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Productivity Improvement by Reducing Waiting Time and Over Production Using Lean Manufacturing Technique

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Abstract

To survive in the market, the goal of any manufacturing industry is to produce goods at the lowest time possible and the lowest cost. Thus, it was decided to implement lean to improve productivity. Generally, in an industry, more focus is given on profit. Though there are different expenditures involved in cost reduction internally spent by industry through finding wastages, avoiding and improving faulty work would end in vast reserves. A study was carried out in a garment industry located at TIRUPUR, TAMILNADU, INDIA, at sewing section to identify non-productive actions to eradicate them for saving time, cost and improve internal throughput time.

Keywords: *Productivity, lean manufacturing*

I. INTRODUCTION

Prolific actions emphasize any action that the customer is ready to pay for. Non-productive activities designate that the customer does not ponder as adding value to his product (for example, waiting time, inspection time, zigzag movement due to improper layout, improper line balancing, no proper planning, improper machine use, sharing of working instruments, absence of operators, workers' fatigue) [1]. One of the ways to decrease wastages can be the elimination of non-productive activities that can result in drop-in time, cost, and lead time. As it is acknowledged that time is money, if additional time is mandatory in a product or service, extra money is involved. By responding faster to make a product as per customer demand, the company can capitalize less money and more savings. Therefore, a study was carried out in the garment industry located at TIRUPUR, TAMILNADU, INDIA, at sewing section to identify non-productive actions to eradicate them for saving time, cost and improve internal throughput time. Manufacturing productivity can be improved by reducing waste in production processes. People run processes. The support, proper leadership, and guidance drive people to improve the processes that add value to the customer continuously. The system that helps to achieve this is a Lean Management system. Lean Management system uses various tools to connect the purpose (providing value to the customer) to the process and people. Some of the lean management tools commonly used are Leader standard work, visual control boards, 5S, and daily accountability. Lean management is characterized by its drive toward achieving profitability and productivity through continuous improvement and resource waste elimination. It is organizational culture, as well as specific practices with clear goals[4]. Thousands of organizations worldwide have achieved tremendous productivity and return on investments by implementing lean practices and techniques.

II. LITERATURE REVIEW

In recent years, many literature works have extensively documented the implementation of lean manufacturing in various manufacturing sectors. Lean production is a conceptual framework popularized in many western industrial companies since the early 1990s. Initially, the book "The Machine that Changed the World" [5] started the diffusion of some lean manufacturing practices developed by the most competitive auto manufactures in the world.

The interest in lean production is mostly based on empirical evidence that it improves the company's competitiveness. Lean manufacturing is most frequently associated with the elimination of seven wastes. Implementing it is to increase focus in lean manufacturing because poor quality management should result in huge waste and scraps. Proper quality management at the right time will help to control the manufacturing process. Lean manufacturing is an integrative concept that can be adopted by a particular set of keys or factors. Those key areas are believed to be very critical for its implementation.

Productivity, reduce lead time and cost and improve quality [5]. Quality is a major though many literatures on lean implementation are comprehensively available, very few have addressed the garment industry. The pressure placed on firms in the garment industry from international competition has been enormous. The increase in competition has led to an increased focus on customer satisfaction as a survival of the company in the long run".

The garment industry has opportunities to improve but requires some changes. Under the highly competitive environment, the garment industry has numerous opportunities for improvement using lean principles.

Lean practices can fulfill customer demands with high quality and services at the right time. Now, many countries have started to practice lean tools in the garment industry and observed tremendous improvement. In addition to this, lean production involves, motivates, and develops employee skills through education and a multi-skilling program.

The companies that adopt lean manufacturing as a working philosophy within their organizations can significantly improve their operational performance, even if it is in a modified format that best suits their particular business culture [8]. The organizations intending to go for any Japanese manufacturing technology and practices should first understand the need to use that tool and its application, prepare for its adaption, and then identify the ways and measures required for its successful implementation. To implement lean thinking in any organization, the first step is to identify the value stream map. Value Stream Mapping is a functional method aimed at recognizing production systems with lean vision. VSM has been applied in a variety of manufacturing industries.

In this paper, an application of VSM has been discussed to identify the various forms of waste on the garment shop floor.

The goal of lean manufacturing is the aggressive minimization of waste, called Muda, to achieve maximum resources efficiency. Cellular manufacturing, sometimes called cellular or cell production, arranges factory floor labor into semi-autonomous and multi-skilled teams, or work cells, who manufacture complete products or complex components. Properly trained and implemented cells are more flexible and responsive than the traditional mass-production line and can manage processes, defects, scheduling, equipment maintenance, and other manufacturing issues more efficiently. The Cellular manufacturing system is the concept that is emerged from the group technology.

In industrial garment manufacturing plants, various types of sewing systems are installed. A plant owner chooses these systems depending on the production volume, product categories, and cost-effectiveness of high tech machines [11]. The “Progressive Bundle System” (PBS) is mostly installed sewing system to date. In this production system, bundles of cut pieces (bundle of 5, 10, 20, or 30 pieces) are moved manually to feed the line.

With the advancement of technology, mechanical material transportation systems are brought into the sewing plant. An overhead material transport system, known as UPS (Unit Production System), transports cut pieces hanged in hangers (one hanger for one piece) by an automated mechanical transport system. It reduces manual transportation, and it has many other benefits against the progressive bundle system. This article is not to recommend one to replace this well placed progressive bundle system.

A comparison between these two production systems has been drawn in the following table based on production KPIs (Key Performance Indicators) to show how a UPS system (overhead hanging and sensor-controlled system) is most effective over PBS.

A. Lean manufacturing

Lean is the optimal way of producing goods through the removal of waste [12].

“Lean manufacturing is the system which aims in the elimination of the waste from the system with a systematic and continuous approach.” In simple words, lean is manufacturing without waste.

B. Concept

Lean is a team-based approach to identify and eliminate waste through continuous improvement.

Any activity that adds cost or time without value to our customers' service is called waste.

C. Objectives

- Meet customer demand on time
- Eliminating non-value-added activates
- Minimize the work in process inventory
- Create flexibility of style changeover
- Creating multi-skilled operators responding quickly for style change over.
- Steps to achieve lean systems
- Design a simple manufacturing system.
- Recognize there is always room for improvements.
- Continuously improve the lean manufacturing system design.

D. Types of waste

The waste is classified into seven types as:

a) Overproduction

The department produces at their operating capacity irrespective of the delivery date to the customer, and they sometimes create an unnecessary pull at the beginning of the process due to the massive capacity they are operating with. It is production ahead of demand.

b) Excess Motion

It means people or equipment was moving or walking more than required to perform the processing. As this is a more machine, intensive industry savings related to motion is relatively low than a labor-intensive industry. Movement of people or machines that does not add value.

c) Waiting

Waiting for the next production step. It is an idle operator or machine time [15]. When resources like people and equipment are forced to wait unnecessarily because of delays in the arrival or availability of other resources, including information, there is waiting time waste.

d) Transportation

This is the movement of product within the production process without producing any value addition (VA). A progressive bungling system will stretch unnecessary bundle movement between the processes [16]. Any material movement that does not directly support value-added operations.

e) Inventory

It includes excess WIP inventory as well as finished product inventory. Any supply over required producing product.

f) Defects

Any undesired characteristic that affects product fit, form & functions. It is making defective parts.

g) Over-processing

It defines the unnecessary processing of the product. Any process that does not add value to the product.

III. METHODS

A. Study phase

A day to day study was conducted in the different departments, and the style and the process flows were observed; the cut parts to packing are preceded.

B. Data collection

Two types of data were used to conduct the research:

1. Primary data
2. Secondary data

Primary data was collected physically from the production plant. Moreover, the secondary data were collected based on data from other sources.

Primary data was collected from the following,

- Shop floor visits and intensive physical observations
- Questionnaires and check sheets for professionals to identify the wastes in the cases chosen
- Informal interviews with concerned bodies (top-level management)

Secondary data was collected from the following,

- Review of relevant literature, concerned with the seven types of wastes
- Manuals, historical documents, and other necessary sources from case companies
- Economic cost analysis relating to the objectives defined to minimize and eliminate the problems identified

C. Findings and analysis

The case study deals with various types of waste existing in the sewing section, more specifically, spare time and overproduction. The information, as well as data, have been gathered through the questionnaire, observation, and interview. The data and information were collected through the observation of the production floor and some records from the industrial engineering and planning department of the industry.

D. Findings of wastes in the sewing section

After visiting the sewing section of the industry, several wastes were identified to influence the overall production process of the industry. According to the lean principle, these wastes are discussed as follows,

1. Overproduction
2. Waiting

Table1

TYPES	REASON	RESOURCES WASTED			
		MAN	MACHINE	MATERIAL	OTHERS
OVER PRODUCTION	Produce more than order	v	v	v	
WAITING TIME	Stock outs	v			v
	Lot processing delays	v	v	v	v
	Equipment downtime(for maintenance, poor m/c quality, breakdown)	v	v		

E. Implementation phase

Out of the seven wastes, two were identified as waiting time and overproduction.

So it was decided to concentrate on the sewing floor and use different lean methods and tools like group technology and JIT.

F. Waiting time

When resources like people and equipment are forced to wait unnecessarily because of delays in the arrival or availability of other resources, including information, there is a waste due to waiting time.

- Man idle or waiting time
- Machine idle or waiting time

G. Causes

Unsynchronized processes; line imbalance, Inflexible workforce, over-staffing, Unscheduled machine downtime, Long set-up, Material shortage or delay, Manpower shortage or delay.

This includes waiting for the bundle, accessories like thread, labels, and tools. The reasons vary concerning style and the operation. The most common reason the operators are waiting for the bundle, machine break downs, and needle breakages.

The company follows the bundle production system. So the operator has to wait for the next process in the production line. So the productivity is less due to the waiting of bundle, accessories like thread, labels.

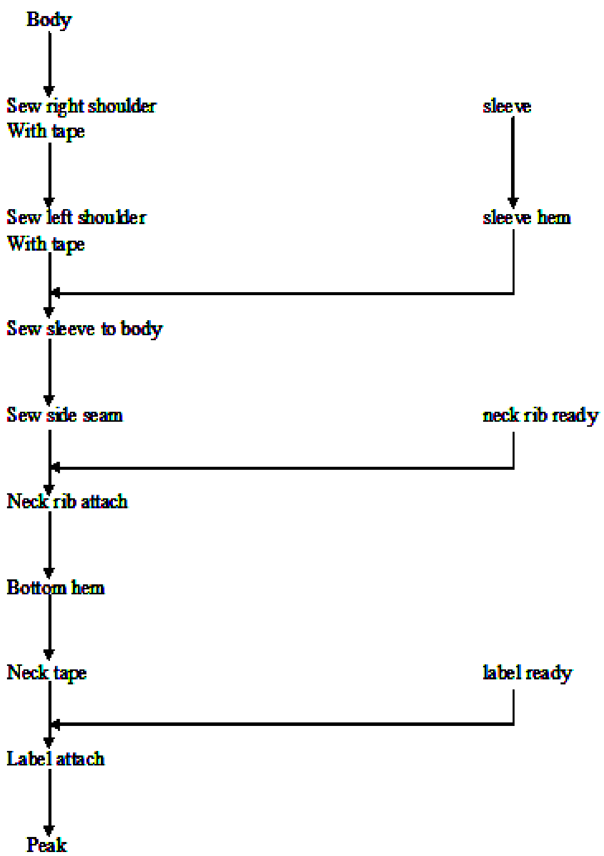

Figure-1

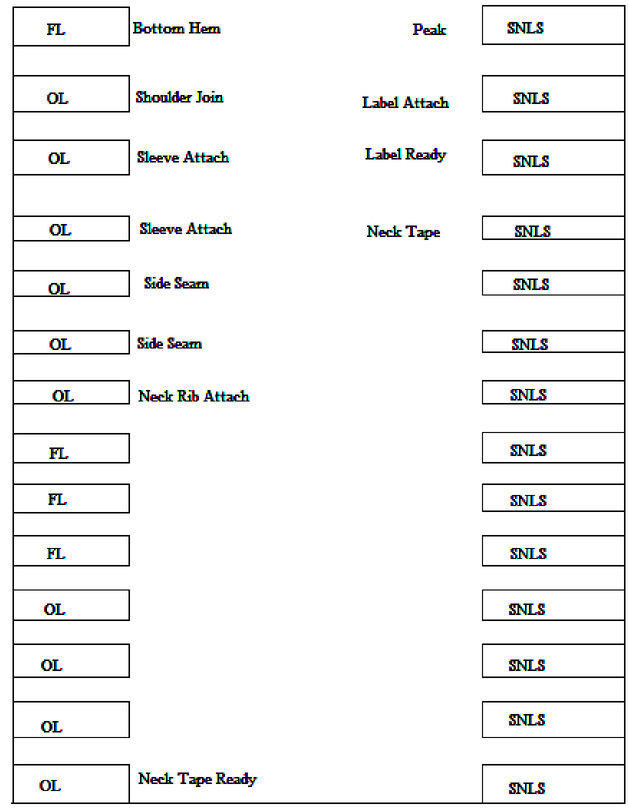

Figure-2

Table – 2: Sewing Process Flow for T-Shirt Machine Alignment Production Target

Production target/day (8 hours) =800 pieces		**Shift hours = 8 hours or 480 minutes**		**Plan on Efficiency = 60%**	
Opr. No.	Description	Machine Type	SMV	No. Of Calculated M/c	Round off Machine No.
1	Make Neck Rib & Run stitch	SNLS	0.55	0.9	1
2	Join shoulders	4TOL	0.45	0.8	1
3	Insert Neck Rib	SNLS	0.45	0.8	1
4	Serge Margin	4TOL	0.31	0.5	1
5	Topstitch on Neck rib	3TFL	0.34	0.6	1
6	Attach Sleeve	4TOL	0.78	1.3	2
7	sew side seam with labels	4TOL	0.84	1.4	2
8	Hem sleeves	3TFL	0.68	1.1	1
9	Bottom Hem	3TFL	0.56	0.9	1
10	Label ready	SNLS	0.15	0.9	1
11	Label attach	SNLS	0.25	0.9	1
TOTAL			5.36	8.27	13

1) Breakdown / Seizing

Sewing machine breakdown can be a major problem. Nevertheless, then, this can be avoided by subjecting your sewing machine unit to regular maintenance.

2) Needle breaks

One of the common cases of sewing machine malfunction is breaking needles. Needles often break in case of any malfunction in the sewing machine. This can also occur if sewing thick fabrics such as pieces of denim.

3) Productivity losses due to waiting time

Total minutes waited (machine stoppage) in a week
= 240 mins
Time wasted by individual per day
= 4 mins
Time wasted by 18 operators per day
= 72 mins
Time wasted by 18 operators per week
= 360 mins
Total mins wasted in a week
= 600 mins
Total working mins in a week
= 3240 mins
Total quantity produced in a week
= 9600 pieces
Pieces reduced due to waiting time
= 1778 pieces
Productivity loss due to waiting time
= 18.5%
Pieces reduced due to waiting time
= (600/3240) x 9600
= 1778 pieces
Productivity loss due to waiting time
= (1778/9600) x 100
= 18.5%

The company has extra 3 machines. So, the plan is to use the extra machine to reduce the waiting time. When the machine was stopped during the sewing process, the worker will have to wait for the mechanic to come and repair the machine.

After implementing this kind of action, the waiting time was tremendously reduced.

4) After implementation productivity losses due to waiting time

Total minutes waited (machine stoppage) in a week
= 90 mins
Time wasted by individual per day
= 4 mins
Time wasted by 18 operators per day
= 72 mins
Time wasted by 18 operators per week
= 360 mins
Total mins wasted in a week
= 450mins
Total working mins in a week
= 3240 mins
Total quantity produced in a week
= 9600 pieces
Pieces reduced due to waiting time
= 1333 pieces
Productivity loss due to waiting time
= 13.88%
Pieces reduced due to waiting time
= (450/3240) x 9600
= 1333 pieces
Productivity loss due to waiting time
= (1333/9600) x 100
= 13.88%

After implementing waiting time reduction techniques, the production rate is increased, and the productivity loss rate is minimized from 18.5% to 13.88%. The efficiency rate can further be increased by reducing idle time.

H. Overproduction

It is production waste that cannot be eliminated, but it can be reduced by lean manufacturing technique. It was noticed that for every order, an extra 6% was cut to meet the complete order. Hence it was decided to reduce the overproduction percentage by implementing a lean manufacturing technique from 6% - 3% in the next order for the same style.

I. Using tools

a) Group Technology

1) Technique used for reducing overproduction

It was decided to change the bundle system (chain) into a unit production (line) system. It calculates the measurement of the material before cutting and after cutting for the correct measurement. It will help to reduce the overproduction of the product during the process and produce good quality.

2) Before implemented in production systems

a.)Bundle production system

This system gives more production with less quality than the line system. It is also known as the Chain system.

b.) Production quality

Total order quantity in before 8 days (3/2/14 – 10/2/14)
= 11540 pieces

And with 6% over production
= 772 pieces
Total production (before implementation)
= 12312 pieces
Total order quantity in after 8 days (26/2/14 – 6/3/14)
= 9104 pieces
With 6% over production
= 543 pieces
Cut with 3% over production (after implementation)
= 273 pieces
So, this reduced the total number of pieces to be sewn.

Calculation

7043 A & Navy color, it is only 6% of the order quantity is cut.

Order quantity
= 1848 pieces
Additional cuts (6%)
= 130 pieces
Total pieces cut
= 1848+130
= 1978 pieces
With 3% cuts
= 55 pieces
Total pieces cut
= 1848+55
= 1903 pieces
So, the extra pieces cut can still be reduced to 3%.

Production status

DATE	CUTTING	PRODUCTION	DESPATCH	STOCK	ORDER NO & COLOR
Day 1	1268	1268	1200	68	7165 A & WHITE/NAVY
Day 2	1978	1978	1848	130	7043 A & NAVY
Day 3	628	628	600	28	7036 AS & NAVY
Day 4	937	937	889	48	7040 A,B,7145B & PINK
Day 5	1538	1538	1423	115	7148 B,7041 B & L.PINK
Day 6	703	703	657	46	7041B,7145B &W/BLACK
Day 7	1606	1606	1523	83	7148 R,H,B & PINK
Day 8	3654	3654	3400	254	7145 B1,7039H,4314 B & NAVY BLUE, OLIVE GREY

After Implementing Unit Production System
Production status

DATE	CUTTING	PRODUCTION	DESPATCH	STOCK	ORDER NO & COLOR
Day 1	942	942	915	27	3421 N & WHITE
Day 2	1854	1854	1800	54	3432 B & GREEN
Day 3	637	637	619	18	3267 SH & NAVY
Day 4	767	767	745	22	3478 BS & WHITE
Day 5	1442	1442	1400	42	3120 NH & L.BLUE
Day 6	684	684	665	19	3908 AB &RED
Day 7	1622	1622	1575	47	3765 & W\NAVY
Day 8	1426	1426	1385	41	3932 & RED

IV. RESULT

After converting the Bundle production system into a Unit production system, the waste is reduced, and the result has indicated an increase in productivity. In modern industries, it is difficult to identify the key areas and practices, which can be used to eliminate waste in their processes. As the sewing section is the most important section among different sections of the garment industry, so this research study proceeds with a focus on the improvement of the sewing section. In this connection, the lean manufacturing concept is applied as a new manufacturing concept in the sewing section of the studied garments industry. Thus, lean manufacturing helps the organization to visualize the present level of wastes occurring in the organization and the future possibilities of reducing or eliminating them. In order to continuously reduce or eliminate waste, management of companies need to apply different Lean tools and techniques accordingly while giving adequate training to their employees.

After the implementation of waiting time reduction techniques, the production rate is increased, and the productivity loss rate is minimized from 18.5% to 13.88% and reduce the overproduction percentage by implementing lean manufacturing technique form 6% - 3% in next order for the same style.

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