Implementation of Kaizen on a Basic Shorts Manufacturing to Reduce Cost and Accelerate Productivity

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ABSTRACT

The economy of Bangladesh is growing rapidly with the power of the Ready Made Garments industry which remains the highest exporting sector of the nation from the very beginning. With time being RMG sector has been facing many challenges and increasing production cost is always a bigger concern. Bangladesh is facing a higher production costs of manufacturing any garment compare to its previous ten years while the offering cost from the buyer remains approximately the same. Considering the challenges this sector is more focused on reducing production costs to maximize the profit margin. This paper aims to demonstrate comparative changes in terms of Cycle time, Standard Minute Value (SMV), Capacity, Hourly target, Manpower and salary by implementing the Kaizen process on a basic shorts manufacturing process. Improving and implementing kaizen, work study and motion study in three separate processes of shorts result in a huge saving for the industry. Comparison of data is done by evaluating the process breakdown of the products considering before and after kaizen implementation. This comparison considers basic shorts manufacturing in a floor results in 4 minutes, 10 operators and $11,520 yearly savings also ensures the increase in capacity, efficiency and hourly target. So this paper can lead to a better output showing the guidelines for the manufacturers and also the expertise as well.

Keywords: RMG, Kaizen, SMV, Motion study, Lead Time, Line balancing, and Process breakdown.

INTRODUCTION:

Before the independence of Bangladesh, no major industries were developed and rebuilding the country with limited resources appeared to be the biggest challenge after the liberation. The nation has successfully developed a strong economy, which majorly depends on the Ready Made Garment sector as a key player since 1978 (Nabi *et al.*, 2015). The industry has been making a crucial contribution to rebuild the country and the sector accounts for more than 83% of total export earnings (Hosen *et al.*, 2020).

The sector creates millions of employment opportunities and contributions significantly to the GDP of the nation (Niknazar *et al.*, 2009). Ready Made Garments in Bangladesh is powered by young, energetic workers most of whom are women. Bangladesh is countries where labor is available at low wages and many reputed buyers come to this country for lower labor cost with a high-quality product (Quddus *et al.*, 2014). Though the RMG sector of Bangladesh has achieved the second position for the highest number of garment exports in the world market still has been

facing a huge number of challenges. The RMG sector continues to lack adequate support for backward linkage industries resulting in importing raw materials from external sources. The vast majority of export money is spent on these important accessories and raw materials which is undermining the confidence of exporters and manufacturers as well. Now a day the cost of raw materials, labor, utility costs and so on is increasing for time being. However, the product's price did not increase in comparison and so we must have to focus on lowering manufacturing costs to sustain ourselves in the world market. There is a very close connection between product and production cost as every minute counts and it is very important in the production section. Improvement in productivity and reduction lead time becomes necessary and here comes the importance of the best utilization of modern techniques like Kaizen, Time study and Motion study in the garment industry (Alam *et al.,* 2018). Kaizen means is a Japanese word that means continuous improvement (Otsuka *et al.*, 2022). Continuous improvement is one of the core strategies for excellence in production and is considered a vital role in today's competitive environment. The textile and Ready Made Garments industry is witnessing the introduction of Kaizen which will alter the future of the sector as a very large of small improvements are found more effective in production (Abdolshah *et al*., 2006).

Furthermore, there are several functions in the Ready Made Garment industry, but the sewing section is one of the most important and valuable ones where the implementation and modifications are widely ensured by using both technology and modern tools (Mohibullah *et al*., 2019). So this paper focuses on implanting Kaizen, time and motion study on the sewing section to reduce the processes, SMV, Lead Time, and Manpower and also to ameliorate Profit, Production Capacity, and Daily Target at the same time.

METHODOLOGY:

This is a comparative analysis of a basic shorts manufacturing process on the sewing section. The comparison was done by evaluating the primary and secondary data of a sewing floor of shorts. First of all data collection was done by running the production process of shorts process breakdown including the cycle time, SMV, manpower, capacity, hourly target and salary. Following the collection of data, this paper considered the possible ways to reduce the SMV and increase the target, capacity by eliminating any unnecessary processes. From the continuous analysis of kaizen and motion study the idea of improving three processes of shorts are found separately. Improvement of the processes is focused on J stitch decoration, Pocket attachment and Tack waistband with the body of shorts. After completing these improvements primary data collection is done again including the cycle time for each process and then the calculation of average cycle time, SMV, manpower and salary are ensured at the same time. By using the proper formula from collected data further calculations of capacity and target are found chronologically.

Calculation of SMV, target, capacity and manpower using the conventional process for basic shorts
The following **Table 1** shows the process breakdown, SMV, Target, Capacity and Manpower required for making basic Shorts using the conventional process in the sewing section.

Table 1: Process breakdown, SMV, Target Capacity and Manpower for shorts.

SL No	Process	Type of m/c	SMV	Average cycle time(s)	Target 100%	Target 70%	No. of m/c	No. of Hp
1	Paring	Helper	0.12	7	500	350		1
2	Join front & Back Rise	4TO/L	0.33	20	182	127	1	
3	Front & Back Rise inner sewing & TPS	SNLS	0.40	24	150	105	1	
4	Front and Back rise TPS	SNLS	0.35	21	171	120	1	
5	Mark for J stitch Decoration	Helper	0.30	18	200	140		1
6	Front part J stitch Decoration	2NLS	0.25	15	240	168	1	
7	Facing Close	4TO/L	0.32	19	188	131	1	
8	Join pocket facing (1st)	SNLS	0.28	17	214	150	1	

9	Join pocket facing(2nd)	SNLS	0.28	17	214	150	1	
10	Mark Pocket position	Helper	0.17	10	353	247		1
11	Attach Pocket	SNLS	0.60	36	100	70	2	
12	Cut front Pocket edge	Helper	0.25	15	240	168		1
13	Top stitch pocket opening	SNLS	0.50	30	120	84	1	
14	Close front pocket bag	4TO/L	0.30	18	200	140	1	
15	Tack at waist	SNLS	0.24	14	250	175	1	
16	Tack at pocket side	SNLS	0.25	15	240	168	1	
17	Piping attach at side panel	SNLS	0.37	22	162	114	1	
18	Piping Excess cut	Helper	0.28	17	214	150		1
19	Tack at pocket side	SNLS	0.40	24	150	105	2	
20	Process check	QC	0.22	13	273	191		1
21	1st side seam	4TO/L	0.40	24	150	105	1	
22	2nd side seam	4TO/L	0.40	24	150	105	1	
23	Top stitch side seam	SNLS	0.30	18	200	140	1	
24	Join inseam	4TO/L	0.38	23	158	111	1	
25	Make hole	Hole	0.22	13	273	191	1	
26	Leg Hem	3TF/L	0.50	30	120	84	1	
27	Trimming	Helper	0.24	14	250	175		1
28	Elastic cut, tack& mark	SNLS	0.36	22	167	117	1	
29	Mark waist band & body	Helper	0.33	20	182	127		1
30	Attach waist band	3TO/L	0.50	30	120	84	1	
31	Attach label	SNLS	0.18	11	333	233	1	
32	Tack waist band with body	SNLS	0.40	24	150	105	1	
33	Top stitch at waist band	Kansai	0.40	24	150	105	1	
34	Bartack at pocket side & front	B /T	0.40	24	150	105	1	
35	False tack remove	Helper	0.25	15	240	168		1
36	Trimming	Helper	0.35	21	171	120		1
37	End Line Q.C	QC	0.35	21	171	120		2
	Total		**12.17**				**28**	**12**

From the conventional sewing process data this report found that Shorts took approximately 12.17 minutes and 40 workers to complete sewing. It was not a small figure at all in this competitive market. While concerning various issues like limited lead time, higher production cost, lower productivity etc. It is always important to reduce production time, reduce helper and reduce thread consumption for efficacious production and profit. This paper focuses on the marked processes on the process breakdown chart and ensures improvement in manufacturing.

Comparison of processes: Using both conventional and Kaizen processes

The process of making basic shorts was compared using both conventional and kaizen processes. Those processes were Mark for J stitch decoration, Front part J stitch decoration, Attach pocket, Tack waist band with body and false tack remove. For comparing the data of conventional and kaizen processes, they are demonstrated chronologically.

Mark for J stitch decoration and Front part J stitch decoration

The comparison was done based on a "Five lines" sewing floor. For this comparison, the conventional process and kaizen process of Front part J stitch decoration including, its required Process breakdown SMV, Target, Capacity and Manpower are shown together.

The conventional process of Mark for J stitch decoration and Front part J stitch decoration

From the data for completing Mark for J stitch decoration per shorts in the conventional process, this process consumed 0.30 minutes and 1 worker. The calculation was prepared for only 1 line.

Table 2: Conventional process of Mark for J stitch decoration and Front part J stitch decoration.

SL No	Process	SMV	Target 70%	Capacity	Manpower		Salary ($)
					Machine	Helper	
1	Join front & back rise	0.33	127	180	1		$96
2	Front, back rise inner sewing & TPS	0.40	105	150	1		$96
3	Front and back rise TPS	0.35	120	172	1		$96
4	Mark for J stitch decoration	0.30	140	200		1	$96
5	Front part J stitch decoration	0.25	168	240	1		$96

For five lines per floor calculation, this required 0.30×5=1.5 minutes, capacity 200×5=1000 pieces, Target 140×5=700 pieces and 1×5=5 workers. If a worker's monthly salary in Bangladesh is $96, then $96x5 = $480 per month from 5 lines on 1 floor. And from the data for completing the Front part J stitch decoration per shorts in the conventional process consumed 0.25 minutes and 1 worker. The calculation is prepared for only 1 line. For five lines per floor calculation, this required 0.25×5= 1.25 minutes, Target 168×5=840, Capacity 240×5= 1200 pieces and 1×5=5 workers. If a worker's monthly salary in Bangladesh is $96, then $96x5 = $480 per month from 5 lines on 1 floor.

The proposed process of Front part J stitch decoration

Table 3: Kaizen process of Mark for J stitch decoration and Front part J stitch decoration.

SL No	Process	SMV	Target 70%	Capacity	Manpower		Salary ($)
					Machine	Helper	
1	Join front & back rise	0.33	127	180	1		$96
2	front, back rise inner sewing & TPS	0.40	105	150	1		$96
3	Front and back rise TPS	0.35	120	172	1		$96
4	Mark for J stitch decoration	0.30	140	200		1	$96
5	Front part J stitch decoration	0.20	210	277	1		$96

From the data for completing the Front part J stitch decoration per shorts in the proposed kaizen process required less time and removing 1 helper than the conventional process. The process consumed 0.20 minutes and also removes 1 worker. This calculation is only for 1 line. For five lines or per floor calculation this required 0.20×5=1 minutes, target increase 210×5=1050, capacity 277×5=1385pcs and 1×5=5 workers. If a worker's monthly salary in Bangladesh is $96, then $96 x 5 = $480 per month from 5 lines on 1 floor.

Statistical difference between conventional and kaizen process for Front part J stitch decoration

Selecting the kaizen process of Front part J stitch decoration instead of conventional can minimize a considerable figure. It saved a total of 1.75 minutes; Target increased to 210 pieces, 5 workers, saved $480 monthly wages and increased Capacity by 185 pieces. This calculation is only for 1 floor containing 5 lines.

Pocket Attachment

The comparison was done based on a 'five lines' sewing floor. First of all, the conventional process of the Pocket Attachment is shown. This is basic double-pocket shorts which finally demonstrate the kaizen process, leading to show the comparison.

The conventional process of Pocket Attachment

Table 4: The conventional process of pocket attachment.

SL No.	Process	SMV	Target 70%	Capacity	Manpower	
					Machine	Helper
1	Join pocket facing(1st)	0.28	150	212	1	
2	Join pocket facing (2nd)	0.28	150	212	1	
3	Mark pocket position	0.17	247	360		1
4	Attach pocket	0.60	70	100	2	

5	Cut front Pocket edge	0.26	168	240		1
6	Top stitch opening	0.50	84	120	1	
7	Close front Pocket bag	0.30	140	200	1	

From the data for completing Pocket Attachment per shorts in the conventional process, it required seven processes. This process required 0.60 minutes and 2 workers. This calculation was for only 1 line. For five lines or per floor calculation, this will be required 0.60×5=3 minutes, Capacity 100×5=500 pcs, Target 70× 5 = 350 and 2×5=10 workers.

The proposed process of Pocket attachment

Table 5: kaizen process of Pocket Attachment.

| SL No. | Process | SMV | Target 70% | Capacity | Manpower | |
					Machine	Helper
1	Join pocket facing(1st)	0.28	150	212	1	
2	Join pocket facing (2nd)	0.28	150	212	1	
3	Mark pocket position	0.17	247	360		1
4	Attach pocket	0.50	84	120	2	
5	Cut front pocket edge	0.26	168	240		1
6	Top stitch opening	0.50	84	120	1	
7	Close front pocket bag	0.30	140	200	1	

From the data of completing Pocket Attachment per shorts in the kaizen process, it required seven processes. These processes required 0.50 minutes and 2 workers. This calculation was for only 1 line. For five lines per floor calculation this required 0.50× 5= 2.5 minutes, Capacity 120×5=600 pieces, Target 84× 5 = 420 and 2 ×5=10 workers.

Statistical difference between conventional and kaizen processes for pocket attachment
Selecting the kaizen process of Pocket Attachment instead of the conventional can minimize a considerable figure. It saved a total of 0.5 minutes, increasing the Target to 70 pieces and the Capacity increases to 100 pieces. This calculation is considered only for 1 floor containing 5 lines.

Tack elastic with body and false tack remove
The comparison was done based on a 'five lines' sewing floor. First of all, the conventional process of the Tack elastic with body and false tack remove is shown. Then finally demonstrating the kaizen process leads the report to show the comparison.

The conventional process of Tack elastic with body and false tack remove

Table 6: Conventional process of Tack elastic with body and false tack remove.

| SL No. | Process | SMV | Target 70% | Capacity | Manpower | | Salary ($) |
					Machine	Helper	
1	Elastic cut, tack & mark	0.36	117	164	1		$96
2	Mark waistband & body	0.33	127	180		1	$96
3	Attach waistband	0.50	84	120	1		$96
4	Attach label	0.18	233	327	1		$96
5	Tack waistband with body	0.40	105	150	1		$96
6	Top stitch at waistband	0.40	105	150	1		$96
7	Bartack at pocket side & front	0.40	105	150	1		$96
8	False tack remove	0.25	168	240		1	$96
9	Trimming	0.35	120	171		1	$96

From the data for completing Tack elastic with body per shorts in the conventional process, it required nine processes. This process required 0.40 minutes and 1 worker. This calculation is for only 1 line. For five lines per floor calculation, this required 0.40×5= 2 minutes, Capacity 150×5=750 pcs, Target 105× 5 =

525 and 1×5=5 workers. If a worker's monthly salary in Bangladesh is $96, then $96 x 5 = $480 per month from 5 lines on 1 floor. And from the data for completing false tack remove shorts in the conventional process this required 0.25 minutes and 1 worker. This calculation was for only 1 line. For five lines per floor, this required 0.25×5=1.25 minutes, Capacity 240×5=

1200 pcs, Target 168× 5 = 840 and 1×5=5 workers. If a worker's monthly salary in Bangladesh is $96, then $96 x 5 = $480 per month from 5 lines on 1 floor.

The proposed process of tack elastic with body and false tack remove

Table 7: Kaizen process of Tack elastic with body and false tack remove.

SL No.	Process	SMV	Target 70%	Capacity	Manpower		Salary ($)
					Machine	Helper	
1	Elastic cut, tack & mark	0.36	117	164	1		$96
2	Mark waistband & body	0.33	127	180		1	$96
3	Attach waistband	0.50	84	120	1		$96
4	Attach label	0.18	233	327	1		$96
5	Tack waistband with body	0.25	168	240	1		$96
6	Top stitch at waistband	0.40	105	150	1		$96
7	Bartack at pocket side & front	0.40	105	150	1		$96
8	False tack remove	0.25	168	240		1	$96
9	Trimming	0.35	120	171		1	$96

From the data for completing Tack elastic with body per shorts in the kaizen process, it required nine processes. This process required 0.25 minutes and 1 worker. This calculation was for only 1 line. For five lines or per floor calculation this required 0.25×5=1.25 minutes, capacity 240×5=1200 pcs, target 168× 5 = 840 and 1×5 =5 workers. If a worker's monthly salary in Bangladesh is $96, then $96 x 5 = $480 per month from 5 lines on 1 floor.

Statistical difference between conventional and kaizen process for Tack elastic with body and False tack remove
Selecting the kaizen process of Tack elastic with body instead of conventional can minimize a considerable figure. It saved 1.75 minutes for the tack waistband with body, increasing the Target by 315 pcs and increasing capacity by 450 pieces for the Tack waistband with the body. And also proposed method saves 5 workers and $480 monthly. This calculation is only for 1 floor containing 5 lines.

RESULTS AND DISCUSSION:
From this paper, a reader can get a clear idea about the implementation of the kaizen process with its financial benefits. It has separately demonstrated a substantial amount of resource-saving in the Mark for J stitch decoration, Front part J stitch decoration, Attach

pocket, Tack waist band with body and False tack removal by implementing the kaizen process chronologically. The output of the machines was added to this study as well. Finally, it can be stated that from the Mark for J stitch decoration and Front part J stitch decoration total increasing capacity for 5 lines is 185 pieces and removing 5 extra workers and also removing the process of Mark for J stitch decoration.

Not only the workers but also the industry can save SMV up to 1.75 minutes and increase the Target to 210 pieces per short for that specific process. It also helps to increase productivity by optimum utilization of resources. Chronologically from Attach pocket, the total savings for SMV is 0.5 minutes, increasing Capacity to 100 pieces and the target for this process is 70 pieces. From Tack elastic with body and False tack removal, it saved a total of 1.75 minutes, for Tack waist band with body increasing the Target to 315 Pieces, increasing Capacity to 450 Pieces and removing the process of False tack removal, also removed 5 workers. So, this is a considerable save collectively for all categories and is estimated for one floor of five lines. If we assume that a worker's salary in Bangladesh is $96, then the implementation of Kaizen can save $96 x 10 = $960 per month from 5 lines on 1 floor. And if we consider it yearly, we can

save $960×12=$11,520. So, from the report result is very clear that the industry will be benefited finan- cially with an abridged lead time forthe kaizen process instead of the conventional.
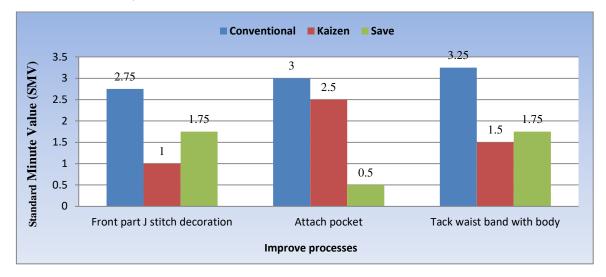

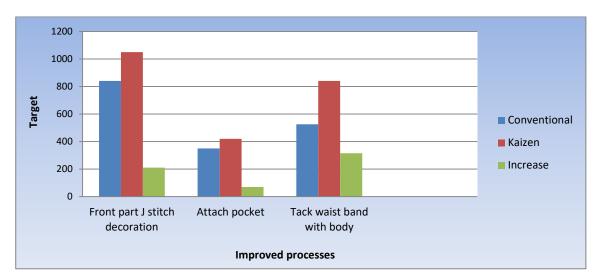**Fig. 1:** Graphical difference of SMV for shorts manufacturing.

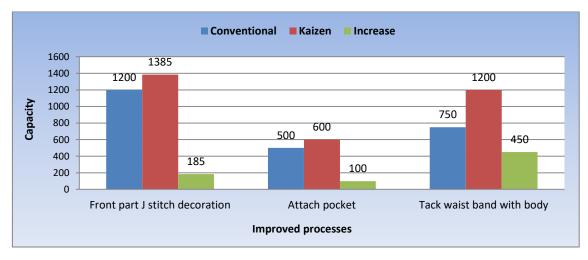**Fig. 2:** Graphical difference of Target for shorts manufacturing.

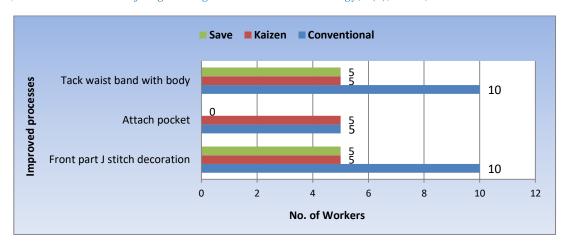**Fig. 3:** Graphical difference of Capacity for shorts manufacturing.

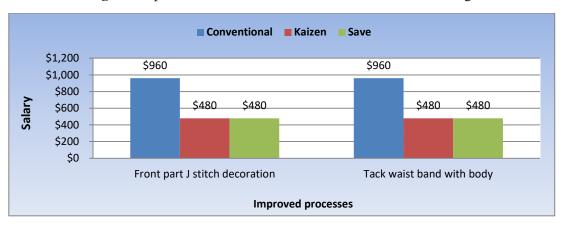**Fig. 4:** Graphical difference of Workers for shorts manufacturing.

Fig. 5: Graphical difference in Salary for shorts manufacturing.

Total Time and Production Save for Shorts Manufacturing

Table 8: After implementation of kaizen, Total statistical saves for shorts manufacturing.

SL. No	Process	SMV	Target 70%	Worker	Capacity	Salary ($)
1	Front part J stitch decoration	1.75	210	5	185	$480
2	Attach pocket	0.5	70	0	100	$0
3	Tack waistband with body	1.75	315	5	450	$480
	Total save	**4**		**10**		**$960**

CONCLUSION:

According to the paper, employing kaizen processes in the sewing area rather than traditional processes results in significant cost savings for the company. The decrease in SMV makes it immediately possible to boost productivity and the reduction of personnel also makes it possible to raise profit. Every time an organization introduces a continuous improvement strategy, the outcomes are very widely seen. So by implementing the kaizen process time saving from a basic short for Front part J stitch decoration, Pocket attachment and Tack waistband with the body is possible with increased productivity. This may be considered a further vali-

dation of different garment manufacturing though it is a matter of great concern that most of the industries in Bangladesh are not conscious and even they don't know the techniques for implementing Kaizen and its benefits. Bangladeshi garment industries have low-cost labor, but they could not make the highest profit because of not implementing new techniques such as lean, kaizen and 5S. Some apparel industries using these techniques are in the leading position. In a modern competitive market implementation of Kaizen or continuous improvement is widely required and can result in huge industrial savings.

CONFLICTS OF INTEREST:

The author affirms that there is no conflict of interest in the article's publication.

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