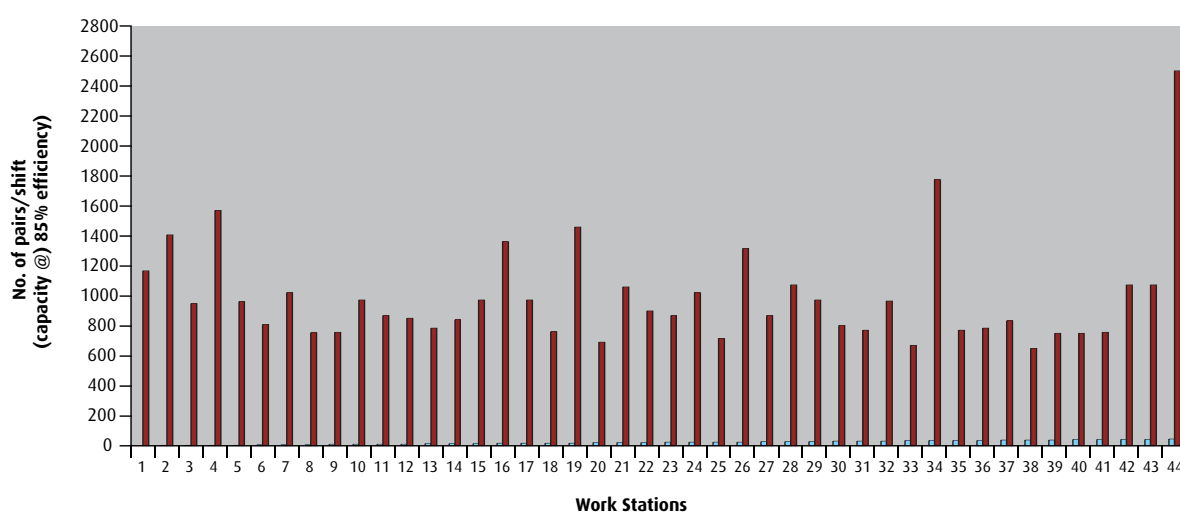


Improving productivity through work-study (part 2)

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Figure 1: Proposed lasting conveyor



In the first part of his study published in the January/February issue of *World Footwear*, Mohammad Siddique measured the performance of a lasting and finishing line. In this second part, he analyses the results he obtained and shows how they can be used to introduce changes and improve productivity.

CRITICAL ANALYSIS (Existing line – Figure 1 Part 1)

- (1) Figure 1 shows double sole cementing (9 & 16). As a TPR sole was being used, one application was sufficient.
- (2) Time between double upper cementing (19 & 21) was only 3.2 minutes, which is not sufficient for PU adhesive to dry. The recommended time difference should be 10-15 minutes. This can be achieved by eliminating operation 16 and rearranging worktables.
- (3) Time between second upper cementing (21) and sole attaching (23) was only 12.8 minutes. It is recommended that it should be at least 25 minutes for PU adhesive.
- (4) It takes only 73.5 minutes up to de-lasting. Total time for one conveyor rotation should be 115.2 minutes but in fact was found to take an average of 150 minutes. In every rotation, 34.8 to 45 minutes was being lost through conveyor stoppages due to poor line balancing.
- (5) Machine idle time was also occurring when the insole plate

on the forepart lasting machine did not rise fully, causing the operator to stop the conveyor.

- (6) Periodic feed problems with the melt pot on the seat and side lasting machine were causing starvation of adhesive at the extrusion nozzles necessitating repeat processing.
- (7) As output from both lasting machines affects overall workflow, all other operations are limited.
- (8) The conveyor periodically stopped due to a lack of components as the daily plan for the lasting department was incomplete (not carried out by the production planning department).
- (9) Poor timekeeping after the 10 am break (as much as 15-20 minutes) was increasing both last and conveyor rotation times.
- (10) Poor planning resulting in a shortage of the correct uppers was causing unnecessary machine and worktable adjustments. The subsequent mixture of styles was leading to faulty forepart lasting and rejects.

METHOD STUDY (Existing line – Figure 1 Part 1)

Certain workstations created bottlenecks due to improper working methods. These were observed and analysed to see if the operations could be split differently.

- (1) The position of the worktable in operation 9 (sole

Figure 2: Proposed balanced line for reducing work content

Key					
DS	Distance between work stations (metres)	ST	Standard time (centiminutes/pair)	CA	Capacity at 100% efficiency (pairs/shift)
TS	Time between work stations (centiminutes/pair)	MP	Manpower	CB	Capacity at 85% efficiency (pairs/shift)
	Operation	ST	MP	CA	CB
1	Upper inspecting + size checking	35	2	1371.43	1165.72
2	Load conveyor with upper, last and sole	29	1	1655.17	1406.89
3	Insole attaching	43	1	1116.28	948.84
4	Apply toe softener to upper	26	1	1846.15	1569.23
5	Toe steaming	59	1	813.56	961.53
6	Toe lasting	50.45	1	951.44	808.72
7	Inspection, hammer toe etc	40	1	1200.00	1020
8	Seat & side lasting	54.26	1	884.63	751.94
9	Cement sole (1)	54	1	888.89	755.56
10	Hot air blowing	42	1	1142.86	971.43
11	Heat setting	47	1	1021.28	868.09
12	Pounding	48	1	1000	850
13	Heel crowning	52	1	923.08	784.62
14	Ironing	146	3	986.30	838.35
15	Apply wax to upper	42	1	1142.86	971.43
16	Brushing upper	30	1	1600	1360
17	Scouring	84	2	1142.86	971.43
18	Cementing upper (1)	53.8	1	892.19	758.36
19	Filler setting on lasted upper	28	1	1714.29	1457.15
20	Apply adhesive to upper (2)	59	1	813.56	691.53
21	Remove excess adhesive	77	2	1246.75	1059.74
22	Sole attaching etc	90.67	2	1058.78	899.97
23	Chilling	47	1	1021.28	868.97
24	Thread cutting	40	1	1200	1020
25	Inspection & removing adhesive	57	1	842.11	715.79
26	Cleaning stitchmarking	31	1	1548.39	1316.13
27	Apply shoe cream to upper etc	47	1	1021.28	868.09
28	De-lasting	38	1	1263	1073.55
29	Pair inspection etc	42	1	1142.86	971.43
30	Apply adhesive to sock	51	1	941.18	800
31	Fitting sock	53	1	905.67	769.82
32	Ironing	127	3	1133.86	963.78
33	Brushing	61	1	786.89	668.86
34	Inspection & thread burning	46	2	2086.96	1773.92
35	Apply shoe cream (1)	53	1	905.67	769.82
36	Apply shoe cream (2)	52	1	923.08	784.62
37	Brushing	98	2	979.6	832.66
38	Sole cleaning by crepe rubber	63	1	761.90	647.62
39	Shoe treeing	109	2	880.73	748.62
40	Lacing	109	2	880.73	748.62
41	Wax polishing	54	1	888.89	755.56
42	Inspecting	38	1	1263.16	1073.69
43	Level attaching	34	1	1411.76	1073.69
44	Poly bag packing	49	3	2938.78	2497.96
	Total	2492.14	58		

cementing) required the operative to take several steps to pick up the sole and then replace it on the conveyor. This took an average observed time of 87 centiminutes/pair. Adjusting the table position reduced this to 58 centiminutes/pair.

- (2) Operatives ironing lasted uppers in operation 14 added to the work content by using too low a temperature. Adjustments improved technique and reduced the observed time.
- (3) Machine settings at operation 23 (sole attaching) were incorrect and operator technique poor. Adjustments and improvements reduced the observed time.
- (4) Brushing in operation 34 would be improved if cream was properly applied.
- (5) Cleaning in operation 39 could be reduced if both upper and sole cementing was more accurate.

MODIFIED LINE (Figure 2)

- (1) Operation 8 (seat and side lasting) shows a standard of 54.26 centiminutes/pair. We know the production target is 672 pairs/shift, so a maximum 71.43 centiminutes/pair can be taken and one operator can achieve the target.
- (2) In operation 14 (ironing), the standard is 146 centiminutes/pair. Here, two people have been employed but have not achieved the target, so a third should be added.
- (3) In operation 16 (sole cementing), the standard is 37 centiminutes/pair. This has already been carried out in operation 9 and, as this is a TPR sole that has been halogenated, there is no need for two applications. Two people can be transferred to other operations as required.
- (4) In operation 21 (removing excess adhesive), one operator has been unable to achieve the standard of 77 centiminutes/pair, so an additional person should be added.
- (5) In operation 37 (brushing with cotton mop), the standard is 98 centiminutes/pair but only one operator was employed. Two are needed to achieve the target.

RESULTS

The project was carried out using the work-study method in order to reduce ineffective time so that productivity could be improved. As previously mentioned, the target for this particular style of ankle boot was 672 pairs/shift, but only 605 had been achieved. The tables above show that if proper planning is carried out and the proposed balanced line in Figure 2 is adopted, the target can be achieved.

Every effort was made to balance the proposed line without shedding any manpower and keeping in mind a sense of social accountability. As the proposed line has been designed around the same number of operators, production appears higher in operations such as 4, 16, 19, 26, 34 and 44. The operators employed at these points are in fact semi-skilled or unskilled and can be moved around or used as cover for absenteeism.

Current line efficiency is 54.44%. To achieve the target 672 pairs/shift, it needs to be raised to 60.15%. If it could be increased to 85%, output would be 786.5 pairs/shift with no additional manpower (Figure 3). Overtime is sometimes used to achieve target output for which extra payments have to be made. By adopting the proposed line the overtime costs can be minimised. Production planning can be improved by implementing a daily production plan.

Figure 3: Productivity calculation

Aspects	Existing Line (Figure 2)	Proposed Line (Figure 3)
1 Manpower	58	58
2 Working hours per day/shift	8 hrs or 480 mins	8 hrs or 480 mins
3 Average production (pairs/day/shift)	605	672 (projected)
4 Work Content (std.centiminutes/pair)	2526.18	2492.14
5 Man-hour (pairs)	1.29	1.45
6 Labour productivity (pairs/man-hour)	465.12	463.45
7 Hourly productivity (pairs/hour)	75.625	84
8 Standard output (pairs/shift)	1102.14	1117.17
9 Efficiency of the line	54.44%	60.15%

Figure 4: Production efficiency

	Efficiency	Improvement	Pairs/shift
1	Current 55%	0%	605.00
2	At 60%	5%	635.25
3	At 65%	10%	665.50
4	At 70%	15%	695.75
5	At 75%	20%	726.00
6	At 80%	25%	756.25
7	At 85%	30%	786.50

Figure 2 also shows that by reducing work content, the target can be achieved with only 60.15% labour efficiency. If we consider plant efficiency to be 85%, the proposed line could in fact produce more than its target. It would also improve working methods and conditions, reduce operator fatigue and at the same time, improve quality.

CONCLUSION

This project shows that footwear manufacture requires the correct distribution of machines and manpower, correct working methods and workstation sequencing, plus line balancing so that optimum output can be achieved and input resources minimised. Footwear is a batch-type manufactured product, so it is therefore one where productivity can be improved by reducing work content using the work-study method as this project has clearly demonstrated.

This is an edited version of an original article based on a project carried out on behalf of The Footwear Design & Development Institute (FDDI), Noida, Delhi, India. A full copy of the work produced by the author is available on request to Mohammad Azad Rahman Siddique, Bangladesh College of Leather Technology, marsiddique@gmail.com