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Underpin the Productivity of Apparel Industries in Dhaka District by Effective Utilization of Line Balancing

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Abstract:
For clothing production the productivity growth has an immense implication. For this, a number of productivity expansion tools and techniques are bringing into play in many factories. Despite several factors in this paper Line Balancing has been picked out to identify the prime techniques for productivity improvement. This paper is carried out by literature reviews and scenario approach to analyze the future of garment industries. The main intention of the paper is to show productivity improvement which can be attained by exploring Line Balancing in Bangladeshi apparel sector at large.

Keywords: *Apparel Industries, Dhaka District, Line Balancing, Productivity*

1. Introduction

The task of a manager of an apparel-manufacturing industry, in the new millennium, has become quite challenging. The growing international competition has put a lot of pressure on the apparel manufacturers to produce quality products at a Competitive price and deliver them to the customer just in time. In this scenario, the managers of apparel industries will need to lead the factories to the path of continuous improvement. This improvement also needs to be measured continually, to understand how much improvement has taken place. One of the ways of doing this could be the review of profitability data of the factory. However, it is often seen that the production/factory managers rarely have access to financial data. In such a case, productivity data could be a useful indicator of the level of performance of the factory. Though the factory managers are aware of the importance of productivity, the data on productivity is rarely available. Managers, sometimes, feel that collection of productivity data, its measurement and generation of reports is yet another paper work. As most of the managers in apparel factories are busy with managerial task, they seldom have time for so called paper work. The managers and their supervisory team often have misconceptions about productivity and lack the knowledge of the true dimension of the benefit they can derive from productivity measurement, and subsequently the productivity improvement.
Productivity is also one of the most frequently encountered words in management discussions and in national economic debates. Notwithstanding its popularity, 'Productivity' is not fully understood by many and used wrongly in many cases. Therefore, it is important to understand the fundamental concepts related to productivity. This thesis is aimed at explaining what is productivity, different approaches to productivity measurement, mainly Fortification or improvement of Productivity in Sewing Section by Effectual Implementation of Ergonomics, along with this calculation of productivity index and how productivity is lost in the apparel industry [i].

1.1. Productivity

Productivity in simple word is a relationship between output and input. The output in garment factories can be pieces of finished garments. Whereas the output of the sections or departments within the garment factories could be: meters of fabric inspected in fabric inspection section, cut components in cutting room, number of garments ironed in the ironing section and so on.
The examples of input are; man-hours, machine hours, meters of fabric consumed or electricity consumed [ii].
Productivity can be calculated as:
Productivity=Output / Input
Productivity denotes the productiveness of the factors of production, labor and capital, in creation of wealth. In modest words productivity is concerned with the efficient utilization of resources (inputs) producing goods (output). Efficiency is the ratio of actual output attained to the standard expected output. The concept of efficiency is closely associated with productivity. Quite often productivity is expressed in terms of efficiency [iii].
For example if the standard expected output per operator is 25 pieces of jeans per shift and the operator productivity is of 20 jeans per shift, the productivity efficiency becomes 20/25 = 80%. This expression may also be called 'productivity efficiency' [iv].

Productivity in the ready-made garment (RMG) industry in Bangladesh is around 30-35% as compared to international productivity norms which stand at more than 60%. One of the reasons for such low productivity is poor quality. About 5% of the garments produced in Bangladesh are rejected completely in the final inspection and around 15% must be altered before they can be exported. The main reason for low quality is the lack of skilled workers. Those who are engaged in quality control have no formal training in quality control measures. They have learned their work through on-the-job training provided by someone who is also not an expert.
The Bangladesh Garment Manufacturing Export Association (BGMEA) with the assistance of the German Technical Cooperation (GTZ) has been implementing various productivity and quality improvement measures over the last four years. The aim of these development measures was twofold. The goals were to first train and build institutional capacities to improve the overall quality of ready-made garments, and then secondly, to demonstrate to garment producers the benefits accruing from quality improvement measures [v].
In recent days our country is encountering few problems that result our competitors becoming stronger day by day. As a consequence of this we need to take some actions so that we can compete them in international Market.

2. Literature Review

The garment industry has played a pioneering role in the development of industrial sector of Bangladesh. Though it took a rather late start i.e., in 1976 but it soon established its reputation in the world market within a short span of time. Resultantly garment is now one of the main export items of the country. Besides, enriching the country's economy it has played a very important role in alleviating unemployment. At present there are more than two thousand one hundred garment factories in the country employing more than 12 lack labors. 85 percent of the labor force is woman.
With 5,000 factories employing about 3.6 million workers (of a total workforce of 74 million), Bangladesh is clearly ahead of other Southeast Asian suppliers in terms of capacity of the ready-made-garment industry. It also offers satisfactory levels of quality, especially in value and entry-level midmarket products.
Ready-made garments manufactured in Bangladesh are divided mainly into two broad categories: woven and knit products. Shirts and trousers are the main woven products at same time undergarments, socks, stockings; T-shirts, sweaters and other casual soft garments are the main knit products. Woven garment products still dominate the garment export earnings of the country. The share of knit garment products has been increasing since the early 1990s; such products currently account for more than 40 per cent of the country's total RMG export earnings [vi].
Although various types of garments are manufactured in the country, only a few categories, such as shirts, T-shirts, trousers, jackets and sweaters, constitute the major production-share [vi].Economies of scale for large-scale production and export-quota holdings in the corresponding categories are the principal reasons for such a narrow product concentration.
With about $15 billion in exports in 2010, ready-made garments are the country's most important industrial sector; they represent 13% of GDP and more than 75% of total exports. Recent surveys carried out by the consulting firm McKinsey and the accounting firm KPMG identified attractive prices as the most important reason for purchasing in Bangladesh. Price levels will remain highly competitive in the future, since significant efficiency increases will offset rising wage costs.
Having discussed what is productivity it is now important to understand how to measure productivity in apparel industry. There are mainly two approaches to the measurement of productivity. These are partial and total productivity measurement. Further explanation of partial and total productivity measures provided by ILO Action Manual Improving Working Conditions and Productivity in Garment Industry', is as follows.
"Partial productivity is the ratio of output to one class of input. For example, labor productivity (the ratio of output to labor input) is a partial measure. Similarly, material productivity (the ratio of output to material input) and machine productivity (the ratio of output to machine input) are examples of partial productivity.""Partial productivity measures are easy to understand and use. The data needed are both easy to obtain and easy to compute. Partial productivity is also a good diagnostic tool for pinpointing improvement areas. However, it has some disadvantages. If used alone, it can be misleading and may lead to costly mistakes. Partial measures cannot be used to explain overall cost increases. Studies show that among industrial corporations partial productivity measures are the most commonly used at all organizational levels, particularly in the plant division level".
"Total productivity is the ratio of total output to the sum of all input factors. Thus, a total productivity measure reflects the joint impact of all inputs in producing the output. It is kind of a higher level of productivity assessment combining several or many partial productivity measures. Total productivity measure considers all the quantifiable output and input factors; therefore, it is a more accurate representation of real economic picture of an enterprise. However, total productivity measure does not tell the management of a industry which of its products or services is causing a decline or growth .Nor does it tell them which particular inputs –workers, material, capital, energy, or other expenses-are being utilized inefficiently so that corrective action can be taken. However, data was difficult to obtain unless data collection systems are designed effectively based on purpose" [vii].
Apparel manufactures, internationally, prefer to use partial productivity measures like labor or machine productivity. This is mainly because of the fact that the data needed for the partial productivity measurement is easily available and the department or the section in-charge to evaluate its performance or to plan improvement can use the results of productivity computation.

2.1. Measuring Output and Input

Productivity is measured by achievement toward established goals based on relationships between inputs and outputs. Management strives to increase productivity through more effective use of resources. Productivity is an indicator of whether a firm is meeting its objectives. Management monitors productivity and makes both routine and strategic decisions based on productivity data. Smaller

runs may be scheduled to meet customer demand and more market research or merchandising changes may be required if styles are not selling. Style changes might be made if throughput time is long; more education and training may be provided to assist employees; new technology and equipment might be added to increase production of more first-quality goods.
Productivity may be determined for a plant, center, machine, or individual; however, individual goals must support the goals of the firm. For example, the goal for an automatic pocket-setting operation may be to run at 100% efficiency per workday. This supports an operational goal for a high-efficiency, low-cost work center. However, the plant's goal is to respond to customer demand for quick response and a diverse product mix. Thus, high efficiency on one operation (pocket setting) feeds excess inventory into the system, reduces flexibility, and lessens the plant's ability to respond to the market. When patch pockets are needed on only one style in the line, it is unrealistic to schedule volume just to meet the operation goal. If the pocket setter runs only half the time, its efficiency goes down; but when consumers do not want styles with patch pockets, then a high efficiency at the pocket-setting operation does not contribute to the goals of the firm [viii].

2.2. Example of Productivity Calculation
The calculation of productivity in apparel industry is further explained by following example of a shirt-manufacturing factory. The data on the output and various inputs is as below:

Number of Machine	105
Number of Operators	100
Number of Helpers	20
Number of Checkers	10
Number of Supervisors	3
Duration of Work shift	450 Minutes
Product SCW	Men's Full Sleeve Dress Shirt
SAM[1] of the Shirt (Sewing)	16.59 minutes
Average Daily output (per shift)	2000 Shirts

Table 1: Sample data Productivity calculation.

The calculationof productivity based on above data can be done as follows:

$$\text{Operator Productivity} = \frac{\text{Volume of output}}{\text{Direct labour input(volume)}}$$

$$\textit{Operator Productivity} = \frac{\text{2000 shirts per shift}}{\text{100 operators per shift}}$$

$$\textit{Productive Efficiency of Operator} = \frac{\text{SAM X Units Produced per Operator}}{\text{Inputs in Minures per Opeartor}}$$

$$= \frac{16.59 \text{ X } 20}{450}$$

$$= \frac{331.80}{450}$$

$$= 73.33\ \%$$

$$\textit{Total Labour Productivity (Sewing)} = \frac{\text{Volume of Output}}{\textit{Total Labour Input}}$$

$$= \frac{\text{2000 shirts}}{\text{130 Workers}}$$

$$= 15.38 \text{ Shirts per Shift}$$

$$\textit{Machine Productivity (Sewing)} = \frac{\text{Volume of Output}}{\textit{Machine Input}}$$

$$= \frac{\text{2000 shirts per shift}}{\text{105 Machines per Shift}}$$

$$= 19.04 \text{ Shirts per Shift}$$

[1]Standard Allowed Minutes (SAM) is the time value arrived at for a task based on the average rate of output, which qualified workers, will naturally achieve without over exertion provided that they know and adhere to the specified method and provided that they are motivated to apply themselves to their work. It is based on definition of Standard Performance in Introduction to Work Study, ILO, 1992.

Labor or machine productivity can also be communicated in terms of volume of labor / machine inputs consumed per unit of output. In such cases, productivity will be calculated as below:

$$Total\ Labour\ Productivity = \frac{\text{Total labour minutes consumed per shift}}{\text{Number of units produced per shift}}$$

$$= 29.25 \text{ minutes per shirt} = \frac{450 \times 130}{2000}$$

$$\text{Sewing Operator Productivity} = \frac{450 \times 100}{2000}$$

$$= 22.5 \text{ minutes per shirt}$$

Annual labor turnover	24%	Machine delay-Other work	4%
Absenteeism	10%	Unmeasured work	20%
Methods effectiveness	90%	Others' Repair	2%
Average factory performance	90%	Waiting Time	1%
Repairs returned to operatives	10%	Balancing Losses	5%
Rejects	2%	Work Study	1%
Machine delay-ideal	1%		

Table 2: Sample data for Productivity Loss Calculation.

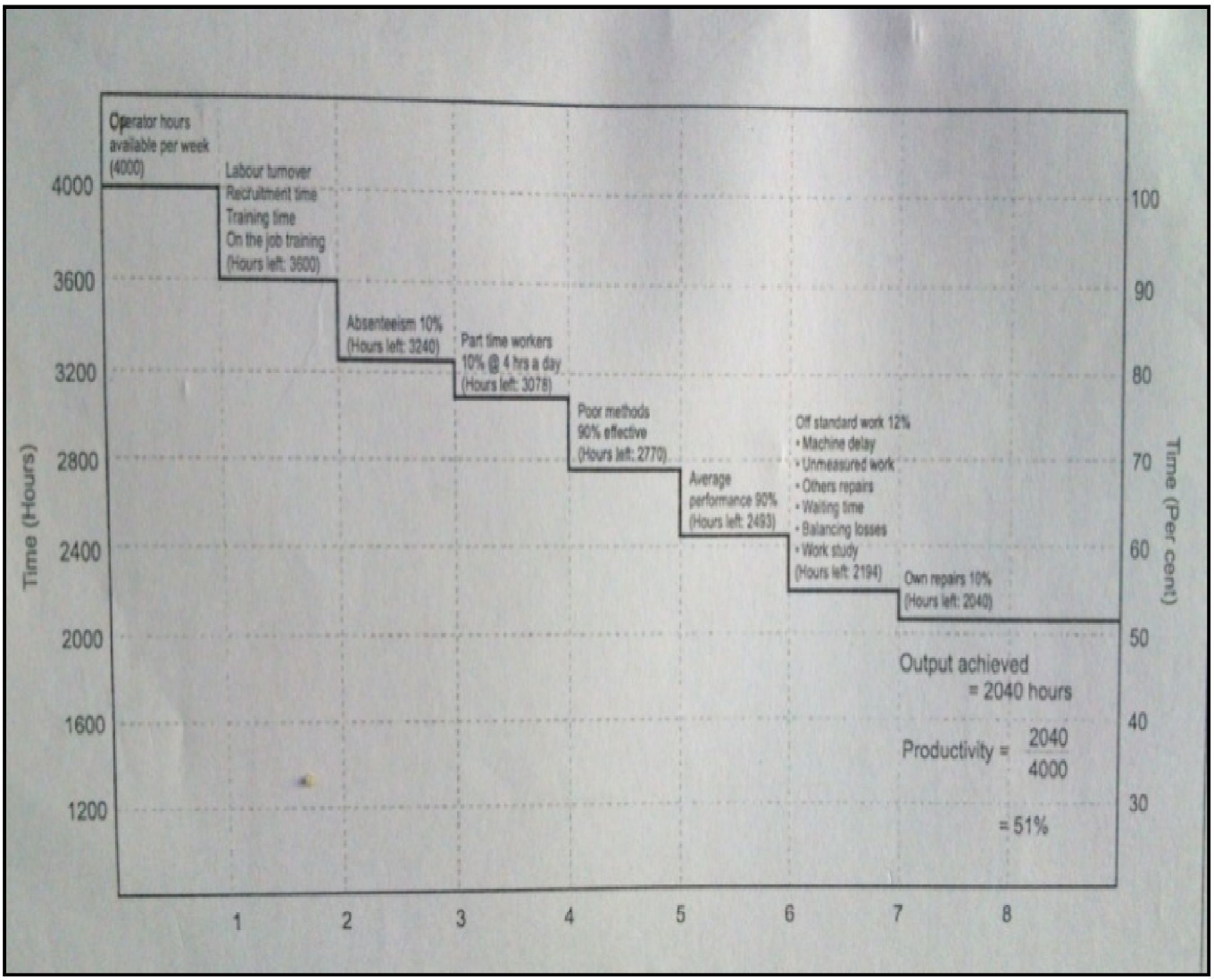

Figure1: How Output and Productivity is Lost in Apparel Plant (100 operators at 40 hours a week) [ix].

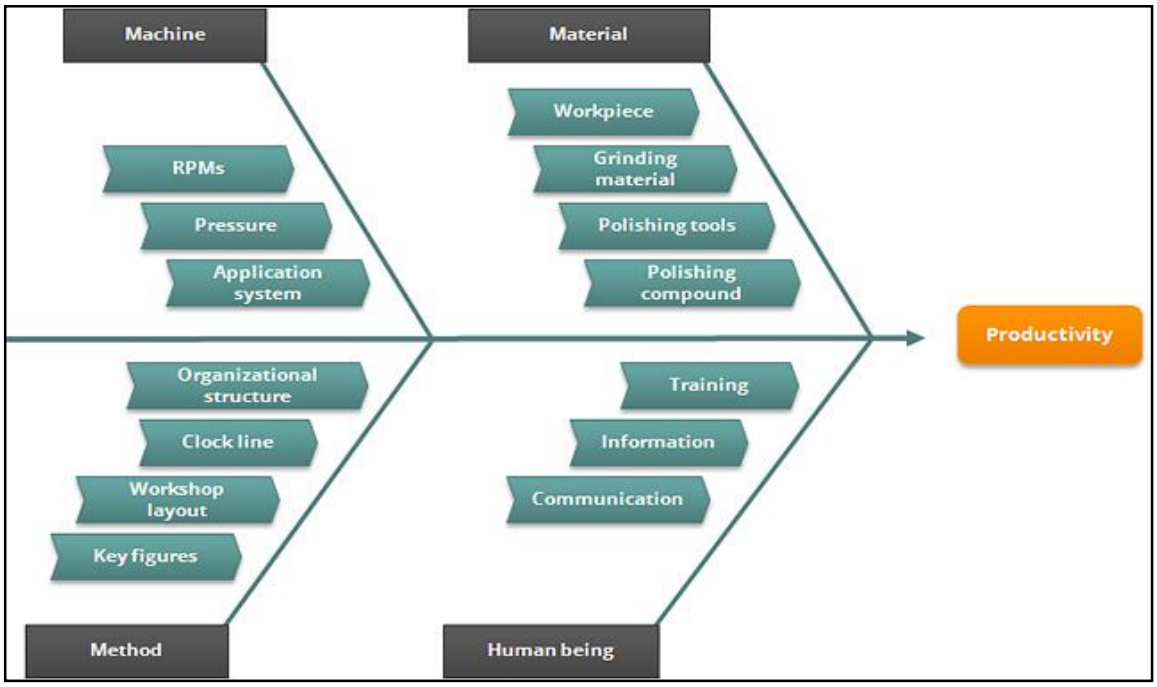

Figure 2: Different Components of Productivity

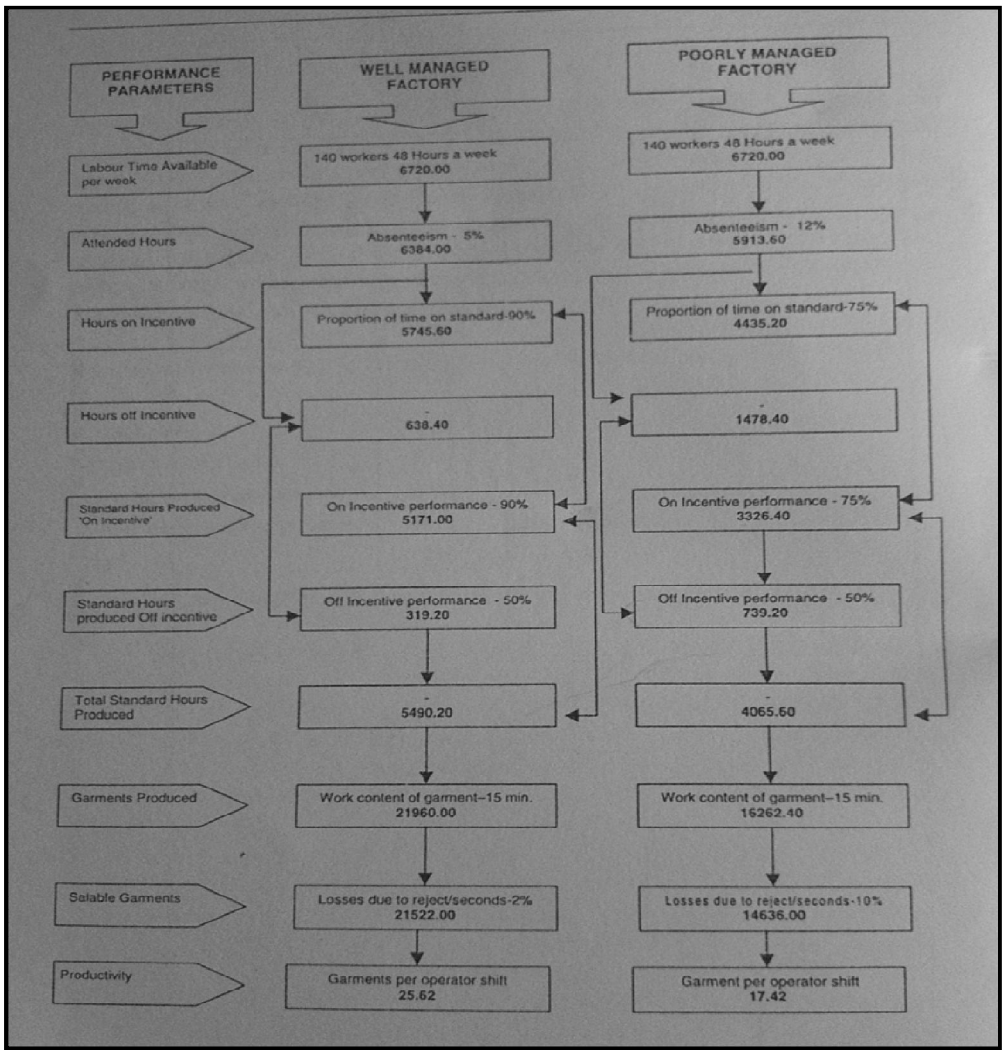

Figure 3: Productivity in Well Managed & Poor Managed Factories
(Based on the inputs provided Mr. Alan Chandler, Alan Chandler Associates, UK)

2. 3. Assembly Line Balancing

Moberly and Wyman (1973) propose the approach of using simulation two compare two assembly line configurations. According to Moberly, the study of production line configurations along the length of the line is called "assembly-line balancing". The set of workstations along the line that results from this balancing is the generated line configuration. They demonstrate splitting the assembly line width wise rather than length wise i.e., one workstation is replaced by two identical parallel stations and they named it as dual production line [x].

Assembly lines are one of the most widely used production systems. Productivity of a manufacturing system can be defined as the amount of work that can be accomplished per unit time using the available resources. Pritchard (1995) defines assembly line productivity as how well a production system uses its resources to achieve production goals at optimal costs. The conventional productivity metrics, namely throughput and utilization rate gives a substantial measure of the performance of an assembly line [xi].

These two metrics alone are not adequate to completely represent the behavior of a production system Huang et al (2003). A set of other measures such as assembly line capacity, production lead time, number of value added (VA) and non-value added (NVA) activities, work-in-process, material handling, operator motion distances, line configuration and others, along with the throughput and utilization rate, completely characterize the performance of a production system. An assembly line yields optimal performance by an optimal setting of all these factors [xii].

Flexibility and agility are the key factors in developing efficient and competitive production systems. For products involving light manufacturing and assembly, this level of flexibility can be easily achieved with manual assembly systems. Manual assembly lines are most common and conventional and still provide an attractive and sufficient means production for products that require fewer production steps and simple assembly processes. Global competition is forcing firms to lower production costs and at the same time improve quality with lower production lead times.

With the introduction of Lean Manufacturing, this systematically and continuously identifies and eliminates waste at all levels of a production system, many improvement opportunities that substantially increase the assembly line productivity can be successfully implemented.

3. Methodology

I have made the paper by analyzing different techniques of productivity to improve the productivity and profit of the factories. I used quantitative method for analyzing data. Most of the data is primary data, but I also used some secondary data. Woven Apparel factories have been chosen to collect the primary data. Questionnaire survey has been done in different departments with direct interview. For data analysis and graphical representation I use Statistical Programme for Social Science (SPSS). I have recorded the time to make each process for each and every worker to find out the number of operator and helper, type of machines, basic and standard pitch time and individual capacity.

3.1. Practical Part

As several techniques are available for the improvements of productivity in apparel industries, so to identify the precise situation a questionnaire is prepared as well as this has been applied to some factories four exactly to find out the factors whether or not Assembly Line Balancing can increase the productivity.

3.2. Questionnaire Survey

Few techniques are considered in questionnaire, based on the magnitude of Apparel Industries.On the whole, 5 questions were there on the survey and the data are applied on four factories. After that, a specific style was chosen to find out productivity of machine and labor. In addition, their survey responses were analyzed by using SPSS software. Finally individual data was compared along with graphical representation and their productivity was also compared so that is can conclude that whichever the organization will use this methods their productivity will improve or the companies are still using it they have to implement it entirely to get best outcomes.

At last, the collected data are analyzed and the frequency tables and corresponded graphical representation are attached here.

4. Data Analysis

4.1. Frequencies for Line Balancing

Company Name					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	"Ananta Apparels Ltd"	25	25.0	25.0	25.0
	"Ananta Casual Wear."	25	25.0	25.0	50.0
	"DNV Clothing"	25	25.0	25.0	75.0
	"Hameem Group"	25	25.0	25.0	100.0
	Total	100	100.0	100.0	

Table 3: Frequency for Line Balancing (Company Name)

Questionnaire					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No. of production line change with style change	20	20.0	20.0	20.0
	No. of operational breakdowns provide same output	20	20.0	20.0	40.0
	No. of operators get proper operational breakdown based on skill	20	20.0	20.0	60.0
	No. of operators used hand trimmer instead of scissors	20	20.0	20.0	80.0
	No. of operators provide same efficiency in an individual line	20	20.0	20.0	100.0
	Total	100	100.0	100.0	

Table 4: Frequency for Line Balancing (Questionnaire)

Weight of Response					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	"40-60 %"	14	14.0	14.0	14.0
	"60-80 %"	55	55.0	55.0	69.0
	"80-100 %"	31	31.0	31.0	100.0
	Total	100	100.0	100.0	

Table 5: Frequency for Line Balancing (Weight of Response)

4.2. Graphical Representation

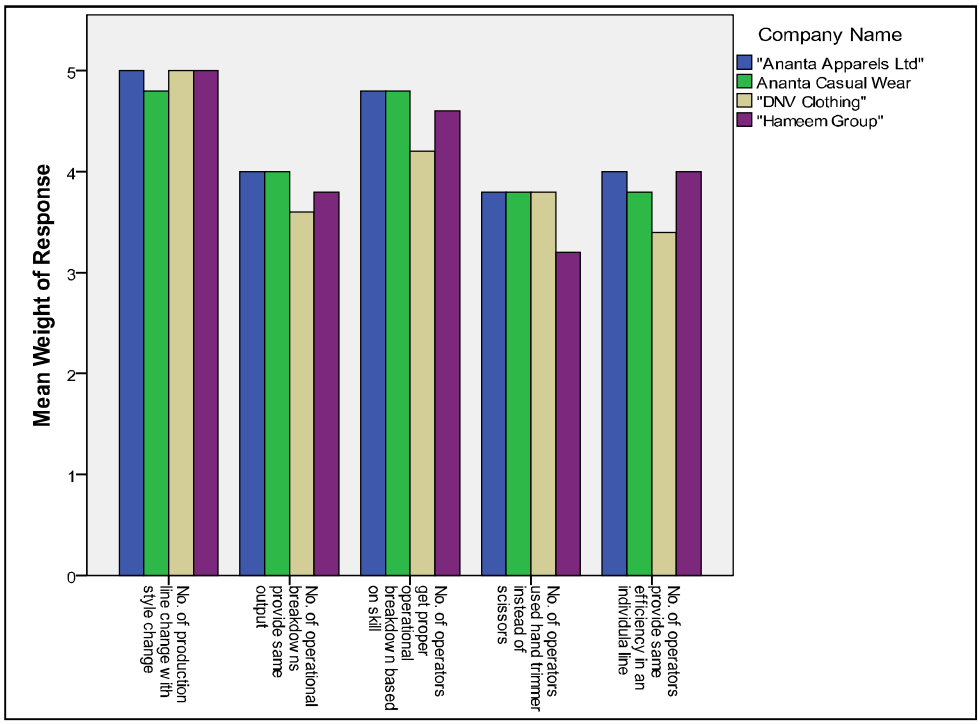

Figure 4: Survey Responses in Line Balancing

4.3. Productivity Calculation

As discussed earlier, a specific style was chosen so that a clear comparison can be done among four factories. A basic five pocket men's trouser has been selected, and its production per hour is also calculated in order to find out productivity.
A table is given below.

Factory Name	No. of Machines	Total manpower	Output/ hour	Machine Productivity	Manpower/Labor Productivity
Ananta Apparels Ltd	58	78	145 pieces	2.5 pieces per hour	1.85 pieces per hour
Ananta Casual Ltd.	53	71	120 pieces	2.26 pieces per hour	1.69 pieces per hour
Hameem Group	45	61	100 pieces	2.17 pieces per hour	1.63 pieces per hour
DNV Clothing	38	50	80 pieces	2.10 pieces per hour	1.6 pieces per hour

Table 6: Machine & Manpower Productivity Calculation

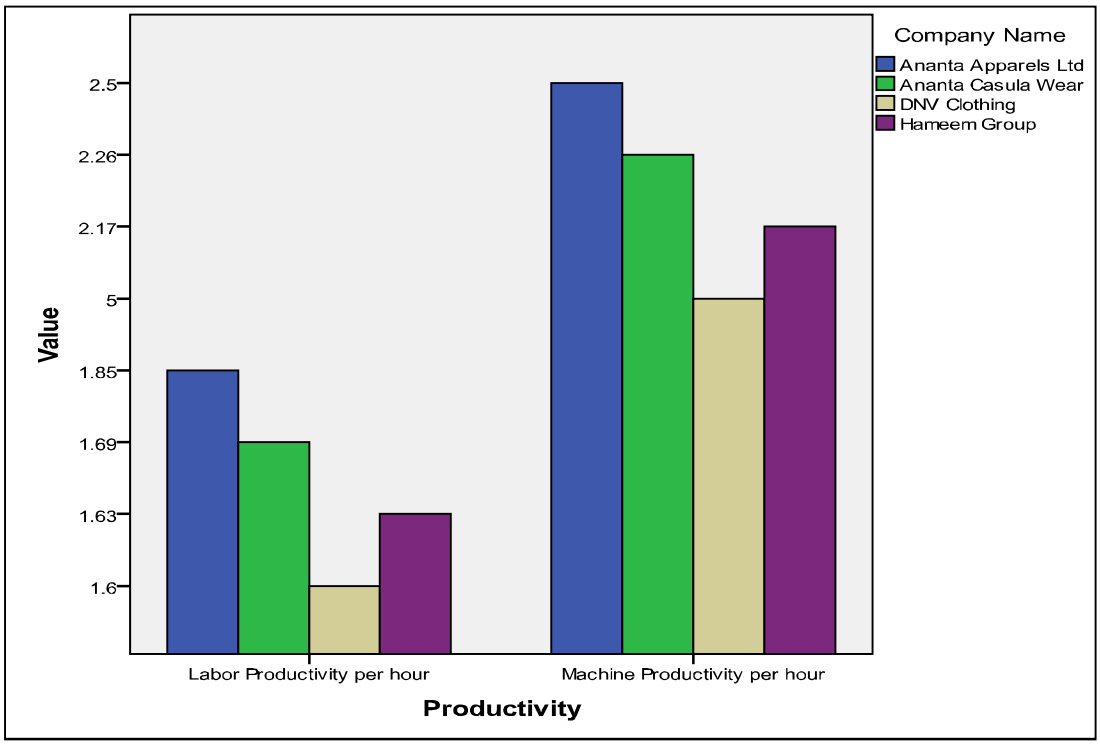

Figure 5: Comparison of Productivity

5. Conclusion

As Line Balancing discussed for productivity improvement in the survey and one thing is very clear that, Ananta Apparels have more implementation of the factor than others, and it is followed by Ananta Casual Wear, Hameem Group and finally DNV Clothing.

For the productivity improvement one specific item 'five pocket men's trouser was selected, this is a common item in apparel industries, and it is selected so that productivity of different companies can be compared and conclusion can be drawn by implementing Assembly Line Balancing techniques,with the intention that productivity can be fortified for identical items.

In a nutshell, the primary intend of this paper is to show that, the productivity can be improved by applying different tools and procedures, finally it has been proved that the apparel factories applied more tools and procedures like Assembly Line Balancing better their productivity is.

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Appendix A

Age: _____
Sex: _____
Section: _____
Have you any acquaintance of Assembly Line Balancing: Yes [ ] No [ ]

Questionnaire

Line Balancing	**0-20%** 1	**20-40%** 2	**40-60%** 3	**60-80%** 4	**80-100%** 5
1. How many production line change with the change of style?	**O**	**O**	**O**	**O**	**O**
2. In a line how many operational breakdowns provide same output?	**O**	**O**	**O**	**O**	**O**
3. How many operator get proper operational breakdown based on his skill?	**O**	**O**	**O**	**O**	**O**
4. How many operators used Hand trimmer instead of scissors?	**O**	**O**	**O**	**O**	**O**
5. How many operators provide same efficiency in an individual line?	**O**	**O**	**O**	**O**	**O**