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Implementation of Lean Tools in RMG Sector through Value Stream Mapping (VSM) For Increasing Value-Added Activities

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Lean manufacturing is become a buzzword of new era. The implementation of a lean manufacturing strategy represents a robust contribution to the phase sequence that leads to operational excellence and the continuous improvement through the elimination of non value added activities. Therefore, lean practices contribute substantially to plant operational performance. This paper studies the use of value stream mapping (VSM) as a tool in lean manufacturing implementation and a framework of improvement activities in particular for an efficient introduction of 5's and TPM (Total Productive Maintenance). Here the adaption of lean principles for the process of a large integrated Ready Made Garments (RMG) manufacturer is being described. For this purposes about forty one sewing related operations were observed in the assembly line for different styled polo T-shirts. Finally a simulation model was developed to contrast the "before" and "after" scenarios in detail, in order to illustrate to managers some potential benefits such as employee reduction, reduced non value added time, reduced production lead-time and lower work-in-process inventory etc.

Keyword: Lean Manufacturing System, VSM, 5S Philosophy, Simulation.

1. Introduction

Lean manufacturing is a set of tools and methodologies that aims for the continuous elimination of all waste in the production process which is a system for improving productivity and product quality. Laconically more value with less work.

Lean manufacturing is a manufacturing philosophy that shortens the time between the customer order and the product build or shipment by eliminating sources of waste. Another way of looking at lean is that it aims to achieve the same output with less input-less time, less space, less human effort, less machinery, less material, less costs. Japanese manufacturers' re-building after the Second World War was facing declining human, material and financial resources. The problems they faced in manufacturing were vastly different from their Western counterparts. These circumstances led to the development of new and lower cost manufacturing practices. Early Japanese leaders such as the Toyota Motor Company's Eiji Toyoda, Taiichi Ohno and Shigeo Shingo developed a disciplined, process-focused production system which is known as the "Toyota Production System", or "Lean Production". The objective of this system was to minimize the consumption of resources that added no value to a product. When a U.S. equipment manufacturing company, Lantech completed the implementation of lean in 1995, they reported the following improvements compared to their batch-based system in

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1991: manufacturing space per machine was reduced by 45%, defects were reduced by 90%, production cycle time was reduced from 16 weeks to 14 hours-5days and product delivery lead time was reduced from 4-20 weeks to 1-4 weeks.

Bearing all the perspectives of Lean manufacturing, the authors were very much intended to have a detailed demonstration on it through real factory data & to implement those concepts. Throughout the research work the ultimate target was to identify the non value added time, analyze the root causes of those non value added time, increase value added time by redesigning assembly line and finally decrease the total manpower involvement without hampering production efficiency & productivity. The ‘‘lean’’ approach has been applied more frequently in discrete manufacturing than in the continuous/process sector, mainly because of several perceived barriers in the latter environment that have caused managers to be reluctant to make the required commitment (Abdulmalek & Rajgopal, 2007). But in this paper the authors concentrated on continuous/ process sector to strengthening the traditional manufacturing process. Here after applying VSM tool & 5S principles, the authors remarkably decreases the non value added time via increasing value added time. This work also improved the productivity of current production system by 62% & also minimizes the number of workers without hampering production efficiency, which is rare achievement by any other past research. On this regard this case work has a strong contribution for increasing net GDI (Gross Domestic Income) especially for the RMG sector.

The rest of this paper is organized as follows: Section 2 gives some explanations regarding previous studies on Lean manufacturing philosophy. Section 3 describes the problem, followed methodologies and key things to gain by solving that problem. Section 4 presents an industrial case designed on Bangladeshi perspective to implement the feasibility of applying the proposed Value Stream Mapping (VSM) approach to real garment manufacturing process. Subsequently, Section 4 discusses the results and findings for the practical application of the proposed VSM approach. Conclusions are drawn in Section 5. Finally in section 6 some future recommendations to improve this existing study are given.

2. Literature Review

VSM is a pencil and paper tool, which is created using a predefined set of standardized icons (Rother and Shook, 1999). In recent years, huge literature has extensively documented the implementation of lean philosophy into various manufacturing sectors, but very few have addressed the garments environment. Lean manufacturing has received ample attention in academic literature and practical performance, from how the lean production concept was formulated and disseminated (Browning and Heath, 2008) until recent comprehensive literature review (Shah and Ward, 2003, Soderquist and Motwani, 1999 and McDonald et al 2002). This research addresses the confusion and inconsistency associated with “lean production”. They attempted to clarify the semantic confusion surrounding lean production by conducting an extensive literature review using a historical evolutionary perspective in tracing its main components. They identified a key set of measurement items by charting the linkages between measurement instruments that have been used to measure its various components from past literature, and using a rigorous, two-stage empirical method and data from a large set of manufacturing firms, they narrow the list of items selected to represent lean production to 48 items, empirically identifying 10 underlying components. In doing so, they made map the operational space

corresponding to conceptual space surrounding lean production. Configuring theory provides the theatrical underpinnings and helps to explain the synergistic relationship among its. In them, a common topic appears, that is, the need to explore the implementation and performance relation-ship with a practical focus and with a definition of the context because the results depend on the manufacturing environment. We affirm that it is not possible to define the context without including the product and the manufacturing process, at least from an operational and technological perspective. In this sense, a real and detailed case study provides the sufficient items to evaluate the implementation and under what conditions, allowing the benchmarking between practical of companies. It is possible to find analysis of case studies about steel production (Liker and Mier 2006), forging processes (Pavnaskary et al 2003), aircraft manufacturing (Browning and Heath, 2008), or assembly lines of vehicles (Shah and Ward, 2003); although the last one has been studied deeply, some criticisms can be found in the literature due to lack of resulting data (Browning and Heath, 2008). Their methodology is similar, using lean tools, and they are adapted to the study variables, but the improvement point and the results achieved are different. Furthermore, in line with Milterburg (Miltenburg, 2001) (Bamber and Dale, 2000), how an implementation can be done is a subject that benefits from research. In addition, “a line of interesting researches is one that follows real one-piece flow production systems over time to learn what problems are most difficult at different points in time, how these problems are solved” (Bamber and Dale, 2000). An assembly line comprises a sequence of workstations through which a predefined set of tasks are performed repeatedly on product units while they are moving along the line. It was originally developed to support mass production of single homogeneous standardized com- modify to gain a competitive unit cost. As a consequence of just-in-time (JIT) implementation, manufacturers aim to achieve continuously improved productivity, cost, and product quality by eliminating all wastes in their production systems. However, the straight line cannot fully support the adoption of JIT principles to manufacturing especially in the utilization of multi-skilled operators. Hence, such companies as Allen-Bradley and GE have replaced their traditional straight lines with U-shaped production lines, called U-lines hereafter. It was suggested a hierarchical structure in their research to model the design process of a lean production system, which consisted of design parameters and process variables (Houshmand and Jamshidnezhad, 2006). They also asserted about the generic nature of this architecture. VSM means working on the big picture not on the individual processes and improving the whole flow but not just optimizing the process, which facilities more thoughtful decisions to value stream mapping. VSM is prescribed as part of the lean toolkit and has been applied in a variety of industries. We have also introduced 5S. 5S is needed to stabilize the process and reduce the much non value activities. TPM is a tool for achieving the above-mentioned goal. Like Lean, it requires employees’ involvement in all levels throughout the organization (Houshmand and Jamshidnezhad, 2006). Lean goals are not achievable without reliable machinery and processes, on the other hand, TPM (Total Productive Maintenance) is more effective in Lean driven enterprises. Main focus on the relationship between Lean and TPM, by comparing their goals and principles as well as how Lean and TPM can strengthen each other’s results in order to reach sustainable growth of the organization. Merging the benefits of two well-known methodologies, Lean Thinking and Total Productive Maintenance, "Lean TPM" shows how to secure increased manufacturing efficiency.

Based on their experience of working with organizations that have successfully achieved outstanding performance, McCarthy and Rich provide the tools and techniques that convert strategic vision into practical reality. "Lean TPM" accelerates the benefits of

continuous improvement activities within any manufacturing environment by challenging wasteful working practices, releasing the potential of the workforce, targeting effectiveness and making processes work as planned. It unites world-class manufacturing, Lean Thinking and Total Productive Maintenance (TPM). It shows how to achieve zero breakdowns. It optimizes processes to deliver performance and new products efficiently. It delivers benefit from continuous improvement activities quickly. "Lean TPM" provides a single change agenda for organizations. It will help to develop robust supply chain relationships and to optimize the value generating process. Supported by an integrated route map and comprehensive benchmark data, this book enables engineers, technicians and managers to explore this potent technique fully. It unites the concepts of world-class manufacturing, Lean and TPM. It shows how to accelerate the benefits gained from continuous improvement activities. It includes an integrated route map for Lean TPM, including benchmark data.

3. Methodology

As the authors were intended to work on Lean Manufacturing in their work, for this purposes a production line of a Ready Made Garments (RMG) sector was selected. After over viewing the production floor some wastes such as waiting, over processing, backtracking, huge number of In-process inventory, transportation etc were found, which leads to increase the Non-Value Added Time & simultaneously decrease the Value Added Time. That means the productivity level is so poor. So the sole target was to improve the productivity level with increasing in Value-added Time and minimizing the Non-Value Added Time. As it is clear from the literature part that among all the tools of Lean philosophy, VSM is mostly capable of giving a picturesque view of current scenario which depicts further elimination of wastage. Here for completing this case work the authors followed some important steps. Among them the first step was to choose a particular product or product family as the target for improvement. Here the targeted product was batches of T-shirt. The next step was to draw a current state map that is essentially a snapshot capturing how things are currently being done. This was accomplished while walking along the actual process, and provides one with a basis for analyzing the system and identifying its weaknesses. The third step in VSM was to create the future state map, which is a picture of how the system should look after the inefficiencies in it have been removed. Creating a future state map is done by answering a set of questions on issues related to efficiency, and on technical implementation related to the use of lean tools. This map then becomes the basis for making the necessary changes to the system. Some other methodologies could be as following house-keeping guidelines, applying Poka-Yoka concepts or JIT concepts to minimize non value added times.

4. Calculations & Result Analysis

As mentioned earlier the main objective of this work was to study and implement Lean Manufacturing tools and techniques. To perform it, Viyellatex garment was chosen for focusing all activities of the garments production line. When the study started the floor was in haphazard situations. No systematic ways were present. Operations were done here and there and there was a very little degree of integration. Lots of In-process inventories were present. From this study several areas were found where significant improvements can be made. But it was really hard to apply the lean manufacturing tools and techniques, it was time consuming as well. Some tools and techniques applied in the

production line are Value Stream Mapping (VSM), Workplace organization (5S), Continuous flow, Multi skilled workers, U-shaped line, Kanban, Cellular manufacturing system, Pull production & Poka-Yoka. After some calculations, some comparison was shown between the current situations and the proposed situations which are shown in the tables 4.1 to 4.5.

Table 4.1: Comparison of Total Operation Times between Existing & Proposed Layout

Existing Layout			Proposed Layout		
Value Added Time (sec)	Non Value Added Time (sec)	Total Time (sec)	Value Added Time (sec)	Non Value Added Time (sec)	Total Time (sec)
196.7	8765.7	8962.4	215	917	1132

Table 4.2: Comparison of Operation Times between Existing & Proposed VSM

Buyer	Existing		Proposed		Improvement (% value added)
	% Non-value added time	% Value-added time	% Non-value added time	% Value-added time	
Burton	97.81%	2.19%	81%	19%	16.81%

Figure 4.1: Existing proportion of value added & non value added

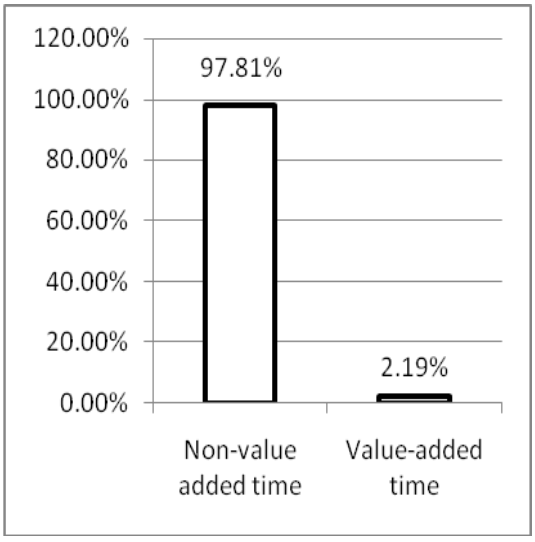
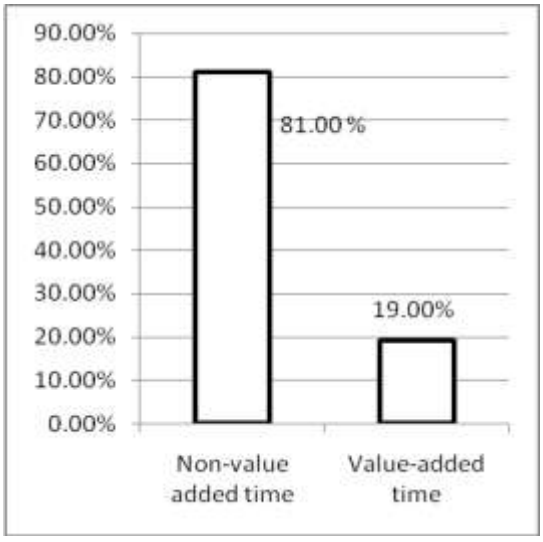


Figure 4.2: Proposed proportion of value added & non value added



From the value stream mapping of current situation the value added time and non-value added time for BURTON was calculated. Where the value added time for existing layout was found 2.19%. As focus was to reduce non-value added time as much as possible and to do so the tools and techniques of lean manufacturing was used. All the processes

required were made grouped and made cells to reduce the In-process inventory, smooth production flow and pull system so that the much of the idle time can be saved. By doing so it eventually reduced the non-value added time significantly. For instance, for BURTON existing value-added time is 2.19% and improved value added time is 19%. Therefore Value added time is increased about 16.81% (Table 4.2). On the other hand ARENA simulation software gives the value-added time is 7% (Table 4.3). The daily outputs were not met by the production line. That is, the finishing department's daily output was less than that of sewing department. As a result, there was a large amount of In-process inventory between the two successive stages.

Table 4.3: Comparison of Operation Times between Existing & Proposed VSM

Buyer	Existing		Proposed with ARENA		Improvement (% value added)
	% Non-value added	% Value-added	% Non-value added	% Value-added	
Burton	97.81%	2.19%	93%	7%	4.81%

Table 4.4: Comparison of productivity

Buyer	Existing productivity (Units per day 10 hour)	Proposed productivity (Units per day 10 hour)	Improvement	% of Improvement
Burton	340	890	550	62%

Here also the target was to eliminate this inventory which of course is a waste, and to make the flow continuous and streamlined throughout everywhere. If a comparison is made, it can shows that the existing output for BURTON is 340pcs daily and the output from our proposed layout is 890pcs. So there is an increment of 550pcs daily which is about 62% (Table 4.4). Another important improvement is associating workers. By incorporating multi skilled workers and with the help of cellular layout designing number of worker needed was reduced. The benefit of multi skilled workers is that they are able to perform two or more different types of work that can results minimum material handling with a minimum or no In-process inventory. Here it was found that existing workers for BURTON is 51 where in the proposal it is 39. Therefore it saves an extra 12 persons here (Table 4.5).

Figure 4.3: Comparison of Productivity

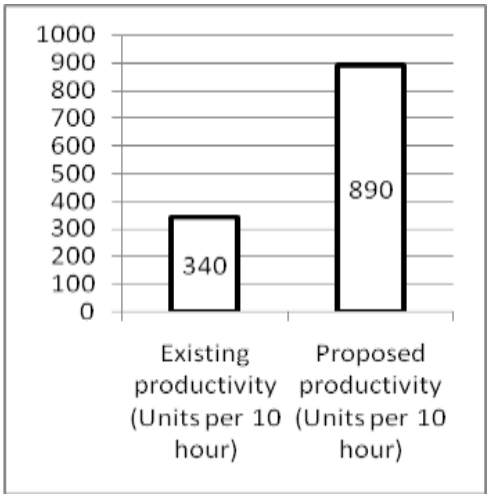


Figure 4.4: Comparison of Number of workers

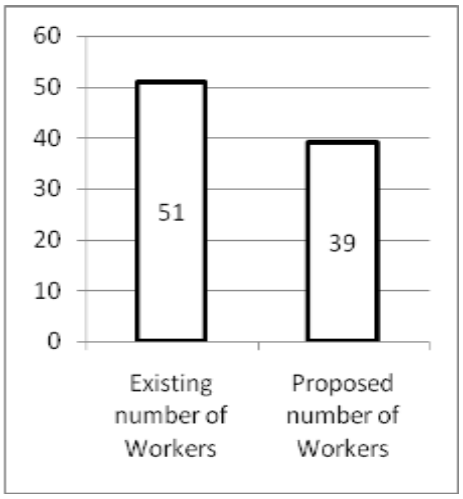


Table 4.5: Comparison of Required Worker

Buyer	Existing No. of Worker	Worker in Proposed Layout	Improvement
BURTON	51	39	12

5. Conclusions

The thesis work was on Study and Implementation of Lean Manufacturing in a Garment Manufacturing Industry. For the first few weeks the authors tried to learn the processes in the garments production line. Then those processes were studied as well as analyzed using some lean manufacturing tools and techniques where found some problems. Eventually some layouts and process flows are proposed in this case work which certainly maximizes the productivity and minimizes cost. It was also ensured that the better utilization of manpower and factory floor space is still possible. At the same time these proposals will help to develop a good relationship among the workers and will provide an easier way for the management to coordinate and integrate the factory production with the current level of resources. It is hoped and believed that, if the management accepts these proposals and implement these techniques, it will certainly help them to increase the productivity with this existing level of resources.

6. Further Recommendations

There have some recommendations for improving the paper works, and those are as follows: Here triangular distribution was used for performing Arena Simulation in some operation so the recommendation is to use normal distribution instead of using triangular distribution. Again using supermarket concepts in both cutting and packaging station will certainly give some accurate results. This work considered only production line, so the future recommendation is to consider the whole supply chain from order picking of raw-material to transportation of final product.

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Appendix 1:

Figure A: Present Layout of Burton (T-shirt) Production line

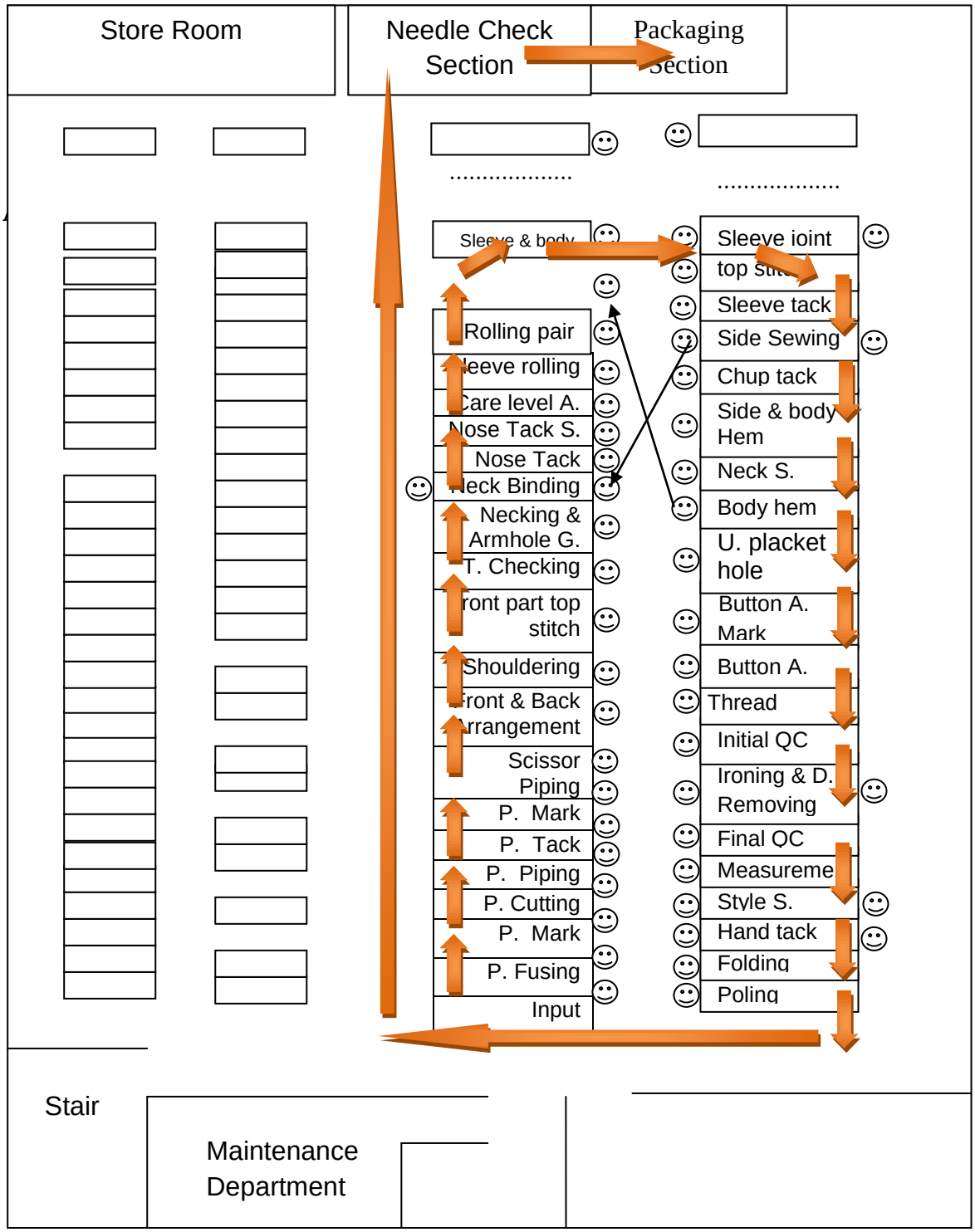

Figure B: Proposed Layout of Burton (T-shirt) Production line