PRODUCTIVITY ENHANCEMENT IN GARMENT INDUSTRY USING INDUSTRIAL ENGINEERING PRINCIPLES

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ABSTRACT

The industries are always trying to improve production and the quality of their products to sustain in the enormous competitive market. The sustainability and profitability of the industry is governed by the productivity of that industry. Improving productivity of an industry is very essential for its growth and development. Such productivity is achieved only with the help of industrial engineering. To know more about Industrial Engineering and its application in solving industrial problems done literature survey for applying industrial engineering concepts to solve industrial problems. A Case study was carried out in an Textile industry and identified the problems affecting the productivity of the company. Then collected related data for solving and solved the problem using Lean concepts and TRIZ. Finally, and got solution to improve the productivity of the company.

Keyword – *TRIZ, Lean, Productivity, Yarn, industries*

1. INTRODUCTION

Industrial engineering is a branch of engineering that involves considerate how to do better things. Industrial engineers are concerned with reducing production costs, increasing efficiency, improving the quality of products confirming the health and safety of workers, protecting the environment, and complying with government principles.

In an outsaid, Industrial Engineering has tools such as Process analysis, motion analysis, time study, operational analysis, Line balancing, material handling etc and having techniques like method study, work study, work sampling, motion economy, value analysis, production, planning and control, ergonomics, operation research. Lean manufacturing, TRIZ, KAIZEN etc.

It is important to algin the customer purpose, process and people developing a lean organization. Mangers act as couches and help to get comfortable with identify the problems and practice continuous improvement.

Out of the above discussions, LEAN and TRIZ are taken into this paper. The share of the utilization of LEAN goes with Toyoto Production systems and the 7 wastages of LEAN usually happening in industries., such as in Transport, Inventory, Motion, Waiting, Overproduction, Over

processing, Defects, and skills.

TRIZ is a problem-solving method based on the logic and data not instinct, which accelerate the project crew ability to solve the problems creatively. TRIZ also provides repeatability, predictability, and reliability due to its structure and algorithmic method. There are some tools like, Technical and Physical contradictions, Standard principles and solutions, Contradiction Matrix etc are the part in it to suggest the solution to the problems.

TRIZ Steps: 1. Specific Problem, 2. General Problem, 3. General Solution, 4. Specific Solution

1.1 Literature survey

Aminah Ahmad., et.al [1] have discussed about profitability of a firm relies on productivity improvements. Ateeq ur Rehman, et al [2], have concluded that time study is an effective tool for efficient floor management in industries. Benjamin and Hazim [3] , have briefed about Six Sigma is an opportunity for organizations to increase the product/process quality and profits, and to reduce costs. Leandro et.al.,[4] paper presents of seeking the theoretical foundation of the philosophy of Lean Manufacturing, followed by a diagnosis that was developed in a textile company. Md. Atikul Islam, et.al [5] have discussed about the Industrial Engineering and Operations Management Functions was analyzed and successfully implemented at some major sections of apparel manufacturing industry including sampling & preproduction, cutting, sewing, finishing & packing and finally changeover areas. Md. Syduzzaman, er.al [6], have briefed about Total quality Management (TQM) tools. Mohammad Abdul Baset and Md. Mominur Rahman [7] represented the application of Industrial Engineering in garments sector for reducing the cost of SMV and improving productivity by implementation of proper line balancing. P F Bariani et.al [8], had combined Theory of Inventive Problem Solving (TRIZ) with design for manufacture and assembly (DFMA). It is possible to apply the concepts in Theory of Inventive Problem Solving (TRIZ) to solve drawbacks that arise in applying other industrial engineering concepts and tools. Pranjali Chandurkar et.al [9], had briefed the concept of Industrial Engineering is a key to apparel industry to improve their work nature and the methods.

1.2 Summary of Literature

From the literature review came to know that profitability of a firm greatly depends on the productivity. Lean manufacturing concepts is the most widely and commonly used concept in industrial engineering. Lean manufacturing aims in improving the quality of products by reducing the number of wastes generated during each stage of production. TRIZ is a problem-solving tool that encourage innovation to solve problems.

2.0 INDUSTRIAL CASE STUDY

A case study has been conducted in a garment industry for the solution to their problem related with the productivity improvement.

2.1 Existing Process

1. Raw Material, 2. Fabric inspection, 3. Cutting, 4. Sewing, 5. Checking and Packing

2.2 Problem statement

Loss of time during manual inspection and inconsistency in the final product

Improvement in quality because of defects

Waiting time is found to be more because of slow down due to manual inspection

Poor visibility during the inspection

2.3 Technical Terminologies

Weft /Pick – Horizontal thread

Warp /Fill – Vertical thread

Front side / Right side – Printed side of fabric

Back side / Wrong side – Unprinted side of fabric

2.4 Raw material specifications

Type of fabric used – printed woven fabric

Width of fabric – 60 inches

Length of fabric – Depends on requirements

2.5 Fabric Defects

Fabric defects are classified into three – Minor defects, Major defects and Critical defects

3.0 SOLUTION WITH TRIZ TO THE PROBLEM STATEMENT

3.1 The Specific Problem have been identified as

The loss of time and quality due to the generation of lean wastes in quality checking – waiting, defects that affects productivity.

3.2 The General Problem statement identified with TRIZ

There are two demands in the form of lean waste reduction. In the existing method of quality checking the waiting time is reduced by speeding up the process it will generate more defects. So, there arise a contradiction between waiting and defects. Referring to TRIZ matrix, we matched improvement of waiting to speed and defects to measurement accuracy. Speed and measurement accuracy are the technical feature of TRIZ.

3.3 The General Solution with TRIZ

The contradiction has been considered as Speed Vs Measurement Accuracy and noted down the principles which have been stated in the theory.

3.4 The Specific Solution

Automation of the whole process of fabric inspection is the most difficult. Computerized and scanning technologies have been designed to inspect fabric accurately, quickly, and consistently.

The visual inspection system requires an individual to monitor and supervise the whole process of inspection. This method is time consuming and does not account to complete accuracy. Addition to that the human based inspection cause errors.

3.5 The available solutions matching with TRIZ and with the practical constraints in the companies are listed below.

3.5.1 Solution 1 – Semi-Automated (Fabric Inspection Machine)

Fabric Inspection Machines are designed to check weaving, knitting defects and shade variations in fabrics. The fabric Inspection method allows us to inspect and make necessary markings for Quality Control in the manufacturing process. The fabric inspection machines facilitate in fabric inspection process, by mechanical unrolling and rerolling of fabric. The fabric inspection machines also come with fabric length counter (length measurement), which measures fabric length while fabric checking is done.

Fabric inspections machines are equipped with all necessary features like tensionless handling, accurate length measuring, appropriate illumination, Straight roll selvedge, variable roll hardness, auto cutting of fabrics in case big rolls are converted in batch rolls. Machines are equipped AC motor thus ensuring saving of power.

With the development of latest technology, the recent fabric inspection machines can mark the faults by paper tag labels and by ink. Denim cloths, single piece dyed, plain greige, wool, filament yarns, cotton blends, and unicoloured fabrics all can be measured using one single machine

In comparison to manual visual inspecting systems used in the textile industry, these mechanized systems are good investments since they save labour, time, and inefficiencies to deliver quality. The facilities like digital maps that can be availed with these automatic machines can help in subsequent processes like cutting. Moreover, marking and mapping defects makes the job of spreading and cutting patterns around the defects easy. To achieve high quality and better organization in garment making, automated fabric inspection is a one stop solution.

3.5.2 Solution 2 - Fully Automated (Computerized Inspection System)

The textile industry world-wide has experienced dramatic technological changes during the last decade. Automated visual inspection system is an example of such advancement in fabric inspection process. The most important change is switch over from dependency on human eye to scan by CMOS/CCD camera. The process is such that the location, size and image of the defects are recorded in the system. After the inspection, the product is graded in terms of severity and the detailed report gets printed. The aim is to obtain saving of manpower and time, as well as increased accuracy in the inspection process.

At the first level of processing, the image of the fabric is transformed into a threshold image which is a digital image in grey shades, this helps the software to read and differentiate between the image of the defect and the fabric. The software marks the region with defects in the form of a window and the location of each defect is stored into the data. The defect window is further probed at the secondary level of image processing based on five attributes, namely, height and width of the defect window; the ratio of total defect area to the overall window area; total number of defects in the overall defects window and finally the ratio of the smallest defect area over the largest defect area. Based on the above-mentioned attributes, data regarding each defect is generated, which helps in the recognition and classification of defects based on standard inspecting systems such as 4-point system. The system utilizes high resolution colour line scan technology and enhanced Defect Sorting Algorithms (DSA) to achieve defect detection and interpretation.

The Web SPECTOR by Shelton Vision Systems and IQ-TEX 4 by Elbit Vision Systems (EVS) are two such products which can perform full inspection automatically.

The system has the capability to detect defects less than 0.1 mm in size, at speeds of up to 1,000 metres per minute. The solution can be used at many stages starting from the weaving of the fabric to the final of finished products. Some of the features which help in better identification of the defects are real time process monitoring and alarm, defect data for documentation, synchronization with marking and cutting software, and proprietary defect sorting algorithms.

Line scan camera, often in two or three planes of view, each with a different lighting position for better defect detection and these are back light transmission, diffuse top light and low angle top light. As the defects are detected, an image of each defect is stored along with all the identified data that allows the factory to classify the 'defect by type' in real time. An electronic defect map is created which helps in implementing the most efficient cut plan.

Automatic inspection systems are designed to increase the accuracy, consistency, and speed of the detection of defects not only in the inspection but also the manufacturing processes of fabrics. There are more advantages in using automated technology for inspection system since it is faster and eliminates high inspection error due to human frailty. More importantly, it can save the labour cost by reducing the demand for highly skilled inspectors. It takes years to train a good human inspector, and these automated systems can be installed and "trained" in a matter of weeks

4.0 PROPOSED SOLUTION

It is suggested, full automated solution with fabric inspection (suggested fabric machine 1 due to its low cost) and computerized inspection system. Due to its high cost, we can improve the productivity of the firm by stepwise implementation. First, Semi-automation of fabric inspection with fabric inspection machine by eliminating 1 labour. Later, Complete automation of the fabric inspection with computerized inspection system. The payback period for our solution is given below.

4.1 Payback Period

The payback period refers to the amount of time it takes to recover the cost of an investment. Simply put, the payback period is the length of time an investment reaches a break-even point.

The desirability of an investment is directly related to its payback period. Shorter paybacks mean more attractive investments.

4.2 Calculation - Data

Initial investment = Rs. 1,95,000 (inspection machine)
+ Rs.2,50,000 (computerized system)
= Rs. 4,45,000 /-

Cash inflow = Rs. 30,000/- (monthly labor cost)

Solution

Payback period = Initial Investment / Monthly cash inflow
= 4,45,000 / 30,000
= 15 months or 1 year 3 months

5.0 CONCLUSION

The combined Lean and TRIZ together to solve the problem more effectively and efficiently. The proposed methodology satisfies the 3 major objectives of lean manufacturing – reduced operation cost, reduced operation time and improved quality of the products.

The operation cost is greatly reduced by eliminating labor cost, automation of fabric inspection reduces the

time for inspection and identifying defects at early stages with increased accuracy improves the quality of the products.

The prosed solution also reduces the lean wastes – Waiting and Defects. Waiting is reduced by the full automation of fabric inspection. Defects are reduced by increasing the measurement accuracy. There are many industrial engineering concepts other than lean manufacturing and TRIZ that can be used to improve the productivity thus increasing the profitability of the firm

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