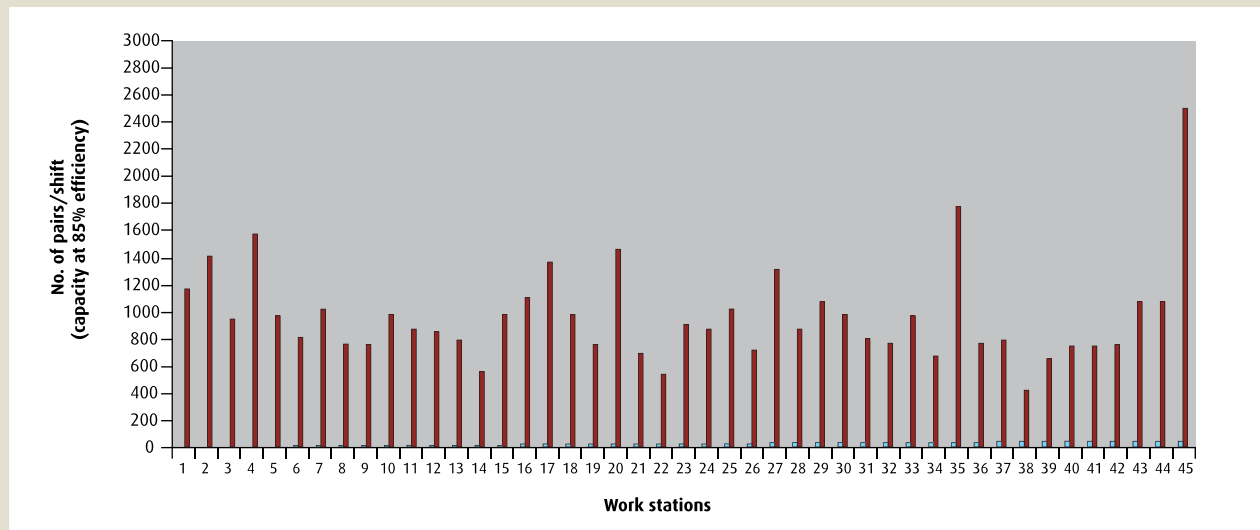


Improving productivity through work-study (part 1)

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Figure 1: Existing lasting conveyor



Work-study, more widely known as time and motion study, offers a scientific way to investigate all forms of work with a view to increasing productivity. It has two parts—method study and work measurement—which are used to systematically examine work in all its contexts in order to effect improvement. It also involves some basic definitions.

A *man hour* is the labour of one man for one hour. A *machine hour* is the running of a machine for one hour. The time taken by either to produce a given quantity of product comprises the basic work plus the labour and/or machine hours involved.

Work content is the time taken to produce one unit of product measured in man or machine hours. Basic work content is the time needed to manufacture a perfect design specification under perfect conditions and with no down time. Interruptions—other than legitimate rest periods—due to shortcomings by either management or employees will reduce productivity by adding time. Basic work content is therefore the absolute minimum time theoretically needed to produce one unit of output with uninterrupted work. Any interruption whatsoever is lost time, as no effective work takes place.

In practice, interruptions do of course occur. Sometimes they are unavoidable as in the case of power cuts or machine breakdowns. On other occasions, they may be caused by management or employees. In either instance, they add ineffective time. The actual working time under such conditions is therefore the sum of the total work content plus the ineffective time.

Method study is the systematic recording and critical examination of existing and proposed ways of working, as a

means of developing and applying easier and more effective methods for reducing costs. It is therefore essentially aimed at reducing the work content of a manufacturing operation.

Critical examination of recorded facts and/or a proposed method is the basic method study procedure. It determines the true reasons underlying each event and follows a set plan to seek all possible improvements. Whilst its purpose is to challenge, its main aim is to see if an activity could be eliminated entirely. If that proves necessary, the objective is then to modify it either by changing its sequence or by combining it with other activities. Improvements are often obtained by combining activities, changing the workplace and the sequence in which a person performs the work.

Work measurement is mainly concerned with the investigation and reduction of associated ineffective time, and with the subsequent establishment of time standards for the operation when carried out in the improved fashion, as determined by the method study. It is obviously only applied after a method study has been conducted. It therefore provides the basic information necessary for designing, planning, organising and controlling work when time is important.

EXAMPLE

A project carried out on the lasting and finishing department of an export-oriented factory in Ambur (Chennai), India provides a good illustration. A fully staffed U-shaped conveyor system with 124 x three-tier trolleys carrying one pair per trolley had a production target of 672 pairs per shift/day on a specific style ➤

Figure 2 – Flow process chart (existing line)

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	Work station	DS	TS	ST	MP	CA	CB
1 Inspect upper & check size	Work table	---	---	35	2	1371.43	1165.72
2 Load upper, last & sole	---	---	---	29	1	1655.17	1406.89
3 Insole attaching	Work table	1.5	2.4	43	1	1116.28	948.84
4 Apply toe softener to upper	Work table	1.0	1.6	26	1	1846.15	1569.23
5 Toe steaming (upper)	3 prs / 3-5 mins	1.0	1.6	59	1	813.56	961.53
6 Forepart lasting	1 m/c	1.0	1.6	50.45	1	951.44	808.72
7 Inspection, hammer toe & adjust back height	Work table	1.5	2.4	40	1	1200.00	1020
8 Seat & side lasting	1 m/c	3.5	5.6	54.26	1	884.63	751.94
9 Hand cement sole (1)	Work table	1.5	2.4	54	1	888.89	755.56
10 Hot air blowing	1 m/c	1.0	1.6	42	1	1142.86	971.43
11 Heat setter	5 mins at 140° C	1.0	1.6	47	1	1021.28	868.09
12 Pounding	1 m/c	4.0	6.4	48	1	1000	850
13 Heel crowning	1 m/c	1.5	2.4	52	1	923.08	784.62
14 Ironing	2 m/c	1.5	2.4	146	2	657.53	558.90
15 Hand apply wax to upper	Work table	1.0	1.6	42	1	1142.86	971.43
16 Hand cement sole (2)	Work table	1.5	2.4	37	2	1297.30	1102.71
17 Brush the upper	1 m/c	1.5	2.4	30	1	1600	1360
18 Scouring (no wire brush)	1 x 2 station m/c	2.0	3.2	84	2	1142.86	971.43
19 Hand cement upper (1)	Work table	1.5	2.4	53.8	1	892.19	758.36
20 Bottom filling	Work table	1.0	1.6	28	1	1714.29	1457.15
21 Hand cement upper (2)	Work table	1.0	1.6	59	1	813.56	691.53
22 Remove excess adhesive	Work table	1.0	1.6	77	1	623.38	529.87
23 Sole attaching etc	Activate upper 65°C ± 5 & sole 45°C ± 5 for 5-6sec. 2 station press 5sec at 3 bar + 15 at 43.	7.0	11.2	90.67	2	1058.78	899.97
24 Chilling	5°C for 4 min	1.0	1.6	47	1	1021.28	868.97
25 Thread cutting by hand	Work table	4.0	6.4	40	1	1200	1020
26 Inspect & remove adhesive from sole wall with crepe	Work table	1.0	1.6	57	1	842.11	715.79
27 Clean stitch marking	Work table	1.0	1.6	31	1	1548.39	1316.13
28 Wax complete shoe upper	Work table	---	---	47	1	1021.28	868.09
29 De-lasting	1 m/c	1.5	2.4	38	1	1263	1073.55
30 Pair inspection, remove tape & cement for sock	Work table	1.0	1.6	42	1	1142.86	971.43
31 Hand cement sock	Work table	1.0	1.6	51	1	941.18	800
32 Fit sock	Work table	---	---	53	1	905.67	769.82
33 Ironing	3 m/c at 80°C	1.5	2.4	127	3	1133.86	963.78
34 Brushing with cotton brush	1 m/c	1.5	2.4	61	1	786.89	668.86
35 Inspection & thread burning	Work table	1.5	2.4	46	2	2086.96	1773.92
36 Hand apply shoe cream (1)	Work table	1.5	2.4	53	1	905.67	769.82
37 Hand apply shoe cream (2)	Work table	3.0	4.8	52	1	923.08	784.62
38 Brushing with cotton brush	1 m/c	3.0	4.8	98	1	489.80	416.33
39 Clean sole by crepe rubber	Work table	1.0	1.6	63	1	761.90	647.62
40 Shoe treeing	Work table	1.5	2.4	109	2	880.73	748.62
41 Lacing	Work table	---	---	109	2	880.73	748.62
42 Wax polish	1 m/c	2.0	3.2	54	1	888.89	755.56
43 Inspect	Work table	1.0	1.6	38	1	1263.16	1073.69
44 Label attaching	(Same table)	1.0	1.6	34	1	1411.76	1073.69
45 Poly bag packing	(Same table)	1.0	1.6	49	3	2938.78	2497.96
46 Inspection & size check	Work table	4.5	7.2				
Totals		72	115.2		58		

of ankle boot, but only averaged 605. The author was asked to identify the problems and offer solutions in order to reach the chosen target.

To do this, it was necessary to investigate the existing conveyor and use the work-study method to analyse specific problem workstations where bottlenecks were occurring. Work measurement was carried out using standard stopwatch method, and a balanced line was proposed along with further suggestions for technical and production planning improvements.

TERMINOLOGY

Basic time =
$$\frac{\text{average observed time} \times \text{observed performance rating}}{\text{standard performance rating}}$$

Standard Time = basic time + 3% contingency allowance + 15% relaxation allowance.

Performance rating = assessment of operator's work rate relative to the observer's concept of the rate corresponding to standard pace.

Standard performance rating = rate of output that trained operators can achieve without over-exertion over a working day/shift, provided they know and adhere to the specified method and are suitably motivated (denoted as 100 on standard rating and performance scales as shown below). 

Rating	Description
0	No activity.
50	Very slow, clumsy, fumbling movements, operative appears half asleep and showing no interest.
75	Steady, deliberate and unhurried performance of operative not on piecework but properly supervised. Appears slow but time is not being intentionally wasted.
100	Brisk, business-like performance of an average qualified worker on piecework. Necessary standards of quality and accuracy achieved with confidence.
125	Very fast and exhibiting a high degree of assurance, dexterity and co-ordination of movement well above that of an average operator.
150	Exceptionally fast, requiring intense effort and concentration. Only achieved by a few outstanding operators and unlikely to be maintained for long periods.

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 from Mohammad Azad Rahman Siddique, Bangladesh College of Leather Technology, marsiddique@gmail.com (part 2 will appear in the March/April issue of World Footwear).



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