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Maximization of Fusing Machine Utilization through Leaner approach in Fabric Preparation and Feeding in Fusing Section of Woven garments

Chowdhury Noman Hossain[1], Al Haque Shabab[2] and Arifuzzaman S.M.[3]
[1]School of Business, State University of Bangladesh (SUB), Dhaka, BANGLADESH
[2]Head of Industrial Engineering, Group QA, Dhaka, BANGLADESH
[3]Faculty of Business Administration, East-West University (EWU), Dhaka, BANGLADESH

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Abstract

Like experts in any other manufacturing industries, garments experts are also concerned of all pressing efficiency issues like low productivity, longer production lead time, high rework and rejection, poor line balancing, low flexibility of style changeover etc. Continuous studies in different domains in garments manufacturing are contributing in gaining increasing efficiency and lowering wastes. These problems were addressed in this study by the implementation of a number of lean approaches. This study is conducted in the fusing section of a garments manufacturing company. Study includes time studies between three approaches for preparation of fabrics for feeding and tries to come up with the most efficient approach of all.

Keywords: Garments, Lean, Fusing, Tray method, Sandwiching, Ironing, Fabric preparation, Feeding, SAM (Standard Allowed minutes), Target level.

Introduction

In any manufacturing industry, low productivity, longer production lead time, high rework and rejection, poor line balancing, low flexibility of style changeover etc are pressing issues. And garments industry is no exception. Running after low cost manufacturing opportunities, most companies in developed countries are shifting their manufacturing works to lower wage countries[1]. But mere lower wage does not deem sufficient to feel comfortable in ever increasing competitive environment. The very inherent nature of garment industry, like, the short production life cycle, high volatility, low predictability, high level of impulse purchase, the quick market response; garment industries are causing challenges these days[2].

Greatest challenge with these developing countries is lack of productivity and study of efficiency[3]. Continuous studies in different domains in garments manufacturing are the only way around for gaining increasing efficiency and lowering wastes. Researches have been conducted vertically virtually in all types of steps within manufacturing processes to make them more optimized, leaner and flexible. For example, this is all because of researches that we have come to know that how Fuzzy logic, Genetic Algorithm, Geometric programming, Artificial Neural Network etc can be implemented in cutting process in manufacturing industry[4]. Plasma technologies can make textile processing more cost-effective, energy-saving and environment-friendly[5]. Even research showed how Cellulse enzyme can be used in textile processing to substitute non eco-friendly chemical treatments[6]. Research and development (R and D) is thus so important in garments sector lack of which results in low quality of goods (i.e. cotton) from Bangladesh in comparison to rest of Asia[7]. This is undeniable that industries especially in this sub-continent still lack proper orientation to lean philosophy in their manufacturing industries. One study done on 26 electronics manufacturing industry shows that, India, a manufacturing giant in many domains still is at nascent stage in implementing lean tools[8].

In an woven ready-made garments industry (e.g tops and Bottoms items) generally there are a separate section of Fusing which is in most cases adjacent to the cutting department. This study is conducted in the fusing section of a garments manufacturing company. Study includes time studies between three approaches for preparation of fabrics for feeding and tries to come up with the most efficient approach of all. This might be an untouched area where the industrial experts given their concentration. But as the apparel industry is more competitive the way to get the maxi mum output from all the operational areas is must.

There are three common-most approaches practiced by most of the fusing personnel in garments industry, which are Tray method, Iron method and Sandwich method. Through these methods, fabrics are prepared for feeding into the fusing machines. Again in the feeding method, fabrics can either arranged in trays, as mention above, or can be bundled together for later feeding. Here we brought another approach of Aligned Bundling in our time study. This approach is quite new to most of Bangladeshi manufacturing companies and hence yet to be popular in fusing floors.

Before going into the details of the time study, this paper discusses lean methodology, garments manufacturing, fusing technologies. The final chapters provide detailed study on the efficiency and target level of different approaches for fabric preparation and feeding. The paper also tried to determine the best approach in terms of SAM (Standard Allowed Minutes) and Target level. In the concluding chapter, we also made a recommendation with achievable benefits a company may enjoy from practicing the best approach the study determined.

Objective of the study: Objectives of this study are as follows: i. Getting optimum approach for feeding the fusing m/c which would ensure best utilization and efficiency. ii. Finding out alternative method that would replace Iron press that causes higher heat generation, electricity consumption. iii. Ensure optimum manpower utilization.

Data Collection

The case study considered in this research is one of the leading garment industries in Bangladesh. The organization has 22 lines. This factory produces various types of tops and bottoms items for gents and ladies for European and American continents. The annual turnover of this company was around US$ 18 million. The industry has made huge capital investments to take initiatives in expansions, modernizations etc.

All data has been collected through Digital Stopwatch (with Lap) model Casio. Standard work-study /motion-study data collection technique has been followed for measuring SAM. In addition to primary reading, 10% fatigue allowance, 10% allowance for iron method and 0.002% bundle-handling allowance have been incorporated to corresponding data calculation. To get a conclusive decision and for simplification and quick result same processes have been taken for all the studies.

Lean Manufacturing: After the second world war, Japan was left with quite a devastated economy, with scarce sources of finance and an industrial infrastructure that needed something special to stand back on its feet. Neither layoff of human resources seemed wise to them, nor taking American mass-production concept as their instant tactic was found realistic.

Toyota, being pioneer in Japanese manufacturing industry, was looking for any feasible and sustainable strategy for gearing up their already sick scenery of manufacturing industry and opted for production tactic in short batches. The perceived benefits were flexibility required to changing dimensions of demand and very less amount of inventory saving a huge amount of cost. With this in mind Japanese manufacturing industry led by Toyota in front row, opted for designing multipurpose machineries with short changeover time. They then realized and focused on training of their existing labor force in operating many-in-one machineries. That eventually made up a motivated workforce capable of dealing with numbers and varieties of production processes and tools. Toyota's flexible production process, capable of responding changing needs in terms of both quantity and designs, within a while, proved to a very effective and efficient model of manufacturing, and in many cases more profit-making then to American style of mass production as was depicted in one literature: "short production runs started by Toyota became a benefit rather than a burden"[9]. Over time, this new approach to operations paved the foundation of lean or Toyota Production System (TPS).

Toyota's methods were rapidly adopted by other industries, giving many of them a competitive advantage worldwide, this led to many Western companies studying and adopting some of these practices. Although the term lean is a fairly recent introduction to the language of management, the philosophy is based on principals and work practices used, developed and perfected by Japanese companies since the 1950s.

There are three key issues that define the lean philosophy: elimination of waste, the drive for continuous improvement and the involvement of staff[10].

As said, lean philosophy firstly is about reducing of waste, more specifically 'any human activity that absorbs resources but creates no value'. Toyota identified seven different types of waste (defects, overproduction, unnecessary inventory, unnecessary motion, inappropriate processing, waiting time, transport of goods) as part of the Toyota production system[11].

Continuous improvement (Kaizen in Japanese language) is essential to the lean philosophy, that, improvement can be achieved by a never ending process of questioning the workings of a process or activity.

And the third pillar of lean philosophy is to involving others. People are the key element in the system. The lean approach to people management has been referred to as the respect for humans system. This system encourages and often requires team based problem solving, job enrichment, job rotation and multi-skilling.

Now we come back to garment manufacturing process. Broadly two categories of processes (namely pre-production process and production process) are involved in garments manufacturing. Designing of garments, pattern design, sample making, production pattern making, grading and marker making etc are related to pre-production process. And then cutting, stitching (preparatory and assembly) and finishing- all these process are within the boundary or production process.

Fusing is one of the vital steps in any garment manufacturing process. In almost all fusing processes temperature, time, pressure and cooling – these four parameters define the fusing process. By now in garments industry various types of tools are used in fusing that include specialized fusing presses, continuous fusing systems, flat bed fusing press, Hand iron, High frequency fusing, steam press etc. Methods of fusing include single fusing, reserve fusing, sandwich fusing, double fusing etc.

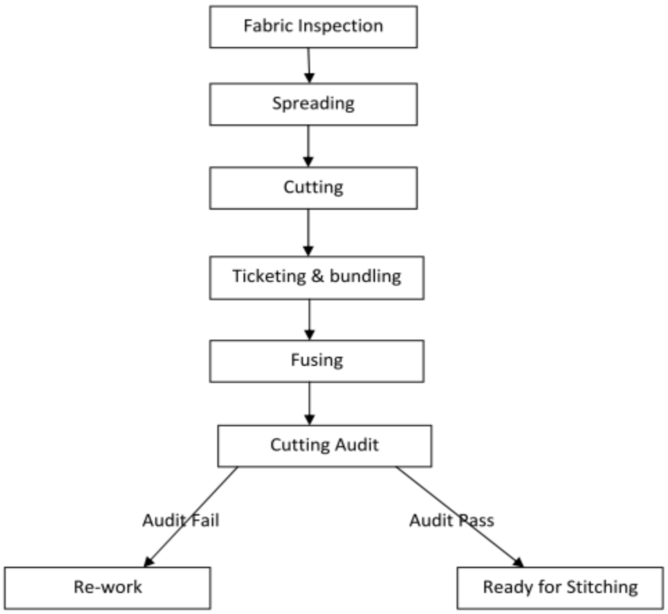

Figure-1
Flow of operations for the preparatory section

Project Work and Survey results

Fabric Preparation: As fusing machines are highly energy consuming, the less a fusing machine is kept in running the better, in terms of electricity cost and depreciation cost. By adopting the process that we have discussed in this paper, around 50% savings can be achieved from machine usage. As mentioned earlier, this is a comparative study between Tray method, Sandwich method and Iron method in terms of time efficiency.

Table 1 provides data regarding Tray method. For this survey, we chose Welt Pocket and Waist Belt for Cameron style. For both, interlinings need to be provided in between two layers of fabrics. On a standard sized hard-paper tray, around 326 Welt pockets can be placed and cycle time (time required for arranging a tray with fabric-interliner pairs) measured is 185s. SAM (Standard Allowed Minutes) per piece calculated as follows:
SAM = Cycle time / # of units per tray*Adjustment for speed rating/60* Bundle allowance * Fatigue Allowance
= 185.136/32 * 80%/60 * 1.0002 * 1.1 [for Cameron Welt Pocket], = 0.17 minutes, Target = 60/SAM = 352.94 per hour

So, from this calculation, we can see that, if we adopt Tray method, s/he should be given target for 353 Welt pockets and 202 Cameron Waist pocket per hour. Now we can take it as benchmark and as basis of comparison with other methods.

Tray method is a very usual way now-a-days for forwarding fabrics into the machine. Many experts are of the same opinion. Now, we would go for Iron method (conventional method - which does not require trays). In this method, a pair of fabric and interliner are attached together and then flattened through iron machine and then are bundled in small lots for later use. Fabric-interliner pairs are then placed in the fusing machine belt from bundles. Using the same calculation method used for Tray method, we have calculated target for Iron method. Only difference is, here another allowance which is specific to iron machine operation is used in formula.

Table-1
Fabric preparation data for Tray method

Style	No. of pieces (1 tray)	Cycle Time	Cycle Time /Unit	SAM	Target
Cameron Welt	16	185.136	11.571	0.170	353
Cameron W/B	8	162.385	20.29813	0.298	202

Table-2
Fabric preparation data for Iron method (Conventional)

Style	No. of pieces(1 tray)	Cycle Time	Cycle Time /Unit	SAM	Target
Cameron Welt	50	7.280	0.146	0.131	457
Cameron W/B	25	6.644	0.266	0.240	250

Table-3
Fabric preparation data for Sandwich method

Style	No. of pieces (1 tray)	Cycle Time	Cycle Time /Unit	SAM	Target
Cameron Welt	50	4.356	0.087	0.081	736
Cameron W/B	25	4.652	0.186	0.164	366

Table 3depicts that, target for Sandwich method is 736 and 366 respectively for Cameron Welt Pocket and Cameron Waist Belts.

SAM = Cycle time / # of units per bundle *Adjustment for speed rating/60 * Bundle
Allowance * Fatigue Allowance * Fatigue Allowance for iron machine usage
SAM = 7.28/50 * 95%/60 * 1.0002 * 1.1 * 1.025 [for Cameron Welt Pocket]
= 0.131 minutes
Target = 60 / SAM = 457 per hour

Now comes Sandwich method. In Sandwich method, two pairs of fabric-interliners (with layer of adhesive in the inner side of interliner-fabric pair) are placed back to back and are bundled in small lots for placing in the fusing machine later. These could be placed through tray, but study says, in Sandwich method, bundling the inputs and then placing the fabric-interliner sandwich from bundles is faster than arranging the sandwiches in tray and then placing the sandwiches from the tray. In that sense, we can tell that, sandwiching and then bundling can be considered as a hybrid of ironing and Tray method.

Utilization comparison: From data in tables, this is clear that the method that ensures highest machine utilization is the Sandwich method. In Tray method, machine utilization is the least among the three approaches. Figure-2 depicts the comparison.

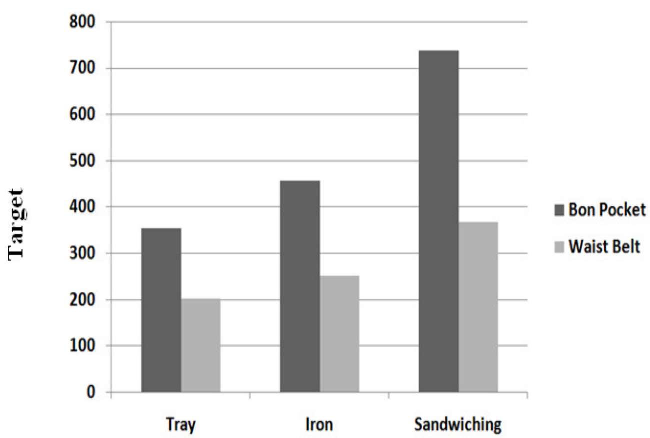

Figure-2
Target comparison among three approaches

Machine utilization in Sandwich method is two times higher than tray method and one and half times higher than Iron method.

Fabric Feeding: Now we would provide data related to the study of efficiency of feeding method. Here we are leaving tray method out of the scope of this study, as from gross observation, it is quite evident that Tray method is much less efficient than to bundling method when it comes to feeding.

The reason here for not even considering Tray method in feeding comparison is as follows:

The total SAM for iron method for preparation and feeding for Welt pockets is (0.131[preparation] + 0.025[feeding]) = 0.156 minutes and the same for Sandwich method is (0.081[preparation] +0.017[feeding] = 0.098.

Total SAM in both the cases are lower than total SAM for Welt pockets in Tray method even after assuming SAM for feeding as zero.
Total SAM (Tray method) = 0.170 + 0.0 (assuming) = 0.170 minutes
Similarly, for Waist belts:
Total SAM (Iron method) = 0.240 (preparation) + 0.045 (feeding) = 0.285 minutes
Total SAM (Sandwich method) = 0.164 (preparation) + 0.032 (feeding) = 0.196 minutes
Total SAM (Tray method) = 0.298 (preparation) + 0.0 (assuming for feeding) = 0.298 minutes
Here, again the similar results for waist Belts.

In a word, even after taking the best possible timing for feeding for Tray method, this method is outperformed by both Iron method and Sandwiching method. Hence we only limited our study on feeding through Iron and Sandwich method.

It is to note that, in iron method, after putting together the interliner with fabric and ironing, the fabric-interliner pairs are kept bundled for later feeding. Whereas, in sandwich method, two pairs of fabric-interliner sets arranged in sandwich form, keeping the interliners inside, are bundled together without ironing for later feeding into the fusing machine.

Table-4
Feeding data for Iron method with Regular Bundling approach

Style	No. of pieces (1 tray)	Cycle Time	Cycle Time /Unit	SAM	Target
Cameron Welt	50	72.368	1.447	0.025	2380
Cameron W/B	25	68.525	2.741	0.045	1326

Table-5
Feeding data for Sandwich method with Aligned bundling approach

Style	No. of pieces (1 tray)	Cycle Time	Cycle Time /Unit	SAM	Target
Cameron Welt	50	47.896	0.958	0.017	3596
Cameron W/B	25	48.215	1.929	0.032	1885

Before going into the calculations, some light deem worth to be put on an issue regarding feeding. In sandwich method, the feeding is done on the running belt of fusing machine with manual hands without using trays or even without some extent of pressing by iron machines for making the fabric-interliner more attached. So, is there not any significant risk of disarrangement while putting fabric-interliner sets on the machine belt? The answer is, no; the risk of such disarrangement is ignorable thanks to the extra weight due to sandwiched arrangements of the interliner and fabrics.

Another point to note. In the Sandwich method , the sandwiched sets of twin pairs of fabric-interliner are bundled in according to an aligned arrangement, meaning, one sandwich is placed on top of another in such a way that the angle between the longitudinal axis of two adjacent sandwiches are 30 degrees and longitudinal axis of every alternative sandwich is set parallel [figure-3].

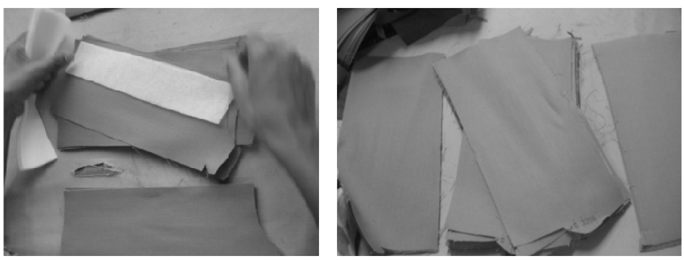

Figure-3
Aligned placement of Sandwiches

This aligned arrangement also found to contribute in speeding up the separating process of sandwiches from bundled lots and feeding into the machine. It is observed that, this alignment arrangement is absent in most of garments companies in the country, which we believe undermining efficiency of the floor.

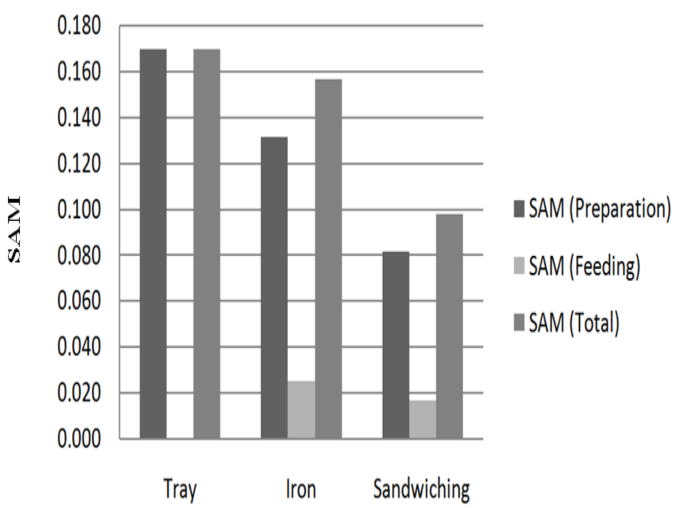

Figure-4
SAM (Standard Allowed Minutes) for fabric Preparation and Feeding *(Cameron Welt Pocket)*

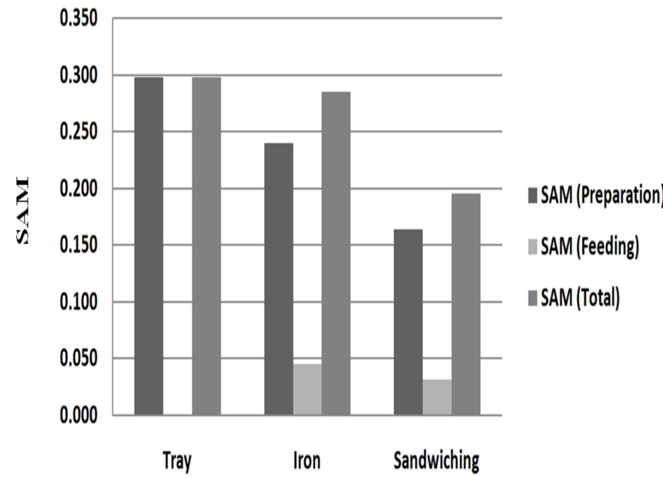

Figure-5
SAM (Standard Allowed Minutes) for fabric Preparation and Feeding (*Cameron Welt Pocket)*

So, now let's go into the target calculation. From tables we can see, target for Cameron-Welt pocket in Sandwich feeding (with aligned arrangement) is 3596, whereas the figure is 2380 for Iron Feeding (with regular bundling). As example, SAM calculation for Iron method with regular bundling approach is as follows:

SAM = Cycle time / # of units per tray *Adjustment for speed rating/60 * Bundle
allowance * Fatigue Allowance
= 72.368*95%/60*1.0002*1.1 [for Cameron Welt Pocket]
= 0.025 minutes
Target = 60 / SAM = 2380 per hour

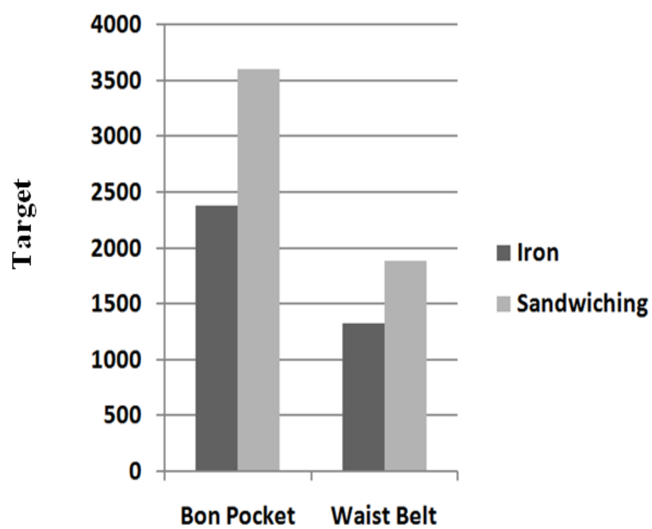

Figure-6
Target Comparison between Ironing with regular bundling and Sandwiching with Aligned bundling

This is evident from the observed data, the target in aligned-bundled feeding is much higher than iron feeding where bundles are prepared without such alignment arrangements.

So in summary the studies are as follows: i. when it comes to comparison among SW/Tray and iron methods for fabric preparation, Sandwich target is higher than all other methods and target for Tray method is the lowest. ii. For feeding, evidently Sandwich target is much higher than Iron feeding.

Conclusion

As indicative from the above chapter, Sandwiched bundling and feeding method is the most efficient method of all. If this method is adopted as approach for bundling and feeding a great deal of cost saving and other benefits can be achieved. For example, in a medium sized floor, typically 20 iron machines are required to be engaged for iron feeding. If Sandwich method is implemented, at least 18 Irons out of 20 along with all electrical connections and plug boards can be eliminated. 2 Irons might still be maintained there on standby mode for straightening of fabrics like Sheel, Gorget fabric, some polyester fabric and in case of precise fusing requirements (Collar Inside Part, Waist belt inside interlining, and in cases of check matching which are needed to be precise.

Benefits of Removal of Irons from Fusing: Electricity consumption saved will be 10 units per Irons per day. Hence from 40 irons total saved consumption will be 400 units per day (40 irons X 10 units). Per Unit average cost is BDT 6.00.

So, Monthly (26 working days) monetary savings from electricity bill will be = (400 units X 26 days X BDT 6) = BDT 62400. In addition: i. Investment on Irons, Iron shoes will be saved, ii. Heat Generation will be zero (Green manufacturing), iii. There will be very less fatigue as not needing to handling of Irons (approx 2 KG) along the whole day

The Fusing machine utilization will be 65-70% higher as the feeding will be in sandwiched form and more parts can be gathered to feed into the fusing machine.

Moreover, no extra investment is required, only method/ work process change is needed.

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