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3. Industrial Engineering Tools and Methods for Productivity Improvement

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ABSTRACT

Any company's outputs and earnings are directly influenced by the number of flaws they have. Optimum productivity is achieved by maximising the use of available resources while reducing industrial waste to the minimum amount achievable, resulting in lower production costs. The investigation began by observing the regular operating procedures and gaining a grasp of the current process flow. There was also a focus on the production line as a way to identify potential issues and areas for improvement. An integrated platform of time and method studies and layout studies helped detect and correct the time lost in unnecessary movements of labour and tools that resulted in long machine idle time. The usual and time-consuming packing procedure was simplified by the adoption of a newer method. There were ideas put up about how to reduce the amount of time that machines sit idle, how to use zip ties instead of the old packaging approach, and how to reduce the amount of non-value-added tasks that occur in the industry. In a highly competitive business, spinning mills face the problem of increasing productivity in order to remain profitable. It is critical to give better products at lower costs to the end user through increasing the efficiency of the plant, as every input cost rises year after year. At this point in time, the company is capable of producing over 85680 spindles each day. Due to a variety of factors, this capacity cannot be fully exploited.

KEYWORDS

Industrial Engineering, Productivity, WIP, Industry.

Introduction:

The key to improving productivity is to focus on the correct things and make them a part of your daily routine. Therefore, it is critical to implement an effective productivity enhancement strategy to ensure the progress of both individuals and organisations. It is the ratio of output to input that determines productivity. What we produce and what we spent to make it are quantitatively related. In the end, productivity is nothing more than a reduction in the amount of resources that are wasted. A human effort to produce more and more with fewer and fewer inputs of resources can be used to describe this concept, which aims to maximise benefits to the broadest possible audience. It is the link between output and one or more of the associated inputs that is defined as productivity. Success and profitability are both dependent on increasing productivity [1]. Measurement of productivity takes time. A long-term increase or decrease in numbers can be seen in the dynamic potential of a system.

On the other side, industrial engineering focuses on developing, improving and putting in place an integrated system of people, materials and equipment. Engineering analysis and design principles, as well as specialised knowledge and abilities in the mathematics, physics, and social sciences, are used to anticipate and evaluate the outcome of a system's performance. Quality has become increasingly crucial in today's market because it leads to an increase in product sales and a rise in the company's profits [2]. Each of these factors had a significant impact on the other. Increasing productivity necessitates an increase in quality, which in turn lowers the rate of rejections or defects.

Increased productivity (improved) should be sought in countries where capital and talent are scarce, while unskilled labour is numerous and poorly paid, so that the output per machine or piece of plant or per skilled worker can be maximised. Increasing or enhancing productivity by employing the same amount of materials, machine time, land, labour, or technology is known as productivity improvement [3-5]. To increase productivity, products must be created to meet the needs of the client while consuming the least amount of resources possible without generating waste. Japanese Holistic Productivity can be easily seen in the following figure 1.

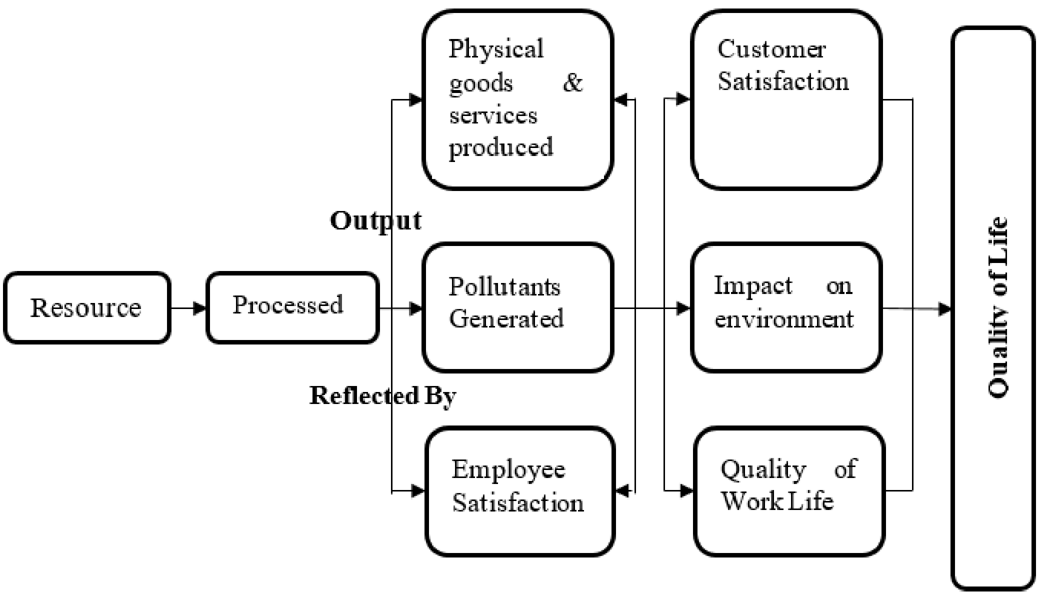

Fig.1: Japanese Holistic View of Productivity Concept

'Productivity is an attitude of mind,' says the European Productivity Council. That which is already there is always being improved upon. Confidence that you can accomplish better than you did yesterday and every day. It is a continual adaptation of economic and social activity to shifting conditions and circumstances. It's a never-ending battle to keep up with the latest tactics and methodologies [6]. It is a belief in human advancement. According to 'Peter Drucker,' productivity is the ability to maximise output with minimum effort by balancing all aspects of production. It's also worth noting that according to International Labour Organization (ILO) standards, productivity is a measure of how much output is produced compared to how much labour is put into it.

Responsibilities of Industrial Engineers:

1) Capacity study
2) Work study
3) Time study
4) Operator performance
5) Follow-ups
6) Work in Progress (W.I.P)
7) Line balancing

Before proposing a solution, an engineer must first understand the root cause of the problem. However, a rational and systematic approach should be used to locate and eliminate the main cause of the problem, thereby making the task easier. From simple and straightforward procedures to more complex and advanced statistics, there are a wide range of options for problem solving. Scientific management approaches can be applied and understood more easily with the Seven QC Tools. In all stages of the product development process, from the beginning to the end, it can be employed, on a daily basis and in a systematic manner. All issue resolution and quality control activities are based on them [7-10]. The seven QC tools are: the check sheet, the Pareto chart, the flowchart, the cause-and-effect diagram, the histogram, the scatter diagram, and the control chart. This type of instrument is referred to as Total Quality Management (TQM).

Importance of Higher Productivity:

- Productivity is a key to prosperity
  Higher production as a result of improved productivity has a direct bearing on people's well-being. As a result, the cost of each unit is reduced, allowing the sale price to be reduced. It raises wages for workers and boosts the bottom line of the company. As the economy grows, so do the number of job openings.
- Higher productivity leads to economic growth and social progress.
- Increased production lowers the cost per piece, making the product more accessible at a lower price. As a result, customers stand to gain from this. As a result of the increased demand for the goods, the company's profits rise as well. An organization's increased earnings allows it to pay a larger dividend to shareholders. It boosts a country's exports and its foreign exchange reserves.
- Higher productivity requires elimination of waste in all forms.
  In order to increase output, it is vital to reduce wastage of raw materials, time, space, and other resources. Waste of resources can be minimised by employing a variety of methods, including work studies, statistical quality control, inventory control, operational research, and value analysis, among others. In countries like ours, reducing poverty and unemployment can be achieved through increasing productivity.

Objectives:

- To identify areas for potential productivity improvement.
- To have higher level of output through wastage reduction

Review of Research:

Varsha Karandikar, Shriram Sane, and Rahul Pulkurte, the authors of a research paper entitled 'The research Improvement in Line Feeding System in Assembly Plant using Lean Manufacturing Technique' expressed their thoughts as, Effective planning and designing of manufacturing processes and equipment leads to maximum utilisation of the resources available, resulting in the least possible industrial wastage, thus resulting in low production costs.

Industrial engineering tools in the paint industry will be examined in this article. After watching the regular operating procedures and learning about the current process flow, this investigation began. Observations of the production line were also made in order to spot any potential issues or places in need of improvement.

The combination of time study, method study, and layout study methodologies provided a solid foundation for identifying and correcting the time lost due to unnecessarily extended idle times on machines caused by excessive labour and tool movements. The customary and time-consuming packing procedure was streamlined.

Proposals for streamlining the manufacturing process and utilising more efficient material handling were made, as well as the usage of zip ties as a more effective packing method, which would reduce the amount of time spent on non-value-added tasks.

To improve productivity, operational availability, and the overall efficiency of the production line, modern forging businesses are embracing new equipment and techniques. This study examines how an Axle Beam line straightening cell's setup time can be shortened.

To reduce waste in a manufacturing process, SMED is one of many lean strategies. In order to reduce setup time, SMED and other Lean Production tools such as 5S, Visual Management, Kaizen, and Standard Work were used.

As a result, the setup time for the procedure was greatly reduced (from 52 to 24 minutes). The set-up time was reduced by 53.85 percent.

Statistical Process Control was used by Pierchala and JyotiSurti and Winco to tackle challenges in their case study.

Check sheets, pareto charts, cause-and-effect diagrams, and control charts were all used by a plastic injection moulding company to reduce monthly failure rates from 13.59% to 7.41%, according to Jafri and Chan. Figures like histograms and pie charts were employed by Naser in their case study.

Research Methodology:

The researcher travelled through the facility and identified each operation process involved from raw materials to finished items, located all of the sites where inventory is housed between the processes, and watched how the material flowed from one operation to the next. There were then several visits to the company's production lines, product process flows, and amount of faults produced in each production line to be studied in detail. In addition, operators were interviewed and defect product data was collected and analysed using a Pareto Chart to get their feedback. An investigation was then carried out to discover the root source of defects, and four solutions were presented to address this issue. Before deciding on the optimum solution for the organisation, a manufacturing cost study was conducted.

Result and Discussion:

Factors of Productivity Improvements:

Table 1 lists a number of elements that might have a good or negative impact on productivity. Some variables are within our power to influence, while others are out of our hands due to the laws of nature [11].

Sr. No.	Factors
1	Capital investments in production
2	Capital investments in technology
3	Capital investments in equipment
4	Capital investments in facilities
5	Economies of scale
6	Workforce knowledge and skill resulting from training and experience
7	Technological changes
8	Work methods
9	Procedures
10	Systems
11	Quality of products
12	Quality of processes
13	Quality of management
14	Legislative and regulatory environment
15	General levels of education
16	Social environment
17	Geographic factors

Table 1: Factors of Productivity Improvement

A plant layout, problem identification, productivity analysis, project scope, and project timetable are all addressed in this phase of the project planning.

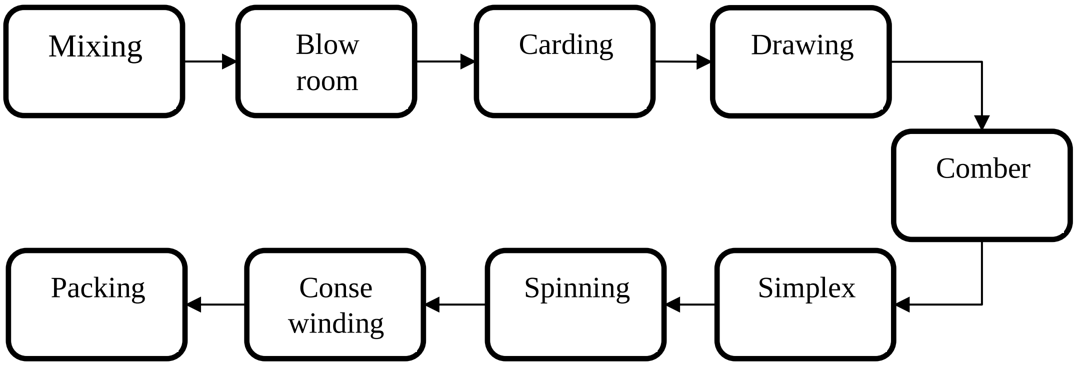

Fig.2: Plant Layout

Measure:

During this phase, data is gathered to establish baselines for the process. Every month, the plant's actual capacity was measured and recorded.

Spindle count per unit of time is a common unit of measurement for determining plant capacity. Spindle capacity per month can be used to calculate this figure [12].

Thus plant capacity is found by the following method:

Total number of frames available = 34

Number of spindles available in 1 frame = 840

Total number of spindles available= 840 * 34 = 28560

If 100% of spindle run in a day, spindles can be changed 3 times,

Therefore, total number of spindles available in day = 28560*3 = 85680

In a month total number of spindles available = 85680 * 30 = 2570400

So total Plant capacity =2570400 Spindles / month

Utilization Factor = (Actual spindles worked in a month /2570400)100

Actual Production Rate:

Data regarding actual production rate is taken from the industry.

Month	No. of spindles	Utilization
Apr-15	1891260	81.75
May-15	2198700	85.54
Jun-15	2239860	87.14
Jul-15	2312100	87.05
Aug-15	1279740	62.23
Sep-15	1897560	85.63
Oct-15	2131920	82.94
Nov-15	2133180	82.99
Average	2010540	81.90875

Table 2: Average no. of spindles and utilization factor for 8 months

How many spindles can a factory create in a given period of time? The factory has a monthly output capacity of 2570400 spindles. We calculated the average monthly production rate of 2010540 spindles by analysing the monthly production statements for eight months.

This resulted in a monthly loss of around 559860 spindles. By analysing the data, we were able to calculate the plant's utilisation factor for 8 months as 81% [13-15].

Analysis:

Monthly cause-wise stoppages are discovered and their percentage of occurrence is estimated using Pareto chart analysis in the analysis stage Critical variables reducing productivity were discovered through WHY–WHY analysis [16].

Month	Maintenance and repair		Power failure		want of hands		Others		BS stoppage	
	Spindle	%	Spindle	%	Spindle	%	Spindle	%	Spindle	%
Apr-15	39900	1.73	219240	9.48	12600	0.54	150360	6.5	0	0
May-15	55780	2.22	224370	8.74	28560	1.11	62990	2.39	0	0
Jun-15	61320	2.38	223440	8.69	23520	0.92	22260	0.87	0	0
Jul-15	63420	2.44	206220	7.76	45780	1.72	28560	1.03	0	0
Aug-15	36960	1.79	134820	6.56	31920	1.55	21000	1.03	551880	26.84
Sep-15	70980	2.76	197400	7.68	212520	8.27	159600	4.08	32340	3.39
Oct-15	57960	2.26	163380	6.36	177240	6.9	39900	1.56	0	0
Nov-15	65520	2.55	257460	10.02	77280	3.01	36960	1.43	0	0
Average	56480	2.26	203291.3	8.161	76177.5	3.002	65203.75	2.361	73027.5	3.77875

Table 3: Monthly Cause-wise stoppage

Pareto Chart Analysis:

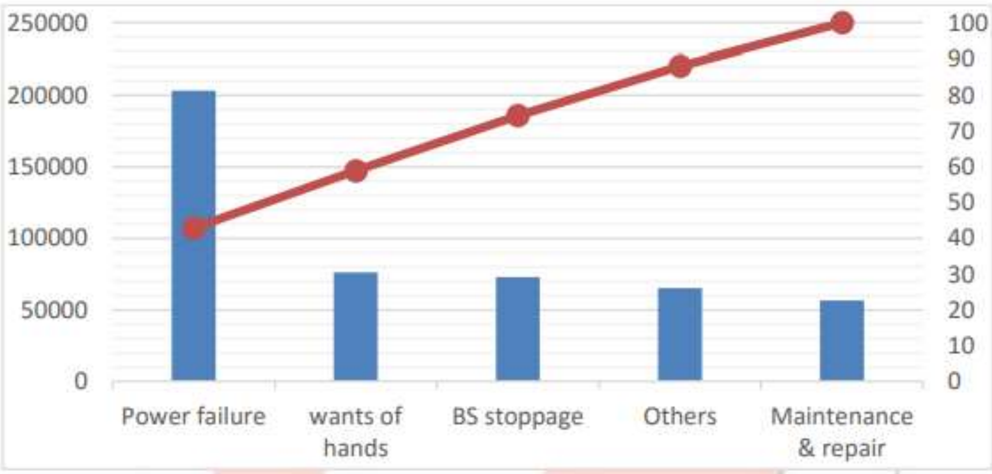

Fig.3: Pareto chart analysis of cause wise stoppage of Spindle

Over 60% of overall productivity losses are attributable to power failure and absenteeism according to Pareto study. Only for the past two months has there been a back step shortage. Due to the quick shift in the product, each industry has its own explanation. Because Maintenance and repair costs account for only a small percentage of the total losses, we can ignore them. This means that power outages and employee absence are the most significant contributors to decreased production in the spinning mill business [17-18].

Why-Why Analysis:

Because power outages and employee absenteeism have been recognised as important causes of productivity loss, a why-why study has been done to determine the true causes of these issues [19].

Reason	Why	Why	Why	Why	Why
Productivity loss	Absenteeism	Morale drop	Working condition	Hot atmosphere	Poor ventilation
Productivity loss	Absenteeism	Attitude	Remuneration Paid	Lack of incentives	Company Policy
Productivity loss	Absenteeism	Skill gap	New workers	Lack of training	Lack of commercial integration
Productivity loss	Power failure	Drop in compressed air pressure	Leakage in piping system	Old GI piping network	Lack of maintenance of underground piping network

Table 4: why-why analysis

Suggestion of New Compressor Pipe Line Layout:

Compressed air is essential to the manufacture of yarn in the textile industry. Using compressed air more efficiently can have a huge economic impact on the industry. Compressed air systems can be more efficient if they are correctly configured and maintained. This can be done through reducing energy waste. Mahe spinning Mills' compressed air system may be improved by reorganising the compressor pipe system, adjusting air supply to demand, and applying a control plan that eliminates moisture carryover [20]. The most cost-effective way to conserve energy is to stop compressed air leaks. It's possible to do so.

- Replace GI pipes with aluminium composite pipes, which will lessen the amount of compressed air that leaks out of the system.
- Some adjustments have been made to the current piping network structure.

New compressed air pipeline design attempts to reduce air leakage and maintain a steady pressure level. An auxiliary compressor system (ELGI 22 kW, 1000 lit receiver, tiny drier) is located next to the cone winding section and serves as a backup to the plant's main compressor system (ELGI 75 kW, 2000 lit receiver, 500cfm drier). In the revised design, the compressor configuration and pipeline layout are somewhat altered. It is possible to switch between the two compressors. In the event of a power outage, the plant's generator only has the capacity to run some of the cone winding and spinning sections [21-22]. So, if the main compressor is located closer to the cone winding section and the ringmain with 2" aluminium composite pipes is installed in the cone winding and spinning sections, the compressed air can be circulated solely to the appropriate parts during power failures by closing valves. In addition, it would be beneficial to keep the air pressure constant.

Conclusion:

In order to enhance the nature of their job and their processes, the garment industry needs to use this Industrial Engineering approach. Because the garment business is considered a buyer-driven or customer-driven one, worldwide rivalry has increased the intensity of apparel production. The industry needs to be more efficient in order to compete in today's competitive marketplace. The most critical elements for enhancing the industry's productivity and efficiency are those discussed in this article. Employees at the Spinning Mill were polled about their feelings about their jobs, and the results revealed that the pay and benefits package was the biggest source of unhappiness. The corporation was advised to implement an incentive programme based on productivity in order to lower absenteeism and boost output. Another issue that hampered output in the industry was a power outage. In the event of a power outage, the plant's generator can only be used to power the cone winding and spinning portions. There will be a loss of productivity as a result of all other operations being put on hold. Additionally, it takes 20 to 30 minutes for the spindle to reach full functionality, resulting in a loss in overall production. Compressed air leaking was a major factor in this. It was proposed that the existing pipeline layout be modified in some way to accommodate the new pipeline structure. The new layout's cost and return on investment were calculated. The proposed compressed air piping system layout is expected to cost Rs 39,99,314. The anticipated expense has a payback period of 5.2 months. The industry will be able to run an additional 28560 spindles every two months if the recommendations are implemented, resulting in an additional shift of work every two months. Spindle usage can be raised by about 4%. Payback period will yield a profit of Rs 949190 per year for the company.

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