Journal of Entrepreneurship & Organization Management

Sayid Mia and Swarna, J Entrepren Organiz Manag 2018, 7:2
DOI: 10.4172/2169-026X.1000234

Research Article Open Access

Productivity Improvement of Leather Products Industry in Bangladesh Using Lean Tools: A Case Study

Sayid Mia MA* and Swarna NA

Department of Leather Products Engineering, Institute of Leather Engineering and Technology, University of Dhaka, Dhaka, Bangladesh

Abstract

There is great potential for the leather industry in Bangladesh to become one of the country's major foreign exchange earners, experts say. After readymade garments (RMG), Productivity improvement can help to enrich profit of a leather products industry by minimizing excess work and developing a new method for particular operation. Now a day, productivity improvement is a popular topic for any kinds of industry. Therefore, improving productivity is one of the main concerns of leather products industries. Lean manufacturing tools are most important tools that can help to increase productivity in leather products industry. In Bangladesh, few industries use these lean tools which can be proved as a real beneficial one. Hence, this study addresses the implementation of lean principles in a leather goods manufacturing industry in order to evaluate present process cycle efficiency (PCE), lead time and productivity prior to developing an improved strategy to bring the improved PCE, productivity and to reduce the lead time. By applying lean tools in the industry at the production line for bi-fold wallet, productivity has been improved by 85.42%. At the beginning state, the PCE was found 38.19% and after the implementation of lean tools, it would be 77.51% and lead time would also be reduced by 46.68% evaluated by takt time, bottleneck analysis, cause-effect analysis and Pareto analysis. The production flow was optimized by minimizing several non-value-added (NVD) activities such as bottlenecking, machine breakdown, queue time, waiting time, material handling time, etc.

Keywords: Productivity; Lean tools; PCE; Lead time; Pareto chart; Wallet production line

Abbreviations: DT: Down Time; CT: Cycle Time; UT: Up Time; VD: Value Added Time; NVD: Non Value Added Time; LT: Lead Time

Introduction

The leather sector is playing a vital role in our national economy, earning us huge amounts of export earnings. Most leather goods and footwear manufactured here are export-oriented. According to the Export Promotion Bureau (EPB), leather exports totaled USD 116.73 million in the last fiscal year 2016-2017; the amount was USD 92.50 million the previous year [1]. In the World, it is one of the leading manufacturing industries based on raw material, geographical condition, and workforce and is highly favorable for the growth of leather products industry. The demand for processed leather products is rapidly increasing in the busy World and consequently, it seems a rapid expansion of leather products industry in Bangladesh as like as other countries. It needs several production steps to produce the finished goods from raw materials. Today Higher Productivity achievement is a very important factor for the production field. With the Higher productivity, other various factors must be taken into consideration in manufacturing industries such as global competition, lead time and customer need in terms of quality and quantity [2,3]. Lean manufacturing is based on the Toyota Production System developed by Toyota which focuses on eliminating waste, reducing inventory, improving throughput, and encouraging employees to bring attention to problems and suggest improvements to fix those [4]. 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 [5,6]. 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 [7,8]. To sustain the positive growth, it is necessary to ensure the proper utilization of resources. Financial growth of any industry largely depends on minimizing excess work and productivity improvement. This study was masterful with some specific objectives which were to identify, quantify and to reduce the non-value added (NVD) activities and time towards the exalted Process Cycle Efficiency (PCE) and therefore to reduce the lead time.

Methodology

The primary data was collected from personal observations of researchers of bi-fold wallet production lines at different production stages from a leading export-oriented leather products industry in Bangladesh. The secondary data was taken through the internet, books, journals, related studies and other sources of information. The methodology of carrying out this project work is divided into the following steps. In each of the steps, lean tools have been used which have been discussed in each section further.

Process mapping → Take time calculating Lead → time counting → Bottleneck analysis

Cause-effect analysis → Introducing time reducing technique → Results

Existing Process Mapping

A process map is a planning and management tool that visually

***Corresponding author:** Sayid Mia MA, Department of Leather Products Engineering, Institute of Leather Engineering and Technology, University of Dhaka, Dhaka-1209, Bangladesh, Tel: +8801674772545; E-mail: emsayid@gmail.com

Recieved March 26, 2018; **Accepted** May 16, 2018; **Published** May 24, 2018

Citation: Sayid Mia MA, Swarna NA (2018) Productivity Improvement of Leather Products Industry in Bangladesh Using Lean Tools: A Case Study. J Entrepren Organiz Manag 7: 234. doi: 10.4172/2169-026X.1000234

describes the flow of work. Process maps show a series of events that produce an end result. It shows who and what is involved in a process and can be used in any business or organization and can reveal areas where a process should be improved (Figure 1 and 2).

Takt Time Analysis

Takt-time is the unit of time in which a product must be produced (supply rate) in order to match the rate at which that product is needed (demand rate) [9]. It is calculated by dividing the total available time per day by the daily customer demand.

Takt time=Available work time/ Customers demand

Available production time=(7 hours 45 minutes) × 8

=465 × 8) minutes

=3720 minutes.

Customer's demand is 50 pcs of Double wallet.

Takt Time Formula=3720/50= 74.4 minutes/wallet.

In this research, after receiving order, the production process

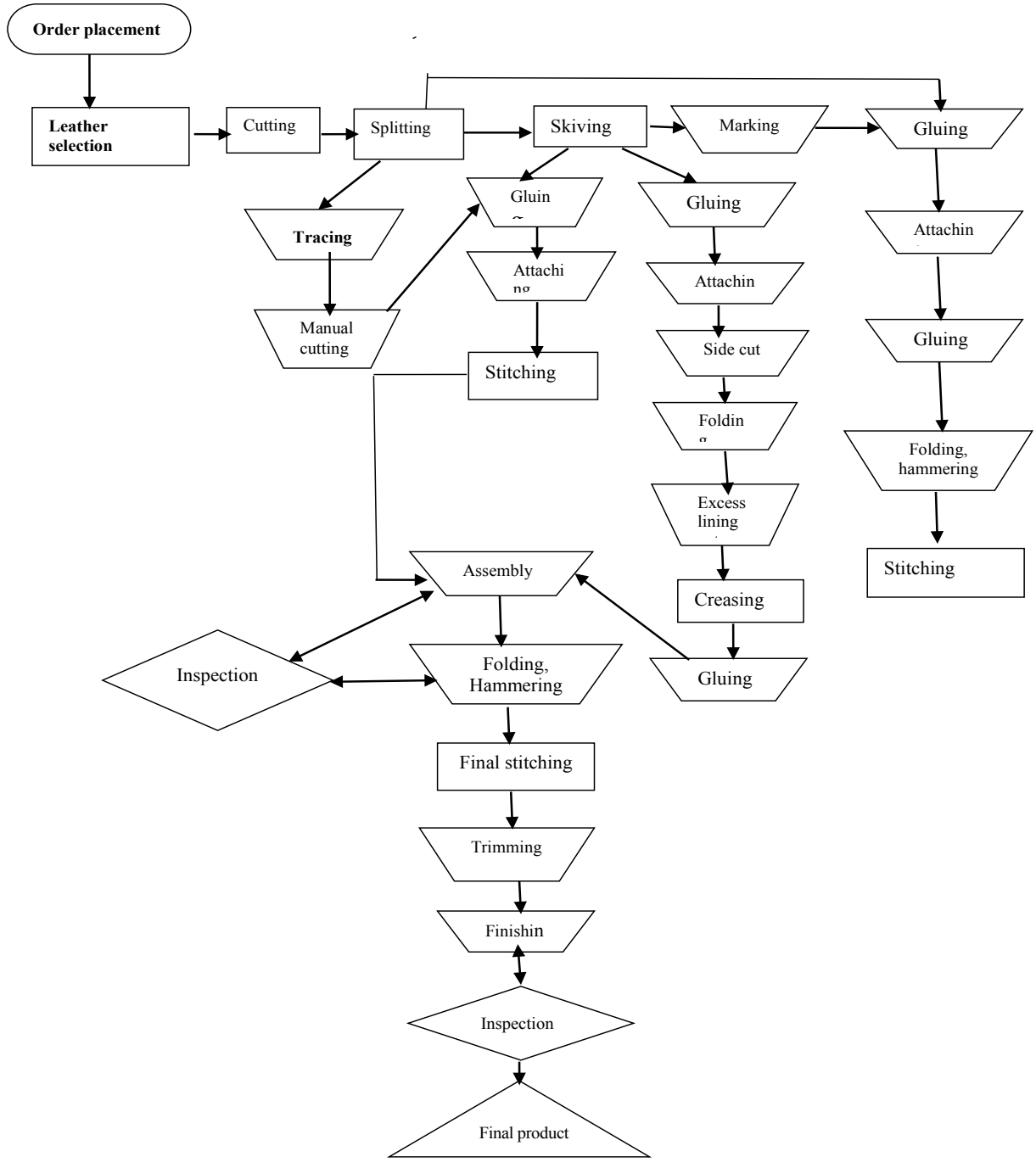

Figure 1: Existing process mapping.

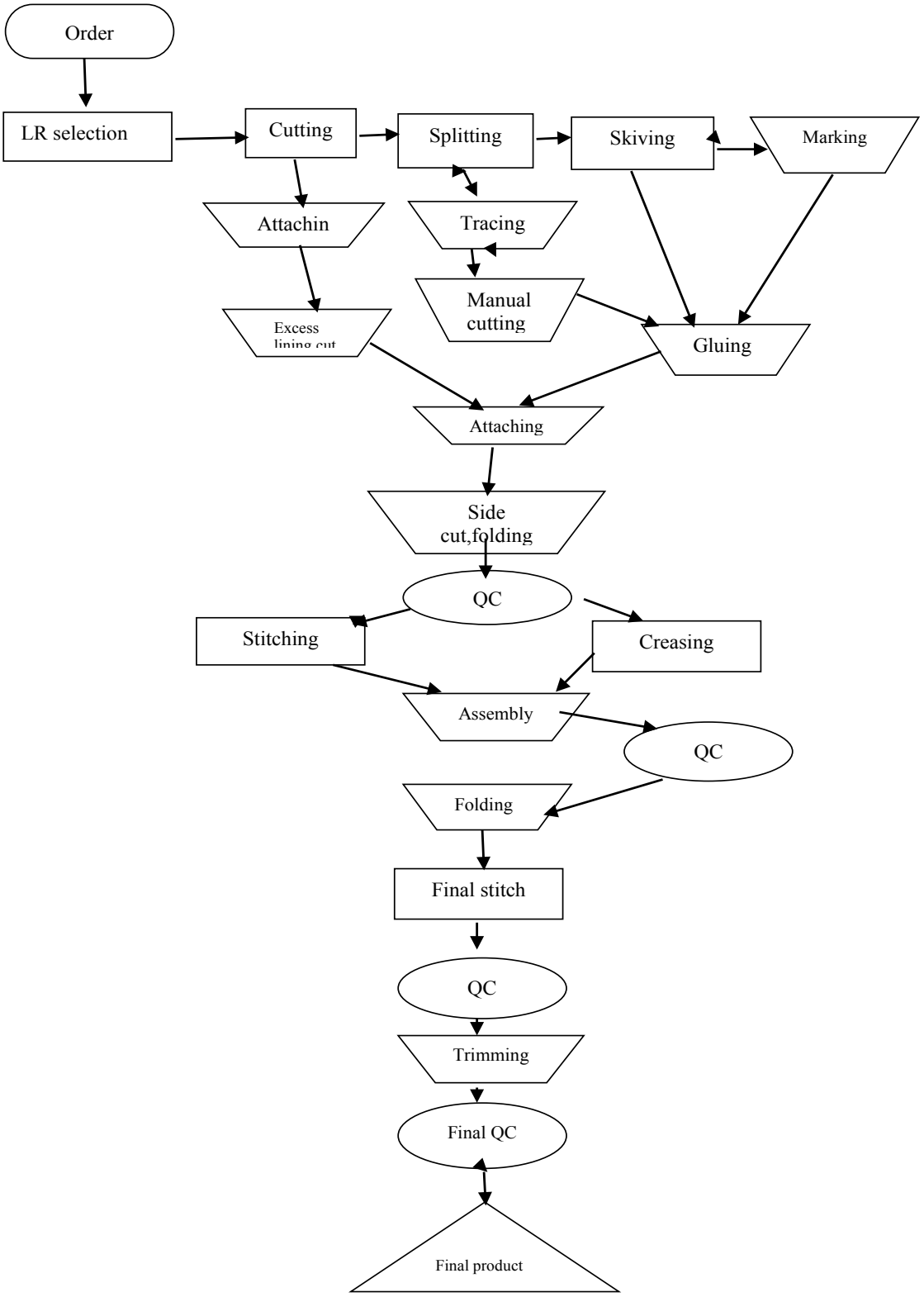

Figure 2: Proposed process mapping.

started and the final product (Double wallet) was delivered to the customer. The factory had 8 days to deliver 50 pcs of wallet, of which 1 day was off-day. The factory has a 9-hour workday for its workers and staffs, of which 01 hour is allocated lunch break, 15 minutes is wasted in the startup process in the morning.

Data Analysis

With the help of table the Data analysis of Existing Cycle time analysis of bio-fold wallet production line has been explained here (Table 1).

No	Operation name	Average cycle time(sec)	No. of workers	Waiting time in seconds	Total waiting time	Process gap time (sec)	No. of pcs of work	Total time (sec)
1	Cutting leather, lining, net	6	4				1800	10800
2	Splitting leather	4	1				750	2823
3	Skiving	12	1			86400	250	3000
3	Marking outer top	50	1				50	2500
4	Foam attaching on lining	56	2				50	2800
5	Excess lining cutting	20	1	16	800		50	1000
6	Gluing outer top	25	1	25	1250		50	1250
7	Lining with foam attaching on outer top	9	1	19	950		50	450
8	Adhesive applying on top side	10	1	18	900		50	500
9	Folding, hammering	45	1				50	2250
10	Stitching	10	1			293	50	500
11	Gluing center piece	20	1			293	100	2000
12	Center piece attaching on lining	18	1	2	200		100	1800
13	Stitching	10	1	40	4000		100	1000
14	Gluing on step pocket	10	1			293	360	3600
15	Lining attaching	6	1	4	1440		360	2160
16	Top side folding, hammering	40	2				360	7200
17	Gluing on stamp pocket	12	1	16	2400		150	1800
18	Lining attaching	6	1	22	3300		150	900
19	Side cut for folding	5	1	23	3450		150	750
20	Folding, hammering excess lining cutting	45	1				150	6750
21	Inspection	10	1	35	5250		150	1500
22	Creasing	20	1			3750	150	3000
23	Window pocket tracing	18	1				50	900
24	Manual cutting	88	1				50	4400
25	Gluing on window pocket	15	1	73	3650		50	750
26	Net attaching on window pocket	10	1	78	3900		50	500
27	Side cut for folding	5	1	85	4250		50	250
28	Top side folding, hammering	23	1	67	3350		50	1150
29	Inspection	18	1	72	3600		50	900
30	Creasing	20	1			350	50	1000
31	Gluing on both sides of step pocket	5	1				360	1800
32	Assembling 3 step pockets	25	1				120	3000
33	Stamp pocket placing	12	1	17	850		120	1440
34	Excess lining cutting	20	1	11	550		50	1000
35	Stitching	10	1			4050	50	500
36	Assembling 2 step pockets	15	1				50	750
37	Window pocket placing	20	1				50	1000
38	Excess lining cutting	22	1				50	1100
39	Stitching	5	1			2850	50	250
40	1step pocket,1 cut pocket attaching	40	2			405	100	4000
41	Joining window and 1 cut pocket by stitching	10	1	17	850		50	500
42	Assembling asther-1	50	1			285	50	2500
43	Assembling asther-2	50	1			300	50	2500
44	Joining by stitching	10	1			2350	50	500
45	Attaching asther on outer top	55	1				50	2750
46	Gluing three sides of outer	20	1	35	1750		50	1000
47	Folding, hammering	62	1				50	3100
48	Final stitching	12	1	50	2500		50	600
49	Trimming, thread cutting	25	1	37	1850		50	1250
50	Final checking	50	1	12	600		50	2500
51	Packaging	30	1	32	1600		50	1500
	Total	1244			53240	101619		102373

Table 1: Existing cycle time analysis of bio-fold wallet production line.

Present process cycle efficiency

PCE is measured as the percentage of ration of VD time and lead time, where lead time is the summation of VD and NVD time [10]. PCE is a measure of the relative efficiency in a process - it represents the percentage of value add time (changing form, fit, function) of a product down the critical path.

Value added time = 102373 seconds=28.44 hrs

Non-value-added time =Set-up time+Total waiting time+Total process gap time

=(10800+53240+101619) seconds=165659 seconds=46.02 hrs

Lead time = Value added time+Non-value-added time

=(102373+165659) seconds=268032 seconds=74.45 hrs

No. of worker =14

Productivity =0.048

PCE =(Customer Value Added Time ÷ Process Lead Time) ×100%

=(102373 ÷ 268032) ×100%=38.19%.

Bottleneck analysis

By definition, a bottleneck is a phenomenon where the competency of a complete system or line is restricted or limited by a single or limited number of components or resources and analysis of such event is called as Bottleneck analysis. Hence, Bottleneck analysis is nothing but the identification which part/machine of the manufacturing process/line limits the overall output and focuses on improvement the performance of that part/machine of the process/line [11]. Bottleneck analysis is usually done along with the Time Study Method. From the process map and cycle time analysis table, we can calculate the time required in each path.

Path-1: Splitting-Skiving-Making-Gluing-Attaching-Gluing-Folding-Stitching=297 seconds

Path-2: Splitting-Gluing-Attaching-Stitching =106 seconds

Path-3: Splitting-Skiving-Gluing-Attaching-Side Cut-Folding-Excess lining cut-Creasing =270 seconds

Path-4: Splitting-Skiving-Gluing-Attaching-Side Cut-Folding-Excess lining cut-Creasing =270 seconds

Path-5: Splitting-Tracing-Manual Cutting-Gluing-Attaching-Side Cut-Folding-Creasing =576 seconds

Path-6: Creasing-Gluing-Assembly-Folding-Final Stitch-Trimming-Finishing-Inspection-Final product= 736 seconds

Here, Path-6 takes the longest period of time to complete one cycle. So, the Bottleneck is Path-6.

Cause-effect analysis

As the Ishikawa diagram is prior to any data analysis, every possible cause is taken into consideration. Although it was originally developed as a quality control tool, can be used just as well in other ways. For instance, can be used to-Discover the root cause of a problem, Uncover bottlenecks in your processes, Identify where and why a process isn't working etc.

Since we found that lead time is 88.8 minutes/wallet, whereas, take time is 93 minutes/wallet; this is a serious problem that may cause huge delay in delivery. Therefore, we used Fishbone Diagram to find out possible cause behind this which is shown below (Figure 3).

Pareto analysis

It is a statistical technique in decision making that is used for selection of a limited number of tasks that produce significant overall

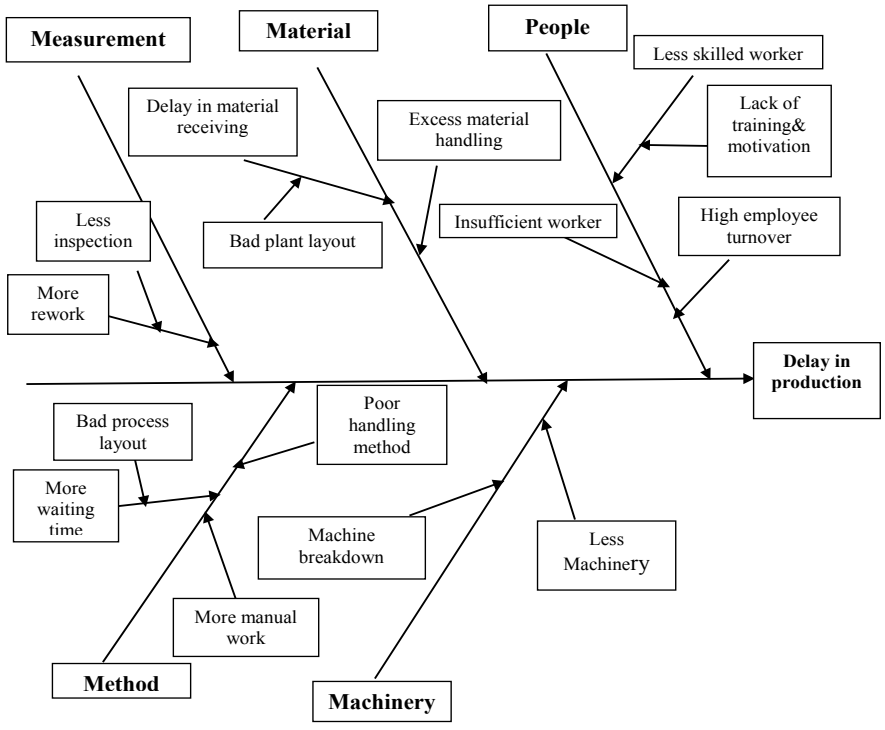

Figure 3: Cause-effect analysis.

effect. It uses the Pareto principle – the idea that by doing 20% of work, 80% of the advantage of doing the entire job can be generated [12]. The Pareto Principle also known as the "80/20 Rule" which is the idea that 20% of causes generate 80% of results [13-15]. In this study, by using this tool it was tried to find out the 20% of causes that is generating 80% NVD activities. This tool focuses on the most damaging causes on a project.

In this essence, the application of the Pareto chart consisting of causes for downtime or NVD activities along the X axis while the Y axis represents the cumulative percentage of downtime. Most of the NVD activities were documented on sewing, pre-lasting, post-lasting and finishing steps where these were frequently observed due to different causes. The highest frequency of NVD activities that derived the down time were found for mainly Needle and threads breakage while the lowest frequency was varied (Figure 4 and Table 2).

No	Operation name	Average cycle time (sec)	No. of workers	Waiting time (sec)	Total waiting time	Process gap time (sec)	No. of pcs of work	Total time (sec)
1	Cutting leather, lining, net	6	4				1800	10800
2	Splitting leather	4	1				750	2823
3	Skiving	12	1				250	3000
4	Marking outer top	50	2				50	2500
5	Foam attaching on lining	56	2				50	2800
6	Excess lining cutting	20	1	16	800		50	1000
7	Gluing on outer top	25	1				50	1250
8	Lining & foam attaching on outer top& gluing on top side	19	1	6	300		50	950
9	Folding, hammering	45	1				50	2250
10	Stitching	10	1			237	50	500
11	Gluing center piece	20	1			237	100	2000
12	Center piece attaching on lining	18	1	2	200		100	1800
13	Stitching	10	1	10	1000		100	1000
14	Gluing on step pocket	10	1			237	360	3600
15	Lining attaching	6	1	4	1440		360	2160
16	Top side folding, hammering	40	1				360	14400
17	Gluing on stamp pocket	12	1			237	150	1800
18	Lining attaching & side cut	11	1				150	1650
19	Folding, hammering excess lining cutting	45	1				150	6750
20	Inspection	10	1	19.36	2905		150	1500
21	Creasing	20	1				150	3000
22	Window pocket tracing	18	1				50	900
23	Manual cutting	88	2				50	4400
24	Gluing on window pocket, net attaching & side cut	30	1	14	700		50	1500
25	Top side folding, hammering & inspection	41	1	3	150		50	2050
26	Creasing	20	1	24	1200		50	1000
27	Gluing on both sides of step pocket& assembling 3 step pockets	40	1				120	4800
28	Stamp pocket placing & excess lining cutting	33	1	7	840		120	3960
29	Stitching	10	1	30	3600		120	1200
30	Assembling 2 step pockets	15	1				50	750
31	Window pocket placing	20	1				50	1000
32	Excess lining cutting	22	1				50	1100
33	Stitching	10	1	12	600		50	500
34	1step pocket,1 cut pocket attaching	40	2				100	4000
35	Joining window and 1 cut pocket by stitching	10	1	17	850		50	500
36	Assembling asther-1	50	1				50	2500
37	Assembling asther-2	50	1				50	2500
38	Joining by stitching	10	1	40	2000		50	500
39	Attaching asther on outer top	55	2				50	1375
40	Gluing three sides of outer	20	1	15	750		50	1000
41	Folding, hammering	62	1				50	3100
42	Final stitching, thread cutting	45	1	17	850		50	600
43	Final checking	50	1	12	600		50	2500
44	Packaging	30	1	32	1600		50	1500
		Total=1218			Total=20385	Total=948		Total=110768

Table 2: Cycle time analysis for proposed way of bio-fold wallet production line.

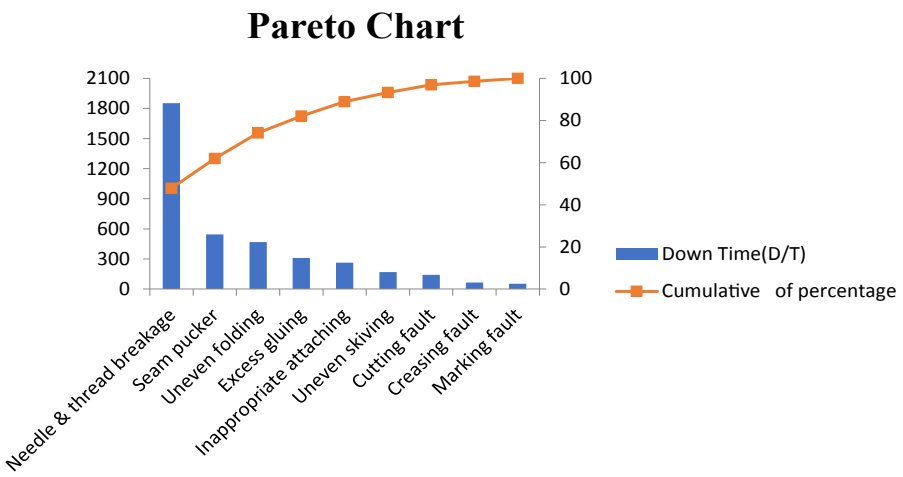

Figure 4: Pareto Chart of Bio-fold wallet production line.

Process cycle efficiency after using lean tools

Value added time = 110768 seconds= 30.8 hrs

Non-value-added time = Set-up time + Total waiting time + Total process gap time

= (10800+20385+948) seconds= 32133 seconds=8.93 hrs

So, Lead time = Value added time + Non-value-added time

=(110768+32133) seconds=142901 seconds=39.69 hrs

No. of worker = 14

Productivity = 0.089

Productivity improvement = (0.089-.048)/0.048 ×100%=85.4%

PCE = (Customer Value Added Time ÷ Process Lead Time) ×100%

= (110768 ÷ 142901) ×100%= 77.51%.

Existing productivity

Value added time = 102373 seconds or, 28.43 hrs

Non-value-added time = 165659 seconds or 46.02 hrs

Lead time = 268032 seconds or 74.45 hrs

Productivity =0 .048

Process cycle efficiency =38.19%

Productivity after using lean tools

Value added time =110768 seconds or 30.77 hrs

Non-value-added time =32133 seconds or 8.92 hrs

Lead time =142901 seconds or 39.69 hrs

Productivity =.089

Process cycle efficiency =77.51 %.

Results

Productivity improvement = (.089-.048)/.048×100%=85.42%

Lead time reduction =(74.45-39.69)/74.45×100%=46.69%

Value added time increased =(30.77-28.43)/28.43×100%=8.23%

Non- value-added time reduction =(46.02-8.93)/46.02×100%=80.59%

PCE improvement =(77.51-38.19)%=39.35%

Conclusion

The leather products industry is one of the key export-earning sectors in Bangladesh. Productivity improvement is a crucial matter in this industry. The profit earning of this industry totally rely on productivity improvement. The implementation of the lean concept in the leather products industry is primarily focused in order to reduce lead time and improve PCE. This model paves the way to ease implementation of lean concepts in leather products industry not only in Bangladesh but around the globe.

References

1. Hossain L, Sarker SK, Khan MS (2017) Evaluation of Present and Future Wastewater Impacts of Leather Industries in Bangladesh. Environmental Development.
2. Sayid Mia MA, Nur-E-Alam M, Ahmad F, Kamal Uddin M (2017) Footwear Industry in Bangladesh: Implementation of Six Sigma Methodology. Ind Eng Manage 6: 211.
3. Sayid Mia MA, Nur-E-Alam M, Lutfor Rahman M, Kamal Uddin M (2017) Footwear Industry in Bangladesh: Reduction of Lead time by using Lean Tools. JECET 6: 251-259.
4. Womack JP, Jones DT, Roos D (1991) The Machine that Changed the World. Harper Collins Publishers.
5. Hobbs DP (2004) Lean Manufacturing Implementation: A Complete Execution Manual for any Size Manufacturer. J Ross Publishing.
6. Sayid Mia MA, Nur-E-Alam M, Kamal Uddin M (2017) Court Shoe Production Line: Improvement of Process Cycle Efficiency by using Lean Tools. Leather and Footwear Journal.
7. Abdullah F, Rajgopal J (2003) Lean Manufacturing in the Process Industry. Proceedings of the IIE Research Conference, pp: 1-6.
8. Sayid Mia MA, Nur-E-Alam M, Ahmad F, Kamal Uddin M (2017) Implementation of Lean Manufacturing Tools in Footwear Industry of Bangladesh. Aspects Min Miner Sci.

9. Frandson A, Berghede K, Tommelein ID (2014) TAKT-Time Planning and the Last Planner. Production, Planning and Control; Proceedings IGLC-22, Oslo, Norway.

10. Zhen Y (2011) Food safety and lean Six Sigma Model. University of Central Missouri.

11. Leporis M, Kralova Z (2010) A simulation Approach to Production Line Bottleneck Analysis. International Conference in Cybernetics and Informatics.

12. Pareto V, Trattato di Sociologia GF (1935) The Mind and Society.

13. Kimber RJ, Grenier RW, Heldt JJ (1997) Quality Management Handbook. Marcel Dekker.

14. Dyche J (2001) The CRM Handbook: A Business Guide to Customer Relationship Management.

15. Arthur LJ (1992) Rapid Evolutionary Development-Requirements, Prototyping and Software Creation. John Wiley and Sons 2: 43-44.