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IMPLEMENTATION OF LEAN TOOL TO REDUCE STAINS AND DAMAGES IN GARMENT MANUFACTURING – A CASE STUDY IN AN EXPORT ORIENTED UNIT

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ABSTRACT
In the present study, the visual control system was implemented in one of the leading export oriented garment manufacturing units in Bangalore to minimize stains and damages of garments. This study was conducted in the bitting and washing section from where more stains and damages occur. Seven garment styles were selected for the study, which included pale light and bright colors. Primary data was collected using the observational method. Interaction with supervisors was also helpful in understanding types of stains and damages and the root cause of their occurrence during the process to some extent. During the initial investigation, stain and damage percentage was recorded for all the styles. After successful implementation of visual controls such as dos and don'ts displays, information boards and story board postures, the data was collected, analyzed and compared with the initial recordings. There was a considerable reduction in the percentage of stains and damages. Among the results obtained, the stains section marked the highest reduction by 50 %, whereas damages were reduced by 26.57 % which may be rated as moderate. Therefore, changing dynamics of garment manufacturing need such practical approach to prove themselves as tough competitor in global market. However, to achieve more effective results, constant motivation of workers and time to time modification of visual control tools according to the requirement is a must.

KEYWORDS: Garment defects, Rework, Lean tools, Visual control system, Lean waste

I. INTRODUCTION
In recent years, views of Indian apparel industry has changed drastically. With constant efforts and technological adaptations, Indian garment industries have strived hard to stay competitive (Ravikumar et al., 2011). The changing dynamics of the industry have forced garment manufacturers to be more cautious about product quality, cost and lead time (Karlsson, & Ahlstrom, 1996). Though garment manufacturers are working constantly to overcome quality control failures, there are still unavoidable issues which are leading to reworks and rejections. Some of the garment defects may be corrected through reworks, whereas some may not and end up with rejection (Md. Mazedul Islam, 2013). Rejects are non-repairable defects may have occurred due to low quality raw materials or improper processing, and reworks are those which are repairable seems better than rejects when compared but they are nonproductive activities which is lowering the production rate and adding additional cost (Mazumder, 2015). However, eco concern is required in case of the rejected garments which might turn into a waste at later stages (Simboli et al., 2014).
The washing process in garment manufacturing plays a vital role. Washing is normally done after stitching. But some buyers specify washing before fabric gets transformed into a garment, which requires each lay to be cut according to the specified marker width and then folded to half width and joined with stitches at ends temporarily in bitting section. Usually, garment defects like stains and damages occur during the garment sewing process and many researchers have concentrated in that area and successfully implemented methods to reduce the same. Though the prime objectives of garment washing is to remove the starch that is applied during fabric manufacturing, to soften garment hand feel and to remove dirt, unwanted stains and spots that have accumulated while garment manufacturing process, there is a possibility of getting stained or damaged during the preliminary processes like bitting and after washing process like drying, folding and storing due to inappropriate working methods followed by the workers which goes unnoticed.

Lean manufacturing concept is one such method which helps manufacturers to identify such unnoticed errors and reduce nonproductive activities. The Lean approach is based on increasing efficiencies, removing wasteful steps that don't add value to the end product and standardizing the working environment. Lean visual controls use easy to understand system to monitor and control the process (Nizam, 2015). They graphically highlight the problems and posted in plain site very near the place where the actual work is done.
In the present study an attempt was made to implement visual control tools to reduce stains and damages in bitting and washing section of an export oriented unit in Bengaluru.

II. MATERIALS AND METHODS

The present study was carried out in a leading export oriented garment manufacturing unit in Bengaluru. The bitting and the washing section was selected for the case study from where more stains and damages occur. The bitting section consisted of 15 members which included department head, associates, supervisors, helpers and equipment include automatic bitting machine, manual end cutting tables, relaxing machine and O/L machines, whereas washing section consisted of 25 members which included manager, associates, supervisors and helpers and equipment such as washing machine, eye washer, hydro extraction machine, bulk drying machine, perch machine and dryer were used.

Materials

Sony Handycam with 30x optical zoom with 26.8 mm wide angle was used to capture video of the processes and click appropriate images to develop visual control system tools such as dos and don'ts display chart and story display board.

Methods

Primary data was collected using observational method and interaction with supervisors and operators was also helpful in understanding root cause of the stains and damage occurrence. The percentage analysis tool was helpful to categorize and compare data.
Primarily, 7 days were spent to understand the processes in detail in both the departments. Then, from ongoing production, the following seven styles were selected for the study, which consisted of pale light and bright colors.

Table 1. Style Particulars

Sample	Style No.	Item No.	Buyer	Fabric Particulars	Colour	Composition
1.	19057	430	ANNTAYLOR	40s, Single Jersey	Soft Pink	100 % Cotton
2.	9920	282	ANNTAYLOR	40s, Single Jersey	Mint Leaf	100 % Cotton
3.	9922	283	ANNTAYLOR	40s, Single Jersey	Classic White	100 % Cotton
4.	256247	K436	ANNTAYLOR	40s, Single Jersey	Otter Brown	100 % Cotton
5.	4455	K145	ANNTAYLOR	40s, Single Jersey	Snow White	100 % Cotton
6.	939	J134	TOMMY	40s, Single Jersey	Blue Turquoise	95 % Cotton, 5 % Lycra
7.	2844	J573	TOMMY	40s, Single Jersey	Tackle Green	95 % Cotton, 5 % Lycra

The selected styles were observed from bitting to washing section and data was collected on a daily basis for 11 days. The collected data was analyzed and categorized under stain and damage section, followed by defect percentage calculation based on the actual daily production.
Based on the observation and discussion with the department heads and associates, it was possible to select appropriate visual control tools which could yield expected result. After considering cost and available time, two types of visual control tools were designed with the help of supervisors and assistants. Among them first tool was dos and don'ts display chart. A simple chart was designed in which only images and symbols were used effectively to convey the right way of working. Don'ts images were clicked when operators working on the floor, where as dos images were clicked after oral instructions were given. Second visual tool was story display board in which graphic design software was used to develop a speaking garment. The story was based on how operator deals with garment throughout the manufacturing process and its effects on quality approvals. The local language was used in the story to make the operator more comfortable and easy to understand the concepts. Finally, concluding line of the story was connected to the operator's responsibility in delivering quality product which lowers the chances of rejects and rework.

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The dos and don'ts and story was first conveyed using power point presentation to all associates who work in bitting and washing section at weekend. Then it was displayed as board at operator common visiting places.
After successful implementation of visual control tools, the processes were observed for another 11 days for the same styles and defect percentage was calculated, recorded, analyzed and compared with initial data.

III. RESULTS AND DISCUSSION

Initially the whole process was observed in depth for 7 days to make necessary changes in operation procedure. A well-equipped handy camera was used to capture relevant information for this purpose. Captured videos and images were used to find out root cause of the stain and damage occurrence and to prepare dos and don'ts display chart and story display boards. The defects like dirt marks, mud stains, turmeric stains, beverage stains, oil/grease marks, pen/pencil stains, rust marks were listed under the stains section whereas tear and holes were listed under damages.
Among ongoing production orders, seven styles were selected for the study. The selected styles were observed on daily basis for 11 days and defects were recorded before the fabric bit leaves from washing store for the sewing section for stitching. The major defects observed under the stains section were dirt marks, colour stains, turmeric stains, pen marks and oil/grease marks and in damage section tear marked higher than the hole. The defect percentage was calculated in relation with actual production.
The table-2 represents stains and damage percentage of seven styles before implementation of visual control tools.

Table 2. Defects observed before implementation of visual control tools

Day	Style 1		Style 2		Style 3		Style 4		Style 5		Style 6		Style 7	
	ANNTAYLOR		ANNTAYLOR		ANNTAYLOR		ANNTAYLOR		ANNTAYLOR		TOMMY		TOMMY	
	STN %	DMG %	STN %	DMG %	STN %	DMG %	STN %	DMG %	STN %	DMG %	STN %	DMG %	STN %	DMG %
1	9.2	1.5	10.5	1.7	15.5	1.5	10.1	1.1	16.5	2.6	12.5	1.5	8.5	1.2
2	8.5	1.3	11.0	1.6	14.4	2.2	10.5	1.3	16.1	2.8	12.1	1.0	8.2	1.1
3	10.0	1.1	11.6	1.5	14.6	2.5	9.9	0.9	15.5	2.9	10.5	1.8	8.1	1.1
4	10.5	1.0	12.5	1.3	15.7	2.2	8.5	1.5	15.6	2.8	09.5	1.7	8.6	1.0
5	9.5	1.7	10.1	1.3	15.1	2.7	10.6	1.4	15.1	3.0	09.9	1.8	8.6	1.5
6	8.9	1.4	11.7	1.4	16.5	1.8	9.6	1.4	16.7	2.5	09.5	1.5	7.5	1.6
7	9.3	1.3	12.1	1.5	12.0	1.5	9.1	1.3	16.9	2.5	10.9	1.5	7.6	1.7
8	10.0	1.5	12.2	1.8	13.5	1.9	9.7	1.1	17.1	2.6	11.0	1.4	7.9	1.5
9	9.6	1.2	10.9	1.9	14.6	2.3	8.6	1.6	15.2	2.8	12.3	1.9	7.6	1.3
10	8.9	1.4	11.5	2.0	17.2	2.5	9.5	1.5	15.8	3.1	9.6	1.7	7.6	1.5
11	9.1	1.7	11.6	2.1	15.5	2.6	10.5	1.2	16.5	3.2	12.4	1.7	8.2	1.5
AVG	**9.4**	**1.4**	**11.4**	**1.6**	**15.0**	**2.2**	**9.7**	**1.3**	**16.1**	**2.8**	**10.9**	**1.6**	**8.0**	**1.4**

The observation revealed the root cause of stains and damages which occur during the processes. It was found that dirt marks occur when fabric was handled without wearing gloves in bitting section and when folding dried fabric on bare floor. It was also observed that some of the operators don't remove their footwear while folding dried fabric. The fabric storage racks were also not cleaned regularly which was another cause for the dirt. It was found that most operators working in bitting section were women and many of them regularly apply turmeric on their face and the same was transferred to fabric without their knowledge. Another common type stain found was color stain, occurred due to storage of wet fabrics of dark and light colours in bins for a long time. Pen marks were also found common among stains which usually occur when operators recorded number of lays cut during bitting process and the reason for presence of oil/grease marks was due to improper filling of fabrics leading them to come in contact with trolley wheel area which was greased often for smooth flow. Another major reason of the latter was fabric being line dried at lower heights which was making them come with contact of heads of people moving around.
In damage category, tear being the most common type defect, occurred in bitting department when fabric rolls were lifted or placed inappropriately on wooden trolleys which consisted of nails around. Holes being observed less in comparison with tear, which occurred when operator cut fabric roll cover before placing them for bit cutting and while taking off label tied at end of the fabric rolls.
Based on the observation and interaction with supervisors, dos and don'ts display charts were prepared using appropriate images. A unique story display board was prepared in which garment narrates its journey in a

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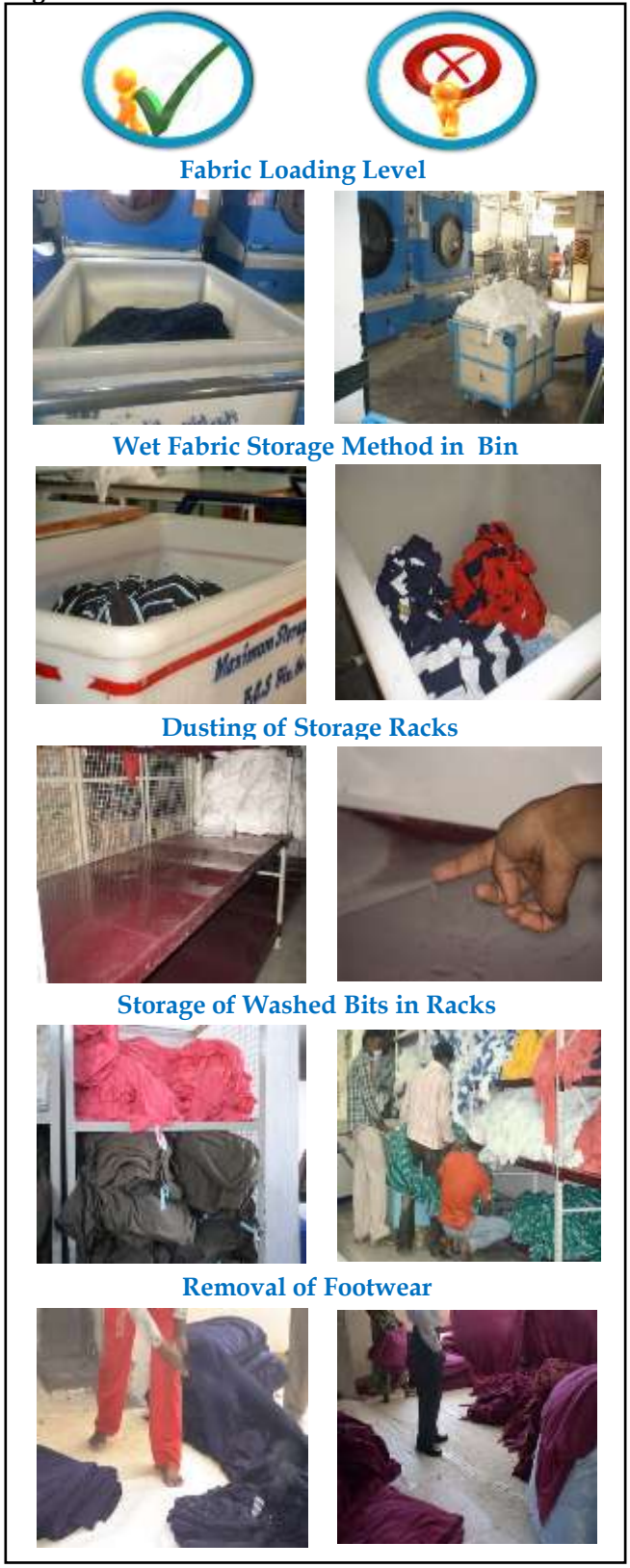
garment industry. Both visual systems were displayed at most common visiting places both in bitting and washing section.

Figure 1

Bitting Section

Figure 2



Washing Section

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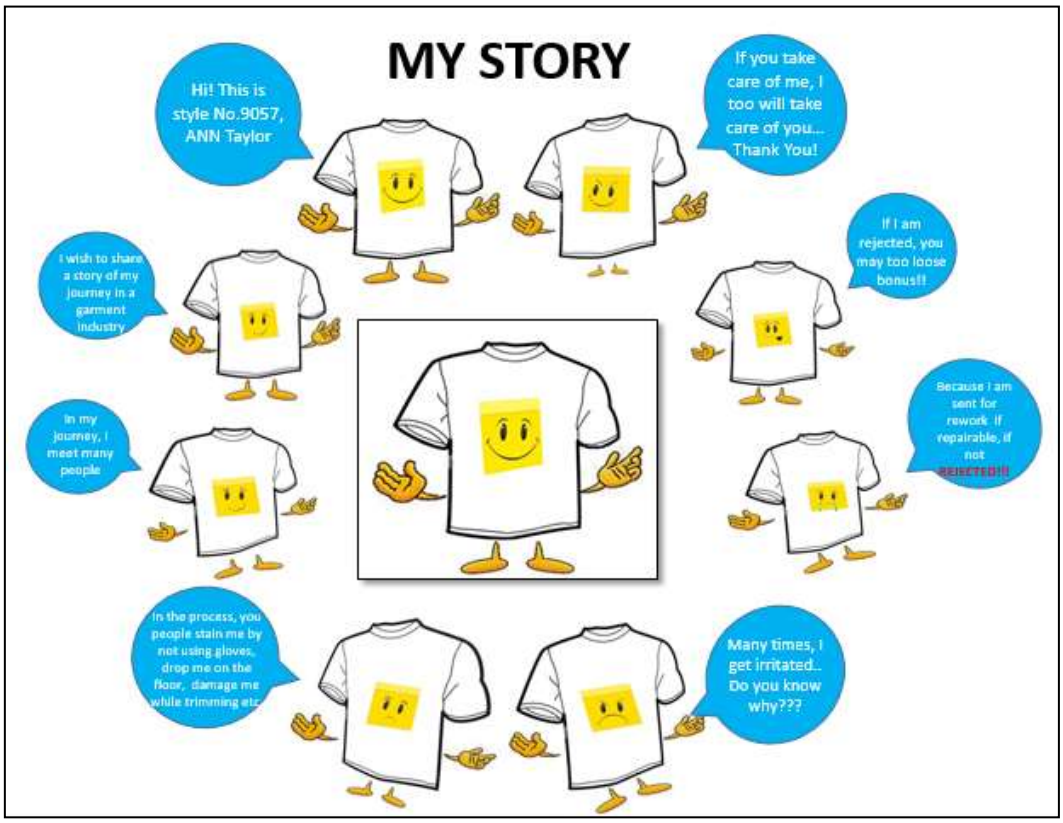
Figure 3



Story Board

After successful implementation of visual control tools, the styles were observed for another 11 days and the data was collected on daily basis and tabulated. The obtained results were highly encouraging. The table 3 represents stain and damage percentage of the same seven styles after implementation of visual control tools.

Table 3. Defects observed after implementation of visual control tools

Day	Style 1		Style 2		Style 3		Style 4		Style 5		Style 6		Style 7	
	ANNTAYLOR		ANNTAYLOR		ANNTAYLOR		ANNTAYLOR		ANNTAYLOR		TOMMY		TOMMY	
	STN %	DMG %	STN %	DMG %	STN %	DMG %	STN %	DMG %	STN %	DMG %	STN %	DMG %	STN %	DMG %
1	7.5	1.2	10.2	1.5	15.5	1.2	8.5	0.9	11.2	1.5	9.5	0.9	7.5	1.1
2	8.0	1.1	10.5	1.4	14.2	1.1	7.5	0.8	11.8	1.1	9.2	0.8	7.5	0.9
3	8.1	0.9	8.5	1.4	12.5	0.7	6.5	0.9	12.1	1.4	9.1	0.5	7.4	0.9
4	7.9	0.8	8.5	1.3	10.5	0.6	6.6	0.7	11.8	1.0	8.7	0.9	6.5	0.8
5	7.5	0.9	8.6	0.8	9.2	0.5	6.7	0.8	12.1	1.4	8.5	0.8	6.1	0.6
6	7.6	0.7	7.5	0.7	9.1	0.6	6.5	0.8	11.7	1.3	8.1	0.7	5.5	0.5
7	6.5	0.8	7.6	0.8	8.5	0.7	6.4	0.7	11.6	1.2	7.3	0.7	5.4	0.7
8	6.4	0.6	7.0	0.6	7.5	0.7	6.3	0.6	11.1	1.3	7.8	0.6	5.6	0.5
9	6.6	0.6	6.9	0.7	7.1	0.6	5.9	0.7	11.5	1.2	7.2	0.4	5.2	0.4
10	6.3	0.5	6.5	0.6	6.8	0.5	5.5	0.6	11.5	1.1	7.1	0.5	5.1	0.5
11	7.5	1.2	10.2	1.5	15.5	1.2	8.5	0.9	11.0	1.8	9.5	0.9	7.5	1.1
AVG	**7.3**	**0.8**	**8.4**	**1.0**	**10.6**	**0.8**	**6.8**	**0.8**	**11.5**	**1.3**	**8.4**	**0.7**	**6.3**	**0.7**

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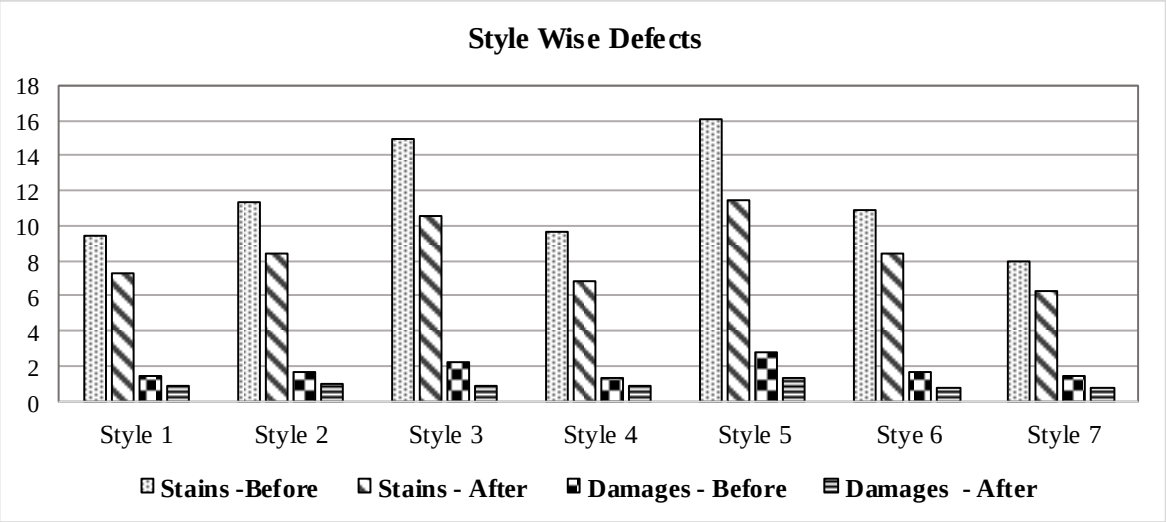
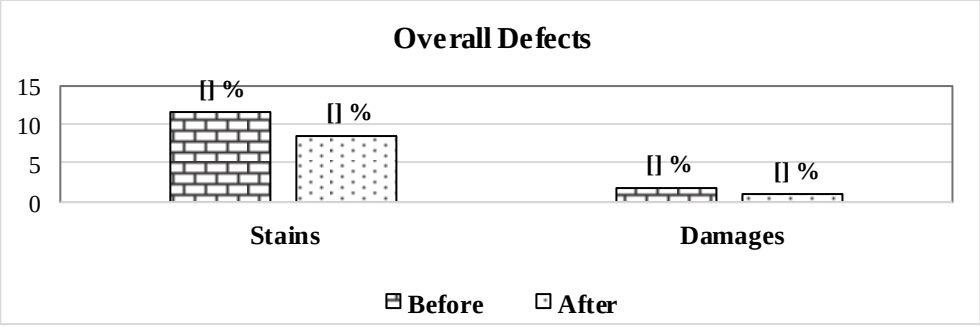
Figure 4



Style wise defects - Before and After

In figure 4 it was noticed that style 5 recorded highest stains and damages whereas style 7 being least in in stains and style 4 in damage section before implementation of lean tool. After implementation of visual tools, it was noticed that style 7 recorded highest reduction in stain and damage percentage whereas style 5 marked lowest reduction in both types of defects. The fabric colour is the prime reason for the results obtained. White colour fabrics are prone to get stained sooner and darker ones conceal light stains to some extent. Damages occur due to inappropriate lifting and placing of fabric rolls on wooden trolley and while removing label tags

Figure 5



Overall Defects

Figure 5 shows overall defects of all the styles recorded after successful implementation of visual control tools. There was a considerable reduction in the percentage of stains and damages. Among the results obtained, the stains section marked the highest reduction by 50 %, whereas damages were reduced by 26.57 % which may be rated as moderate. Constant efforts in motivating people to follow the right method of working will help to bring more effective results.

IV. CONCLUSION

Modern industrial trends are focusing more on environmental issues and moderately leading towards concepts of creating more value with low impact. Green approach in garment manufacturing constantly assessing the environmental impact of the processes is closer to the lean manufacturing methods. Defective components or garments require recycling if rejected or more space for rework or repair increases energy use in terms of heating, lighting and cooling processes which is considered as waste in lean.

This study was intended to demonstrate the benefits of implementation of lean tool in garment manufacturing. The lean initiative has addressed quality issues of present garment manufacturing like defects leading to reworks

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and rejects. This study carries evidence for minimization of defects in bitting and washing area in an export oriented units by using visual management system, one of the lean tool with less investment and time. There was an appreciable reduction in stains and damages. With constant motivation of operators and modification of visual control tools as per the change in the processes, it is possible to reduce the amount of energy flowing for the rework process and reduce waste which is generated when components or garments get rejected for unrepairable defects.

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