Study on minimizing the cost of making of t-shirt by effective line balancing and efficiency for improving productivity in Apparel Industry

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Abstract

Line balancing is an effective tool to improve the throughput of assembly line while reducing non-value-added activities, cycle time. Line balancing is the problem of assigning operation to workstation along an assembly line, in such a way that assignment is optimal in some sense. This project mainly focuses on improving overall efficiency of single model assembly line by reducing the non-value added activities, cycle time and distribution of work load at each work station by line balancing. The methodology adopted includes calculation of cycle time of process, identifying the non –value-added activities, calculating total work load on station and distribution of work load on each workstation by line balancing, in order to improve the efficiency of line and increase overall productivity.

Keywords: CM, T-shirt, Line balancing, Line efficiency, Labor productivity, Work sharing method, Productivity

1. Introduction

Apparel industry has a common goal to minimization of the input and maximization of the output. The relation between of those two factors is called productivity. One of the major causes of an industry's decline is low productivity. Failure to meet targeted productivity can result to high costs per unit which making goods, services not competitive enough on the market. As a result, industry faces low quality, high cost and on time delivery problem. To remain competitive in the market, many industries try to implement strategies to make improvements in productivity levels. Actually productivity varies due to cross county and cross-regional differences, culture & knowledge. Getting the optimum productivity, a management gives concern on scientific management technique to measure man, machine or value utilization. Increment in productivity level reduces manufacturing cost. Industry can make more profit through productivity improvement. Productivity of Bangladesh industry worker is comparable low compare to others country due to the lack of using scientific tools & technique & proper management. This paper intends to improve the productivity of an apparel industry in Bangladesh by the use of line balancing [1]. The production process of garments is separated into four main phases: designing or clothing pattern generation, fabric

cutting, sewing, and ironing or packing. The most critical phase is the sewing phase, as it generally involves a great number of operations. The sewing line consists of a set of workstations in which a specific task in a predefined sequence is processed. In general, one to several tasks is grouped into one workstation. Tasks are assigned to operators depending on the constraints of different labor skill levels. Finally, several workstations in sequence are formed as a sewing line. Shop floor managers are concerned with the balance of the lines by assigning the tasks to workstations as equally as possible. Unequal workload among workstations of a sewing line will lead to the increase of both WIP and waiting time, indicating the increase of both production cycle time and cost. In practice, the sewing line managers or production controllers use their experience to assign tasks to workstations based on the task sequence, labor skill levels and the standard time required to complete each task. As a result, the line balance performance cannot be guaranteed from one manager to another with different assignment preference and/or work experience. Manufacturing a product always requires different types of sewing machines and different yarn colors, making it difficult to assign a worker to perform operations on just a single machine. [2]

2. Background of the study

The RMG (Ready Made Garment) sector contributes around 76 percent to the total export earnings and contributes around 13 percent to the GDP, which was only around 3 percent in 1991. Of the estimated 4.2 million people employed in this sector, about 50 percent of them are women from rural areas. In 2000, the industry consisting of some 3000 factories employed directly more than 1.5 million workers of whom almost 80% were female. [3] McKinsey forecasts export-value growth of 7 to 9 percent annually within the next ten years, so the market will double by 2015 and nearly triple by 2020. [4] To obtain the forecasts growth, each RMG industry must manage the production line very well & follow the cost effective strategy. Cost effective strategy mainly includes two key points: Cost reduction strategy & labor productivity improvement. Cost reduction strategy should begin with assigning the highest priority for establishing backward linkage. The establishment of backward linkages will reduce dependence on foreign sources which will reduce the total & average production cost of garments. This strategy will make products more competitive in the world's RMG market. At the same time, labor productivity must be improved to keep place in the world largest competitive market. In this case, a systematic technique or approach should be introduced. One of the techniques is line balancing technique. The used of line balancing technique was proved able to increase the productivity for the small medium

enterprise. By using the line balancing technique, the production will increase because the arrangement of the line is corrected and the maximum productivity will be archive.

2.2.1 Productivity: Productivity can be defined as "OUTPUT" compared to "INPUT". It is quantitative relationship between what we produce and what we have spent to produce. Productivity is nothing but reduction in wastage of resources like men, material, machine, time, space, capital etc. It can be expressed as human efforts to produce more and more with less and less inputs of resources so that there will be maximum distribution of benefits among maximum number of people. According to Marsh, Brush (2002) in his article Journal of industrial technology, productivity is a measure of the efficiency and effectiveness to which organizational resources (inputs) are utilized for the creation of products and/or services (outputs). [5] In case of garment manufacturing factory, "output" can be measured the number of products manufactured, whilst "input" is the people, machinery and factory resources required to create those products within a given time frame. The key to cost effective improvements in output – in "productivity" – is to ensure that the relationship between input and output is properly balanced. The proper utilization of line balancing technique can be created a dramatic effect for improving the productivity. For example, there is little to be gained from an increase in output if it comes only as a result of a major increase in input. Indeed, in an ideal situation, "input" should be controlled and minimized whilst "output" is maximized. There have different ways of measuring the productivity but mostly used are labour productivity, Machine Productivity and Value productivity.

Process Capacity Chart
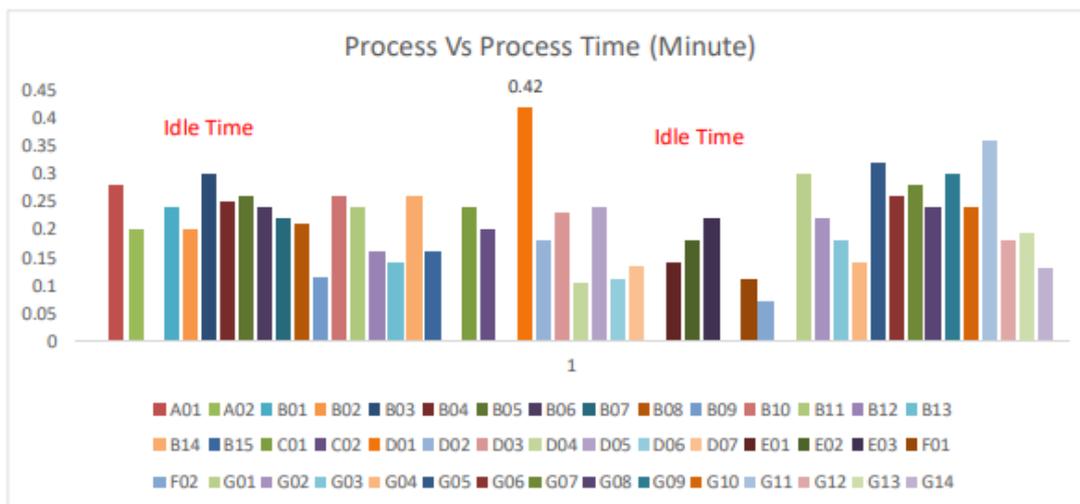
2.2.2 Line Balancing: In RMG industry, the most critical section is sewing section where a set of workstations are assigned for a specific task to process according to a specific sequence. Usually, one or more tasks are assigned to a workstations and several consecutive workstations form as sewing line. Therefore, the aim of line balancing in sewing line is to assign tasks to workstations can perform the assigned tasks with a balance loading. [6] Balance loading means to balance the number & sequence of operations and manpower. Line Balancing means balancing the production line, or any assembly line. The main objective of line balancing is to distribute the task evenly over the work station so that idle time of man of machine can be minimized. Lime balancing aims at grouping the facilities or workers in an efficient pattern in order to obtain an optimum or most efficient balance of the capacities and flows of the production or assembly processes. Line balancing is the technique of assigning the operations to workstations in such a way that the assignment be optimal in some sense. Ever since Henry Ford's introduction of assembly lines, LB has been an optimization problem of significant industrial importance: the efficiency difference between an optimal and a sub-optimal assignment can yield economies (or waste) [7]

Methodology Flowchart
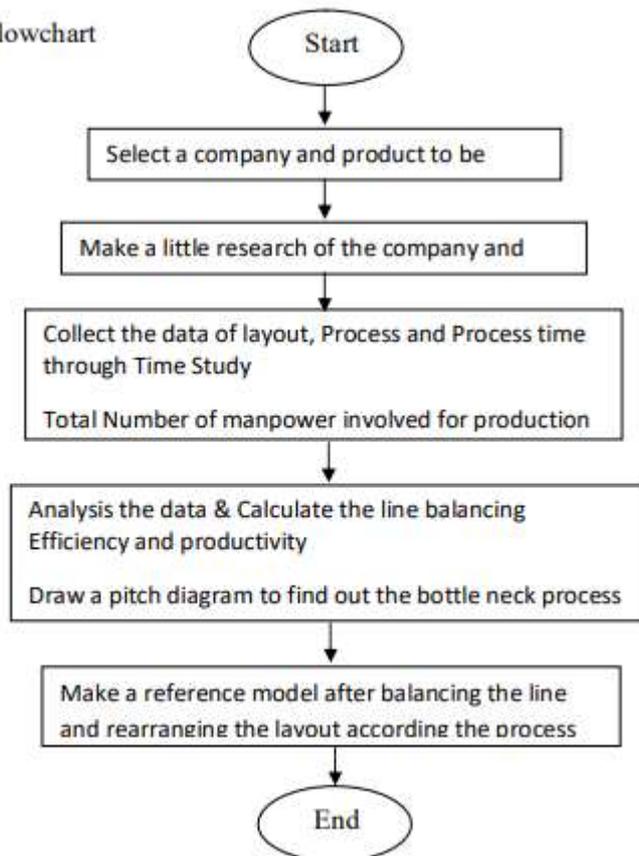
Existing layout
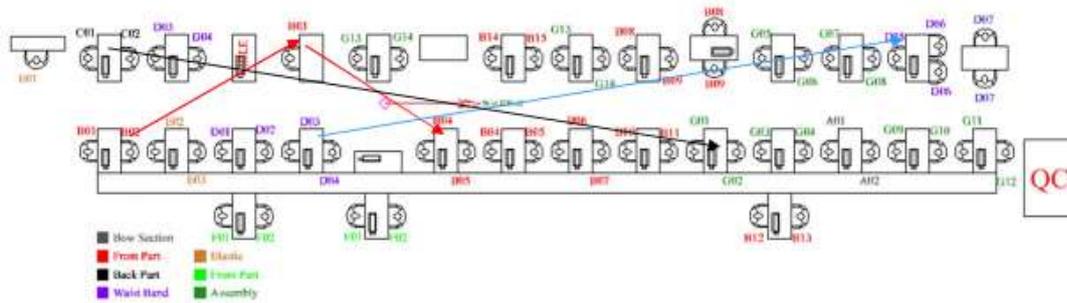
Time Study: The processing time exists simply because the process requires tasks and motion. To put it in a different way, the working method and the number of work components are closely related to the net processing time. The time study begins by measuring the number of seconds required to lift, operation and place. It then proceeds to make improvements based on the time values and ends by defining the differences in the time values caused by the individual differences of the workers. The Industrial Engineering Terminology Standard defines time study as "a work measurement technique consisting of careful time measurement of the task with a time measuring instrument, adjusted for any observed variance from normal effort or pace and to allow adequate time for such items as foreign elements, unavoidable or machine delays, rest to overcome fatigue, and personal needs. [8] Precedence Diagram: PDM is a visual representation technique that depicts the activities involved in a project. Precedence Diagrams are also known as Project Network Diagrams. In this article, both terms are used interchangeably. PDM using for following help. The visual representation makes it easier to communicate the flow of project execution or the project activity flow There is a greater chance for team to identify missing activities. Each activity is dependent on some other activity. When a dependency is not identified, the project will be delayed until such a time that identification occurs Certain activities have a greater impact on project schedule than others. By using PDMs, can possible to determine the activities critical to the project schedule Take Time: Take time is the average time between the start of production of one unit and the start of production of the next unit, when these production starts are set to match the rate of customer demand. [9] Assuming a product is made one unit at a time at a constant rate during the net available work time, the take time is the amount of time that must elapse between two consecutive unit completions in order to meet the demand. This means that a difference in motion levels of operators will directly affect the time value. Work result vary depending of presence/absence of waste time, work speed and degree of consistency. Layout

can be improved through maintain this bellow issues: The distance by which the goods (Products) move shall be minimized. The distance by which the goods worker move shall be minimized The distance by which the information is distributed shall be minimized. Machine shall be laid out so that the progress of work can be visually checked at a glance. The layout of machines shall be flexible to accept a slight change in specifications.
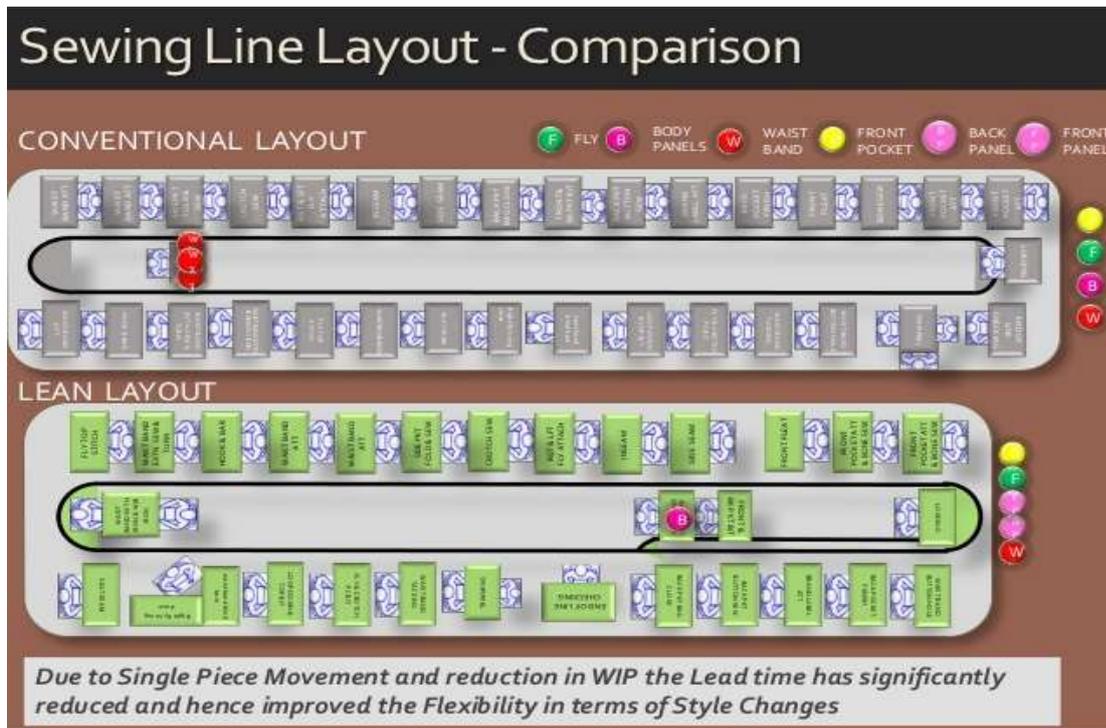
Materials and Methods

Actual time   = 0.22min

Observe time = 0.20min

Ratting

= (observe time/actual time) $\times 100$

= (0.22/0.20)$\times 100$

=90%

Basic time

= observe time $\times$ ratting

= 0.20$\times$90%

= 0.18

- Suppose Shoulder Join process

- SMV= basic time + allowance
- = 0.18+20%
- = 0.22min
- Target= 60÷SMV
- =60÷0.22
- =272 pcs

Target

100% individual target $\quad = \dfrac{60 \text{ miniute}}{\text{operator smv}}$

$$= \dfrac{60}{0.35}$$

$$= 171.42 \text{ pcs}$$

$$= 171 \text{ pcs}$$

90% individual target $\quad = \dfrac{60 \text{ miniute}*90\%}{\text{operator smv}}$

$$= \dfrac{60*90}{0.35*100}$$

$$= 154.28 \text{ pcs}$$

$$= 154 \text{ pcs}$$

Operator efficiency:

operator efficiency= $\dfrac{\text{total min produced} * 100}{\text{total hours worked}*60}$

$$= \dfrac{491*100}{10*60}$$

$$=81.83\%$$

Line target:

Daily line target= $\dfrac{\text{total working in min} * \text{no. of operator} * \text{line efficiency }\%}{\text{garments smv}}$

$$= \dfrac{60*24*90}{7.04*100}$$

$$=184 \text{ pcs/hrs}$$

=184*10 pcs/day

=1840 pcs / day

Line efficiency = $\dfrac{\text{line output * garments smv * 100}}{\text{total no. of operator * min worked}}$

$= \dfrac{2000 *4.33 * 100}{21*60 *11}$

= 62.48 %

Machine productivity = $\dfrac{\text{line output * (in piece)}}{\text{no. of m/c used}}$

$= \dfrac{2000}{21}$

= 95.23 %

Labor productivity = $\dfrac{\text{line output * (in piece)}}{\text{no. of m/c used}}$

$= \dfrac{2000}{21}$

= 95.23 %

Factory Capacity

= working hour * Total Worker * Working Day * Efficiency%

* SMV
* = $\dfrac{10*1500*26*85}{}$
* 7.35 * 100
* = 45102 pcs
* = 45102 * 30 (total line-30)
* = 1353060 pcs

Cost of Making (CM)

Suppose,

H.N apparels has received an order of basic T-Shirt item.

Where,

H.N apparels total expenditure per month-30,00,000 taka.

Total number of machines in the factory-100

Total number of machines required to complete an item-25

Targeted production per hour from the existing layout-180 pcs

Total working day per month-26

Total working hours per day-08

Now calculate the cost of making(CM) of the mentioned item.

Solution:

Cost of making (CM) per pcs,

=Factory Total Expenditure/month*Total No of M/C Required

  Total m/c*Total Working day/month*Tgt Prod./hrs

= 3,000000*25

  100*8*26*180

= 20.03 taka per pcs

= (20.03 × 12) taka per dozen

= 240.38 taka per dozen

= 240.38/82 (in dollar) {1dollar-82taka (running)}

= \$2.93 per dozenSo, the cost of making (CM) per dozen basic T-Shirt is \$2.93

Proposed Layout:

Earlier explained the condition to set a good layout like short transportation, short jumping, no back flow. In existing layout, there was long transportation like BO2 to BO3, DO4 to D05 and back flow like G12 to G13 & many more. To minimize the layout difficulties and improve the product flow, already make a process flow chart where all the process sequence is showing through T-Diagram. Taking aid form flow chart, the sequence of process and parts can be set in layout. All the parts section and assembly point is identified with collar for easy visualization [10]
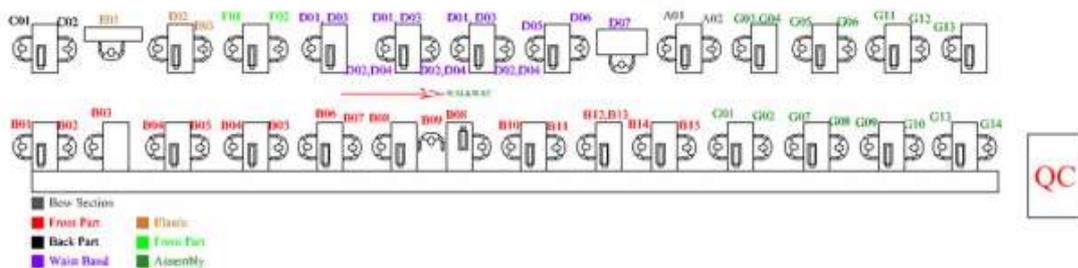
Results and Discussion

Changing from existing line balance to reference model, there are considerable improvements have been observed. Existing condition, total was 57 operators where line balance efficiency & productivity were accordingly 48.2 % & 2.5 pc/Op. Latter, it can be referred a reference model through precedent diagram with largest number of follower rules. Allocated all the

operations targeting takt time among the workstations for getting desired output. The line balancing efficiency & productivity will stand accordingly 74.08 % & 3.84pc/hr. So it can be calculating from existing & reference model that the productivity can be increased 53.6 % after taking steps of line balancing & layout technique.

Conclusion

The objective of the study is to improve the productivity to minimize cm cost of T-shirt after balancing the sewing line & build a reference model. This reference model is manually stood up but it would be better to work with simulation software. Beside of this line balancing technique, also have other productivity improvement techniques for improving the productivity. However, this evaluation has given an image that the lack of line balancing is responsible for resources wastage. The observations gained from this research indicate some limitation for future work. Although some meaningful conclusion can be made with respect to the reference model builds in the study.

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