

A REVIEW ON TOTAL PRODUCTIVE MAINTENANCE

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Abstract : Total Productive Maintenance (TPM) is widely used in many industries for better and good efficient result in productivity, also to increase production rate with decrease in wastes. This paper presents early contributions and study of researches on Total Productive Maintenance and also the different case studies on TPM. Total 29 papers are studied which gives an idea about implementation of TPM, its advantages, how the productivity get increased with decrease in waste. Some paper give knowledge about how to calculate the Overall Equipment Effectiveness and also how it shows the real value about OEE, which helps to improve productivity. For better result of organization regarding improvement in productivity, the implementation of 5S is the first step before implementation of TPM pillars. A review shows that, Total Productive Maintenance is now being successfully adopted by some organizations & industries in the world and nowadays TPM becoming world class strategy.

Keywords- Improve productivity, decrease waste, OEE, TPM,5S.

I. INTRODUCTION

TPM stands for Total productive maintenance. TPM is a Japanese concept in which production system and quality systems are maintained and improved step by step with help of the machines, number of equipment, different processes and all employees. The origin of TPM was introduced in early 1950s. TPM based on Eight Pillars. One of them is preventive maintenance. Now a day it is essential requirement for longer life cycle of machines in any industry. In 1960 the first company to introduce plant wide preventive maintenance is Nippondenso, Japan.

TPM focuses on keeping all equipment in top working condition without breakdowns and also without delays in all manufacturing processes. It is a philosophy in which continuous improvement get achieved with maintaining close relationship between Maintenance and Productivity.

The goal of the any TPM program is to improve not only productivity and but also quality. To increased employee morale and job satisfaction and also to drive all waste to zero (that are Zero Defects, Zero Accidents and Zero Breakdowns). TPM is an innovative approach to maintenance that maximize equipment effectiveness, eliminates breakdowns, and promotes autonomous operator maintenance through daily activities involving the total workforce.

5S is the base of TPM. It is a systematic technic and process to get a better environment in the work place. 5S always helps the team to show & helps to solve problems. Making problem visible to employees or supervisors is the first step of improvement. 5S is a foundation for implementation of TPM. Following are the pillars of Total Productive Maintenance 1) Autonomous maintenance 2)Planned maintenance 3) Quality integration 4)Focused improvement 5) Early equipment management 6)Training and education 7) Safety, health, environment 8)TPM in administration.

Now a days, OEE is mostly used for the measurement of how much successfully TPM is implemented. OEE is given by: -
{Availability x Performance Efficiency x Quality Rate} (i.e. $OEE = A \times PE \times QR$)

II. OBJECTIVES

The main objective of this paper to get brief knowledge of TPM, Implementation of Pillars of TPM in various firms. To get an idea about how TPM is useful to reduce waste, to reduce cost, to reduce scrap, to reduce defectives and defects, which helps to increase better production of product.

III. LITERATURE REVIEW

Saureng Kumar et al, (2017), The purpose of this paper is implementation of total productive maintenance, by performing machine wise breakdown analysis. The study establishes that focused on some analysis as section wise breakdown analysis, breakdown types wise and equipment wise breakdown analysis to avoid delay in manufacturing process. A TPM is a medical science of machine which improves the performance of maintenance activity, product and process quality, employee morale and job satisfaction. [1]

Md Meraj Alam et al, (2016), stated that, This dissertation considers on implementation of TPM. In our works, we cover the journey of implementation and any related issue that occurred in any company. The study establishes that focused TPM implementation over a reasonable time period can contribute towards realization of significant manufacturing performance enhancements. It was found that improving overall equipment effectiveness is one of the main benefits in implementing TPM and it has been discussed in most of the literature. The correlation between various TPM implementation dimension and manufacturing performance improvement has been evaluated and verified by calculating overall equipment effectiveness (OEE).[2]

Hope Ngozi Nzewi et al (2016) stated that, Following the apparent intense competition and dynamic turbulence in the business environment, maintaining productivity and sustaining performance are paramount. Specifically, this study explored the type of relationship between Maintenance Autonomy and Employee Commitment. In addition, state of the art equipment should be

provided in order to ensure optimum level of coordination among the various departments in the organizations. The objective of the study was to determine the relationship between Total Productivity Maintenance and the Performance of selected Aluminium Firms in Anambra State. [3]

Soraphon Kigsirisina et al (2016) stated that, Nowadays, many water treatment plants face the problems of equipment breakdown and water loss during water production process. To decrease water loss and enhance equipment effectiveness and reduce equipment breakdown, the Eight Pillar Strategy of TPM is used. Failure rate (FR), availability (A), performance efficiency (PE), quality rate (QR) were determined by evaluating equipment effectiveness through Overall Equipment Effectiveness (OEE). The proposed 17 steps for OEE, NEE and PC evaluations are shown in this paper. To get higher chlorinator effectiveness and lower water loss, paper study might be a good approach for other water treatment plant. [4]

Bupe. G. Mwanzaa et al, (2015) stated that, In today's industries, the concept of Total Productive Maintenance (TPM) has been worldwide accepted and some also implemented yet it's still possible to find industries facing some maintenance challenges. The results of the research came double folded by reviewing that, the maintenance department employed 24.3% preventive maintenance, 67.6% breakdown maintenance, and 8.1% not applicable. Overall equipment effectiveness was calculated at 37% which was below the world class standard by 50%. TPM awareness deduced 70.5% of the employees been aware of the TPM concept. 14.7% indicated the concept of TPM would help improve the current maintenance system. 14.7% were not sure. The researchers then designed such a TPM model which would result in effective implementation of TPM in the dynamic business environment for higher competitiveness. [5]

Mr. Kishor Kumar Aroor et al, (2015) stated that, Now a day's manufacturing systems have become more costly to maintain and operate, day by day it also become complex with the introduction of new technologies. This research work deals with study of TPM and Manufacturing performance of a manufacturing industry. Two small scale manufacturing industries are selected for data collection and for TPM analysis work. Values of Overall Equipment Effectiveness (OEE) and Partial productivity are calculated by using standard formulae's and methods. Finally all required results are obtained and these are analysed properly for obtaining conclusions. [6]

Abhijeet K Digalwar et al, (2014) they proposed paper to understand the usage of Total Productive Maintenance (TPM) tools and its implementation in manufacturing industry. The frequency of various tools are studied. Its result to understand, how to better the implementation of TPM in the manufacturing industry and also provide managers with improved guidelines for identifying the most important tools that will lead to success. [7]

Chetan S. Sethia et al, (2014) they stated that, This paper focusing on calculating the overall equipment effectiveness in Rolling Mill. And it also discuss the big six losses in any industry. A case study has been taken in the rolling mill. The main objective of this is to study the manufacturing process and the problem occurs during the production process which causes stoppage. The data taken along fifteen working days after calculating the OEE of the company a result company achieved 93.48% in quality factor of overall equipment effectiveness equation and 70.90% in availability where in performance it got 90.03% and the result is compared with the World class OEE. [8]

Narinder Singh et al, (2014) stated that, Importance of TPM which stands for Total Productive maintenance for Liberalization of global economy has resulted tough competition in global market and for the sustainability in market for any product or service, the optimization of resources and costs in all sorts is required. TPM provides a method for the achievement of world class levels of overall equipment effectiveness through people and not through technology or systems alone. It includes the organizational structures, human interactions, analytical tools and success criteria associated with the implementation of Total Productive Manufacturing programs. [9]

S.R. Vijayakumar et al, (2014) stated that, OEE is one of the performance evaluation methods that are most common and popular in the production industries. In this work, the OEE of the injection moulding process was increased from 61% to 81% through the high quality products, better utilization of resources, implementation of availability, and also raised employee morale and confidence. [10]

Harsha Lingareddy et al, (2013) This paper involves the study and change in the work place of a manufacturing industry to implementation of 5S. This strategy helps in increases the area of work place and also minimizing the time of manufacturing. The solution found by 5S approach minimizes several kinds of wastes in the production process and which leads to help in the development of the organization. The results analysed to great changes like increasing efficiency in quality and production, improves safety. [11]

Jagtar Singh et al (2013) stated that, this paper will review all the Total Productive Maintenance (TPM) Pillars, TPM Implementation methodology and the contribution of TPM towards improving manufacturing performance. The relationship between various TPM implementation dimensions and manufacturing performance improvements have been evaluated by applying OEE. Set of various techniques like computer maintenance management system, Single Minute Exchange Die (SMED), production planning were suggested to the industry after calculating the overall equipment effectiveness to improve the productivity and to improve their maintenance procedures. [12]

P. M. Rojasra et al (2013) stated that, Small scale industries plays an important role in Indian economy. It contributes more than 50% of the industrial production in value addition terms and generate one third of the export revenue. This paper deals with the implementation of 5S methodology in the Krishna Plastic Company, Udhogynagar, Amreli, and Gujarat. Ten week study is

carried out in the case company. 5S is a basic lean manufacturing tool for cleaning, sorting, organizing and providing necessary groundwork for improvement at work place. The results after the 5S implementations states that production system efficiency is improved from 67% to 88.8% in the successive week. [13]

Ravikant V. Paropate et al (2013) proposed a total productive maintenance (TPM) is a fundamental component of world-class manufacturing which has been recognized as one of the significant operation strategy to regain the production losses due to equipment inefficiency. TPM is the methodology aims to improve the accessibility of the existing equipment and in consequence curtail the further capital investment. The paper intends on analyzing the practical problems accomplishing TPM program and improved the effectiveness for critical machine by significant value. [14]

Ranteshwar Singh et al (2013) stated that, Quality and Maintenance of manufacturing systems are closely related functions of any organization. Over a period of time two concepts have emerged which are Total Productive Maintenance (TPM) and Total Quality Management (TQM) along with other concepts to achieve World Class Manufacturing system. In this paper experience of implementing Total Productive Maintenance is shared and investigated for a company manufacturing automotive component. Concept is implemented in the machine shop having CNC turning centers of different capacity. The losses associated with equipment effectiveness are identified. All the pillars of TPM are implemented in a phased manner eliminating the losses and thus improving the utilization of CNC machines. [15]

Amit Kumar Gupta et al (2012) stated that, The manufacturing industry has gone through significant changes in the last decade. Competition has increased dramatically. The aim of this paper is to study the effectiveness and implementation of TPM programme in an automobile manufacturing organization. Through the case study of implementing TPM in an automobile manufacturing organization, the increase in efficiency and productivity of machines in terms of Overall Equipment Effectiveness (OEE) are discussed. [16]

Melesse Workneh Wakjira et al (2012) stated that, 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 house keeping. Problems cannot be clearly seen when the work place is unorganized. 5S is a foundation program before the implementation of TPM. [17]

Prof. Pradeep Kumar et al (2012) stated that, Total productive maintenance establishes a system of productive maintenance, covers all department, covering the entire life cycle of equipment, involves participation of all employees from top to bottom and also promotes small group autonomous activities. Results obtained through the empirical study reveals the varying trends in the Overall Equipment Effectiveness (OEE) and Total Productivity of the machines taken up for the study. The average values of OEE were found to lay between the ranges of 15% to 60% against world class standards of 85% and Total productivity (TP) varies between 0.09 to 0.34. The results highlight the major causes resulting in the downtime and decrease in the productivity.[18]

Kapil Sharma et al (2012) they proposed work for the implementation of the TPM program in a manufacturing industry. Through empirical study of implementing TPM in a manufacturing industry, the practical aspects within and beyond basic TPM theory, difficulties in the adoption of TPM and problems encountered during implementation are discussed. In this paper, measuring the successfulness of TPM implementation process with direct and indirect benefits for manufacturing industries are also discussed.[19]

Prof. S. B. Khedkar, et al, (2012) This research is dealt with the implementation of 5S in the S. P. Plastic Industry MIDC, Nagpur. 5S implementation impacts the instructors and workman of industry that work within the selected place. By following the 5S methodology, this research effort shows significant improvements to productivity, efficiency, morale, safety, and cleanliness. The research documents improvements by using before and after pictures. [20]

P.K.Suresh (2012) stated that, Liberalization of global economy has resulted tough competition in global market and for the sustainability in market for any product or service, the optimization of resources and costs in all sorts is required. The global competition is based on the innovation of advanced processes, products etc. and the essential requirement for any advancement in product or process is technology support. The advancement in technology had lead to the industrial revolution and higher level competition for survival. [21]

I.P.S. Ahuja et al (2009) stated that, The purpose of this paper is to investigate the contributions of successful total productive maintenance (TPM) initiatives to competitive manufacturing. The study is carried out at a precision tube mill that has successfully implemented TPM and has reaped significant benefits as a result of TPM implementation, to study the TPM implementation issues and achievements realised as a result of strategic TPM implementation. The approach is directed towards the justification of TPM implementation for its support to competitive manufacturing in Indian industries. The study highlights the contributions made by holistic TPM implementation at a precision tube mills in an Indian manufacturing enterprise. [22]

Zahid Habib et al, (2008) The core of this thesis is doing a study on assembly line of automatic brake adjusters at Haldex Brake Products AB. Total Productive Maintenance (TPM) is a plan which concentrates on total involvement of everyone from top management to all employees. The initial study carried out on assembly line indicated some very obvious lapses in the system. A stepwise TPM implementation plan is derived for line with time schedule. The pilot team building process is discussed as it is a basic step for TPM plan. The necessary training should be provided to the pilot team. An autonomous maintenance plan is also derived with checklists to strengthen TPM implementation. [23]

Panagiotis Tsarouhas, (2007) stated that, The purpose of this paper is to adopt the total productive maintenance (TPM) in the food industry and especially in bakery products. The paper aims to develop a methodology for improving the quality of the products, providing a healthier and safer work environment and increasing production rate. The methodology is based on analysing the reliability data of an automatic production line. The continuous inspection of the production process is done with measurements of the overall equipment effectiveness (OEE). This paper presents the implementation of TPM in a pizza production line. And using certain assumptions, the generalization of the results in bakery production lines. [24]

Thun J.H. (2006) stated that, the dynamic implications of TPM are analysed. A system dynamics model gives valuable hints for a successful implementation taking the different influences of Preventive Maintenance and Maintenance Prevention on the Overall Equipment Effectiveness as the central performance measure of a maintenance system into account. After discussing why the successful implementation of this concept might fail, interrelations between the pillars of TPM are identified. The focus of the research conducted is the analysis of fundamental structures and the identification of a strategy for the implementation of TPM. The article contributes to a better understanding of the dynamic behaviour of TPM. [25]

Kathleen E. McKone et al (2001) stated that, In this paper we investigate the relationship between manufacturing performance (MP) and TPM through Structural Equation Modeling (SEM). We find that TPM has a positive and significant relationship with high levels of quality (as measured by higher levels of conformance to specifications), strong delivery performance (as measured by higher percentage of on-time deliveries and by faster speeds of delivery) and low cost (as measured by higher inventory turns). There is a positive and significant indirect relationship between MP and TPM through Just-In-Time (JIT) practices. [26]

F. Ireland et al (2001) given a study of total productive maintenance implementation in three companies. Nakajima's seven steps of autonomous maintenance was the focus for implementation. [27]

G. Chand et al (2000) reported to implement the concept in cellular manufacturing system having tool room, product test room and forming shop. In the paper they have reported 62% OEE and concluded the need of sustained TPM implementation to achieve world class OEE level of greater than 85%. [28]

S. Nakajima (1988) done pioneering work and has given basic definition of TPM, goals of TPM, merits and demerits of TPM, objectives of TPM, its importance and steps to be followed while implementation of TPM. Also author has described about possible areas of wastage of resources which may occur, challenging limits for TPM. He also conclude that TPM activities focus on eliminating the six major losses, equipment failure, defects in process, reduced speed, set-up and adjustment type. [29]

IV. CONCLUSION

Today, with competition in industry at an all time, TPM may be the only thing that stands between success and total failure for any company. Pillars of TPM like Autonomous maintenance, Planned Maintenance, Quality maintenance, Focused Improvement, Education and training, Early Equipment and Management, Office TPM, Safety, Health & Environment with base of TPM i.e. 5S are all important for better result of an organization. Proper implementation of TPM improves Overall Equipment Effectiveness, which also indicate the improvement in productivity and improvement in quality of product. TPM helps to improve the accessibility of the existing equipment. It increases productivity with decrease in scrap, waste, time etc. TPM is about communication. It mandates that operators, maintenance people and engineers collectively collaborate and understand each other's language. TPM should be followed by each person of industry.

4.1 Future Scope and Recommendations

From above study it is helpful in the future to understand and implementing of TPM in any firm. If everyone from the organization involved in a TPM program, does his or her part, then high rate of return may be expected as compared to all resources invested.

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