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Analysis on Production Efficiency of Lean Implemented Sewing Line: A Case Study

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Abstract

In the Present research work, a study has been planned to hold a critical investigation on improving production (Sewing) Efficiency of Lean Manufacturing based system. Sewing department was seen as the principal area in apparel production and this particular department is also called as money making area because in this area the garment product is formed into finished goods. When this fabric is entered to sewing process, it has to be rechecked by each department related to line arrangement, machine preparation, product component preparation such as pieces of fabric, threads, embroidery, and other accessories, and all at once the result of sewing line layout and daily production target made by the IE department based on data records taken and count based on time study. Afterward, the merchandise goes into the sewing course, regular control must be practiced especially in the origin of production because many problems come up at this time, usually with quality, machines setting, operators target and line balancing problem. These work might help apparel manufacturers understand how to overcome basic difficulties and how to improve the yield in the sewing section. From the survey, it was observed that how the lean manufacturing organization can be implemented and to increase the productivity of the stitching department. Before embarking on a production procedure of a style, need to have a meeting with all department IE; Merchandiser, production, QA, IE, PPIC, and mechanic to discuss the manner which will get into production, so they all can do the preparation that will reach the production moving smoothly, avoid mistake in production and increase the yield. The work was planned with the techniques like time study, motion work, downtime report study, performance work, skill matrix, training evaluation, hourly monitoring report and then on from the work, the reason for low output was celebrated and the method to increase the production is also graded.

Keywords: Sewing performance; Time study; Motion study; Down time report study; Performance study; Skill matrix

Introduction

Many researchers have taken note and found that the apparel enterprises a valuable material is treated in the different department before converting into the garment. In this case, the sewing department is taking on a major part in the whole house. Because there are lots of different operations performed manually. Hence it demands constant oversight and review. For improving the competitiveness for increasing productivity, efficiency in sewing through improved management systems and training. The work was examined, the competitiveness, productivity, benchmarking, strengths and weaknesses of garment industries. Garment industry as an intensive labor industry means to produce one piece of product through many procedures and involve many operators. Recognizing this, as unitary of the businessman in the garment industry, we have to pay more attention to what we can perform to maximize the productivity of the project. To increase productivity in garment industry can be reduced in the sewing field. Sewing department is the primary area in apparel production. This particular section is also called as money making area because in this area the garment product is made become finished goods [1-6].

Even today, industries are getting the same or more volumes (orders), but the number of styles they have to handle has increased drastically. Earlier industries were getting bulk order so there is no need to worry; if the production line was set for the first time it would run for a month or at least a week or two. But nowadays due to small order quantities and complex designs, the garment industry has to produce multiple styles even within a day; this needs higher flexibility in volume and style change over [7-24]. In this way, short production runs started by Toyota became a benefit rather than a burden, as it was able to respond much more rapidly to changes in demand by quickly switching production from one model to another [25]. Lean manufacturing has increasingly been applied by leading manufacturing companies throughout the world. A core concept of lean manufacturing is pulling production in which the flow on the factory floor is driven by demand from downstream pulling production upstream. Some of the changes required by lean manufacturing can be disruptive if not implemented correctly and some aspects of it are not appropriate for all companies [26]. A lean manufacturing facility is capable of producing the product in only the sum of its value added work content time. On the other hand, applications of lean manufacturing in the continuous process sector have been far fewer [27]. It has sometimes been argued that in part, this is because such industries are inherently more efficient and have a relatively less urgent need for major improvement activities.

Lean production practices are the practices implemented and the changes made to eliminate waste and create value. The literature suggests organizations should introduce a bundle of multifaceted lean production practices that work synergistically to minimize waste and thereby successfully implement a lean production system. This multifaceted bundle of lean production practices are also referred to as determinants of a lean production system. At the very detailed level, these lean production practices include but not limited to practices such

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as cellular manufacturing, multifunctional workforce, lot size reduction, just-in-time, work delegation, total productive maintenance, set-up time reduction, total quality management, continuous flow production, agile manufacturing strategies, safety improvement programmes, process capability measurements, and human resource management. The majority of previous studies reduced a lengthy list of lean production practices by classifying them into broad categories using data reduction techniques. Manufacturing performance is explained in terms of various dimensions such as manufacturing plant's labour efficiency, machine efficiency, conformance quality, manufacturing plant productivity, schedule attainment, on time delivery, inventory management, production volume flexibility, and manufacturing cost efficiency. Overall, the achievements in manufacturing performance enhance a firm's manufacturing competitive capabilities [7-23].

Components of industrial engineering/Work study

As per the pragmatic execution of Lean manufacturing system, the organization uses these factors as industrial engineering / Work study. Basic concepts of these details are described for better understanding (Figure 1).

Industrial engineering

In general, industrial engineering is concerned with the design of production and service systems. The industrial engineer analyses and specifies integrated components of people, machines, materials, and facilities to make efficient and efficient organizations that make goods and services beneficial to humans. Industrial engineers are the bridge between management goals and functional functioning. They are required to exercise leadership in workplace education as well as depth psychology, conception and implementation of systems and plans for operating those systems that convey value to the establishment. Industrial engineers identify opportunities for improvement with equipment, materials, methods, layouts, and they prepare designs.

Methods study

Method study is the process of subjecting work to systematic, critical scrutiny to make it more effective and/or more efficient. It is one of the keys to achieving productivity improvement. It was originally designed for the analysis and improvement of repetitive manual work but it can be used for all types of activity at all levels of an organisation. The process is often seen as a linear, and described as its main steps like the process is often seen as a linear, described by its main steps of: Select (the work to be studied); Record (all relevant information about that work); Examine (the recorded information); Develop (an improved way of doing things); Install (the new method as standard practice); Maintain (the new standard proactive).

Work measurement

Work Measurement is a term which covers several different ways of finding out how long a job or part of a job should take to complete. It can be defined as the systematic determination, through the use of various techniques, of the amount of effective physical and mental work in terms of work units in a specified task. The work units usually are given in standard minutes or standard hours.

Improved productivity

Increasing productivity is a major destination for many formations, as the more productive their workforce is, the more money they can take into their enterprise. While this concept may seem simple, to fully realize what it intends to increase productivity, one must get past a literal definition and get a firmer understanding of the concept as a whole and learn how to one could achieve this finish. Most simply, increased productivity means that the workers are putting out products more quickly or competing services at a more rapid rate than before. In most jobs, the more products that workers produce or services they complete, the more money comes into the business, making increased productivity a high priority for many business proprietors.

Methodology

The study was planned to study profile of the selected company, process, procedures of the sewing department, basic module of the line system used in an existing sewing department, application of Time and Motion study to understand the SMV for the operator, Analyzing the performance of the project through the skill matrix, downtime analysis, efficiency of the stitching process. The detailed Methodology involved in bearing out this employment is reported beneath:

Overall module structure

The following Flow diagram represent the overall Organisation structure, this could help the readers to understand about the responsible authority in the Module structure (Figure 2).

Module layout

In this section, given module layout was considered for the production analysis on sewing line of the organisation and diagrammatically it would describes about each operations (Figure 3).

Sewing flow process

The flowing flow processes would explain, the step by step process utilised to produce the final garment with acceptable quality level (Figure 4).

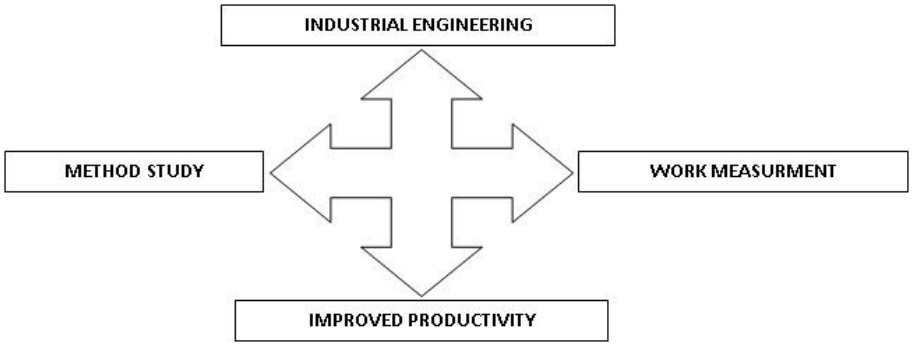

Figure 1: Components of Industrial Engineering.

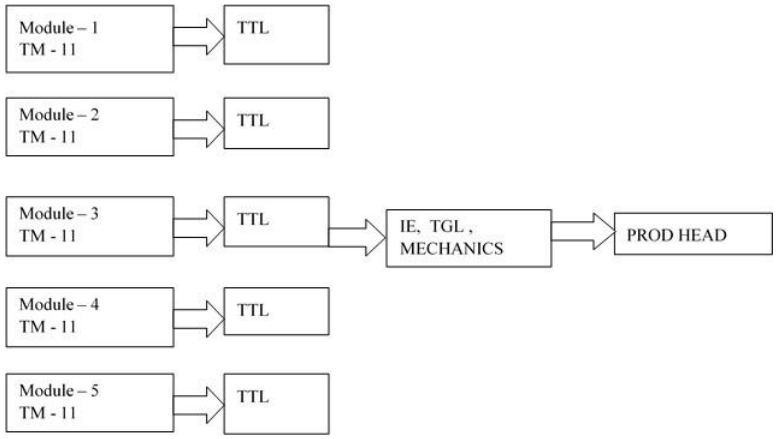

Figure 2: Overall Module Structure.

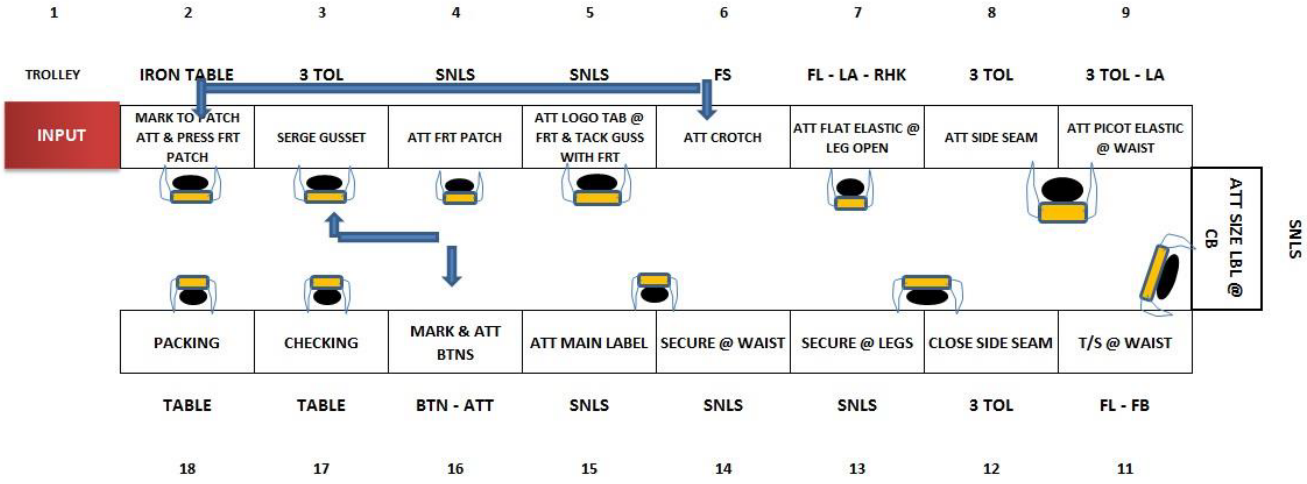

Figure 3: Module Selected for Analysis.

Methodology

Pre-production meeting

The working steps of the sewing department start with the Pre-production meeting, during this meeting the technical planning could be discussed. In this meeting, the Technical Department would hand over the Production file to the Sewing department for the implementation of the Production plan. Further, during this, Pre-production meeting team would discuss around the difficulties and requirements of the style and the style detail will be explained clearly to the Sewing people. The required number of people in the style per module will also be discussed and the target needed will also be explained clearly to the stitching section.

Pilot-run

The Pilot-run will be done to analyse the critical steps involved with the style. During the Pilot-run the BOM will be issued to the sewing so that the calculated production and actual production details could be compared. Based on that pattern problems could be keyed out and updated for improvement.

Pilot study meeting

In the Pilot study meeting the garments done during the Pilot-run will be scrutinized and the requirements are discussed, if the men reach the inspection, production will be started otherwise Re-Pilot have to be done till approval.

Production normal process

The core feature of the selected Factory is the LEAN system of manufacturing along with the Stand-Up mode of sewing, so the manufacturer will have the single piece flow, and also a single operator will handle more than one machine, the stand-up mode will facilitate for the movement. The Layout was in the form of a straight line, the input is on one end and the output on the other terminal.

There are 12 members per module; they are balancing the line with the 12 operators irrespective of the style. In that 10 will be doing the sewing operation (9 operators and 1 Team Training Leader) and 1 will do the checking and another 1 will do the packing. Unlike other companies, the checking and the compacting are done on the Module it rather than doing separately. Another most important feature is that, they are directing all the operators to be Multi-Skilled and the Module was arranged in such a manner that everyone can be able to see

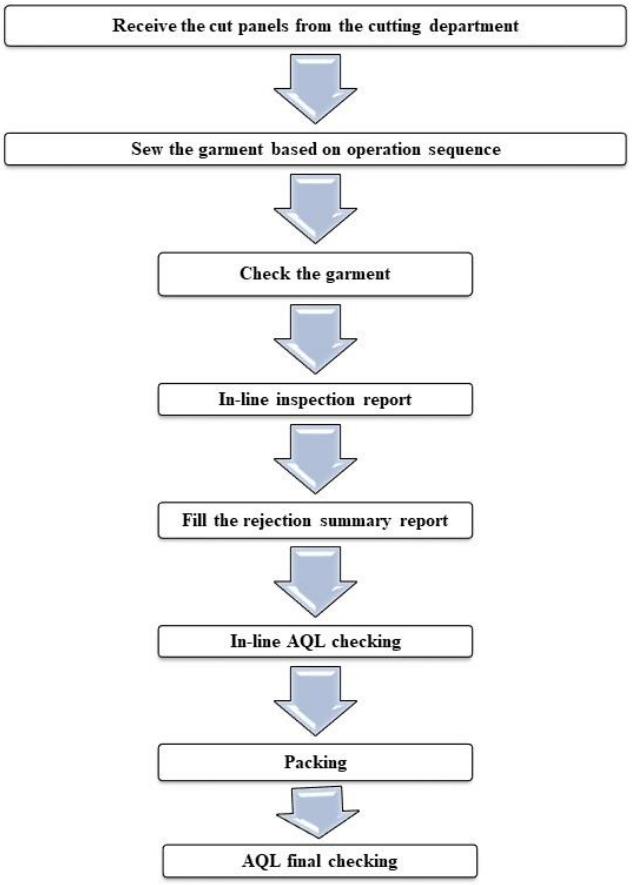

Figure 4: Flow Process Sequence adopted for Garment Production.

everyone, so that if there is any problem in the module they can be able to know because of whom the production got struck, so that they can travel and help the operators. The input to the modules will be in the form of cartons along with the Internal Logistics Slip. Internal Logistics will handle the cartons to the modules; there is no need for the sewing people to run from the module to receive the input. Immediately after sewing, the operators will do the trimming and after finishing it will run to the end line checkers. The end line checkers will check the garment and fill the In-line inspection report on an hourly basis.

The rejection summary report will be filled by Team Leader in case of any damage and hand over the report to the AQL checker from quality assurance. Founded on the rejection the Re-cut requisition slip will be satisfied with the AQL people.

If there is required of any trims extra in case of harm or defect the productive people will fill the Trims Requisition Slip and forward it to RMWH directly. If the goods pass the AQL checking the cartons will be moved to FGWH and if the goods failed in AQL, rework will be applied to the same Module. The Internal Logistics Slip will be gratified by the TL and forwarded to AQL checkers, the pass or fail of the goods will also be mentioned in the Internal Logistics slip, the number of rejections will also be mentioned in the slip and finally forwarded to FGWH.

The Production Control Board is there to monitor the hourly production and in that board, the target for the day will be given split upon the hourly basis. And then that the objective and the accomplishment can be compared after every time of day. If the object is not achieved the reason has to be written on the board and this will also be conserved by the Team Leader. Presently there are 36 modules running and their future plan is to expand to 150 modules. One more AQL board is there in production in that board they will remark around the number of times AQL inspection is made in a Module and Green color will be applied if the inspection is passed and Red will be collapsed if the inspection fails. Strolling entertainment is also available on an hourly basis.

Training

The Training in Factory is quite dissimilar from other manufacturers and the training period takes in four levels, and the training is under the control of HR.

Stage 1: This level of training is planned for 10 days and during the training, the trainees would understand about, Company profile, Salaries, Do's and Don'ts, Laws of HR, SMV, target, efficiency and standardization system of IE and Types of machines, needle types, no of threads in the automobile and the needles used and cleaning and needle breakage procedures of Engineering. Then the 5S procedures class, MQA class and needle policy class will be extended.

Stage 2: Complete training would be given to operate a SNLS machine with the required number of stitches. During the training, the trainees would get practiced with how to carry out each operations and settings like pedal position, standing position, threading and bobbin winding with the parts. Every trainees, whoever trained at this stage would move on to second and third level. In case of second level the trainees would get training on advanced stages of level of machine operations, similarly in case of third level they would get trained with various paper exercises.

Stage 3: In addition to paperwork the trainees would trained with special machines like over lock, Flat lock, and Flat seam machine, about the Threading, parts and Fabric exercise. Even trimming and unravelling of the stitch would also be trained.

Stage 4: In this stage they are trained for product development training and various fabrics and trims of production concepts would be given to them as training. Overall efficiency of 15% is expected for producing garments with higher productivity with the acceptable quality level, where the team efficiency is not the average of individual efficiency. It is computed on the basis of hourly production.

Standard formats utilized: Operation bulletin; Yamazumi chart; Potential study report; Hourly monitoring sheet; Skill matrix/spider diagram; Training evaluation sheet; Downtime analysis reports; Capacity calculation sheet.

Formulas: Various parameters are required to carry out the production analysis. Following formulae would be helping the sewing section to carry out the production analysis in effective manner.

- SMV = STANDARD MINUTE VALUE
- TARGET / OPERATOR = WORKING TIME / SMV
- OPERATOR EFFICIENCY = OUTPUT / SAM
- LINE EFFICIENCY = NO. OF PCS X SMV / WORKING TIME X NO. OF OPERATOR

Result and Discussion

During the research work following results were obtained to extend out the analysis.

From the above Tables 1 and 2, it is clearly proven that, Average Minute taken to complete the operation is more on the operations like side seam attachment, Binding attachment of front and back, shoulder attachment, bottom Hemming, label heat setting, secure track attachment. The average minute value is more compared to the SMV results in a reduction in production and reduction in actual production per time of daylight. During the analysis, it is observed that, the line was 100% balanced and the cable is capable producing the required score. But it is getting varied due the machine maintenance, labour absenteeism and lacuna in the communications. This is also clearly observed from the Figure 5 operation bulletin which is inserted here for reference.

The Figure 6 Yamazumi chart also here to symbolize the act of non-value added, required non-value added and value added operations details. Farther, it likewise helps to measure the actual time taken to meet in each performance, where it is getting delayed, and which operation needs more time to finish. This could clearly understand from Table 3 Potential Study Report, which shows the few samples of operator and their efficiency. The planned process sequence, types of machines, no. of operations combined to to get appropriate production with higher efficiency. Example the Labor Aaravali and Kuttiyammal is showing the highest efficiency, it is due to the machine which assists to achieve higher efficiency percentage. Since the elastic attachment is automatic operation, which result in a higher percentage of efficiency. The Table 4 Hourly Monitoring Sheet would give the detailed module output of shift A and B, which helps to develop the Down time report, science report, rejection percentage, machine problem etc.

From the Figure 7 and Table 5 would facilitate the readers to see the skill of the project based on the performance. Farther, the Table 6 shows the minimum and the maximum skill, efficiency of the combined operations and flow sequence. Which would assist the supervisor to allocate the appropriate project for each procedure and assists to improve the output pace. Farther, this research would aid the system hold the skill record of the each operator, who can perform each operation at highest rating and lowest rating. This matrix also helps the line supervisor the balance the line by every moment. In continuation with the skill matrix and spider web diagram, the Table 7 and Figure 8 reports the down time facts of the subject area to understand, which area of the equipment and labour is failing to get the required SMV. Likewise from the Table 8 process capacity of the industry based on the

Style I		Side seam attachment – 1	Side seam attachment – 2	Binding attachment back & Front neck	Binding attachment front neck	Binding attachment arm hole	Shoulder attachment	Bottom hemming	Label heat setting	Secure tack
DAY 1 SHIFT A	SMV	0.69	0.69	0.54		0.58	0.32	0.48	0.20	0.38
	A min	0.80	0.60	0.40		0.40	0.50	1.00	0.50	0.50
	APH	72.00	97.30	150.00		138.50	116.10	63.20	112.50	120.00
	Target		86.96	111.11		103.45	187.50	125.00	300.00	157.89
DAY 1 SHIFT B	SMV		0.69		0.54	0.58	0.32	0.48	0.20	0.38
	A min	0.78		0.88	0.38	0.53	0.50	0.68	0.53	0.43
	APH	76.60		67.92	156.52	112.50	120.00	87.80	112.50	138.46
	Target			86.96	111.11	103.45	187.50	125.00	300.00	157.89
DAY 2 SHIFT A	SMV		0.69		0.54	0.58	0.32	0.48	0.20	0.38
	A min	0.88	0.62		0.53	0.62	0.57	0.95	0.68	0.55
	APH	67.92	97.30		112.50	97.30	105.88	63.16	87.80	109.09
	Target	86.96			111.11	103.45	187.50	125.00	300.00	157.89
DAY 2 SHIFT B	SMV		0.69		0.54	0.58	0.32	0.48	0.20	0.38
	A min	0.65	0.60		0.53	0.50	0.53	0.73	0.48	0.87
	APH	92.31	100.00		112.50	120.00	112.50	81.82	124.14	69.23
	Target		86.95		111.11	103.45	187.50	125.00	300.00	157.89
DAY 3 SHIFT A	SMV		0.69		0.54	0.58	0.32	0.48	0.20	0.38
	A min	0.82	0.68		0.55	0.58	0.73	1.05	1.12	0.62
	APH	73.47	87.80		109.09	102.86	81.82	57.14	53.73	97.30
	Target	86.96			111.11	103.45	187.50	125.00	300.00	157.89
DAY 3 SHIFT B	SMV		0.69		0.54	0.58	0.32	0.48	0.20	0.38
	A min	0.92	0.97		1.15	0.73	1.48	1.52	1.33	0.73
	APH	65.45	62.07		52.17	81.82	40.45	39.56	45.00	81.82
	Target	86.96			111.11	103.45	187.50	125.00	300.00	157.89
DAY 4 SHIFT A	SMV		0.69		0.54	0.58	0.32	0.48	0.20	0.38
	A min	0.55	0.55		0.43	0.58	0.78	0.83	0.43	0.53
	APH	109.09	109.09		138.46	102.86	76.60	72.00	138.46	112.50
	Target	86.96			111.11	103.45	187.50	125.00	300.00	157.89
DAY 4 SHIFT B	SMV		0.69		0.54	0.58	0.32	0.48	0.20	0.38
	A min	0.75	0.77		0.75	1.03	1.07	1.00	0.57	0.83
	APH	80.00	78.26		80.00	58.06	56.25	60.00	105.88	72.00
	Target	86.96			111.11	103.45	187.50	125.00	300.00	157.89

Note: A min: Average Minutes; APH: Actual Production/Hour

Table 1: Time Study report-style I-Park avenue.

STYLE II		Attach fly binding	Tack fly	Attach leg binding	Leg attaching	Close inseam	Attach elastic at waist	Secure inseam & back elastic	Close waistband	Heat seal (woven & size)
DAY 1 SHIFT A	SMV	0.20	0.28	0.38	0.48	0.25	0.30	0.38	0.36	0.45
	A min	0.38	0.43	0.45	0.55	0.35	0.92	0.65	0.83	1.58
	APH	156.52	138.46	133.33	109.09	171.43	65.45	92.31	72.00	37.89
	Target	300.00	214.29	157.89	125.00	240.00	200.00	157.89	166.67	133.33
DAY 1 SHIFT B	SMV	0.20	0.28	0.38	0.48	0.25	0.30	0.38	0.36	0.45
	A min	0.38	0.43	0.45	0.55	0.35	0.92	0.65	0.83	1.58
	APH	156.52	138.46	133.33	109.09	171.43	65.45	92.31	72.00	37.89
	Target	300.00	214.29	157.89	125.00	240.00	200.00	157.89	166.67	133.33
DAY 2 SHIFT A	SMV	0.20	0.28	0.38	0.48	0.25	0.30	0.38	0.36	0.45
	A min	0.38	0.43	0.37	0.28	0.22	0.42	0.47	0.42	1.32
	APH	156.52	138.46	163.64	211.76	276.92	144.00	128.57	144.00	45.57
	Target	300.00	214.29	157.89	125.00	240.00	200.00	157.89	166.67	133.33
DAY 2 SHIFT B	SMV	0.20	0.28	0.38	0.48	0.25	0.30	0.38	0.36	0.45
	A min	0.42	0.48	0.72	0.85	0.40	0.50	0.83	0.57	0.88
	APH	144.00	124.14	83.72	70.59	150.00	120.00	72.00	105.88	67.92
	Target	300.00	214.29	157.89	125.00	240.00	200.00	157.89	166.67	133.33
DAY 3 SHIFT A	SMV	0.20	0.28	0.38	0.48	0.25	0.30	0.38	0.36	0.45
	A min	0.35	0.55	0.43	0.82	0.37	0.52	0.93	0.62	1.03
	APH	171.43	109.09	138.46	73.47	163.64	116.13	64.29	97.30	58.06
	Target	300.00	214.29	157.89	125.00	240.00	200.00	157.89	166.67	133.33
DAY 3 SHIFT B	SMV	0.20	0.28	0.38	0.48	0.25	0.30	0.38	0.36	0.45
	A min	0.27	0.48	0.68	0.90	0.38	0.75	0.68	0.67	0.88
	APH	225.00	124.14	87.80	66.67	156.52	80.00	87.80	90.00	67.92
	Target	300.00	214.29	157.89	125.00	240.00	200.00	157.89	166.67	133.33
DAY 4 SHIFT A	SMV	0.20	0.28	0.38	0.48	0.25	0.30	0.38	0.36	0.45
	A min	0.47	0.32	0.48	0.78	0.67	0.55	0.50	0.85	0.70
	APH	128.57	189.47	124.14	76.60	90.00	109.09	120.00	70.59	85.71
	Target	300.00	214.29	157.89	125.00	240.00	200.00	157.89	166.67	133.33
DAY 4 SHIFT B	SMV	0.20	0.28	0.38	0.48	0.25	0.30	0.38	0.36	0.45
	A min	0.32	0.42	0.80	1.23	0.27	0.57	0.83	0.43	1.27
	APH	189.47	144.00	75.00	48.65	225.00	105.88	72.00	138.46	47.37
	Target	300.00	214.29	157.89	125.00	240.00	200.00	157.89	166.67	133.33

Table 2: Time Study Report-Style II.

PRODUCT DEVLOPMENT INDUSTRIAL ENGINEERING

OPERATION BREAKDOWN / SECTIONAL BALANCE — DATE :

	STYLE NO	PA01				REV :		
	PRO TYP		BALANCING EFFICIENC		100%	NO OF OPERATORS	9	
	DEFINIT ION	VEST	CAPACITY PCS / DAY @		1270	AVALIABLE MINUTES	450	
	FILE NO	PARK AVENUE				LINE TARGET / DAY @	1270	
	REMARK	ORKED WITH SAMPL	CAPACITY PCS / HOUR		169.28	LINE TARGET/HOUR @	169.28	
OPER NO	OPERATION DESCRIPTION	SMV	SOURCE	TGT / HOUR	ED MANNIN	MACHINE TYPE	ATTACHMENTS	
1	LABEL ATT @ HEAT SEAL	0.2		300	0.56	HEAT SEAL		
2	BINDING ATT @ BACK NECK	0.2		300	0.56	FL BN		
3	BINDING ATT @ FRT NECK	0.34		176	0.96	FL BN		
4	ATT SIDE SEAM	0.69		87	1.95	4 TOL		
5	BINDING ATT @ ARMHOLE	0.58		103	1.64	FL BN		
6	ATT SHOULDER	0.32		188	0.90	4 TOL		
7	SECURE TACK @ SHOULDERS (4)	0.38		158	1.07	SNLS		
8	HEM BOTTOM	0.48		125	1.35	FL LHK		
9								
10								
11								
25					9.00			
TOTAL STANDARD MNIUTE VALU		3.19		PITCH TIME (IN MIN)	0.354			
TOAL STANDARD ALLOWED HOU		0.0532						

Figure 5: Operation bulletin.

Figure 6: Yamazumi chart.

Sl. No.	Operator	Style	Ae #7352	Seconds	No	28 A	Efficiency %
		SMV	3.96		Actual Time	Capacity Per Hr	
		Operation	Smv		Time	Hrs (Pcs)	
1	V. Valli	Serge Guesset	0.1	6	8.4	429	71%
2	V. Valli	Att Frt,Bk & Guesset	0.2	12	25.1	144	48%
3	S. Aaravalli	Att Size Lbl @ Bk & Tack Guesset @ Frt	0.32	19.2	31.6	114	61%
4	S. Sumathi	Att Elastic @ Leg	0.55	33	22.9	157	144%
5	R. Sasikala	Join Right Side Seam	0.12	7.2	19.3	186	37%
6	R. Sivagangai	Att Elastic @ Waist	0.4	24	22.2	162	108%
7	R. Sasikala	Close Side Seam	0.12	7.2	30.5	118	24%
8	D. Kuttiyammal	Secure @ Leg & Waist	0.4	24	45.8	79	52%
9	S. Revathi	Att Twill Tape	0.45	27	31.9	113	85%
10	K. Rekha	Tack Twill Tape & Trim	0.66	39.6	44.3	81	89%
11	M. Devi	Att Main Label	0.2	12	22.7	159	53%
12	M. Devi	Att Button	0.2	12	16.3	220	73%

Table 3: Potential study report.

mental process required to complete the selected set. Which also helps to understand the bottlenecks of the performance based on the time required to complete the procedure.

Highest percentage also mentioned for easier and more honest understanding. The above said variation are observed due to the following reasons, Like vise, Working Skills should be improved (mechanic), Maintenance should be done weekly once (2-3), Preventive maintenance should be conducted under careful, Worker should have the basic knowledge about the auto mechanism. During the research following reworks were found and it was finally make the author to conclude that the large percentage decrease in production rate and sewing operation is getting cut due to make over.

During the rework analysis, basic knowledge about the operations (workers), the raw material inspection should be studied under care. Similarly, Utilization of the modules. Preparation was done according to the accomplishment of the worker, setting of style in sequence of modules, when style change is done, planning was properly incorporated, and Housekeeping was improved. Time field and

Day	Shift	Target	Module 1 Output								
			1	2	3	4	5	6	7	8	Total
1	A	750	20/100	30/100	30/100	70/100	25/50	45/100	60/100	20/100	300
2	A	750	15/100	26/100	32/100	55/100	28/50	40/100	54/100	18/100	268
3	A	750	20/100	32/100	34/100	49/100	25/50	47/100	61/100	25/100	293
4	A	750	25/100	40/100	45/100	40/100	20/50	53/100	65/100	33/100	321
5	A	750	15/100	38/100	46/100	56/100	23/50	63/100	80/100	29/100	350
6	A	750	24/100	32/100	42/100	58/100	15/50	55/100	65/100	25/100	316
											1848
1	B	750	25/100	35/100	40/100	30/100	20/50	35/100	50/100	19/100	254
2	B	750	20/100	35/100	45/100	25/100	15/50	45/100	60/100	16/100	261
3	B	750	0	0	0	0	0	0	0	0	0
4	B	750	18/100	30/100	30/100	35/100	22/50	48/100	55/100	20/100	258
5	B	750	28/100	40/100	52/100	59/100	24/50	43/100	60/100	20/100	326
6	B	750	25/100	45/100	60/100	66/100	20/50	54/100	85/100	25/100	380
											1479
Down time											
Input delay											
Machine problem											
Quality problem											
Rejection											
Rework											

Table 4: Hourly monitoring sheet.

OP#	NAME	Emp. No	1 Fly Binding	2 Tack Fly	3 Leg Binding	4 Leg Att.	5 Close Inseam	6 Attach Elastic	7 Tack Elastic	8 Close Waist Band	9 Secure Inseam Ends Bt	10 Heat Seal Waist Label	11 Examine	12 Packing	Total Operation
			0.32	0.23	0.36	0.94	0.40	0.33	0.17	0.40	0.18	0.35	0.30	0.45	
1	N. NIRMALA	00306	0.32	0.30	0.70	1.69			0.31			0.46			7
			100%	77%	51%	56%			55%			76%			59%
2	R. SUGANYA	00333	0.57		0.43	0.74			0.31						5
			56%		84%	126%			55%						64%
3	R. NANDHINI	00346	0.52			0.74	0.79		0.32			0.42			6
			62%			126%	51%		53%			83%			63%
4	A. GOWTHAMI	00316				0.88	0.35		0.29			0.47			5
						107%	115%		58%			74%			71%
5	M. BRINDHA	00330	0.44			0.62	0.46	0.57	0.30			0.50			7
			73%			152%	87%	58%	58%			70%			71%
6	S. ELAVARASI	00315	0.52					0.40	0.23						4
			61%					83%	75%						55%
7	S. SEMBARATHI	00328	0.54					0.47	0.30	0.34		0.48			6
			59%					71%	58%	118%		73%			63%
8	S. LAKSHMI	00297							0.29			0.35		0.35	3
									59%			100%		130%	96%
9	SUNDARI	00352	0.47						0.28	0.62		0.51		0.71	5
			67%						60%	65%		68%		63%	65%
Total skill set available			7	1	2	5	3	3	9	2	0	7	0	2	
Min Eff in %			56%	77%	51%	56%	51%	58%	53%	65%	0%	68%	0%	63%	55%
Max Eff in %			100%	77%	84%	152%	115%	83%	75%	118%	0%	100%	0%	130%	96%

Table 5: Skill matrix/Spider diagram.

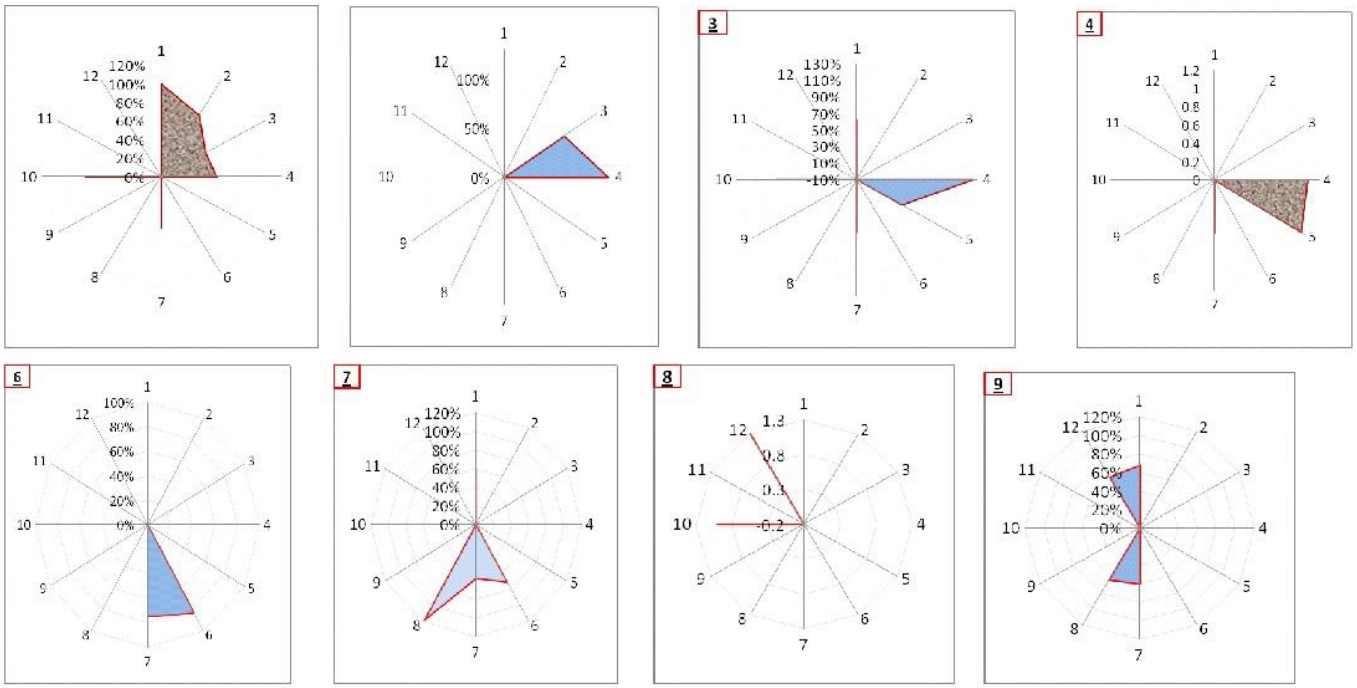

Figure 7: Spider diagram.

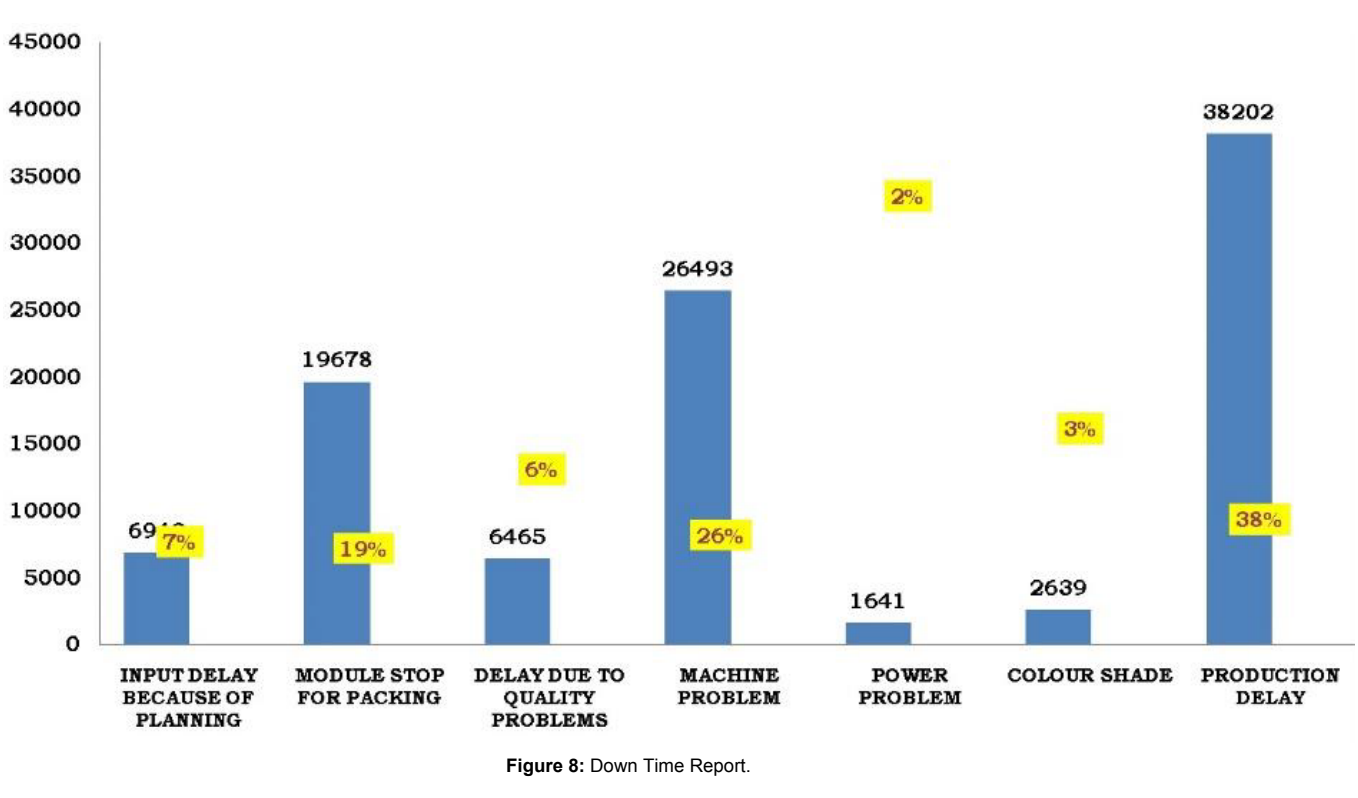

Figure 8: Down Time Report.

OPERATION/MINUTES EARNED DETAILS							WORKING TIME/SEWING EFFICIENCY DETAILS					
S.No	Emp Name	Emp No. / Batch	Operation	Smv	No Of Gmts Sewn	Minutes Earned	From	To	Time In Minutes	Down Time In Mins	Net Working Time	Sewing Eff %
1	SUGANYA	1592	Fly Binding & Serge Inner Front	0.24	25	6.0	11:09	11:28	19	0	19	31.6%
2	SUMATHI	1506	Sew Dart & Join Centre Front Panel	0.34	25	8.5	11:10	11:32	23	0	23	37.0%
3	SATHYA	1578	Tack Inner& Outer Panel	0.15	25	3.8	11:11	11:33	22	2	20	18.8%
4	GOMATHI	1570	Att. Sides To Panel	0.4	25	10.0	11:12	11:57	45	0	45	22.2%
5	VALARMATHI	1563	Top Stitch,	0.48	25	12.0	11:14	12:01	47	0	47	25.5%
6	RENUKA	1559	Back Rise Attach, Join Front Back @ Crotch	0.2	25	5.0	11:16	12:02	46	14	32	15.6%
7	ANJALI	1616	Hem Leg Open	0.55	12	6.6	11:18	12:02	44	17	27	24.4%
8	SRIDEVI	1561	Hem Leg Open	0.55	13	7.2	11:20	12:04	44	5	39	18.3%
9	TILAGAVATHY	1565	Att. Elastic To Waist	0.39	25	9.8	11:20	12:06	46	8	38	25.7%
10	SARASWATHI	1579	Tack Elastic & Tack Ends	0.36	25	9.0	11:22	12:08	46	8	38	23.7%
11	INDRA	1522	Att. Label	0.33								
12	SANGEETHA	1552	Checking	0.3								
13			Packing	0.3								
TOTAL / AVERAGE				4.04		77.8			590	54	536	14.5%

Table 6: Training Evaluation Report.

Day	Target Pcs	Achieved Pcs	Variance	Input Delay Because of Planning	Module Stop For Packing	Delay Due To Quality Problems	Machine Problem	Power Problem	Colour Shade	Production Delay
1	30050	10336	-19714		2545	694	6900	550		9025
2	30150	20215	-9935		1808	675	1056		2250	4146
3	31650	21001	-10649	288	1640	1428	4194			3099
4	28225	18820	-9405	1580	2925	860	1684	186		2170
5	29000	22982	-6018	698	1838		1872			1610
6	29625	28401	-1224	115	400		429		280	
8	30876	26096	-4780		338	60	1004			3378
9	30700	25232	-5468		300		380		30	4758
10	32275	22783	-9492	566	2880	1579	2078	560		2829
11	30000	12432	-17568	3456	4263	649	5435	345	79	3341
12	31100	24292	-6808	240	741	520	1461			3846
TOTAL	**333651**	**232590**	**-101061**	**6943**	**19678**	**6465**	**26493**	**1641**	**2639**	**38202**

Table 7: Down time report.

	Style: Park Avenue=SMV: 3.19									
Sl. No	Operation	SMV	Time taken in seconds					Average in seconds	Average in minutes	Actual production/hrs
			1	2	3	4	5			
1	Side seam attachment - 1		48	47	49	50	56	50	0.83333333	72
2	Side seam attachment - 2	0.69	54	35	25	26	45	37	0.61666667	97.2972973
3	Binding attachment back neck									
4	Binding attachment front neck	0.54	22	24	23	23	27	24	0.4	150
5	Binding attachment arm hole	0.58	22	26	27	24	28	26	0.43333333	138.4615385
6	Shoulder attachment	0.32	37	29	27	25	38	31	0.51666667	116.1290323
7	Bottom hemming	0.48	59	57	63	51	53	57	0.95	63.15789474
8	Label heat setting	0.2	41	29	26	28	35	32	0.53333333	112.5
9	Secure tack	0.38	33	33	28	26	30	30	0.5	120

Table 8: Capacity calculation sheet.

implementation were carried out once in two days by TTL, the Module checker operation was led under care, Good relationship with IE, TTL, TGL, Industrial Engineering (IE)-Team Training Leader (TTL), Training Group Leader (TGL)-Team Training Leader (TTL), Team Training Leader (TTL)-worker. IE might have the basic knowledge about the style, Accessories utilization should be studied under care, In the last one hour all the proletarians are being assembled in packing (lag in performance), Coordination between shift A and shift B, Proper communication between shift A and shift B TTL should be done. For that a note was provided, Team meeting was led under care by IE, TTL, and TGL.

Conclusions

The following conclusions can be drawn from the present research, Referable to the absenteeism the module is balanced properly, thereby going to bottle neck process. The production delay and rework is due to inefficiency of the labour, lack of training, lack of understanding of machine mechanism. High skilled labours (Jumpers) are not used effectively. Lack of preparation, during style changed leads to more stoppages of modules. In addition to that, Lack of planning in the cutting department leads to stoppages of modules due to the lack of supply of raw materials for each sections. Absenting behaviours of

the Labours are more, hence, there is a loss in production. Standing operation is not user-friendly for the unskilled labours. Ergonomics is affecting the wellness of the output.

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