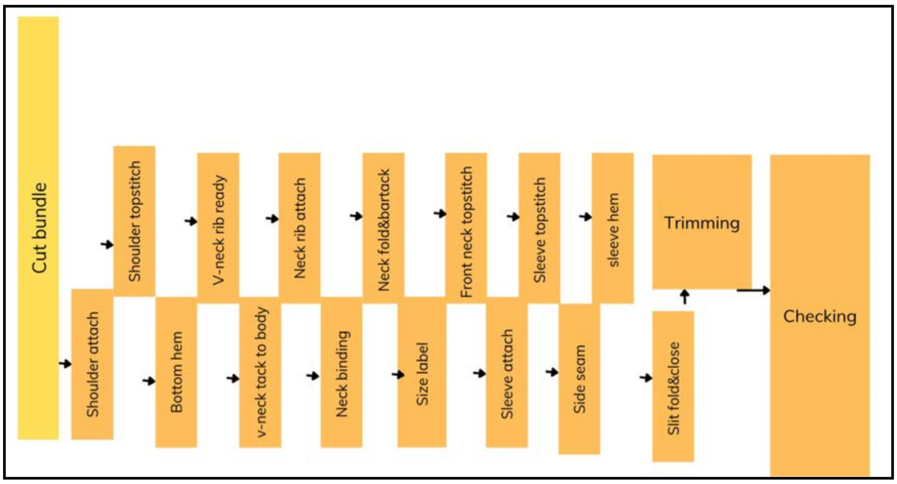

Fig .2 operation breakdown

This operating design Fig.2 Operation breakdown employs a single-piece flow system. This is the most effective in ensuring that it does not let production fizzle out. In this aspect, every workpiece is taken from one operator and handed over to the other for processing without any breaks, thus removing any delay and ensuring continuous flow. By positioning operators on opposite sides, handing over to one another becomes very easy without resulting in unnecessary movement and is much more efficient. This kind of design ensures smooth movement forward of every piece in the production line, increasing overall productivity and reducing waste.

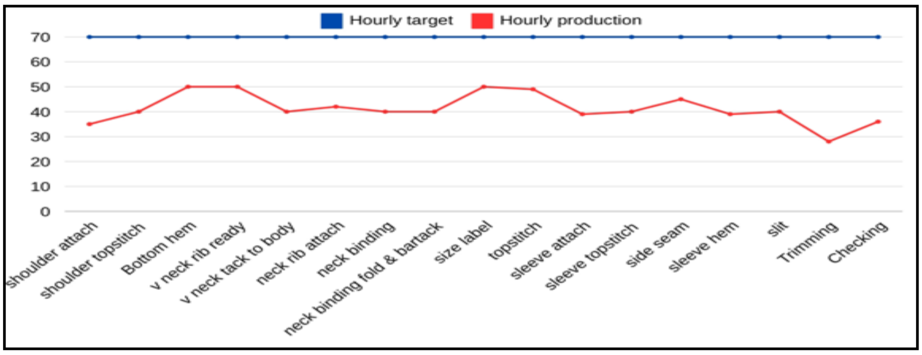

Fig.3 Hourly target

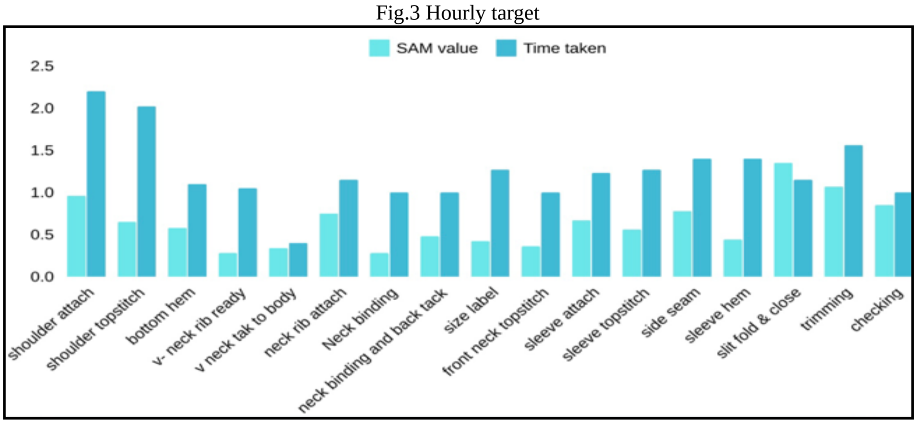

Fig.4 SAM value and time taken

The above charts Fig.3 and Fig.4 result from hourly production targets, upon which the operators fail to meet continuously. Although this target remains at 70 units per hour, the operators have been able to produce between 30 and 50 units every hour. The target is set from a time study when 65% is taken as the target, and the rest 35% is kept as operator allowance. In this scenario, the operators still cannot meet their target. From the graphs themselves, it is evident through comparison of the value of SAM with the actual time spent on each operation at which more time needs to be spent to hit the ideal production level.

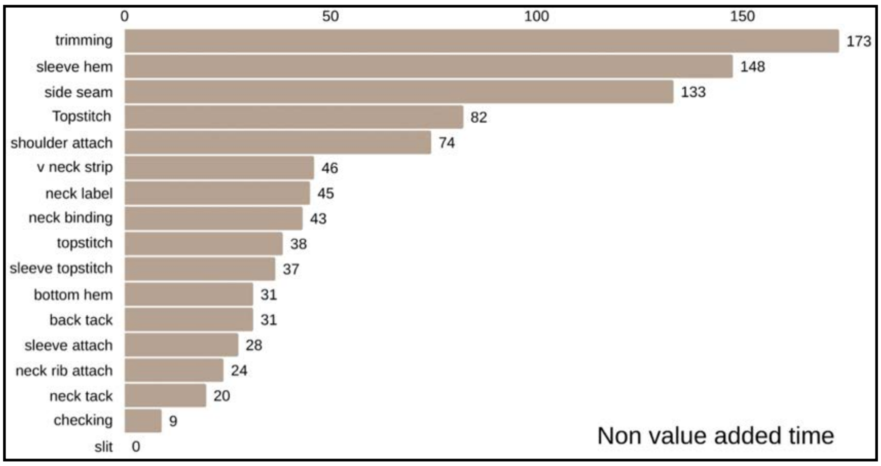

Fig.5 Non value added time

This Fig.5 chart represents NVA time for each operation and identifies operations that consume the most NVA time. Through observation of how much time is spent on non-value-added activities, inefficiencies within the process have been identified. Since the process of eliminating or reducing unnecessary activities should be concentrated on specific aspects of excessive NVA time, it is first important to understand where such extraneous time is being used. Due to this, it is relatively easier to make the workflow smoother, increasing the productivity and optimizing the process altogether by eliminating any non-value-added steps in the process. Failure Mode and Effect Analysis is used to enhance garment quality by looking at a systematic way of assessing potential defects. In this process, rejection abstracts are used where each defect is examined based on severity, occurrence, and detectability. This helps address issues by categorizing the defects at risk to a product. FMEA divides the faults into major or minor; hence, manufacturers get knowledge of where defects need more improvement.

Table 22 RPN calculation

FAILURE MODE	CAUSES	EFFECT	SEVERITY	OCCURRENCE	DETECTION	RPN	CORRECTIVE ACTION
Yarn mistake	Defect in yarn preparation	Weak	8	5	4	160	Review supplier OC. improve varn tension monitoring
Yellow Marks	Contamination during dyeing/finishing	defect	6	4	5	120	Investigate contamination sources, adjust process controls
Fabric Hole	Mechanical damage during production	Unused fabric	9	8	3	216	Train workers, improve equipment maintenance
Needle Drop	Needle damage	holes in fabric	8	4	4	128	Regular needle checks and replacement
Stain Not Removed	Ineffective stain removal	Defect	5	3	6	90	Enhance cleaning process

Table 23 RPN calculation

FAILURE MODE	CAUSES	EFFECT	SEVERITY	OCCURRENCE	DETECTION	RPN	CORRECTIVE ACTION
Cut Part	Incorrect cutting technique	damaged fabric	9	7	3	189	Stricter cutting controls, operator training
Sewing Hole	Incorrect machine tension/needle damage	Holes/weak points	7	6	4	168	Regular machine maintenance, operator training
Trimming Hole	Poor trimming technique	Holes	6	5	5	150	Improve trimming process
Fabric Joint Roll	Improper fabric rolling	Wrinkles/uneven texture	5	3	7	105	Improve fabric rolling procedure

Table 24 RPN calculation

FAILURE MODE	CAUSES	EFFECT	SEVERITY	OCCURRENCE	DETECTION	RPN	CORRECTIVE ACTION
Shape out	Poor fabric Out pattern control	Incorrect fit	7	6	5	210	Improve pattern cutting, check fabric consistency
Semi-Finished Cut Part	Incomplete cutting	Unfinished fabric	8	6	4	192	Quality checks before and after cutting
Needle Line	Machine error during stitching	Visible lines	6	4	5	120	Machine maintenance an calibration

The tables 22-24 Shows the RPN calculation and the charts allow us to identify recorded defects, such as yarn mistakes and fabric holes. Using the Risk Priority Number, appropriate measures can be implemented to address these defects, thereby improving quality and productivity.

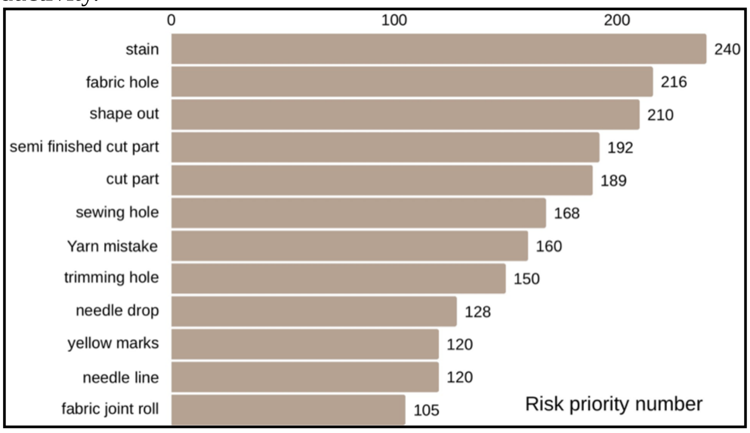

Fig.5 RPN chart

The study as shown, this analysis RPNs' highest were on stains, shape distortion, semi-finished cut parts, and cut parts. Calculations of RPN are expressed as a product of occurrence, severity and detection. Based on the literature review, a minimal defect was as indicated by low RPN, about 40 Fig.5. However, the values in RPNs charts range between 100 and 300; which are in this case, relatively more serious issues.

Although the RPN for the fabric joint roll is the lowest, all the defects-because of their greater values-must be addressed right away to ensure that its adverse effects on quality are not propagated and overall product performance improved.

5.RESULTS AND DISCUSSION

The auto trimmer, that was been used for the undergarment trimming , was diverted and used for lower GSM T-shirts. By looking at the process from the lens of value stream mapping, the process came to be seen as being inefficient compared to its prior use on a single, specialized application. In this respect, through training of the operators and optimizing the usage of the resources, the factory streamlined its trimming process. The working time was cut down while all that more intricate operations were allowed to be performed by other machines as related to the auto trimmer. All these brought in better production capacity, lower labor costs, and increased customer satisfaction, underlining the importance of adaptability, continuous optimization, and hence flexibility in manufacturing.

Table 25 Trimming

Date	Bikni[0.40]	TSHIRT white[1.30]	Crew neck top-tubular maroon[1.40]
19.8.24	500	368	342
20.8.24	550	375	320
21.8.24	530	390	350
22.8.24	547	400	354
23.8.24	589	360	325
24.8.24	550	361	359
26.8.24	577	405	341
27.8.24	572	364	329
28.8.24	559	352	361
29.8.24	650	380	359
30.8.24	582	356	352
31.8.24	584	348	359
Average	565	371	313

After looking on the results over 12 days, it may be seen that the garment trimming process has improved and work-in-progress for the next operation, such as checking, minimized. The output increased from 250 to 580 significantly boosting productivity. The output has boosted but the line layout has been changed for operation such as trimming, side seam attach and shoulder attach, and result has been observed for 4 days; the production is jumped from 30 to 60, which boosts productivity.

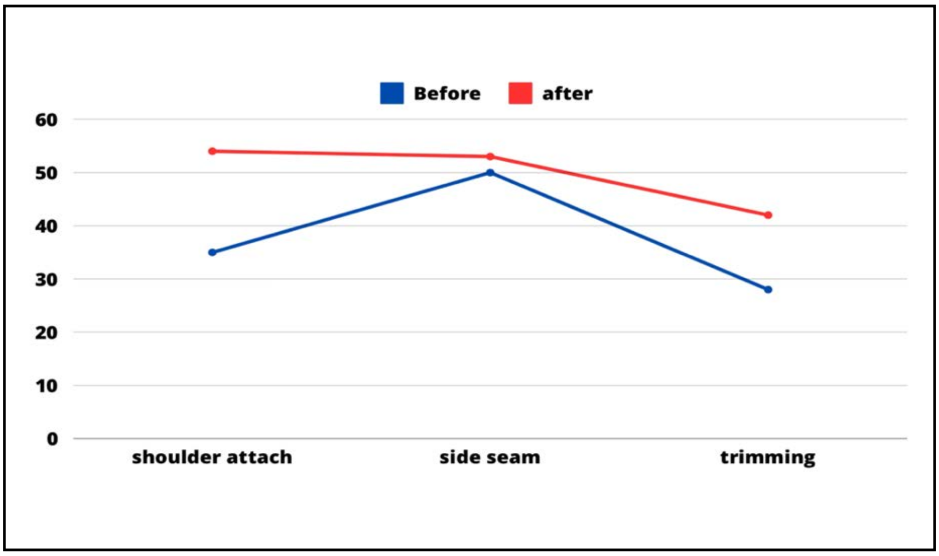

Fig.6 Graph representing T-shirt

This means that the shoulder attachment operation has a positive productivity rate. The yoke and the bodice are next to the operator, thus enabling both hands simultaneously in the use of the side seam operation on which the label would be found at the opposite side. This brings about the efficient use of the cutting side for the operator. In addition, there has been an increased productivity factor due to the use of two operators. The pattern review process has been altered using the FMEA inspection method Fig.6 of analysis of the process. First, the pattern master checks against the specifications whereby he places the piece of fabric onto the pattern and inspects every part. After checking both the pattern and the fabric, he starts with the cutting process. With the measurement, a specification card is given for each cut bundle; the supervisor cross checks it against the reference number in the bundle. The cut bundle then has its barcode card printed, which contains the lot number and number of pieces in the bundle. Bundles are subjected to random checks before going to production. In the training room, operators are taught about how to shape and clothing match, tension settings, and ways of identifying machine defects. All these are in a bid to check for defects at the onset. Additionally, the cutting blades are changed frequently so as not to make any errors in cutting.

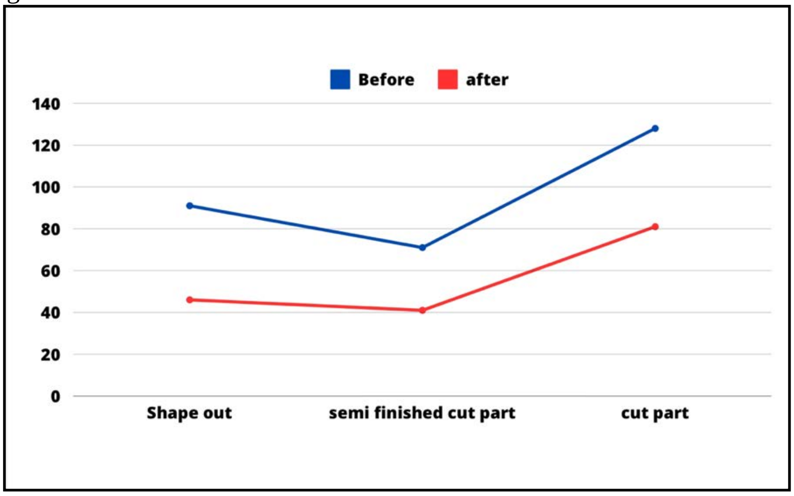

Fig .7 Graph representing FMEA chart

The Fig.7 shows the graph which represents the defects has been reduced significantly from 90 to 40 which helps in ensuring quality.

6 .CONCLUSION

This research, through Value Stream Mapping (VSM) and Failure Mode and Effects Analysis (FMEA), proves productivity improvement in the garment industry. Non-value-added activities are identified and optimized processes with tremendous output enhancement in production capacity, operator training, and quality assurance. The said methodologies not only streamlined operations but fostered a proactive approach in managing defects. The findings are proof that even slight changes can amount to much in productivity, thereby ensuring no company stays ahead of the game for long in case it remains static and uninnovative within this growing garment industry.

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