Quality Improvement in the Manufacturing Industry - A Review Study

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Abstract- *For achieving the global competitiveness and operational excellence in the current market condition, the organizations are bound to produce high quality products at the lowest possible costs. Productivity and quality are being the most important focus for each manufacturing organization. In this paper, different types of quality improvement tools and techniques are analyzed aiming to better quality and customer satisfaction. For achieving continuous quality improvement, different types of techniques are used like; Total Quality Management (TQM), 7 Quality Control tools, Root Cause Analysis, Plan-Do-Check-Act (PDCA) Cycle etc. The methodology for quality improvement may start from customer complaints, or their feedback. The most important task for the manufacturing industries is to identify critical problems due to poor quality, root cause analysis, selection of appropriate technique for improvement and finally long term implementation in the manufacturing system.*

Keywords- Total Quality Management(TQM), 7 QC Tools, Root Cause Analysis, PDCA Cycle etc.

I. INTRODUCTION

In the current scenario, there has been continuously increase in the global competition among the various sectors as a result of fast and frequent technological changes across the world. In this competitive market, industries have to continually seek the best practices in order to improve the processes, products, services and competitive costs. For that, industries should also have to focus on the quality improvement continuously. As a result, industries have commited substantial resources to develope measures such as defect rates, response time, delivery commitments, evaluation of products services and operation performances. (M Ahmed, 2006)

There are many definitions of Quality; but the widely accepted definitions are 'Fitness for use', 'Conformance to requirement' and 'the totality of characteristics of an entity that bear on its ability to satisfy stated and implied needs'. And in the meantime there are different quality models like the Deming Price, the Balbridge award, the EFQM excellence model etc.

Continuous quality improvement can reduce the number errors that occurs in the organization. Defective products and mistakes made when providing services are examples of errors that can be costly. Because small companies cannot produce goods and services in mass production like larger companies, errors will be especially costly. Focusing on continuously identifying potential sources of errors and fixing them can avoid problems that might otherwise crop up over time. Continuous quality improvement can result in decreased in productivity in the short term as businesses implement better processes, but it can lead to increased productivity in the long term. For example, a small business that revises its production processes might have to shut down production for a day to implement the improvements, resulting in a day of lost production. After the changes take effect, though, the company might have fewer production slowdowns and higher productivity. Small businesses often have difficulty in competing with larger competitors that are able to mass produce products at low costs. Continuous quality improvement is a business management system that companies of all sizes can employ and it also focuses on identifying sub-optimal processes in a business and changing them to reduce defects and improve quality.

Continuous quality improvement process assumes and requires that a team of experts together with the company leadership actively use quality tools in their improvement activities and decision making process. (Mirko Soković, 2009). As the global economic condition changing in a rapid motion, generally in an industry more focus is given on profit margin, customer demand for high quality product and improved productivity. (Md. Mazedul Islam, 2013)

Now a days, there are lots of quality assurance and quality management tools are available, so the selection of the most appropriate tools is not always an easy task. Quality assurance and management tools cannot cure of all the quality problems but they certainly are a means to solve the problems.

Hence, it needs to emphasized that the tools can be used in the right manner. Therefore, it is improtant to know that how, when and which particular tools should be used in the problem solving or improvement process. (Mirko Soković, 2009)

The main objective of the study is to identify the problem for improvement by doing systematic analysis. To find the root cause of the problem and try to achieve excellence in the manufacturing processes by using quality improvement techniques. By using these all quality control & improvement techniques, increase in the production and quality as well as performance of the procedure. And also reduce the rejection, rework and overall manufacturing costs.

II. LITERATURE REVIEW

This study is to identify the problem for improvement by doing systematic analysis. To find the root cause of the problem and try to achieve excellence in the manufacturing processes by using quality improvement techniques. By using these all quality control & improvement techniques, increase in the production and quality as well as performance of the procedure. And also reduce the rejection, rework and overall manufacturing costs. The review study is carried out according to tool / techinque used for qulaity improvement. The techniques reviewed are TQM, 7 QC tools, Root cause analysis, and PDCA cycle.

III. TOTAL QUALITY MANAGEMENT (TQM)

The literature presents so many definitions and descriptions of TQM that sometimes it seems that each author has its own definition and each organisation has its own implementation. However, TQM discussion is not complete without acknowledging the work of the five best known 'quality gurus' or TQM experts: Deming, Juran, Feigenbaum, Crosby and Ishikawa. This review revealed that they all agreed on the importance of the following six key elements: customer satisfaction, cost reduction, leadership and top management commitment, training and education, teamwork and organizational culture. (Watson, 1995). TQM can be defined as a set of techniques and procedures used to reduce or eliminate variation from a production process or service-delivery system in order to improve efficiency, reliability, and quality. (Steingrad, 1993)

TQM is also defined as a philosophy, management tool and a set of principles which guides every member of organization who involved in the continuous improvement process to meet customer satisfaction. For providing services to customers with high quality products, TQM concept requires an effective involvement of all members of organization in decision making because their participation and contribution are considered as a critical role in all business activities. However, there is no standard methodology as to how TQM should be implemented. The organization committed to customer satisfaction through continuous improvement varies from organization to organization and also from country to country, but it has common principles that can be applied to secure market share, increase profits and reduce costs. (Rahman, 2009). In brief, TQM is the management of quality throughout all members of organization. The organization must satisfy internal and external customer needs and then use strategic planning including all functional areas to achieve strategic goals.

The key idea of TQM is that an integral part of the production process must be quality control. It includes continuous improvement to remove waste, doing the things right at first time (no inspection needed), and quantitative measurement to analyse deviations. The purpose is to reduce overall costs by preventing unnecessary rework jobs and to satisfying customer needs and expectations of high quality.

IV. SEVEN QUALITY CONTROL TOOLS

During the Quality revolution in Japan, the seven quality tools were first popularized by Dr. Kaoru Ishikawa of Tokyo University. He did not invent all of these tools, some of these were already in use since 1900s, but he took all these seven tools and made a set of these seven tools and named it "the basic seven tools of quality". That's why these tools are also called as Ishikawa tools of quality. These tools are also known as basic quality tools because these tools are suitable and easily understandable for people, required less formal training and can be used to solve the majority of quality-related issues. (Muhammad, 2015).

These seven quality tools which are basic for all other tools are: Flow chart, Pareto diagram, Check sheet, Control chart, Histogram, Scatter plot, and Cause-and-effect diagram.

These simple but effective tools of improvement are widely used as problem-solving methods. These tools are used as graphically analysis and as general management tools in every process between design and delivery. The challenge for the manufacturing and production industry is for: Everyone to understand and use the improvements tools in their work. Some of the the seven tools can be used in process identification and/or process analysis. One possible approach, is presented in Figure 1. where Pareto and Cause and effect diagrams are common and essential in both processes (identification and analysis). (Mirko Soković J. J., 2009)

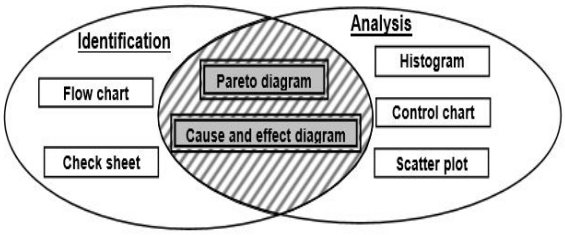

Figure 1

According to EOQ (European Organisation for Quality), the current approach for using 7QC tools, is shown in Fig. 2. The process of data acquisitions includes three tools (Check sheet, Histogram and Control chart), and the process of analysis includes another four tools (Pareto diagram, Cause and effect diagram, Scatter plot, and Flow chart). There is a distinction between the two approaches represented in Figs. 1 and 2. The approach shown in Fig. 1 is much older (1990) and therefore, there are some key distinctions. Some tools which are now used only for analysis were at that time considered as tools for identification or for both processes (identification and analysis). But even then scientists were attempting to find appropriate utilizations of each tool in different processes and methodologies of improvement. (Mirko Soković 2009)

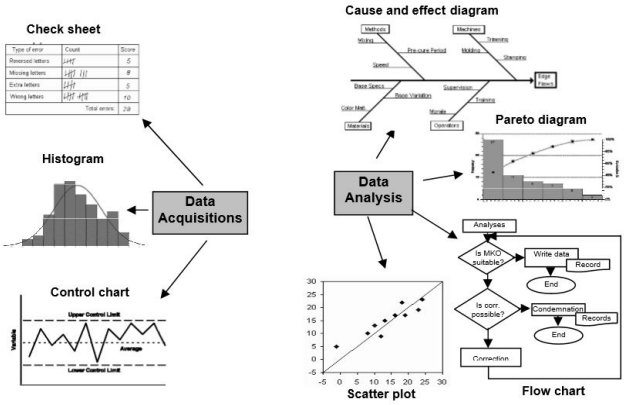

Figure 2: Seven Quality Control Tools / techniques

V. ROOT CAUSE ANALYSIS

Root Cause Analysis (RCA) is a comprehensive term encompassing a collection of problem solving methods used to identify the real cause of a non-conformance or quality problem. The goal of a Root Cause Analysis (RCA) is to get down to the true cause of the problem, the root cause. It is the process of defining, understanding and solving a problem. The root cause has also been described as an underlying or fundamental cause of a non-conformance, defect or failure. Furthermore, the term "root cause" can also be referred to as the precise point in the causal chain where applying a corrective action or intervention would prevent the non-conformance from occurring. It is a Powerful tool used to identify, record and visually represent the possible causes of a problem. Instead of problems and their effects appearing vast and insoluble, root cause analysis breaks down the problem into smaller and easier parts which are graphically represented by fishbone diagram.

To improve the quality, profitability and efficiency it is needed to look beneath the surface to find the root of a problem or issue. By observing the effect of a problem and deducing what has caused it to occur, it can create a preventative solution that should put the end result of a problem. Hence, in order to understand the problem, it is needed to undertake a root cause analysis. There are different types of root cause analysis tools and techniques i.e. 5 why analysis, Pareto analysis, Cause and Effect diagram, Brainstorming, Interviewing, Fault tree analysis, Failure Mode Effect Analysis (FMEA), Process Analysis, Mapping and Flowcharts etc.

VI. PDCA CYCLE

The PDCA-cycle is an integral part of process management and is designed to be used as a dynamic model because one cycle complete represents one complete step of improvement. The PDCA cycle is used to coordinate continuous improvement efforts. It emphasizes and demonstrates that improvement programs must start with careful planning, must result in effective action, and must move on again to careful planning in a continuouos cycle, the Deming's quality cycle is never ending. It is a strategy used to achieve breakthrough improvements in safety, quality, morale, delivery cost and other critical business objectives.

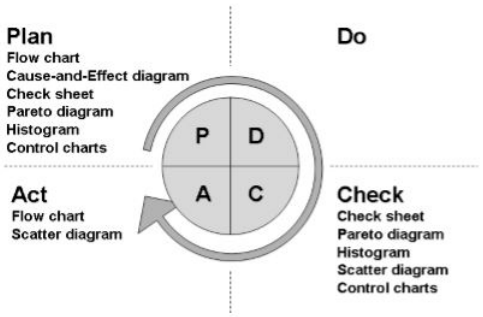

Figure 3

After reviewing the literature, following Table shows the summary of benefits gained after successful implementation of different quality tools.

Sr No.	Title	Author	Tools used	Summary
1	Quality assessment and improvement for Ethiopian garment enterprises	(Alem Demissie 2017)	Pareto chart, PDCA cycle, Process improvement, SQC	This research work was done on primary & secondary data, which were collected and analyzed by using selected tools and then investigate the associated costs and generate a quality improvement model
2	Minimization of Reworks in Quality & Productivity improvement in the Apparel Industry	(Md. Mazadul Islam 2013)	Cause-Effect diagram, Control charts	This paper deals with the application of methodology which provides a framework to identify, quantify and eliminate the source of variation in an operation processes. So by eliminating non-productive activities, time as well as cost are saved by ensuring quality production.
3	Basic Quality Tools in Continuous Improvement Process	(J. J. Mirko Soković 2009)	7 QC tools, DMAIC approach, PDCA cycle	This paper aimed at defining the role of 7qc tools and were presented the improvement status of the organizations to move from static to dynamic improvement.
4	Implementation of TQM in manufacturing Industries in the Kingdom of Saudi Arabia	(Rahman 2009)	Total Quality Management (TQM)	This is an investigation of result on quality control practices within mfg industry to assess the prospective of implementing TQM (here, only MCQ questionnaire technique is used) in order to improve product quality and customer satisfaction.
5	Quality Improvement Of Fan Manufacturing Industry By Using Basic Seven Tools Of Quality: A Case Study	(Muhammad 2015)	7 QC tools	In this paper, by applying 7 qc tools there was an effective identification and removal of defects in the manufacturing process and each tool is giving better result. After removal of defects process control chart was implemented to check that process is under control.
6	The introduction and development of a quality improvement process: a study	(DALE 19991)	Total Quality Management (TQM)	Implementing TQM in the industry
7	Root Cause Analysis for Reducing Breakdowns in a Manufacturing Industry	(Kiran M 2013)	Cause-effect, Pareto chart, Root cause analysis	In this research paper, Root cause analysis is conducted to find the root cause of breakdowns and some parallel improvement opportunities were also identified for implementation so as to reduce the downtime and increase the overall profit.
8	Defects Reduction Using Root Cause Analysis Approach in Gloves Manufacturing Unit	(Singh 2016)	Cause-effect, Pareto chart, Root cause analysis	In this paper, by applying RCA approach and taking corrective & effective measures, the average percentage defect of the total production from two month of data, it reduces upto 17.25%.

9	The application of cause and effect diagram in the oil industry in Iran: The case of four liter oil canning process of Sepahan Oil Company	(Hekmatpanah 2011)	Cause-effect diagram, FMEA	In this paper, cause-effect diagram and six sigma methodology is used to demonstrate how to relate the potential causes of major presenting problems. Findings implied that by using cause-effect diagram the scraps reduces from 50000 to 5000ppm and 0.92% decrease in the oil waste.
10	Evaluation of customer perceptions for Quality Improvement:A Case Study	(Alexander, 2007)	Cause-effect diagram, FMEA	In this paper, company studied and analyzed customer perceptions of company's product in the context of improving quality. For that they surveyed their distributors, then target and prioritize the elements for improvement, then defined the design and operating factors and their causes of the problems and opportunity of improvement.
11	RootCause Analysis – A Practice to Understanding and Control the Failure Management in Manufacturing Industry	(Bhattacharya, 2014)	Root Cause Analysis, FMEA, Fishbone diagram	This paper seeks to examine the root cause analysis management for a manufacturing industry. This paper highlights about the tools which are used in root cause analysis and methodology of root cause analysis.
12	Root Cause Analysis Using Ishikawa Diagram For Reducing Radiator Rejection	(Prof. J.A. Doshi, 2012)	Root Cause Analysis, Fishbone diagram	In this paper, fishbone diagram is used to identify various root cause for radiator rejection. After detailed study for many problems which causes rejection, first problem was chosen and identified causes have to prioritized and attended.
13	Continual Improvement In Small Soaps Company	(Borget Alfred Anoye, 2015)	Ishikawa diagram, Pareto analysis, Histogram, PDCA, TQM	The purpose of this paper was to reduce the unit cost of the bar soaps. By applying these techniques, production capacity increased by 68% in 6 months, decreased in machine brakedown by 85.71% per week and decreased the bar soaps price by 50%.
14	Application of Quality Control Tools in a Bicycle Industry: A Case Study	(Deepak, 2016)	7 QC tools	By applying pareto and cause-effect diagram, production was reduced from 9.45% to 7.75%, savings of rs 3.54 lakhs per year, and by proper cleaning of boiler tubes, efficiency increased upto 10%.
15	Investigation and Analysis of Metal Casting Defect by Using Quality Control Tools on Trumpet Housing of a Tractor	(Prateek Bhatt, 2017)	Pareto chart, Cause-Effect diagram, TQM	There was a analysis based on quality control techniques, blowholes rejection was reduced from 4.54% to 1.92%, total savings of Rs 3,10,800 and rejection rate to sand drops reduced by 1.74% to 0.81%, total savings of Rs 1,11,000

VII. REVIEW REMARKS

Quality leads to improvement in productivity and at the same time it also leads to customer's satisfaction. Following remarks are observed while reviewing literature.

1. Use of 7 Quality Control tools are important for an effective identification and removal of defects in the manufacturing process and each tool is giving better understanding the type of problem, variations in dimensions and performance of results.
2. The prospective of implementing TQM, in order to improve product quality and customer satisfaction.TQM is covering all aspects / resources of manufacturing organization for toal quality mnanagement. TQM includes raw material quality issues, process related quality issues and overall performance of manufacturing organization.
3. Root Cause Analysis practice is useful to solve problems by attempting to identify and correct the root causes of events, as opposed to simply addressing the symptom.
4. PDCA cycle is an iterative four-step management method used in business for the control and continual

improvement of processes and products. This is a very general techanique used to solve any problems related to productivity and quality.

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