Productivity Improvement In Garment Manufacturing Process Through Implementation of Lean Manufacturing Practices

Atul Shukla, Dharmendra Tyagi

Department of Mechanical., SIRT-Excellence, Bhopal

Abstract - The purpose of this review paper is to discuss the lean implementation and its quantified benefits for the textile industry. Both current and future state maps of the organization's shop floor scenarios are discussed using lean techniques in order to highlight improvement areas and to bridge the gap between the existing state and the future state of shop floor of the textile industry. After an exhaustive review it is being found that lean implementation has many benefits at organizational and operational level. It has been concluded that, still many of the Indian textile industry have not adopted lean and it may be beneficial for them.

Keywords - Garment Manufacturing, Lean Process, Textile.

I. INTRODUCTION

The manufacturing industry has experienced an unprecedented degree of change in the last few decades, involving drastic changes in management approaches, product and process technologies, customer expectations, supplier attitudes as well as competitive behavior (Ahuja et al., 2006). In today's highly dynamic and rapidly changing environment, the global competition among organizations has lead to higher demands of the manufacturing organizations (Miyake and Enkawa, 1999). The global marketplace has witnessed an increased pressure from customers and competitors in manufacturing as well as service sector (Basu, 2001; George, 2002).

Compared to widespread implementation of Lean techniques across almost all areas of the manufacture of assembled products, Lean improvement efforts lag within the process industries. Manufacturing operations that produce paints, salad dressings, synthetic fibers, plastics, ceramics, and pharmaceuticals are quite different from operations that assemble refrigerators, automobiles, cell phones, lawn mowers, and medical instruments. The differences are significant enough that manufacturing engineers working in a process environment face challenges unique to those operations, and must adapt traditional Lean tools to apply them successfully. Lean as a concept has evolved over time, and will continue to do so. As a result of this development, significant confusion about what is lean, and what is not has arisen – a fact clearly observable at both academic and practitioner conferences in logistics and operations management.

This present paper is mainly focused on review of implementing lean manufacturing techniques in a textile industry, mainly dealing with fabrication of cloths. The companies are equipped with dying, weaving and processing divisions. The attention of this present research paper is on the review of textile division globally.

In this division the basic raw material yarn is converted into fabric. The textile division has many more departments like; planning, raw material storage, warping, sizing, drawing, weaving, quality control and rework.

II. LITERATURE REVIEW

Manufacturing industry has shown a significant growth through increasing productivity and product quality while reducing product lead times utilizing variety of strategies which are based on technology, employees, process, product, material and management (Kumar 2006). The improvements are achieved through process management strategies such as reduction of human efforts, space, engineering hours, lead times and inventory while increasing the quality, product variety and the flexibility of manufacturing operations (Diekmann et al., 2004). Different philosophies were also introduced to the manufacturing industry, namely total quality control (TQC), total quality management (TQM), theory of constraints (TOC), just-in-time (JIT), lean manufacturing, total productive maintenance (TPM) and six sigma. A critical review on these strategies by Stamm et al. (2009) concludes that aforementioned strategies have a common core aim of eliminating waste or variability using different approaches. Furthermore, Hines et al. (2004) mentioned that the other manufacturing strategies can easily be integrated into lean without contradicting the strategic objective of lean, to provide customer value.

III. LEAN MANUFACTURING

Lean manufacturing philosophy is at the forefront in today's operations management and quality improvement practices. It is characterized by its goal of maximizing productivity (Brown et al., 2008). Its primary focus is to minimise wastage, reduce variation in standards and to improve production quality (Nave, 2002). It also reduces cycle time, increases flexibility, and improves productivity (Hobbs, 2004). Essentially, knowledge is distributed in lean manufacturing because reduction in waste is regarded as common responsibility for all employees in the organisation. It covers aspects of just-in-time (JIT) (Brown et al., 2008; Zhu and Meredith, 1995), workflow management, culture of minimum waste as well as continuous improvement. The driving force of lean manufacturing is the process of continuous improvement through the elimination of waste or non-value adding activities (Burton and Boeder, 2003). Eight types of waste categories that include defects were introduced in Burton's study.

A BRIEF HISTORY OF LEAN

The origins of lean thinking can be found on the shop-floors of Japanese manufacturers and, in particular, innovations at Toyota Motor Corporation (Shingo, 1981, 1988; Monden, 1983; Ohno, 1988). These innovations, resulting from a scarcity of resources and intense domestic competition in the Japanese market for automobiles, included the just-in-time (JIT) production system, the kanban method of pull production, respect for employees and high levels of employee problem-solving/automated mistake proofing. This lean operations management design approach focused on the elimination of waste and excess from the tactical product flows at Toyota (the Toyota "seven wastes") and represented an alternative model to that of capital-intense mass production (with its large batch sizes, dedicated assets and "hidden wastes"). Much of the early work at Toyota was applied under the leadership of Taiichi Ohno to car engine manufacturing during the 1950s, later to vehicle assembly (1960s), and the wider supply chain (1970s). It was only at this latter point that supplier manuals were produced and the "secrets" of this lean approach were shared with companies outside Toyota for the first time. These manuals were written in Japanese, and it took almost another decade before the first English literature was available (e.g. Shingo, 1981; Schonberger, 1982; Hall, 1983; Monden, 1983; Sandras, 1989)

Lean manufacturing has been the buzzword in the area of manufacturing for past few years. The concept originated in Japan after the Second World War when Japanese realized they could not afford the massive investment required to build facilities similar to those in the USA. The goal of lean manufacturing is to reduce waste in human effort, inventory, time to market and manufacturing space to become highly responsive to customer demand while producing quality products in the most efficient and economical manner. Nicholas (1998) found that waste takes many forms and can be found at any time and in any place. Waste consumes resources but does not add any value to the product. Russell and Taylor (1999) define waste as anything other than the minimum amount of equipment, effort, materials, parts, space, and time that are essential to add value to the product. Lean manufacturing combines the best features of both mass and craft production: the ability to reduce costs per unit and dramatically improve quality while at the same time providing an ever wider range of products and more challenging work (Womack et al., 1990). It is a far more focused and contingent view of the value adding (VA) process. Lean manufacturing uses tools like one-piece flow, visual control, Kaizen, cellular manufacturing, inventory management, Poka yoke, standardized work, workplace organization, and scrap reduction to reduce manufacturing waste (Russell and Taylor, 1999; Monden, 1993) suggested a new scheme of classifying operations into three generic categories as non-VA, necessary but non-VA and VA. This scheme proved to be more generic and was extended to different areas.

Over the years, many lean manufacturing tools to support value stream have been developed and many more are being proposed every day (Womack et al., 1990; Barker, 1994; Cusumano and Nobeoka, 1998; Childerhouse et al., 2000; Taylor and Brunt, 2001).

LEAN METHODOLOGY IN TEXTILE INDUSTRY

Lean methodology is one of those concepts introduced to the apparel sector with the objective of increasing productivity, improving product quality and cycle time, reducing inventory, reducing lead times and eliminating manufacturing waste. All these objectives will ultimately formulate one core objective of providing an enhanced customer satisfaction while eliminating the waste activities of manufacturing. Lean manufacturing is yet to be spread widely in the textile industry. The theory of lean manufacturing needs to be adapted accordingly to suit the particular industry in concern. This is because; it is difficult and misleading to use the lean experience (activities and performance indicators) in another industry as a reference point. The economic, cultural and social background of the Toyota Company, where lean manufacturing was developed and is practiced extensively, is largely different from that of companies.

A recent study on benefits of lean methodology by McGrath (2007) indicates that the main driver for becoming lean for most of the companies is to make profits either directly by reducing costs or indirectly by improving productivity. This may be the likely reason that many industries including apparel manufacturers opt to use the lean methodology in being competitive. Liker and Morgan (2006), state that even though many companies adopted some type of lean initiative, most of such efforts represent quick fixes to reduce lead time and costs and to increase quality which almost never created a true learning culture. Implementation of new manufacturing practices has not always been successful as the focus had been mostly on technical factors with little concern for soft issues like organisational culture which has been often ignored (Nahm et al., 2004). Furthermore, Forrester (1995) states that the change in culture to lean manufacturing is a profound one. Therefore studying both of these facets, namely technical performance and cultural impact, are critical in lean implementation.

LEAN PRINCIPLES

Hodge et.al. (2011) determined which lean principles are appropriate for implementing in textile industry. This paper investigates the different tools and principles of lean and the use of lean manufacturing in the textile industry was examined by the researchers by considering plant tours and case studies. From this case study the researchers came to a conclusion that lean manufacturing is a strategy that does not require large investment in automation or IT and it can be implemented in both small and large companies where all employees can be involved in improving operations to meet customer needs.

Overall, Lean is a powerful tool, when adopted it can create superior financial and operational results. But in many cases, the confusion about how to start lean, from where to begin is also a problem for new practitioners. In some cases, the company tries to implement lean but it does not give effective results and stops in-between. All these are due to lack of clarity before implementing lean and lack of top management commitment. So to avoid the chances of failure one has to prepare in advance for the outcomes of the lean and should involve all employees on improvement programs. Lean is not just about the implementation of tools but also the development of its employees to adopt these tools.

So, regular training and upgrading of employee skill is the most important factor for the success of lean. The major five principles of Lean are as follows (Burton T. and Boeder, 2003):

Principle 1: Accurately specify value from customer perspective for both products and services.

Principle 2: Identify the value stream for products and services and remove non-value-adding waste along the value stream.

Principle 3: Make the product and services flow without interruption across the value stream.

Principle 4: Authorize production of products and services based on the pull by the customer.

Principle 5: Strive for perfection by constantly removing layers of waste.

KIND OF WASTES: According to David Magee, (Magee, 2007) different kinds of wastes in a process can be categorized in following categories. These wastes reduce production efficiency, quality of work as well as increase production lead time.

Overproduction – Producing items more than required at given point of time i.e. producing items without actual orders creating the excess of inventories which needs excess staffs, storage area as well as transportation etc.

Waiting – Workers waiting for raw material, the machine or information etc. is known as waiting and is the waste of productive time. The waiting can occur in various ways for example; due to unmatched worker/machine performance, machine breakdowns, lack of work knowledge, stock outs etc.

Unnecessary Transport – Carrying of work in process (WIP) a long distance, insufficient transport, moving material from one place to another place is known as the unnecessary transport.

Over processing – Working on a product more than the actual requirements are termed as over processing. The over processing may be due to improper tools or improper procedures etc. The over processing is the waste of time and machines which does not add any value to the final product.

Excess Raw Material - This includes excess raw material, WIP, or finished goods causing longer lead times, obsolescence, damaged goods, transportation and storage costs, and delay.

Unnecessary Movement – Any wasted motion that the workers have to perform during their work is termed as unnecessary movement.

Defects – Defects in the processed parts is termed as waste. Repairing defective parts or producing defective parts or replacing the parts due to poor quality etc. is the waste of time and effort.

Unused Employee Creativity – Loosing of getting better ideas, improvement, skills and learning opportunities by avoiding the presence of employee is termed as unused employee creativity (Liker, 2003).

WASTE REDUCTION TECHNIQUES

Some of the waste reduction tools include zero defects, setup time reduction, and line balancing. The goal of zero defects is to ensure that products are fault free all the way, through continuous improvement of the manufacturing process (Karlsson and Ahlstrom, 1996). Human beings almost invariably will make errors. When errors are made and are not caught then defective parts will appear at the end of the process. However, if the errors can be prevented before they happen then defective parts can be avoided. One of the tools that the zero defect principle uses is Poka Yoke. Poka-Yoke, which was developed by Shingo, is an autonomous defect control system that is put on a machine that inspects all parts to make sure that there are zero defects. The goal of Poka-Yoke is to observe the defective parts at the source, detect the cause of the defect, and to avoid moving the defective part to the next workstation (Feld, 2000).

Method Study: Method study focuses on how a task can (should) be accomplished. Whether controlling a machine or making or assembling components, how a task is done makes a difference in performance, safety, and quality. Using knowledge from ergonomics and methods analysis, methods engineers are charged with ensuring quality and quantity standards are achieved efficiently and safely. Methods analysis and related techniques are useful in office environments as well as in the factory. Methods techniques are used to analyze the Movement of individuals or material, Activity of human and machine and crew activity, Body movement (primarily arms and hands) (Heizer et al., 2000).

Time Studies: The classical stopwatch study, or time study, originally proposed by Federic W. Taylor in 1881, is still the most widely used time study method. The time study procedure involves the timing of a sample of worker's performance and using it to set a standard. A trained and experienced person can establish a standard by following these eight steps (Heizer et al., 2000). Define the task to be studied (after methods analysis has been conducted), Divide the task into precise elements, Decide how many times to measure the task (the number of cycles of samples needed), Record elemental times and rating of performance, compute the average observed cycle time. The average observed cycle time is the arithmetic mean of the times for each element measured.

Normal Time = (average observed cycle time) x (performance rating factor).

$$Standard\ Time = \frac{Total\ Normal\ Time}{1 - Allowance\ Factor}$$

Personal time allowances are often established in the range of 8% to 15% of total time, depending upon nearness to rest rooms, water fountains, and other facilities. Fatigue allowances are based on our growing knowledge of human energy expenditure under various physical and environmental conditions.

Work Sampling: It is an estimate of the percentage of time that a worker spends on particular work by using random sampling of various workers. This can be conducted by the following procedures (Heizer et al., 2000). Take a preliminary sample to obtain an estimate of the parameter value (such as percent of time worker is busy). Compute the sample size required, Prepare a schedule for observing the worker at appropriate times, The concept of random numbers is used to provide for random observation, Observe and record worker activities, Determine how workers spend their time (usually as percentage).

Layout Design: Layout is one of the key decisions that determine the long-run efficiency of operations. Layout has numerous strategic implications because it establishes an organization's competitive priorities in regard to the capacity, processes, flexibility and cost as well as quality of work life, customer contact and image. An effective layout can help an organization to achieve a strategy that supports differentiation, low cost, or response (Heizer et al., 2000). The layout must consider how to achieve the higher utilization of space, equipment, and people, Improved flow of information, material or people, Improved employee morale and safer working conditions, Improved customer/client interaction. Flexibility (whatever the layout is now, it will need to change).

Cycle Time: Cycle time is defined as how frequently a finished product comes out of our production facility (Rother et al., 2008). Cycle time includes all types of delays occurred while completing a job. So cycle time can be calculated by the following formula.

Total Cycle Time = processing time + set up time + waiting time + moving time + inspection time + rework time + other delays to complete the job

Facility Layout: Ongoing production process layout of jute industry is studied and a new layout will be developed based on the systematic layout planning pattern theory to reduce production cost and increase productivity. The number of equipment and travelling area of material in yarn production have been analyzed. The detailed study of the plant layout such as operation process chart, activity relationship chart and relationship between equipment and area has been investigated. The new plant layout has been designed and compared with existing plant layout. The new plant layout shows that the distance and overall cost of material flow from stores to dispatch area are significantly decreased. (Riyad, 2014).

TOTAL PRODUCTIVE MAINTENANCE (TPM)

TPM is a methodology originating from Japan to support its lean manufacturing system, since dependable and effective equipment are essential pre-requisite for implementing Lean manufacturing initiatives in the organizations (Sekine and Arai, 1998). While Just-In-Time (JIT) and Total Quality Management (TQM) programs have been around for a while, the manufacturing organizations off late, have been putting in enough confidence upon the latest strategic quality maintenance tool as TPM.

Nakajima (1989), a major contributor of TPM, has defined TPM as an innovative approach to maintenance that optimizes equipment effectiveness, eliminates breakdowns, and promotes autonomous maintenance by operators through day-to-day activities involving the total workforce (Conway and Perry, 1999, Bhadury, 2000). The emergence of TPM is intended to bring both production and maintenance functions together by a combination of good working practices, team-working and continuous improvement (Cooke, 2000). Willmott (1994) portraits TPM as a relatively new and practical application of TQM and suggests that TPM aims to promote a culture in which operators develop “ownership” of their machines, learn much more about them, and in the process realize skilled trades to concentrate on problem diagnostic and equipment improvement projects. TPM is not a maintenance specific policy; it is a culture, a philosophy and a new attitude towards maintenance (Chowdhury, 1995). TPM is a system (culture) that takes advantage of the abilities and skills of all individuals in an organization (Patterson et al. 1995). An effective TPM implementation program provides for a philosophy based upon the empowerment and encouragement of personnel from all areas in the organization (Davis and Willmott, 1999). The rapidly changing needs of modern manufacturing and the ever increasing global competition has emphasized upon the re-examination of the role of improved maintenance management towards enhancing organization’s competitiveness (Riis, 1997). Confronted with such reality, organizations are under great pressure to enhance their competencies to create value to customers and improve the cost effectiveness of their operations on a continuous basis. In the dynamic and highly challenging environment, reliable manufacturing equipment is regarded as the major contributor to the performance and profitability of manufacturing systems (Kutucuoglu et al., 2001). Its importance is rather increasing in the growing advanced manufacturing technology application stages (Maggard and Rhyne, 1992). Therefore, equipment maintenance is an indispensable function in a manufacturing enterprise (Ahmed et al., 2005). The recent competitive trends and ever increasing business pressures have been putting maintenance function under the spotlight as never before (Garg and Deshmukh, 2006). For maintenance to make its proper contribution to profits, productivity, and quality, it must be recognized as an integral part of the plant production strategy (Kumar et al., 2004). Thus achieving excellence in maintenance issues has to be treated as a strategic issue for manufacturing organizations to create world-class-manufacturers (Brah and Chong, 2004).

SCOPE OF LEAN MANUFACTURING

Singh et al. (2010) discussed the scope of lean implementation in Indian industries and identified many lean implementation issues in consultation to Indian managers. They also grouped these issues by using principal component analysis. Chitturi et al. (2007) explored practical issues like how to calculate TAKT time, where to place supermarket, where can we use continuous flow processing, what process improvements can be done and how to handle different product families while mapping job shop operations.

Chauhan and Singh (2012) aimed to identify the measuring the associated parameters of lean. There is a broad scope to focus on the elimination of different forms of wastes from manufacturing system for the lean manufacturing in India. Green et.al (2010) wants to implement lean in a material handling system for petroleum drill bit manufacturing company. They addressed that the operational group with a tool to assist in defining the objectives of lean manufacturing has been developed by many of the authors. At the end, it is concluded that a special solution was developed from the process of implementing the project. The methodology was developed using lean manufacturing concepts and the material handling issues and the author identified through assessing the cells selected for the implementation of lean manufacturing in material handling operations. Review based on leanness assessment is presented in Vinodh & Vimal (2012). They presented the 30 criteria based leanness assessment methodology using fuzzy logic. Fuzzy logic has been used to overcome the disadvantages with scoring method such as impreciseness and ambiguity. In this paper, a conceptual model for lean assessment has been designed. Then the fuzzy lean index which indicates the lean level of the organization and fuzzy performance importance index which helps in identifying the obstacles for leanness has been analyzed. The results indicate that the model is capable of effectively assessing leanness and has practical significance. Taj (2005) presented a spreadsheet-based assessment tool to evaluate nine key areas of manufacturing namely, inventory team approach, processes, maintenance, layout/handling, suppliers, setups, quality, and scheduling/control. The results are then displayed in the score worksheet and finally a lean profile chart is created to display the current status of the plant and the gap from their specific lean targets. It is found from the results that lean assessment tool have revealed significant gap from the lean manufacturing target, and also identified opportunities for improvement.

Author provides a practical and easy way to use assessment tool to help manufacturing managers to make their manufacturing operations more productive. There is a lot of scope to implement this tool in other industrial sector for achieving leanness. In this background the scope of this paper is to quantify leanness in a textile industry.

IV. METHODOLOGY

CONDUCTING TIME STUDY

To ascertain standard time for every operation, time study is led in the shop floor. To do this, the standard formal shirt is chosen as a gauge since operations contrast from style to style and it is hard to relate every one of these operations of individual styles. From that point onward, no less than two administrators were chosen for every operation so that the distinction in timing can be cross checked from the watched information of these two administrators. To improve comes about, every operation time is taken for no less than 15 cycles. When time study is made by gathering crude information the execution rating is given to every administrator and real time is ascertained for specific operation. At long last the Individual Weariness and Deferral (PFD) part is included the computed time and the operation time institutionalized.

While leading time concentrate a few parameters are kept settled (for instance machine speed, join per inch, kind of machine utilized and so on.) to get reliable outcomes. The PFD component is taken as 15% of aggregate time. This PFD is a tad bit higher than ordinary industry standard; it is taken higher considering the standing operation and administrator's development inside the phone. Correspondingly the normal execution rating is taken 100% for the simplicity of computation as it were. This rating is balanced normal of real appraisals. The computed SAM esteem for each area is joined in addendums.

The format of time study data collection sheet

Time Study Data Collection Sheet

Date:
Shift:
Name of Operator: Name of Operation:
Machine RPM: Machine Type:
Stitches Per Inch:

Name of Operation	Observed Time					No of Cycles	Total Observed Time	Average Observed Time	Performance Rating	PFD Allowance %	Calculated Time
	1	2	...	..	10						

Note:
PFD: Personal Fatigue and Delay Study Conducted By:

Cuff Section Operation SAM

Stitching Section	Stitching Operation	Observed Time(Sec)	Standard Time	PFD Allow(%)	Performance Rating	Std Alwd Min(Sec)
CUFF SECTION	Cuff Hem	32	26	15	100	29.9
	Cuff Run Stitch	35	28	15	100	32.20
	Trimming	26	20	15	100	23
	Cuff Blocking	22	18	15	100	20.7
	Top Stitch	36	30	15	100	34.5
	Button Hole	28	21	15	100	24.15
	Cuff Press	20	16	15	100	18.4
	Total	199				182.85

Collar Section Operation SAM

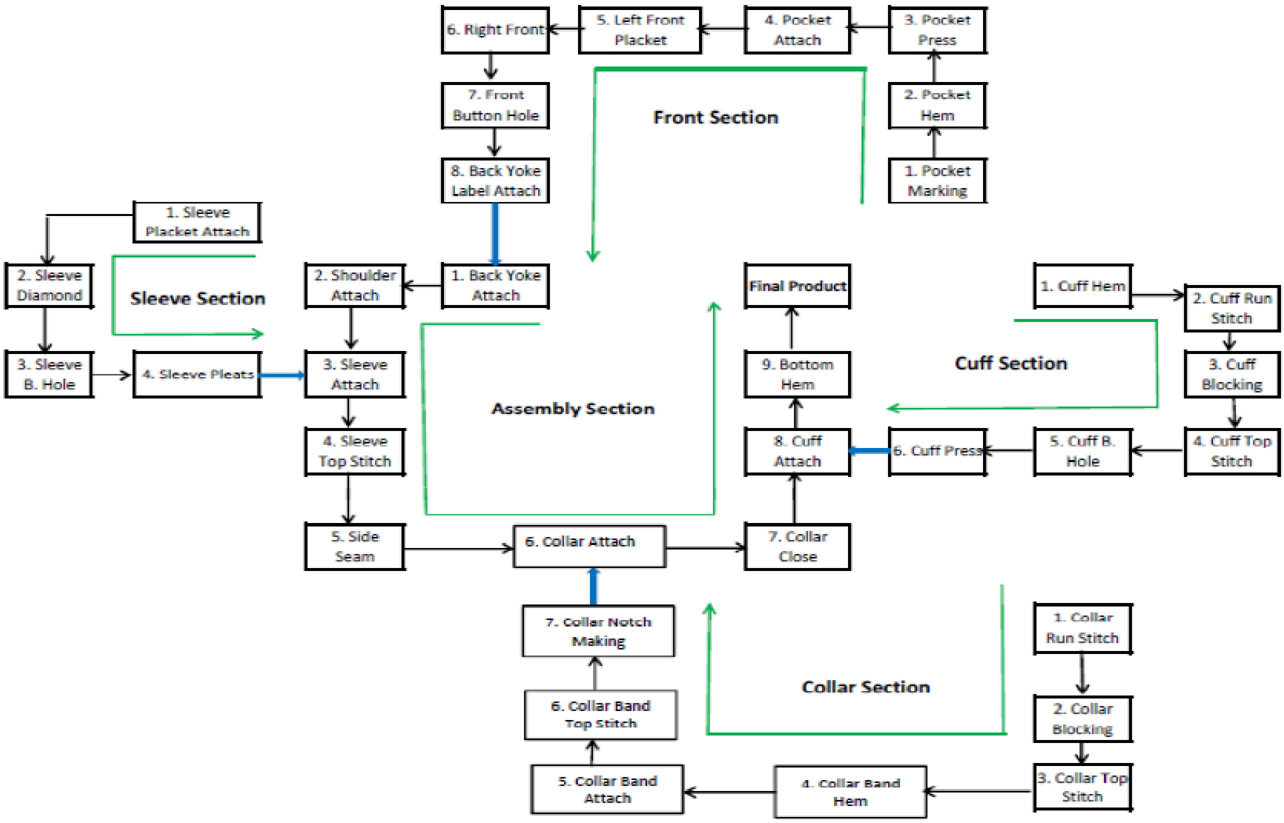
Stitching Section	Stitching Operation	Observation Time(Sec)	Standard Time	PFD Allow(%)	Performance Rating	Std Alwd Min(Sec)
COLLAR SECTION	Run Stitch	30	24	15	100	27.6
	Trimming	20	16	15	100	18.4
	Turning Blocking	20	16	15	100	18.4
	Top Stitch	36	30	15	100	34.5
	Band Hem	19	16	15	100	18.4
	Band Attach	41	32	15	100	36.8
	Peak Ironing	18	15	15	100	17.25
	Band Top Stitch	22	18	15	100	20.7
	Collar Notching	15	12	15	100	13.8
	Total	221				205.85

Front Section Operation SAM

Stitching Section	Stitching Operation	Observed Time(Sec)	Standard Time	PFD Allow(%)	Performance Rating	Std Alwd Min(Sec)
FRONT SECTION	Pocket Marking	16	13	15	100	14.95
	Pocket Hem	18	15	15	100	17.25
	Pocket Iron	41	32	15	100	36.8
	Left Pocket	29	25	15	100	28.75
	Right Pocket	29	25	15	100	28.75
	Pocket Attach	52	44	15	100	50.6
	Front Button Hole	41	32	15	100	36.8
	Yoke Label Attach	38	31	15	100	35.65
	Total	264				249.55

Sleeve Section Operation SAM

Stitching Section	Stitching Operation	Observed Time(Sec)	Standard Time	PFD Allow(%)	Performance Rating	Std Alwd Mint(Sec)
SLEEVE SECTION	Sleeve Placket	47	40	15	100	46
	Sleeve Diamond	56	45	15	100	51.75
	Sleeve Pleats	15	12	15	100	13.8
	Sleeve Button Holes	18	15	15	100	17.25
	Total	136				128.8



CREATING CELLULAR LAYOUT

In new cell design a few operations were expelled from the current one. In the first place, the quality checking focuses were expelled from the preliminary, in light of the fact that the administrator who is creating pieces of clothing ought to know about quality principles and ought to work as needs be. From that point onward, around four operations were expelled from the procedure (three operations were joined with different operations and one operation is totally evacuated by changing the operation succession). When operations were settled, production of work cells happens. The formation of cells is according to the operations expected to finish singular parts. For instance, in the event of sleeve segment there are around six operations to make the total sleeve. In this way every one of these operations identified with sleeve segments are assembled in one cell. Likewise, operations of different areas are additionally assembled in their particular cells and given individual name. Add up to, five cells were made (four cells in preliminary segment and one cell in get together) to finish the article of clothing.

The get together operations are kept at the inside and all other preliminary operations were adjusted in four sides of gathering. The cells working in preliminary operations (Cuff, Collar, Front and Sleeve) were adjusted with the end goal that the last operation of each preliminary segment ought to straightforwardly supply its last items to the individual first operation of get together (for instance, sleeve segment supplies sleeve to the sleeve connect of get together, neckline segment supplies neckline to the neckline join, sleeve segment supplies sleeves to the sleeve append, front segment supplies fronts to the shoulder connect of get together area). This will take out WIP development from preliminary to get together. Along these lines, the preliminary and gathering operations were kept in a nearby circle. In this new design, subsequent to nourishing cut parts they will be changed over into conclusive article of clothing quickly on the grounds that there is no WIP stockpiling territory, and in addition administrators are not permitted to develop a WIP, rather they ought to change their operation instantly if WIP appears to be expanding. In the meantime, every administrator is in charge of their work since quality checkers were expelled from the line. Just the last items after get together are inspected arbitrarily to ensure the nature of yield. The suggested new design is appeared in Figure

The cell design recommended in this exploration is chosen for single piece stream on account of cost viability, administrator ability upgrade and also to abbreviate an opportunity to execute it. Since there is no requirement for requesting or introducing any new gear, it is simply re-orchestrating the accessible machines inside the shop floor. This work of single piece development should likewise be possible with the assistance of robotization (like moderate speed transport and holder framework) however it might set aside extensive opportunity to introduce, noteworthy measure of cost and time to prepare the representatives about the working guideline of the framework. Indeed, even subsequent to utilizing the robotization framework (moderate speed transport or holder) the administrator multi-skilling can't be accomplished on the grounds that for this situation likewise administrators are in settled designated operations while the transport turns pieces consequently, it serves just the single piece development however not the multi-skilling.

WORK BALANCING BETWEEN OPERATORS

In this exploration, the basic operations were distinguished for every cell. For instance, if there should be an occurrence of sleeve segment sleeve run join (high tedious) and sleeve beat line (extraordinary aptitude required because of thickness of sewing region) are basic operations. If there should arise an occurrence of neckline segment neckline band connect (because of expansive number of parts to be dealt with at the same time) is basic operation. Thus, the pocket pressing (because of incessant iron weight lifting) and take connect (because of various states of pocket and from the stylish perspective; in light of the fact that the pocket is in the focal point of the article of clothing in front side) are basic operations in front area and sleeve precious stone making (piece of clothing collapsing ability for making jewel) for sleeve segment. If there should arise an occurrence of get together, sleeve append (because of thickness of the sewing range and exact arrangement of article of clothing) is most troublesome and also time taking work. So while adjusting a cell, additional care ought to be given to these operations. In the meantime, some additional administrators ought to be prepared for basic operations. This will spare from extraordinary generation misfortune without basic administrators or because of breakdowns of machines for these operations.

TRIAL PRODUCTION ON NEW LAYOUT

There are a couple challenges in this procedure since this format is new to the general population who have been working for quite a long time. The main trouble is a direct result of change of sitting operations to standing. Since administrators were routine of working sitting machines and when these sitting machines were changed over into standing they lost their control on pedal and it required some investment to prepare them. Besides, for work adjusting reason one administrator needs to play out numerous operations by evolving machines, though administrators don't care to chip away at different machines since they feel that administration is over-burdening take a shot at them.

The administrators were persuaded by saying that if individuals move around the machine they won't feel sick of a similar operation and can work all the more adequately and in addition feel less drained. In the meantime they will take in different operations inside their cell, which builds their expertise and certainty. So also, the adjusting of a cell is according to standard distributed minutes; so every one of the administrators were given equivalent work stack inside their cell. Prior to this, the basic administrators were reprimanding administration and directors for apportioning them in troublesome operations. Presently by the usage of SAM for work adjusting the issue of uneven work load is settled.

V. RESULT AND DISCUSSION

THROUGHPUT TIME COMPARISON:-

In the current group creation framework throughput time is too high and now and again, it took even two days (7.5 hour for each day X 2 days = 15 hours) to finish a 20-minute piece of clothing. In existing circumstance administrators took packs of cut boards from cutting office and began creating get together parts like sleeve, neckline, front and sleeves in individual areas. The issue comes when the preliminary segments produces unequal measure of parts. For instance, sleeve segment produces 800 bits of sleeves, neckline segment produces 600 bits of neckline, sleeve segment produces 900 bits of sleeves and front segment produces 200 bits of fronts. For this situation most extreme number of articles of clothing that can be delivered will be 200 pieces as it were. In bunch creation, if everything goes well, pieces are delivered without quality deformities, there is no machine breakdown and so forth and administrator takes after the package arrangement appropriately it will take least 220 to 230 minutes. (Around a hour and a half in preliminary and 136 minutes in gathering to finish one package). While this time is not as much as a hour if there should arise an occurrence of single piece stream suggested by this review.

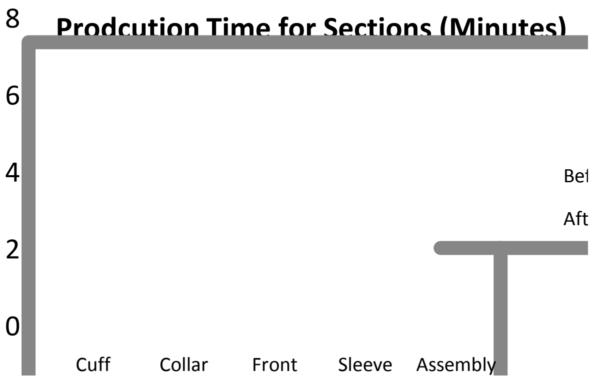
Then again, strict follow up of ticketing numbers is another issue in article of clothing industry. Because of shade variety, the piece of clothing parts of various ticketing numbers can't be blended despite the fact that they are of a similar size. In this manner now and again regardless of the possibility that every single preliminary segment (neckline, sleeve, front and sleeve) deliver measure up to number of parts in their particular region they can't be utilized as a part of gathering in the event that they hadn't taken after legitimate ticketing number.

Now and again, the issue shows up because of value issues or adjusts. The administrator works in package framework and one package comprises of approx 20 to 30 pieces. While checking these packs; if quality checker discover abandons even in a couple pieces, then the entire package will be come back to the concerned administrator for amendment. In this way the misstep in maybe a couple pieces may hold the total package (i.e. 20 to 30 pieces) bringing on lopsided WIP. Along these lines if there is quality related issue in various packages on various segments, the article of clothing can't be finished. For instance, there are 4 packs with 25 pieces in each package are stacked in sewing areas from cutting division. Assume, sleeve segment has seen revise in package number 1, neckline area needs to revamp in package number 2, front segment needs to improve in package number 3 and sleeve segment needs to modify in package number 4, then the yield for gathering will be zero. Since while bolstering in get together all parts of same package number ought to be stacked however for this situation there is not even a solitary package cleared from every one of the segments.

In the current framework, administrators begin creating parts constantly at their full effectiveness independent of the prerequisite of succeeding operation. Because of this there is gigantic WIP in the middle of procedures, which makes issues in light of the fact that as the WIP builds, the odds of slip-ups additionally increment. The most imperative piece of low WIP is; anything which bolsters underway line got to be distinctly completed item at item process duration. Once the issues are seen amid preparing these will be amended instantly which limits the cost of value. For instance, in the event of bunch creation, if there are distinctive styles running in preliminary and gathering and the quality checker discovers a few imperfections after get together, then to right this is extremely troublesome. Since in preliminary, diverse style is running and the administrator has effectively expelled the trims (string, mark, catches and so forth.) of past style. For this situation administrator's chance is squandered in looking these things (trims) and possibility of abuse of trims is high. Subsequently the likelihood of revise will increment with expanding amount and time of WIP (the more seasoned the WIP, the more odds of improve).

COMPARISON OF PRODUCTION TIME

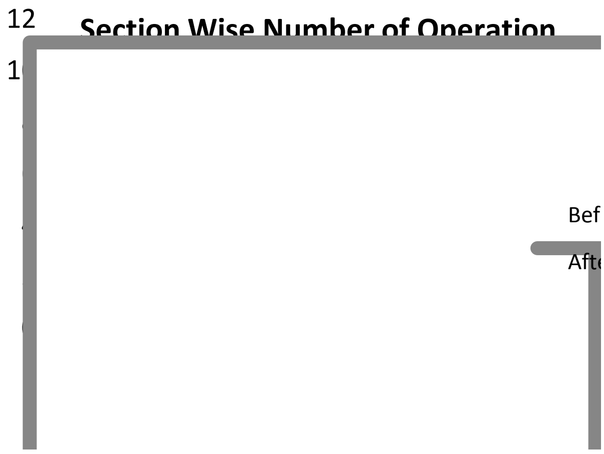
Generation time of the piece of clothing has been lessened by 1.65 minutes (i.e. around 8%).



This has been accomplished by consolidating 3 operations with different operations (sleeve trimming joined with sleeve run fasten, neckline trimming consolidated with neckline run line and sleeve attaching joined with sleeve append) and by disposing of one operation (neckline top pressing expelled by changing the state of intertwining) . The time expected to finish the work on various areas is appeared in Figure

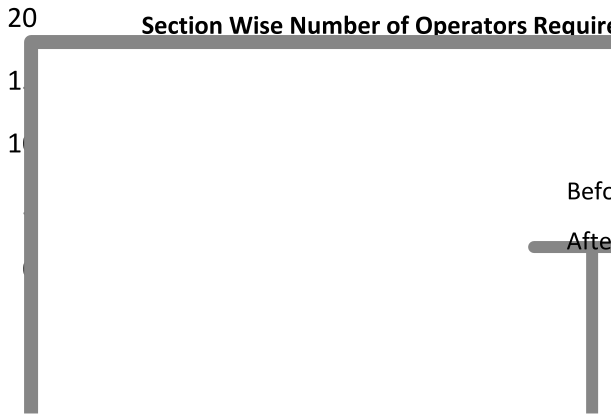
COMPARISON OF NUMBER OF OPERATION

The quantity of operation expected to finish an article of clothing is lessened to 36 from 44. In all out 4 operations were expelled from sewing area and 4 operations from quality checking segment. Those operations were not increasing the value of the last item; so they were evacuated. The examination of the quantity of operations prior and then afterward circumstance is appeared in Figure 5.2. So also from quality check and WIP segments one-one operations are diminished for an indistinguishable reason from these were not including any sort of significant worth expansion to the last yield.



COMPARING NUMBER OF OPERATOR REQUIRED

If there should be an occurrence of cluster creation, there used to be one administrator in each machine and one extra individual who can work in any event in a few operations for adjusting the stream. The occupation of this additional administrator is to bolster in basic operations and limit operational bottlenecks. Though if there should be an occurrence of single piece stream the administrators are apportioned according to standard permitted minutes in every cell and they will adjust the work as per their need. In single piece stream, the revolution of administrators is characterized by the SAM and circumstance of WIP. The quantity of administrators utilized as a part of various segments is appeared in Figure. About 14% (14.28%) of administrators were decreased from group preparing, out of which 8% were from sewing area and 6% from quality checking. The quantity of administrators expected to finish an occupation is lessened by taking out some non esteem included operations from the procedure. Correspondingly there is no need of value checkers after each segment, since quality checkers can't control the nature of work performed before checking.



In the prior framework quality checkers were filling in as the postman, they can give input about the delivered parts yet can't increase the value of the item. So accentuation has been given to the nature of created parts. For this, the administrators were imparted about the required quality measures and detail. Along these lines if the administrator has any perplexity or issue amid creation, he (she) ought to clear it before chipping away at it. This limits the improve level, which eventually expands profitability

VI. COMPARISON OF REWORK LEVEL

The revise level has been diminished by 80% over existing patterns. In existing creation, the revise level is roughly 5% however after execution of prescribed format the adjust level tumbles to 1%. The primary explanation behind revamp decrease is because of diminishment in WIP and adjusted work cells. Because of low stock, oversights are plainly unmistakable and if any deformity is found in the article of clothing, it will be cleared inline, and the piece turns out as a last item. If there should arise an occurrence of cluster preparing, until the imperfection is seen administrators may have heaped up group of WIP and it is exceptionally hard to clear damaged parts. Sometimes, there might be new style running in the following area before discovering deserts. This is the most troublesome work for clearing inadequate parts. The more seasoned the WIP turns into, the more hard to clear on the grounds that there is high probability of blending trims (strings, catches, marks and so forth.) and disarray with respect to style related particulars.

VII. CONCLUSIONS

In conclusion, it has been found that the implementation of lean manufacturing at the organizational level and operational level is crucial to understanding as a whole in order to apply the right tools and strategies to productivity improvement. Much of the discussion in textile industry and others still centers on the shop-floor, which exhibits a limited understanding of what contemporary lean approaches are about. It has been made an attempt to summaries how the lean concept has evolved from industries and it can be utilized for the benefit in the fabric or yarn industries as well. The resulting lean value system encompasses a value-adding network of operations across companies, with the goal of providing a series of contingent lean techniques.

Most of the firms in the Indian textile industry are small. Even so, there are differences in their working culture. In any event, implementation of lean techniques deployment in the textile industry is generally low. Quality control and TPM have a high degree of implementation, but other practices (group technology, kanban, set-up time reduction, multi-function employees and graphs or panels for visual factory) are uncommon. We are of the opinion that variations in operational performance are hard to explain in this sector. The use of Lean techniques practices as described in the present study may have important determinants of high performance. The economies of scale associated with high manufacturing volumes lead to high levels of efficiency in many industries.

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