ICMIEE-PI-140339

PRODUCTIVITY ANALYSIS AND SUGGESTIONS FOR IMPROVEMENT A CASE STUDY IN A LOCAL COMPANY

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ABSTRACT
Productivity is the efficiency with which a firm converts inputs into outputs. Productivity improvement is always a focus area in a manufacturing industry/company. One of the major causes of company's decline in profit margin is low productivity. This paper focuses on productivity improvement of a local Tube Light production company in Dhaka. It is found that the main problem of the company under investigation might be related to improper production process of tube light, design, layout and wastage of final product due to non-conformity (rejection) with designconformity (rejection) with design. We found the lack of good layout also created bottleneck in the flow of semi-finished and finished products in the shop floor. It has been seen that backdated machineries also created bottleneck. In this article it has also been discussed the application of the principles of lean manufacturing for reducing seven types of wastes such as over production, waiting, transportation, motion, inventory, over processing, defective units. It was concluded that for producing mount the two end wires should be placed accurately in correct position and the right flange tube with good properties and best raw materials can be imported for reducing wastes and also for decreasing bottlenecks upgraded machineries are necessary. Finally it is hoped that if the recommendations are accepted and implemented then positive results will surely be achieved along with huge increase of profit margin.

Key words: Productivity analysis and improvement, Tube light manufacturing, Leanmanufacturing.

1. Introduction: [5],[9],[10]

Productivity is the quotient obtains by dividing output by input of production. In this way it is possible to define the productivity of capital, investment or raw materials according to whether how the output is being considered in relation to capital, investment or raw materials etc. Thus, productivity is defined as the efficient use of resources-labor, capital, land, materials, energy, information-in the production of various goods and services. This is usually stated as:

$$\textbf{Productivity} = \frac{\textbf{Output}}{\textbf{Input}}$$

The European Productivity Agency (EPA) has defined productivity as follows:"Productivity is an attitude of mind. It is a mentality of progress of the constant improvement of that which exists. It is the certainty of being able to do better today than yesterday, and continuously. It is the constant adaptation of economic and social life to changing conditions, it is a continual effort to apply new techniques and methods, and it is the faith in human progress."Productivity can also be defined as the relationship between results and the time it takes to accomplish them Productivity compares at production and shop-floor, organizational, sectorial and national levels, etc., with resources consumed.

Bangladesh is a developing country and a lot of industry stands behind on its economic growth, but it is a matter of sorrow that because of different problems related to wastage; backdated machineries, improper management of inventory system; lacking of good supply chain management; management problems related to worker efficiency, worker motivation and distribution problem; lack of research & development, improper supervision on imported material; etc., the productivity remains comparatively low and these industries fail to get their desired or planned goal.

The authors did this study in a local tube light production company at Dhaka for finding out different problems related to productivity and with the aim of giving recommendation on productivity improvement. The authors found out that (i) wastage in backdated machineries is the main culprit for lower productivity and (ii) major wastage came from improper "mount making" (a part of tube light), (iii) the properties of flange tube from which mount was made were not good enough to withstand in high temperature, etc., therefore the wastage of final product was relatively big along with other problems as discussed later.
So, it is not possible to eliminate or solve all the problems but the authors tried their best to find out some possible problems of wastage of final product and they finally mentioned some suggestions to implement. We think, if these are implemented the company can achieve its desirable profit.

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2. Objectives of the study

At the outset of the study, authors set objectives as (i) Analysis of decline in productivity and its improvement through waste elimination. (ii) Making recommendation for improvement of safety and planning for hazardous process (iii) and recommendation of possible changes in present layout system in the plant under case study.

3. Methodology of the study

- At first, the authors decided to explore the whole industry and learn about the whole production system of the industry also want to learn about the different machineries and their working systems.
- After knowing about the whole industry, the authors tried to find out the possible causes of bottlenecks related to production and about various leakages in the industry.
- After that the authors tried to work for achieving set objectives already mentioned earlier.
- The authors collected various data related to productivity improvement, and also talked to related workers and officers of that industry with different issues related to safety and hazardous environment.
- Finally the authors calculated the wastage at individual machine then by incorporating the whole process and found the total wastage.
- Then, recommendation relating to improvement of present system of manufacturing has been made.

4. Case study (Company A)

As requested by the authority of the company the authors decided not to disclose the name of the company and henceforth it will be called "Company A". The fluorescent lamp is an electric lamp consisting of a glass tube, coated on inside with a fluorescent substance that gives off light when acted upon by electricity. Fluorescent lamps and incandescent lamps are the two major sources of electric light today. Typical fluorescent lamps consist of a long glass tube that seals the inner components from atmosphere. These inner components include two electrodes that emit a flow of electrons; mercury vapor, which is the source of ultraviolet radiation; argon gas, which helps in starting the lamp, and of course fluorescent coating on the inner surface of the tube[1]. A step-by-step breakdown of the phases of the process, checking the inputs, checking the outputs, and operations that take place during each phase were checked and observed carefully. A process analysis was made later to improve the understanding of how the process operates, and to determine potential targets for process improvement through removing waste and increasing efficiency[2].

4.1 Manufacturing process

During study we checked the whole process of the manufacturing system of the industry "Company A" systematically and gradually. The whole working process of manufacturing of the fluorescent tube light is shown below in **Fig. 4.1**

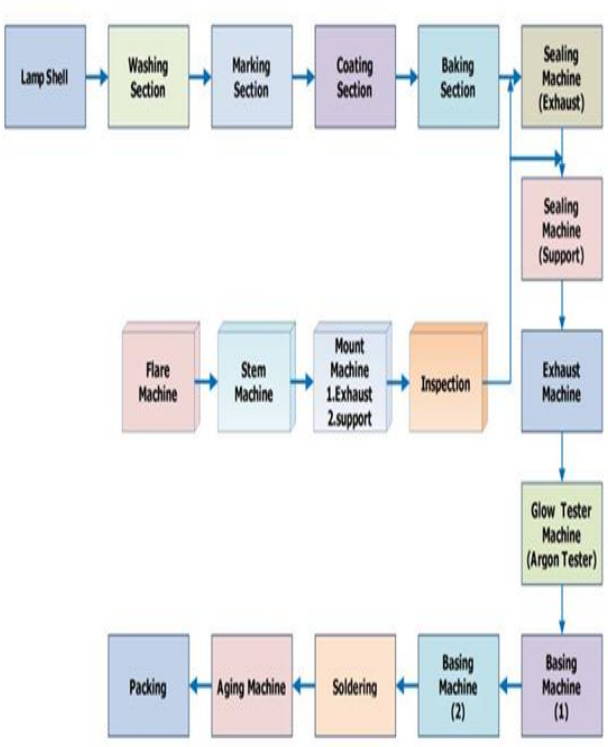

Fig.4.1 Production flow process of company

5. Productivity and wastage Analysis

5.1 Classification of Productivity[10][3]

Productivity can be classified as follows

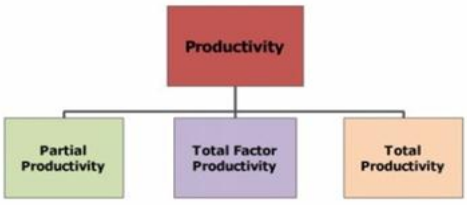

Fig.5.1 Classification of Productivity

A. Partial Productivity
It is the ratio of output to one class of input. For example, labor productivity (the ratio of output to labor input) is a partial productivity measure. Similarly, capital productivity (the ratio of output to capital input) and material productivity (the ratio of output to materials input) are examples of partial productivity

Partial productivity (labor) = Output/Labor input.

B. Total-factor Productivity
It is the ratio of net output to the sum of associated labor and capital (factor) inputs. By "net output, "we mean total output minus intermediate goods and services purchased. It can be noticed that the denominator of this ratio is made up of only the labor and capital input factor.

$$\textbf{Total factor Productivity} = \frac{\textbf{Output}}{\textbf{Labor+Capital}}$$

C. Total productivity
It is the ratio of total output to the sum of all input factors. Thus, a total productivity measure reflects the joint impact of all the inputs in producing the output.

$$\textbf{Total Productivity} = \frac{\textit{Output}}{\textbf{sum of input}}$$

All activities in manufacturing processes that do not add any value to the products are considered as wastes. It is necessary to find all sorts of wastes. All activities in manufacturing process that do not add any value to the products are considered as wastes. It is necessary to find all sources of wastes in manufacturing processes. The main concern of an industry is to reduce the percentage of waste from their production system with an aim to improve productivity. That's why, it is necessary to suggest the ways of wastage elimination.

The Japanese are true believers in eliminating waste. Waste in Japan, as defined by Toyota's Fujjo Cho is "anything other than the minimum amount of equipment, materials, parts and workers (working time) which are absolutely essential". In most organizations, few people in the organization have the ability to change a product or service to increase the value it offers to the customer, but everyone can reduce waste if he/she desires and truly examines.

5.2 Analysis and Finding Percentage of wastage for manufacturing of fluorescent tube light

In "company A" several semi-automated, manual processes are used to produce fluorescent lamps. It was found that in producing these lamps major wastage occurred in several sectors of production process. Machines of the industry were found to be backdated which lost its total depreciation value many years back. Wastes at different machining operation, as actually found, were listed in **Table 5.1**

5.3 Elements of Wastage Elimination
The following elements may be considered relating to waste elimination [3], [4]**:**

- Focus Factory Networks
- Group technology,
- Quality at the Source ,
- JIT production,
- Uniform plant loading,
- Kanban production control system,
- Minimize setup time.

In the case of "company A.", the major causes of wastage are found for improper quality of raw materials (especially for making "*Flange tube*"), non-uniform plant loading and more setup time. Overall production process wastage in this industry is occurred for these three basic elements [7], [8] and [9].

Table 5.1 Average wastage at different machining process

Number of Process	Name of Process	Standard Production per day	Experimental Production per day	Amount of wastage per machine per day	Percentage of Wastage (%)
1	Washing & drying	4800	4000	56	1.4
2	Marking	4240	4000	40	1
3	Coating	6400	6000	96	1.6
4	Backing machine	4240	3224	21	0.62
5	Neck cleaning machine	4240	2984	17	0.57
6	Sealing machine	4000	2928	176	6.01
7	Exhaust machine	4000	2904	256	8.81
8	Basing machine	4800	2448	104	4.25
9	Final inspection	-	-	-	4
	Total production process wastage				28.26(%)

Wastage statement for last 10 (ten) years
In case of "company A" overview of the percentage of wastage for last eleven fiscal years is listed into the **Table 5.2** these data are collected from sales and marketing department of the industry. These shows the industry's past and present situation in case of per year wastes. (Annual Reports of "company A")[7&8]

Table 5.2 wastes statement from 2003 to 2014

Serial no.	Fiscal Year	Percentage of wastage (%)
01	2003-2004	16.33
02	2004-2005	19.92
03	2005-2006	19.90
04	2006-2007	21.99
05	2007-2008	20.99
06	2008-2009	21.97
07	2009-2010	21.72
08	2010-2011	23-22
09	2011-2012	21.98
10	2012-2013	19.18
11	2013-2014	28.26

5.4 Overall Wastes Calculation
The overall wastage calculation of "company A" for the fiscal year 2013 is listed below in Table 5.3[7&8].
Table 5.3 Per year overall wastes in "company A" for the fiscal year '13-'14.

Input	551934 Pcs.
Total production	396000 Pcs.
wastes	155934 Pcs.
Percentage of Wastes	28.26 %

Total cost of wastes for per unit market price cost,
To produce one 4 feet40 inches watt tube light, the estimated cost of production is =94 Tk.
Therefore total cost for wastes during production
= (1, 559, 34×94) Tk.
=14,657,796 Tk. (1)

$$\text{Productivity} = \text{Output/Input}$$
(Before reducing wastes at desired level)

$$= \frac{396000}{551934} \times 100\%$$

$$= 71.74\ \%$$

Here it is clear that, the total cost of production for wastes is about 14,657,796 Tk. This is a big loss of the industry. This huge amount of production loss which actually occurred in the industry hindered to achieve its desired goals as targeted. Now it is essential for this industry to reduce the wastes. If the industry wants to improve its total productivity it is necessary that with respect to input the amount of wastes must be reduced. If the proper implementation of the proposal as discussed in recommendationis done by the industry, the wastage may be reduced from 28.26% to 19.26 % and thus the total production might be increased if wastages are reduced.

Table 5.4 Overview of industry production line for reducing to 19.26% wastes in fiscal year 2013-14[9]

Input	551934 Pcs.
Total production(Output)	4,45,632 Pcs.(increased from 396000 Pcs)
Output increased	49,632 Pcs.
Wastes	106302(Reduced from 1,55,934 Pcs)
Number of wastes reduction	49,632 Pcs

Using the above Table, we get,
Total cost of production for wastes
= (106302×94) Tk.
= 9,992,388 Tk. (2)

Productivity=Output/Input
(After reducing waste to suggested level)

$$= \frac{445632}{551934} \times 100\%$$

$$= 80.74\%$$

Here the difference between the Eq. (1) and Eq. (2) show the amount of reduction wastes after implementation. Thus the amount of wastes reduction becomes around 4.7 million Tk.

6. Layout Design

6.1 Existing layout

The existing layout of "Company A" has been found to be very poor. Machines were arranged as product layout orientation. There was no uniform production operation in different machines therefore bottleneck in flow was created in different areas especially in coating section. It was found that the production rate was 750 pcs./hour in total on an average. After coating operation the flow of production becomes too slow and in baking section the production rate becomes 320 pcs./hour and that was around half of the previous operation. Another important thing was the movement of mount and it was used to be done manually therefore that was time consuming also. The existing layout is shown in **Fig.6.1**. Flow description can be found in details in [9].

6.2 Proposed Layout

To overcome various production related problems a proposed layout was suggested[9]. The proposed layout is shown in **Fig.6.2**. In proposed layout the authors recommended two parallel lines of production after coating section and two different conveyors might be used in the proposed two different sections. That might increase the production rate of the company. Two conveyor belts were also suggested from mount making section to sealing section which might also enhance the production rate. A proper ventilation system might also be incorporated in whole industry and in coating section air cooling system may be instated. If possible present inventory of final products keeping area near the entrance might be rearranged.

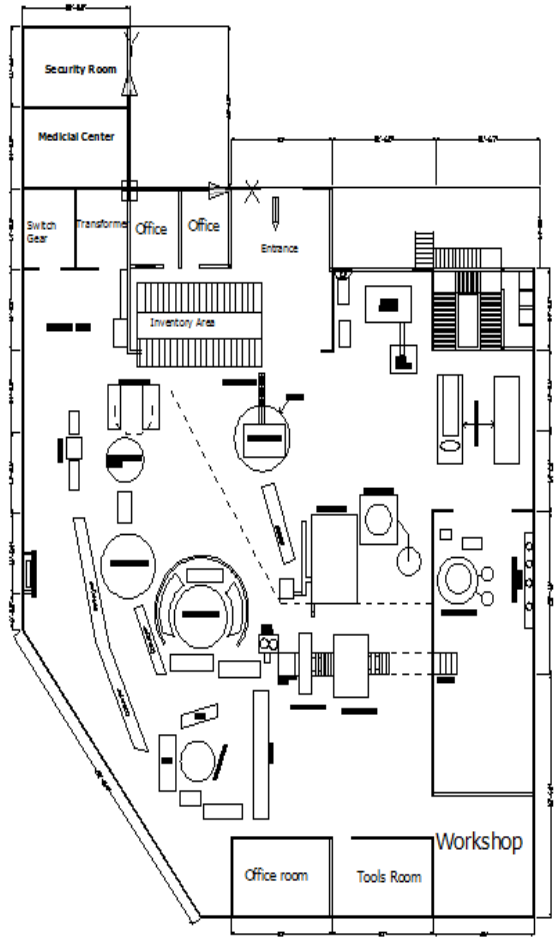

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Fig.6.1 Existing Layout of "Company A"

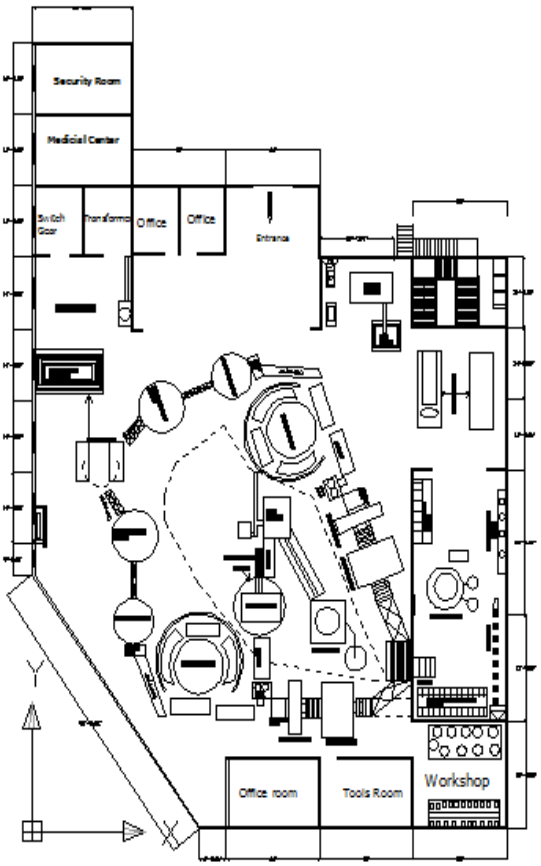

Fig.6.2 Proposed layout of "Company A"

6. Problem as Observed

The authors thought that following problems might be the cause of low productivity that generated from case study of "company A":

i. Poor exhaust system existed,
ii. Unfavorable working condition because of hot surroundings,
iii. Flow of combustible gas for manufacturing process was not continuous,
iv. The properties of flange tube was not good enough,
v. Some machines were found to be too old,
vi. Some portion in exhaust operation area was too hot to be operated manually,
vii. Workers were not conscious about hazardous situations and also about safety standards,
viii. Small broken glass were found in scattered condition here and there,
ix. Poor marketing policy,
x. Bottle neck in production flow process was found in different sections
xi. Improper implementation of 5'S and Kaizen,etc.

7. Recommendations

Here are our suggestions and recommendations for improving the situation:

i. As the inside surroundings are so hot so proper exhaust system should be installed,
ii. The imported properties of material of flange tube should be checked continuously for quality,
iii. Continuous flow of gas for production should be confirmed,
iv. Automated handling system should be increased for improving efficiency,
v. Old machineries are needed to be replaced,
vi. Proper marketing strategy should be implemented therefore advertisement in television / radio / billboard / other media, should be provided,
vii. Although mentioned in company's booklet, 5S' and kaizen, etc., were seen not to be implemented properly. So, That should be properly done for the sake of improving the productivity.
viii. Proper motivation should be done by providing incentives / reward system / other motivational mprinciples, etc.,
ix. To eliminate flowbottlenecks found in coating and baking section, the authors recommended a proposed layout (as shown in **Fig.6.2**) where two parallel lines of production after coating section have been proposed to be installed.

7. CONCLUSION

The authors are of the opinion that if the suggestions made in this paper are implemented, the overall productivity of the company might increase.

8. ACKNOWLEDGEMENT

The authors gratefully acknowledge the suggestions / opinions / advices ect., given by the Company A officials. The authors are also thankful to the authorities of Company A for allowing them to study the problems mentioned in this paper which was essential as a partial requirement of B. Sc. Eng. degree.

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