

Role of TPM and TQM in Productivity Improvement

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Abstract: TPM and TQM can be two beneficiary approaches that help organization to make strategies for productivity. TPM and TQM is the key to getting people together to own processes and performance of the machine and builds teamwork on the shop floor, leading to a standard and disciplined work culture, and improved engineering discipline. This paper has tendency to investigate how the TQM and TPM influence the productivity through the managerial components, efficiency and effectiveness for future. Reducing the price, improving the quality, increasing customer and job satisfaction, promoting the profit and the growth of organization, enhancing outcome and output that leads to raise the efficiency and effectiveness can be considered the results of implementation of TQM and TPM.

Keywords: Productivity, TPM, TQM.

1. INTRODUCTION

Productivity is observed as a significant success factor for organizational operation in global and competitive situation (Hodgetts & Kuratko, 1998; Nachum, 1999) and to be probably the major area for operational and process management (Sink, Tuttle, & Shin, 1989). A. D. Neely, Adams, and Kennerley (2002), Sink et al. (1989), Sumanth (1998), stress that achieving the profitability, cost competitiveness, and growth in long-term would be generated through productivity improvement. There is consensus among researchers that performance management is a significant component of continuous improvement and successful management (Acur & Englyst, 2006; Anderson, Fornell, & Rust, 1997; A. Neely, Gregory, & Platts, 2005). Likewise, it can help firms achieve their missions, visions, policies, objectives and targets (Dixon, Nanni, & Vollmann, 1990; Kaplan & Norton, 1996; Rantanen, Kulmala, Lönnqvist, & Kujansivu, 2007). Tuttle (1983) points out the managerial viewpoint in which organization components that create effective and efficient organization functioning regarding productivity classification meanings. In addition, according to the work that done by Keh et al. (2006) and (Mandl, Dierx, & Ilzkovitz, 2008), the effectiveness is resulted from the ratio of outcome over output and efficiency can be earned from the ratio of output by input. However, Saari (2006) focuses on both quantity and quality input as well as output as productivity determinants in his definition. He defines the total productivity as the ratio of output quality and quantity to input quality and quantity. It is obvious that the evaluating the productivity plays a crucial role in any organization, but as noted by Bernolak (1997), besides the identification of the determinants of productivity that managers might face them, how to enable meaningful productivity improvement, what are the influencing factors and how to boost them can be the other concerns. In other words, how to improve the productivity or whether there exist any tools whereby boosts the productivity. APO (2008) introduced the model that is called "The mechanics of business operation" in which, TQM and TPM consider as productivity tools along with other techniques such as ISO9000, PM, etc. The aim of this study is to review the applying of TPM and TQM techniques the productivity would be improved. In other words, how TQM and TPM impact on input as well as output and outcome to encourage the productivity.

2. TOTAL QUALITY MANAGEMENT

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 & Fitzgibbons, 1993). Vuppalapati, Ahire, and Gupta (1995) stated that TQM is an integrative philosophy of management for the continuous improvement of product and process quality in order to achieve customer satisfaction. According to Dean and Bowen (1994), TQM is a management philosophy or an approach characterized by principles, practices, and techniques. They pointed out three principles that most quality frameworks had in common – customer focus, continuous improvement, and teamwork. Each principle is implemented through a set of practices, and these practices, in turn, are supported by a broad set of techniques. Anderson, Rungtusanatham, and Schroeder (1994) identified some core TQM components derived from Deming's 14-point programme using the Delphi method. These components reflect Deming's principles and are either

explicitly or implicitly similar to the factors included in the other quality management frameworks. However, its weakness is the lack of a systematic scale development and content validity (Motwani, 2001). Joseph, Rajendran, and Kamalanabhan (1999) identified the following 10 TQM factors organisational commitment, human resource management, supplier integration, quality policy, product design, the role of the quality department, quality information systems, technology utilization, operating procedures and training. They also developed a measurement that can be used to evaluate the extent to which these TQM practices are deployed in an organization. According to Motwani (2001), the philosophy of TQM could be visualised as constructing a house with top management commitment being the foundation or base. On top of a solid foundation, four pillars are constructed that include process management, quality measurement and control, employee training, and customer focus. Total Quality Management (TQM), has been extensively identified since the mid-1980s. It is the combination of techniques, theories, strategies of quality in order to obtain the excellent quality.

TQM searches for continuous enhancement in the quality of all people, processes, products, and services of an enterprise (Temtime & Solomon, 2002). Desai and Erubothu (2010) classify the influencing factors into: External Environment: Market Conditions, Market Competitiveness, Economic Environment, Technical Situation, Socio-Cultural Condition, Legal Environment. Internal factors: Corporate Planning, Top Management Leadership, Customer Focus, Human Resources, Quality and Process, Information and Analysis. Likewise, they enumerate Product/Service Quality, Employee Satisfaction, Process Quality and Supplier Performance as Performance Metrics. There is a claim dating back many years which notes the existing interconnected relation between productivity and quality (Sink & Keats, 1982). They state that if efforts toward improving quality are efficient and effective, critical impact on enterprise productivity will soon follow. Mefford (1991) points out three mechanics that highlight the linkage between quality and productivity:



Figure. 1: Performance factors influencing productivity Source: Desai (2010)

It is clear that customer satisfaction is one of the most important factors influencing productivity. leadership, human resource focus, customer and market focus, strategic planning, information and analysis, the results of business and process management introduced by Malcolm Baldrige National Quality Award (MBNQA) as factors those relate with performance of organization (Black & Porter, 1996). Waldman (1994) expresses that the TQM means today as a systematic and organizations' extended strategy to move along with improving the services, goods and organization process continually improved competitive advantage (Douglas & Judge, 2001; Powell, 2006), and enhanced the performance of organization (Hendricks & Singhal, 1997; Reed, Lemak, & Montgomery, 1996) are the main TQM implementation. Additionally, it is stressed in the study by Saylor (1996) and Creech (1994) that system of TQM must include the quality of all level of organization ranging from activity and process to products. Venkatesh (2007) claims that the object of TQM is quality that is referring to the output and effect. He believes that the systematize management is mains of attaining goal of this tool and

that's why to consider TQM as software oriented. Mardani and Kazemilari (2012) points out to some achievements of TQM application that contain: improving the performance of organization including financial achievements (Hendricks & Singhal, 1997) and the quality of product (Agus, 2005) and with regard to intangible factor like customer satisfaction (Choi & Eboch, 1998; Rahman & Bullock, 2005), problem solving (Vouzaz, 2004) and employee commitment (Rahman & Bullock, 2005). Basically, the customer satisfaction as well as the quality of operation and competitiveness of organization are considered the goals of business (Garvin, 1988; Lee & Schniederjans, 1994).

3. TOTAL PRODUCTIVE MAINTENANCE

3.1. TPM Pillars

The basic practices of TPM are often called the pillars or elements of TPM. The entire edifice of TPM is built and stands, on eight pillars (Sangameshwaran & Jagannathan, 2002). TPM paves way for excellent planning, organizing, monitoring and controlling practices through its unique eight-pillar methodology. TPM initiatives, as suggested and promoted by Japan Institute of Plant Maintenance (JIPM), involve an eight pillar implementation plan that results in substantial increase in labor productivity through controlled maintenance, reduction in maintenance costs, and reduced production stoppages and downtimes. The core TPM initiatives classified into eight TPM pillars or activities for accomplishing the manufacturing performance improvements include autonomous maintenance; focused maintenance; planned maintenance; quality maintenance; education and training; office TPM; development management; and safety, health and environment (Ireland & Dale, 2001; Shamsuddin et al., 2005; Rodrigues & Hatakeyama, 2006). The detailed maintenance and organizational improvement initiatives and activities associated with the respective TPM are as follows.

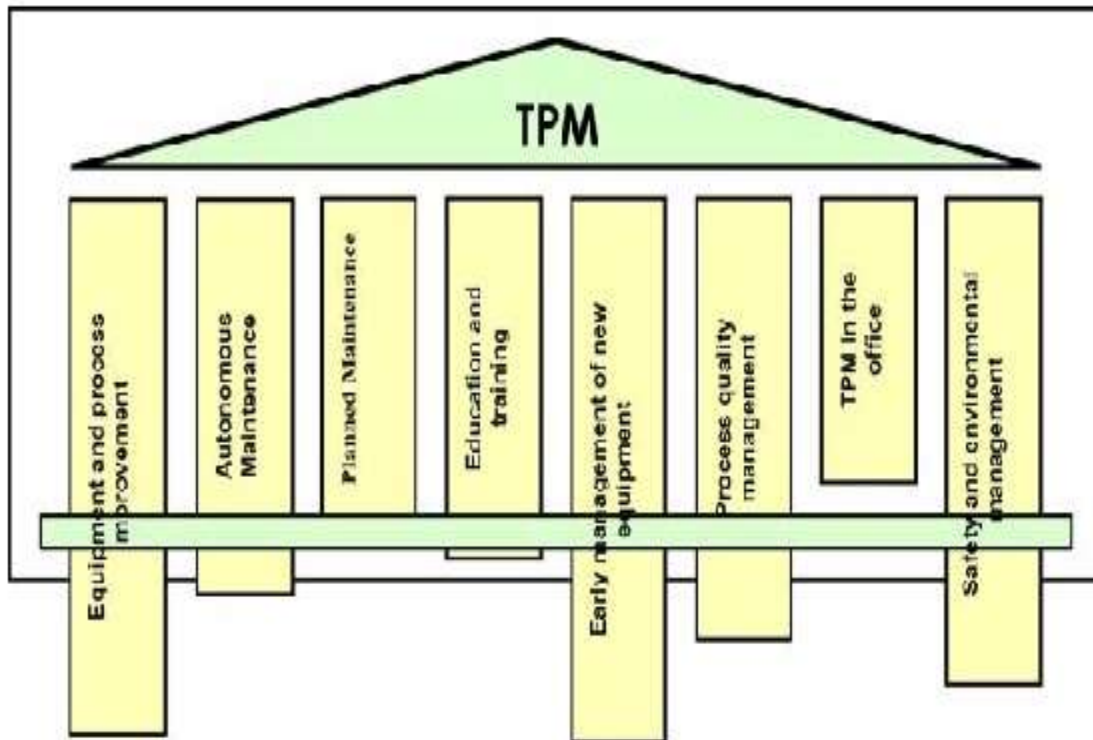


Figure 2. The pillars of TPM

Pillar 1- 5S: TPM starts with 5S. It is a systematic process of housekeeping to achieve a serene environment in the work place involving the employees with a commitment to sincerely implement and practice housekeeping. Problems cannot be clearly seen when the work place is unorganized. Cleaning and organizing the workplace helps the team to uncover problems. Making problems visible is the first step of improvement. 5S is a foundation program before the implementation of TPM. If this 5S is not taken up seriously, then it leads to 5D (delays, defects, dissatisfied customers, declining profits, and demoralized employees). This 5S implementation has to be carried out in phased manner. First the current situation of the workplace has to be studied by conducting a 5S audit. This audit uses check sheets to evaluate the current situation.

This check sheet consists of various parameters to be rated say on a 5-point basis for each ‘S’. The ratings give the current situation. The each of the above-mentioned 5S is implemented and audit is conducted at regular intervals to monitor the progress and evaluate the success of implementation. After the completion of implementation of 5S random audits could be conducted using company check sheets to ensure that it is observed in true spirits by everyone in the work place. Table 1 depicts the key activities to be holistically deployed for effective 5S implementation at the workplace.

Table 1. Key Activities for Effective 5S Implementation at the Workplace.

Japanese nomenclature (English 5S/5C):Features
Seiri (Sort/Clear): Sort out unnecessary items from the workplace and discard them
Seiton (Set in order/Configure): Arrange necessary items in good order so that they can be easily picked up for use
Seisio (Shine/Clean and check): Clean the workplace completely to make it free from dust, dirt and clutter
Seiketsu (Standardize/Conformity): Maintain high standard of housekeeping and workplace organization
Shitsuke (Sustain/Custom and practice): Train and motivate people to follow good housekeeping disciplines autonomously

Pillar 2-Autonomous Maintenance(AM): This pillar is geared towards developing operators to be able to take care of small maintenance tasks, thus freeing up the skilled maintenance people to spend time on more value added activity and technical repairs. The operators are responsible for upkeep of their equipment to prevent it from deteriorating. By use of this pillar, the aim is to maintain the machine in new condition. The activities involved are very simple nature. This includes cleaning, lubricating, visual inspection, tightening of loosened bolts etc. AM policy are-uninterrupted operation of equipments, flexible operators to operate and maintain other equipments, and eliminating the defects at source through active employee participation. Steps in AM are preparation of employees, initial cleanup of machines, take counter measures, fix tentative AM (JISHU HOZEN) standards, general inspection, autonomous inspection, and standardization.

Pillar 3-Kaizen: “Kai” means change, and “Zen” means good (for the better). Basically kaizen is for small improvements, but carried out on a continual basis and involve all people in the organization. Kaizen is opposite to big spectacular innovations. Kaizen requires no or little investment. The principle behind is that “a very large number of small improvements are move effective in an organizational environment than a few improvements of large value”. This pillar is aimed at reducing losses in the workplace that affect our efficiencies. By using a detailed and thorough procedure we eliminate losses in a systematic method using various kaizen tools. These activities are not limited to production areas and can be implemented in administrative areas as well. Kaizen policy are practice concepts of zero losses in every sphere of activity, relentless pursuit to achieve cost reduction targets in all resources, relentless pursuit to improve over all plant equipment effectiveness, extensive use of PM analysis as a tool for eliminating losses, and focus of easy handling of operators. Kaizen target are achieve and sustain zero loses with respect to minor stops, measurement and adjustments, defects and unavoidable downtimes. It also aims to achieve 30% manufacturing cost reduction. Tools used in kaizen are Why-Why analysis, Poka-Yoke (Poka-Yoke is Japanese term, which in English means ‘mistake proofing’ or ‘error prevention’), summary of losses, kaizen register, and kaizen summary sheet. Six losses in the work place: The objective of TPM is maximization of equipment effectiveness. TPM aims at maximization of machine utilization and not merely machine availability maximization. As one of the pillars of TPM activities, kaizen pursues efficient equipment, operator and material and energy utilization that is extremes of productivity and aims at achieving substantial effects. Kaizen activities try to thoroughly eliminate losses. Six major losses that were identified are-equipment failure, set-up and adjustments, small stops, speed losses during production, and losses during warm-up (Nakajima, 1988).

Pillar 4-Planned Maintenance (PM): It is aimed to have trouble free machines and equipments producing defect free products for total Customer satisfaction. This breaks maintenance down into four “families” or groups, viz., preventive maintenance, breakdown maintenance, corrective maintenance, and maintenance prevention. With PM we evolve our efforts from a reactive to a proactive method and use trained maintenance staff to help train the operators to better maintain their equipment. In PM policy are achieve and sustain availability of machines, optimum maintenance cost, reduces spares inventory, and improve reliability and maintainability of machines. PM targets are zero equipment failure and break down, improve reliability and maintainability by 50 percent, reduce maintenance cost by 20 percent, and ensure availability of spares all the time. Six steps in planned maintenance are equipment evaluation and recoding present status; restore deterioration and improve weakness; building up information management system; prepare time based information system; select equipment, parts and members and map out plan; prepare predictive maintenance system by introducing equipment diagnostic techniques; and evaluation of planned maintenance.

Pillar 5-Quality Maintenance (QM): It is aimed towards customer delight through highest quality through defect free manufacturing. Focus is on eliminating non-conformances in a systematic manner, much like focused improvement. We

gain understanding of what parts of the equipment affect product quality and begin to eliminate current quality concerns, and then move to potential quality concerns. Transition is from reactive to proactive (quality control to quality assurance). QM activities are to set equipment conditions that preclude quality defects, based on the basic concept of maintaining perfect equipment to maintain perfect quality of products. The condition is checked and measure in time series to verify that measure values are within standard values to prevent defects. The transition of measured values is watched to predict possibilities of defects occurring and to take counter measures before hand. In QM policy are defect free conditions and control of equipments, quality maintenance activities to support quality assurance, focus of prevention of defects at source, focus on Poka-Yoke (fool proof system), in-line detection and segregation of defects, and effective implementation of operator quality assurance. QM targets are achieve and sustain customer complaints at zero, reduce in-process defects by 50 percent, and reduce cost of quality by 50 percent.

Pillar 6-Training: It is aimed to have multi-skilled revitalized employees whose morale is high and who has eager to come to work and perform all required functions effectively and independently. Education is given to operators to upgrade their skill. It is not sufficient know only “Know-How” by they should also learn “Know-Why”. By experience they gain, “Know-How” to overcome a problem what to be done. This they do train them on knowing “Know-why”. The employees should be trained to achieve the four phases of skill. The goal is to create a factory full of experts. The different phase of skills is phase 1-do not know, phase 2-know the theory but cannot do, phase 3-can do but cannot teach, and phase 4-can do and also teach. Training policy’s are focus on improvement of knowledge, skills and techniques, creating a training environment for self-learning based on felt needs, training curriculum including tools/assessment etc. conducive to employee revitalization, and training to remove employee fatigue and make, work enjoyable. Training target are achieve and sustain downtime due to want men at zero on critical machines, achieve and sustain zero losses due to lack of knowledge/skills/techniques, and aim for 100 percent participation in suggestion scheme. Steps in educating and training activities are setting policies and priorities and checking present status of education and training, establish of training system for operation and maintenance skill up gradation, training the employees for upgrading the operation and maintenance skills, preparation of training calendar, kick-off of the system for training, and evaluation of activities and study of future approach.

Pillar 7-Office TPM: Office TPM should be started after activating four other pillars of TPM (AM, Kaizen, PM, and QM). Office TPM must be followed to improve productivity, efficiency in the administrative functions and identify and eliminate losses. This includes analyzing processes and procedures towards increased office automation. Office TPM addresses twelve major losses, they are processing loss; cost loss including in areas such as procurement, accounts, marketing, sales leading to high inventories; communication loss; idle loss; set-up loss; accuracy loss; office equipment breakdown; communication channel breakdown, telephone and fax lines; time spent on retrieval of information; non availability of correct on line stock status; customer complaints due to logistics; and expenses on emergency dispatches/purchases. Office TPM and its benefits are involvement of all people in support functions for focusing on better plant performance, better utilized work area, reduce repetitive work, reduced administrative costs, reduced inventory carrying cost, reduction in number of files, productivity of people in support functions, reduction in breakdown of office equipment, reduction of customer complaints due to logistics, reduction in expenses due to emergency dispatches/purchases, reduced manpower, and clean and pleasant work environment.

Pillar 8-Safety, Health and Environment: In this area focus is on to create a safe workplace and a surrounding area that is not damaged by our process or procedures. This pillar will play an active role in each of the other pillars on a regular basis. Safety, health and environment target are zero accident, zero health damage, and zero fires. A committee is constituted for this pillar, which comprises representative of officers as well as workers. The committee is headed by senior vice president (technical). Utmost importance to safety is given in the plant. Manager (safety) looks after functions related to safety. To create awareness among employees various competitions like safety slogans, quiz, drama, posters, etc. related to safety can be organized at regular intervals.

4. THE IMPACT OF TPM AND TQM ON PRODUCTIVITY

In accordance with the managerial definition of productivity that is the combination of efficiency and effectiveness, considering the input as well as output and outcome is necessary to attain the productivity. In this way, both quality and quantity features of determinants must be considered so that to achieve the value of productivity accurately. Although, being costly and not be effective the improved quality on enhancing productivity (Deming, 1986; Mohanty, 1998; Parasuraman, 2002; Womack, Jones, & Roos, 1990) can be the main reason that the organizations ignore the quality when evaluating productivity (Kontoghiorghes & Gudgel, 2004). Improving the quality through making reduction of delay, rework, cost, and errors cause to considerable improvement in productivity (Deming, 1986; Deming & Study, 1982).

Quality features must be considered, and so the quality level that is required to meet customer needs should be united. However, the customers might point out to the internal customers (i.e. employees) external customers. To consider the satisfaction of aforementioned customers, the customer satisfaction and job satisfaction must be stressed in outcome of the organization that might place along with the other quantity aims of organization. Additionally, the inherent motivation impact on employee productivity effectively and can be a critical characteristic of workforce (Walters, 2007). In this way, Amabile (2000) claims that two workforce features including motivation and skill are necessary for both job satisfaction and productivity. On the other hand, with regard to the definition of output that involves goods or services earned throughout a producer section and are prepared for utilizing out of this section (OECD, 2001). Output can be appeared at the end of process. One way to attain the quality of output must be the level of customer satisfaction that would be appeared as one of the significant organizations' targets.

Likewise, outcome is the level of performance, and it connects to input, process, and output. In other words, outcomes point out to performance quantification (Ltd, 2007). Velocci (2002) states that strongly stressing on the customer and having a quality culture in a new castings plant diffuse rework, and scrap lead customer time to 75, 40, and 50% respectively, and also productivity became twice. On the other side, job satisfaction promotes higher participation by workforces in decision making (Marelli & Signorelli, 2010). Tranfield and Akhlaghi (1995) identify ways of attaining high productivity and quality for modern organizations simultaneously, by emphasizing on customers and employees, and value added. They point out to a connection that exists between customer satisfaction and employee satisfaction where employee satisfaction can create value added by providing better service, which thus influences customer satisfaction and thus the growth and profit for the organization would be appeared. Stainer (1997) believes there must be a balance between total productivity and the perceived value. He explains that productivity is generated because real unit and volume cost, while value relates to customer and is the effect of quality and price. In accordance with the aforementioned sections, the impacts of TQM on productivity can be as follows:

- Reducing defective process and products leads to increase efficiency.
- Increasing the customer satisfaction that causes increased outcome and improved effectiveness and consequently productivity.
- Improving the customer satisfaction is followed by increasing the profit of the organization. The increased income of organization can lead to increase the motivation of employees through some ways such as increasing the salaries or increasing given bonus that makes the outcome to go up that is followed by going up the effectiveness and consequently productivity.

On the other hand, TPM can affect the productivity through following ways:

- Increasing the involvement of employees that follows the improved employees' motivation and the improved job satisfaction is appeared then leads to enhanced outcome and effectiveness.
- Reducing the price of products that is extracted from reducing the waste leads to increase the profit of organization and consequently improved the salaries of workforces and improved job satisfaction that leads to enhance the effectiveness of organization and boost the productivity.
- An enhanced customer satisfaction is deriving from improved delivery and causes to go up the outcome that leads to improve the effectiveness and then productivity.
- Eliminating the inefficiencies of capital, material, and labour lead to improved efficiency and productivity.

5. CONCLUSIONS AND MANAGERIAL IMPLICATIONS

Productivity plays a crucial role in boosting the growth of the organization and helps them to survive in a competitive world. Nowadays, besides the measuring the productivity that enables the managers to know the current situation of their company, there are some tools and techniques that help managers to improve the productivity value. Among them, this study reviews the TQM and TPM and emphasizes that how these mentioned productivity tools can influence the productivity that defined based on managerial viewpoint. This paper highlight as to how TQM and TPM impact on the productivity through productivity components that are efficiency and effectiveness. TQM influences the effectiveness through the improving the outcome by increased customer satisfaction and also increasing the efficiency by increasing the quality of output. On the other hand, TPM by improving the performance of equipment and also increasing the involving the employees makes improved the job satisfaction or in other words outcome that leads to improve the productivity. The results of both TQM and TPM in long term leads to decrease the price and increase the quality of output that can be the key factor to keep up the organization with competitors. Additionally, this situation follows by improved customer satisfaction

and then increasing the profit of organization, which salaries of workforces can be gone up and causes the higher job satisfaction level. Although, according to the Tranfield and Akhlaghi (1995), job satisfaction makes the services value added to increase and consequently the customer satisfaction improves, as this is a chain makes to repeat these relations, subsequently. Thus, applying TQM and TPM can be the best way that helps managers to keep their organization in stable and good condition. However, the other productivity tools also improve the productivity, but the investigation on those tools and how they affect the productivity can be directed in future studies.

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