PRODUCTIVITY IMPROVEMENT WITH TOTAL PRODUCTIVE MAINTENANCE AND 5S CONCEPT STRATEGIES

A PROJECT REPORT

Submitted by

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His / ~~Her~~ conduct and behaviour were Good.

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ABSTRACT

This project titled "Productivity improvement with Total productive maintenance (TPM) and 5s concept strategies" was carried out at M/s Sakthi Auto Components Ltd., Erode District, Tamilnadu, India. A high level of rejections, rework and breakdown of equipments all of this leading to reduced productivity of production lines was the critical problem faced by the company.

Two production line namely special purpose machines (SPM) line and computer numerically controlled (CNC) machines lines were taken for critical study and analysis. The study revealed that the overall equipment effectiveness (OEE) of the production lines were considerably low. To improve the situation, TPM autonomous maintenance and 5s strategies were implemented. Employees in the production lines were taken into confidence, made aware off and educated in the new concepts with one point lessons. Defects were identified and actions to be taken were given to the concerned employees.

The implementation of the TPM and 5s strategies considerably improved the situation in the company. The OEE of the two production lines went up by notable percentage indicating a remarkable improvement in productivity of the production lines by bringing down rejections, rework and breakdown of equipments.

ஆய்வுச் சுருக்கம்

" மொத்த மேம்பட்ட உற்பத்திக்கான பராமரிப்பு (TPM) மற்றும் 5-எஸ் கோட்பாட்டு உத்திகள் மூலம் உற்பத்தியை மேம்படுத்துதல்" எனும் தலைப்பிலான இந்த ஆய்வு, ஈரோடு மாவட்டம் சக்தி ஆட்டோ காம்பனண்ட்ஸ் லிட். நிறுவனத்தில் மேற்கொள்ளப்பட்டது. பழுதடையும் இயந்திரங்களால் ஏற்படும் பணிநிறுத்தம், குறைபாடுடைய உற்பத்திப் பொருட்கள், குறை நீக்க மறுவேலை செய்தல் ஆகிய இவை அனைத்தும் இணைந்து மொத்த உற்பத்தியை குறைக்கும் சிக்கலான நிலையை நிறுவனங்கள் சந்திக்கின்றன.

இந்த ஆய்வுக்கு சிறப்புத்திறன் கொண்ட இயந்திரங்களின் தடம், கணினியால் கட்டுப்படுத்தப்படும் இயந்திரங்களின் தடம் என இரு உற்பத்தித்தடங்கள் எடுத்துக் கொள்ளப்பட்டன. இந்த ஆய்வில் உற்பத்திதடத்தில் உள்ள இயந்திரங்களின் மொத்த உற்பத்தி திறன் மிகக்குறைவாக இருந்தும் கண்டறியப்பட்டது. இக்குறைப்பாட்டை களைய, மொத்த மேற்பட்ட உற்பத்திக்கான பராமரிப்பு எனும் தானியாங்கி பராமரிப்பும் 5.எஸ் உத்திகளும் பயன்படுத்தப்பட்டன. இந்த உற்பத்தித்தடத்தில் உள்ள தொழிலாளர்கள் இப்புது நடைமுறைகள் குறித்து அறிவுறுத்தப்பட்டு ஏற்றுக்கொள்ளுமாறு செய்யப்பட்டன. அந்தந்த பகுதி தொழிலாளர்களுக்கு, அங்கு உற்பத்தித் தடத்தில் ஏற்படும் குறைகளை களைய பயிற்சி அளிக்கப்பட்டது.

மொத்த மேம்பட்ட உற்பத்திக்கான பராமரிப்பு (TPM) ,5-எஸ் கோட்பாட்டு உத்திகளும் நடைமுறைப்படுத்தப்பட்ட பிறகு, நிறுவனத்தின் உற்பத்தி நிலை கணிசமாக உயர்ந்துள்ளது. மேலும் இந்த நடைமுறையால், குறைபாடுடைய உற்பத்திப் பொருட்கள், பழுதடையும் இயந்திரங்களால் ஏற்படும் பணிநிறுத்தம், குறைகளை நீக்க மறுவேலை செய்தல் என அனைத்து குறிப்பிடத்தக்க அளவு குறைத்து, உற்பத்தி தடங்களின் உற்பத்திக் கோடானது உற்பத்தி அதிகரிப்பை காட்டும் வகையில் நன்கு உயர்வடைந்து உள்ளது.

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LIST OF ABBREVIATIONS

BM	Breakdown
PM	Preventive Maintenance
SM	Scheduled Maintenance
PM	Predictive Maintenance
RCM	Reliability Centered Maintenance
TPM	Total Productive Maintenance
SPM	Special Purpose Machine
CNCM	Computer Numerical Control Machine
PQDCSM	Productivity, Quality, Delivery, Cost, Safety & Morale
OEE	Overall Equipment Effectiveness
S.A.C.L	Sakthi Auto Component Limited
AM	Autonomous Maintenance

CHAPTER 1

INTRODUCTION

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INTRODUCTION

1.1 An overview about the organization

1.1.1 Introduction to the organization

This project was carried out at M/s Sakthi components located at Mukasi-pallagoundenpalayam, a small village in Erode district, Tamilnadu, India. The concern was established in the year 1983. This company belongs to sakthi automative groups with its head office at Germany, and operations at five locations in Europe and India.

The annual sales revenue of the group is E250 millions, with a production of 2 lakhs tones per annum employing around 3000 employees. The company mainly manufactures components for concerns in the automobile industry. The products of M/s Sakthi auto components has a range of uses that include bicycles, cars and heavy duty commercial vehicles. It is to be noted that most of the components that are manufactured are highly stressable parts.

1.2 Corporate Principles

The corporate principles of the group has been based on top quality, top production standards and reliability at a fair price. Focus of the group has always been on satisfying customers, comprehensive environmental protection safety and satisfaction, as identically to meaningful ecoonic success. The common has TSI7040 certification for the year and has been recommended by TUPV for ISO 14001 and OHSAS18001 certifications.

The Sakthi automotive group considers itself responsible with regard to the environment. The following environmental principles characterize its corporate policy.

- Compliance with all statutory regulations and guidelines as well as environmental protection targets that go beyond the legal requirements.

- The preservation of environmental and energy reserves through the reduction, reuse and recycling of resources wherever it makes sense and is practically feasible.
- The continuous improvement of our environmental management system for the setting of targets and the regular checking of our progress.
- Sensitizing and qualification of our employees regarding their contribution to environmental protection.

1.3 Products of the Sakthi Automotive Group

All around the world the automotive industry makes the highest demands of its suppliers. This applies first of all to crucial factors such as material consistence, delivery reliability and competitive costs. Sakthi automotive not only meets these expectations but also understands its customers' wishes for maximum performance. This goes so far that the concern is involved as a partner is the product development phase. As a producer of chassis and powertrain components for cars and trucks the concern know that every part is designed for optimum performance – with the lowest possible weight and costs.

The following products are manufactured by Sakthi Auto Group.

a. Brake housing and carriers
b. Steering gear cases
c. Brackets
d. Wheel carriers
e. Brake discs

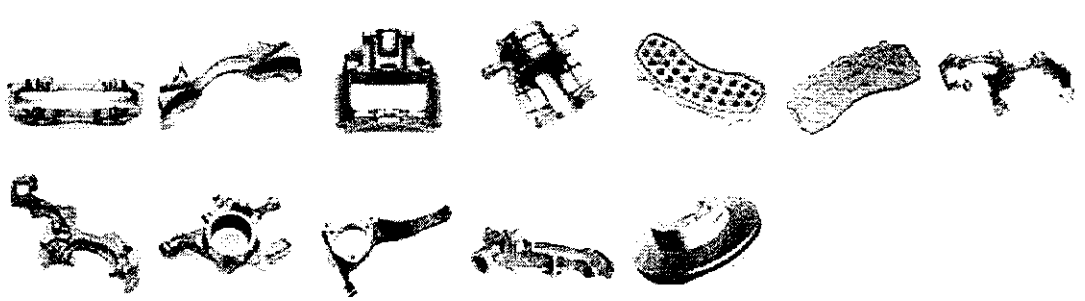


Fig. 1.3 Products of the Sakthi Automotive Group

CHAPTER 2

PROBLEM IDENTIFICATION

CHAPTER - 2

PROBLEM IDENTIFICATION

2.1 Need for Being Competitive

In today's global marketplace, opportunities and competition are the catch phrases, Companies are drawing business strategies to deliver reliable product or services that satisfy customer requirements in time. The prices of the product or service are to be low enough to be competitive and at the same time fetch profitable revenues for the company. It follows that manufacturing companies are to focus more on the reduction and elimination of unwarranted costs associated with material and time wastage. So, to achieve reliable products or services satisfying the customers' requirements on time the companies should improve their performance in all areas.

2.2 Critical Performance Areas

The performance of a manufacturing concern depends mainly on the reliability of its production lines and its efficient functioning. Although many companies automate a major part of their manufacturing operations, maintenance of facilities depends on human inputs. Hence it is to be noted that human inputs in the area of maintenance becomes a critical factor to keep the production lines functioning optimally.

2.3 The Actual Situation in the Company

At M/s Sakthi auto components Ltd., there are around three hundred manufacturing machines in the production line. The machines include conventional, CNC and special purpose machines that have been place in a product layout. The are fourteen production lines, each line involved in the production of a particular component.

The production facilities are kept in operating condition by a maintenance department. Mainly, preventive, productive and break down maintenance are followed. Inspite of the maintenance carried out, the production lines have been poor in their performance.

2.4 Problem Definition

It is to be noted that in a product layout, the production line comes to a stop even if one of the machines in the line functions leading to a breakdown. Hence there is down time of all the machines in the production time and more over during breakdown, the work being performed (mechanical) on the machine gets affected leading to rejections. It has been observed that down time of machines and rejections has brought down the productivity of the production lines. Two production lines have been analysed. The lines have been identified for study and analyses to rectify the problems that lead to bringing down productivity.

CHAPTER 3

METHODOLOGY TO SOLVE THE PROBLEM

CHAPTER – 3

METHODOLOGY TO SOLVE THE PROBLEM

3.1 Importance of the Problem

certain components line steering knuckles that are manufactured in the production line experience a large rejection. The two production lines considered in this project are the special purpose machine (SPM) line and CNC Heid lathe line as they contribute to the maximum number of rejections and breakdowns.

3.2 Focus-Overall Equipment Effectiveness (OEE)

These are three factors to be taken into account for calculating overall equipment effectiveness. They are

- Equipment availability
- Performance efficiency and
- Rate of quality product

Each of the above parameters are to be determined as sown.

$$\text{Availability} = \frac{\text{Loading time} - \text{Down time}}{\text{Loading time}}$$

$$\text{Performance Efficiency} = \frac{\text{Theoretical cycle time / Unit} \times \text{No of Unit's}}{\text{Operating time}}$$

$$\text{Rate of quality product} = \frac{\text{Produced quantity} - \text{defect quantity}}{\text{Produced quantity}}$$

Now, OEE obtained as shown

$$\text{Overall Equipment Effectiveness} = \left(\text{Availability} \times \text{Performance efficiency} \times \text{Rate of quality product} \times 100 \right)$$

When OEE is analysed, the following six losses are to be understood.

Looking at machine operation, one could distinguish six types of waste referred to as losses, because they reflect lost effectiveness of the equipment. These six big losses are grouped in three major categories.

Availability loss

- Breakdown
- Setup and changeover

Speed loss

- Idling and minor stoppages
- Reduced speed

Quality loss

- Defects and rework
- Start up losses

3.3 Methodology

3.3.1 General Methodology

Now OEE has been taken as the focus in this project. The OEE along the two production lines taken for study/analysis is determined. Causes for the OEE being low is analyzed. Now by improving the partially existing total productivity maintenance (TPM) and 5s strategies that are used in the company, the OEE along the lines are enhanced to a considerable extent.

3.3.2 Autonomous Maintenance

The main reason for the poor availability of equipment, plants and production facilities is that the basic equipment conditions are not maintained. The periodic preventive maintenance tasks of cleaning, lubrication, tightening of bolts and fasteners, replacements of wearing parts, equipment inspections and servicing are not performed. The maintenance department, in most cases doesn't get the time to attend to these tasks and is too busy taking care of equipment breakdowns. This makes matter worse and the

maintenance departments find it all the more difficult to carry out the preventive maintenance tasks and ensure that the basic equipment conditions are maintained.

Autonomous maintenance helps to reduce the workload of the maintenance department as well as to improve the machine performance. Autonomous maintenance consists of the maintenance tasks performed by the production operators. The operators are required to performed these tasks in addition to their basic job of running, or operating the production equipment. In TPM, the production operators are required not only to operate the equipment and produce components but also to take care of their equipment.

The purpose of autonomous maintenance is to teach operators how to maintenance their equipment by performing daily checks like,

1. Lubrication.
2. Replacement of parts.
3. Repairs.
4. Precision checks.

They should also contribute to improve the machine performance by eliminating the losses like

1. Failure losses – break down loss.
2. Setup /adjustment losses.
3. Cutting blade loss.
4. Start up loss.
5. Minor stoppage/idling loss.
6. Speed loss- operating at low speeds.
7. defect /rework loss.
8. Scheduled downtime loss.

Losses that impede equipment efficiency

9. Management loss

10. Operating motion loss
11. Line organization loss
12. Logistic loss
13. Measurement and adjustment loss

Losses that impede human work efficiency

14. Energy loss
15. Die jig and tool breakage loss
16. Yield loss

(a) Steps in Developing Autonomous Maintenance

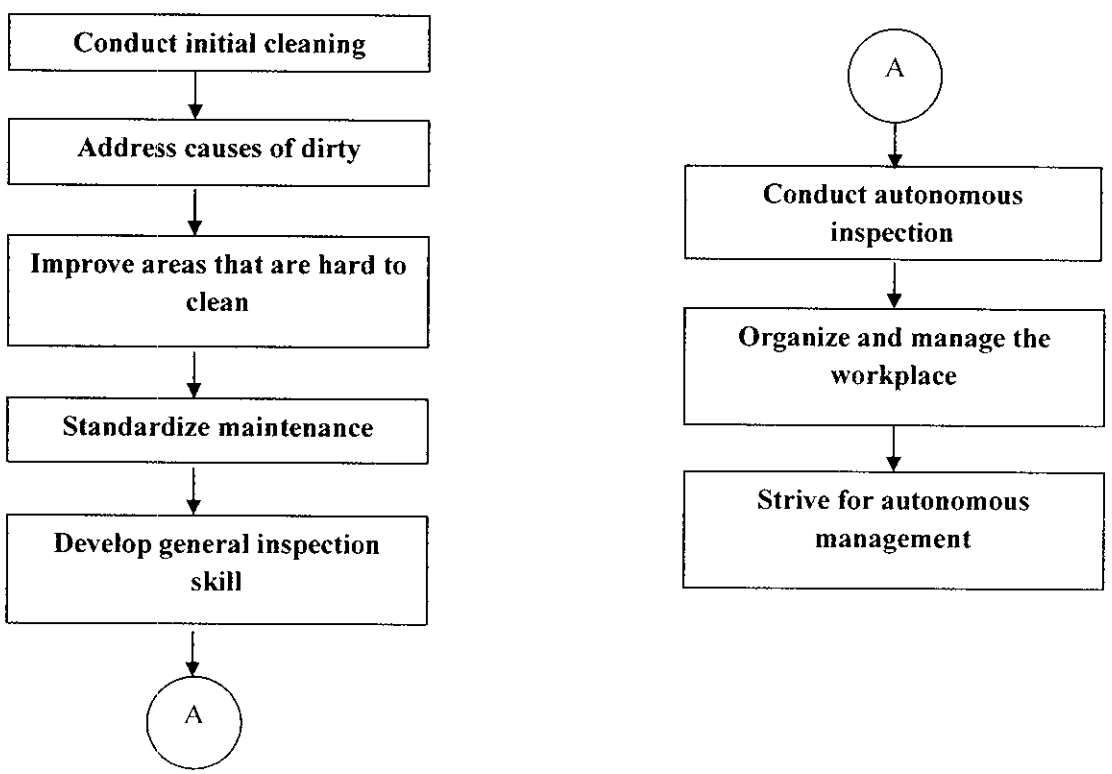


Fig. 3.1 Developing Autonomous Maintenance Steps

CHAPTER 4

LITERATURE SURVEY

CHAPTER – 4

LITERATURE SURVEY

4.1 Literature Survey – From Research Papers

It gives the description of literature reviewed from various research papers published in international and national journals, proceedings of various conferences and books.

(a) Kanthi M.N. Muthiah. SamuelH.Huang. Sangeetha Mahadevan [1] presented a methodology for a quantitative metric for measuring the productivity of individual production equipment in a factory. It was proposed by seiichi nakajimea in the late 1980s. OEE is defined as [a]

$$OEE = A_{eff} \times P_{eff} \times Q_{eff}$$

Where A_{eff} is the availability efficiency.

P_{eff} is the performance efficiency.

Q_{eff} is the quality efficiency.

The overall equipment effectiveness metric is a powerful tool that can be used to measure performance and also perform diagnostics at the equipment level. Although important, gains made in OEE are insufficient; because the ultimate objective is a highly efficient integrated system, not brilliant individual equipment. Factory level performance monitoring and diagnostics can be facilitated by classifying the entire manufacturing system layout's as follows "series."parallel."assembly,"expansion."and the algorithms are implemented into a software tool called SIMPRO.a glass manufacturing case study is

used to illustrate automated performance diagnostics and the benefits obtained by using the approach.

(b) M.Samrout, R.Kouta, F.Yalaoui, E.Chatelet [2] presented a ant colony algorithm applied in preventive maintenance optimization. this method was initially used for resolution of travelling salesman problem. Meta-heuristic applications have evolved a lot nowadays and have been used in many domains. This paper offers a detailed study about the influence of parameter on the AC operation. An experimental design is done. Obtained results are coherent with the convergence condition of the AC algorithms. Based on those latter: improvements are done to the original AC algorithm and interesting results are obtained.

(c) Zimin(max)yang, dragan Djurdjanovic, jun Ni [3] presented a new method for scheduling of maintenance operation in a manufacturing system using the continuous assessment and prediction of the level of performance degradation of manufacturing equipment as well as the complex interaction b/w the production process and maintenance operation. A genetic algorithm based optimization procedure is used to search for the most cost –effective maintenance schedule, considering both production gains and maintenance expenses. In all case that were studied application of the newly proposed maintenance scheduling tool resulted in a noticeable increase in the cost-benefits. which indicates that the use of predictive information about equipment performance through the newly proposed maintenance scheduling method could result in significant gains obtained by optimal maintenance scheduling .

(d) S.R. Fletcher, T.S.Baines, D.K.harrison [4] presented a paper describes a field study that investigated the extent to which worker's production task cycle time vary and degree to which such variation are associated with attitude differences result shows that worker performances varies significantly, much more than is assumed by contemporary manufacturing system designers and that this appears to be due to production task characteristics. The finding of this research and their implication and discussed.

(e) Chin-chin wu, wen-chiung lee [5] presented a recent empirical studies in several industries have verified that unit costs decline as firms produce more of a product and gain knowledge or experience. This phenomenon is know as the "learning effect." How ever most of the papers assume that the machine is available at all time. In reality, the machine might become unavailable at due to machine breakdown or preventive maintenance during period. Motivated by this, single machine scheduling problems with consideration of the learning effect and machine availability are considered in this paper.

It is shown that the shortest processing time rule provides the optimal schedules for makespan and the total completion time minimization problems when jobs are assumed to be resumable. Moreover ,mixed integer programming techniques are used to solve the problem when jobs are non- resumable .

(f) Wen-jinn chen [6] presented as machine is required in many industries, it is usually arranged in a planned schedule. In this paper we discuss a scheduling problem where periodic maintenance and jobs are scheduled on a regular basis. In our research, a periodic maintenance sequence consists of several maintenance period and each maintenance period is scheduled after a fixed time interval. The objective is to minimize the total flow time and maximum tardiness. A heuristic that utilizes the theorem is proposed to solve the problem by providing a small set of efficient sequences according to his preference. We also propose a branch-and-bound algorithm is to find the optimal sequence. Computational result show that the presented heuristic is highly accurate and efficient.

(g) Mehmet Cakmakci, Mahmut Kemai Karasu [7] presented a higher quality and efficient production requires newer production methods and ideas. As lean manufacturing was introduced to production environments, an important question occurred. What must be done to reduce the setup time? Shigeo shingo tried to solve this problem by his methodology called SMED. Here "sustainability" is used as keeping the success level achieved by using SMED at a desired point and not letting it to drop down. To achieved desired sustainability well-arranged standard procedure must be prepared. In this text optimal changeover procedure is constituted with the aid of a predetermined time system (MTM-UAS) to standardize and preserve the improved changeover operation.

(h) Kunal kant [8] presented a careful search for this led to practices followed in Japanese industries and popularly known as total productive maintenance(TPM).as a concept is rapidly growing in popularly worldwide. The potential benefits of TPM as proclaimed by world-class industries include tangible benefits in production / productivity, quality, cost, delivery and safety and intangible benefits like improved morale amnd skill of work force. The mangnitude of benefits claimed has prompted TATA STEEL to initiate TPM concept on a pilot basis in one of the business units i.e ring plant.

(i) Hongyi sun, Richard yam, Ng Wai Keung [9] presented this paper records the pilot implementation and evaluation of total productivity maintenance (TPM) in the advanced manufacturing environment of a hong kong manufacturing company. The management of the company would like to implement TPM in the company. the main concern are; 1) TPM is a Japanese method. 2)the method may not suitable for people in hong kong . the pilot project turned out to be very successful. It can also be a reference for other companies that would like to implement TPM.

4.2 Types of Maintenance

There are 5 types as following

4.2.1 Breakdown maintenance.

It means that people wait until equipment fails and repairs it. Such a thing could be used when the equipment failure does not significantly affect the operation or production or generate any significant loss other than repair cost.

4.2.2 Preventive maintenance.

It is a daily maintenance (cleaning, inspection, oiling and retightening),design to retain the healthy condition of equipment and prevent failure through the prevention of deterioration, periodic inspection or equipment condition diagnosis, to measure deterioration. it is further divided into periodic maintenance and predictive maintenance. Just like human life is extended by preventive medicine, doing preventive maintenance can prolong the equipment service life.

4.2.3 Scheduled maintenance.

It is a time based maintenance consists of periodically inspecting, servicing and cleaning equipment and replacing part to prevent sudden failure and process problem.

4.2.4 Predictive maintenance.

This is a method in which the service life of important part is predicted based on inspection or diagnosis, in order to use the parts to the limit of their service life . Compared to periodic maintenance, predictive maintenance is condition –based maintenance. It manages trend values, by measuring and analyzing data about deterioration and employs a surveillance system, designed to monitor condition through an on-line system.

4.2.5 Reliability centered maintenance.

Rcm is a procedure for determining maintenance strategies based on reliability techniques and encompasses condition monitoring and well-know analysis methods such as failure mode effects and criticality analysis (FMECA).

4.3 Total Productive Maintenance (TPM)

4.3.1 Need for TPM

1. TPM gives insights to employees in improving the performance and maintainability of existing for new equipment that is more reliable as well as easier and less costly to maintain.
2. TPM is based on the understanding that equipment conditions determine product quality and that zero defects can be achieved by carefully identifying and maintaining optimal equipment and processing conditions.
3. TPM aims at raising the skill levels of all employees from design engineers and managers to line-level maintenance personnel and equipment operators.
4. It is to be noted that maintenance cost can account for 15 to 40 percent of total manufacturing costs. Because up to 75 percent of equipment or system life cycle costs are attributable to maintenance and operational activities, which will naturally affect product cost. Moreover, the largest percentage of these costs are determined by decisions made during the planning and early design stages. With sobering figures like these, manufacturers are beginning to recognize that maintenance organization and management and design for reliability and maintainability are strategic factors for success.
5. Today's increasingly competitive markers have exposed the need for much more effective equipment management. Highly automated and sophisticated manufacturing environments require equipment that is failure free and capable of producing zero defects. They also require maintenance and operations personnel skilled in bringing equipment to optimal performance levels and keeping it there.
6. Pressured by demands for higher quality, greater diversity, and shorter lead times from the market and by manufacturing labor shortages, manufacturers are asking for more flexible equipment, workerless production lines, and other automated systems. Responding to these demands, machining and assembly lines that can be operated for long periods without human assistance have been developed. Such

systems are epressions of advanced technological research in automation and computerization. Even so, it is not possible to build complerely workerless systems. When any of these systems break down or operates abnormally, when a blade or drill bit breaks or when their products contain defects, they still require a flesh-and-blood troubleshooter and repair person. So-called workerless systems can run all day and all night only if they can be trusted to operate trouble free. This need for trouble-free operation makes TPM all the more important.

4.3.2 Objectives

TPM policy is composed of the following objectives.

- To maximize overall equipment effectiveness through total employee involvement.
- To improve equipment reliability and maintainability as contributors to quality, and to raise productivity.
- To aim for maximum economy in equipment and management for the entire life of the equipment.
- To cultivate equipment-related expertise and skills among operators.
- To create a vigorous and enthusiastic work environment

Maximum Equipment Effectiveness Through Total Employee Involvement:

Hidden loss of equipment efficient generally ranges as high as 40 to 50 percent. To eliminate this loss and maximize the equipment's overall effectiveness requires the efforts of all employees, from high-level mangers to front line workers. In other words, every one who plans, uses, or maintains the equipment must participate in autonomous maintenance, equipment improvement, preventive maintenance, MP(maintenance prevention) system-building, and education and training.

Improve Equipment Reliability, Maintainability and Productivity

Preventive maintenance includes quality maintenance – activities that establish and maintain the conditions for zero defects to help equipment contribute to overall product quality. Development of quality maintenance is a vitally important activity.

Aim for Economical Life Cycle Costs

It is important to promote an MP system in which MP design, early warning systems, and life cycle costing methods – all aimed at achieving the most economical LCC (life cycle cost) for equipment (LCC is the sum of the initial costs, operating costs, and maintenance costs).

Enhance Equipment Expertise and Skills

As the production lines become ore automated operators must become more skilled at recognizing abnormalities as such and handle them properly. Equipment operators who lack such judgmental, technical and maintenance skills will lose their value on the production line.

To help create a pool of highly skilled equipment operators, it is necessary to promote autonomous maintenance activities and provide education and training in the pertinent techniques and skills for everyone involved in a leadership or support capacity. This includes managers, foremen, and maintenance staff. Furthermore a maintenance technician training and accreditation program should be established in-house for group leaders, maintenance staff, and operators.

Create a Vital, Enthusiastic Work Environment

A vital and enthusiastic work environment can be achieved through a three-step process of (1) changing equipment, (2) changing attitudes, and (3) revitalizing the workshop. In practice, this means promoting autonomous maintenance based on small group activities.

4.4 5s Strategies

- The 5s philosophy is based on the Japanese words that begin with 'S'. The focus is on effective work place organization and standardized work procedures. It is a Japanese concept of good house keeping.
- It is obvious that the work will be more pleasant and beautiful if the work place is neat and clean with all articles placed in position in an orderly manner. Moreover, team based activities result in improving pride, ownership and loyality within the work place. In addition, employees get involved in work when they get a feeling that their thought and ideas will be valued and if worth while, implemented. Also

it is to be noted that production and productivity will go up if the working environment is systematic and safe to carryout work. In order to achieve this, 5s philosophy is used.

- The main objectives in 5s is to sustain a productive work environment by adopting the following methodology.
    - Organizing
    - Cleaning
    - Developing and cleaning up
    - Standardizing
    - Training discipline
- Explanation of each s has been given.

a) SEIRI-Sort:

- Here the focus is to eliminate unwanted items from the workplace.
- Red tagging is an effective visual method used to identify the unwanted items. A red tag is to be placed on all items that are not required to complete the job. Then the items with the red tag are taken to a holding area for evaluation. The items needed are retained and the items not required are disposed off.
- The sorting process helps to prevent JIC job mentality. Sorting also helps to free up valuable floor space by eliminating broken tools, scrap material and so on.

b) SEITON-Set in Order

- Here the focus is on efficient storage methods. The concept here is "A place for everything and everything at its place".
- The questions to be answered here are:
    - What is required to do my job?
    - Where should I locate this item?
    - How many of this item do I really need?
- Some suggested strategies to effectively set in order are:
    - Printing floors to outline work areas and locations

- Modular shelving and cabinets for needed items
- Proper labeling and identification practices

Ex: Locating notice boards where they are easy to see.

- Keeping fire extinguishers in easily accessible places.

- Here a system should be developed to easily return the item to its proper place after it being used.

c) SEISO-Shine

- Here the focus is to thoroughly clean the work area once the clutter and junk items have been eliminated from the work area. It is very essential to have daily follow-up cleaning to sustain the improvement.
- Following are the results of the shine step.
  - Workers take pride in a clean and clutter-free work area.
  - Workers get a sense of ownership of equipment and facility.
  - Workers will be able to identify vibrations, misalignments, coolant leaks and so on.
  - All the above lead to better equipment maintenance and enhancement of production.

  Ex:
  - Clean floors from oil, water, scrap etc.,
  - Check all electric connections for properness.
  - Clean all lighting bulbs, reflectors to be free from dirt.

d) SEIKETSU - Standardise

- Here the focus is to standardize the best practices in the work place.
- For this, employees should be made to participate in the development of standards.
- The objective here is to prevent problems by keeping things standardized and maintaining a good environment.

  Ex:
  - Safe, clean, and tidy clothing to be worn

- Resting, eating and smoking locations to be specified.
- Adequate lighting, ventilation and smoke exhaust to be provided.
- Keeping all surfaces clean and tidy.
- Indications about where, what and how much stored to be displayed.

e) SHITSUKE-Sustain

- Here the focus is on defining a new status quo and standard of work place organization.
- This step is very important because human beings by nature resist change. If good habits, commitment and discipline are not maintained, then the work place will again become a dirty cluttered shop after a short period of implementing 5s.
- Hence it is necessary to sustain achievements by maintaining good habits and discipline. For this act of sustaining achievements, the follow are to be noted.
  - Display correct work procedure
  - Give training to ensure use of correct procedures.
  - Display safety regulations and insist everyone to follow.
  - Establish inspection.
  - Keep private belonging away.
  - Restrict from smoking and eating from work areas.
- Benefits of 5s implementation are:
  - Improved morale, safety, productivity and maintenance.
  - Creates a sense of ownership of workplace.
  - Productivity increases and quality improves.
  - Defects and maintenance are reduced.

CHAPTER 5

MACHINE LINES CONSIDERED AS CASE STUDY

CHAPTER -5

MACHINE LINES CONSIDERED AS CASE STUDY

5.1 Machine Lines Considered for Study

The concern has fourteen production lines, each line having a set of machines placed using the product layout concept. Out of these fourteen production lines, following two lines have been considered for study.

- Special purpose machines (SPM) line
- Computer numerically controlled lathe machines (CNC)

The details of these machines have been furnished.

5.2 Special Purpose Machine Line

As the name goes before entering into the assembly, finishing operations like boring, facing, drilling reaming tapping etc, are to be done machine on SPM. These operations are noted as key operations. SPM are automatic machines having around 40 tool holders magazine and ATC (automatic tool changer). A numerical control display unit is attached with this machine for guiding the tool.

The operator fixes the job and starts the machine. Now the tool moves in x,y,z directions for doing the operation as per the program which is already stored in the machine memory. According to the requirement, the operator keeps on changing the programs in the monitor with the help of codes.

5.3 CNC Lathe Machines Line

Before entering in to the assembly, finishing operation like facing, turning are to be done in CNC lathe machine. These operations are noted as key operations. These are automatic machines having 6 tool turret head. A numerical control display unit is attached with this machine for guiding the tool to a proper direction and does the operation as desired.

CHAPTER 6

DATA COLLECTION

CHAPTER – 6

DATA COLLECTION

6.1 Data Collection for SPM Line

6.1.1 Categories of Defects

There are three categories of defects:

1. Critical defects
2. Major defects
3. Minor defects

Critical defects shut the machine down and prevent it from running altogether. Usually a broken machine will contain only one major defect that can be corrected with normal troubleshooting and repair skills.

Major defects impair the machine's performance but usually won't stop it form running. It may run more slowly or produce product with a lower quality level.

Minor defects by themselves seem to do harm. This probably because one can observe a machine with several minor defects and notice that it appears to be running just fine.

Minor defects don't seem to matter at the moment. But minor defects left unattended may affect machine performance in many ways. So some of the minor defects are to be eliminate before improving the autonomous maintenance.

6.1.2 Defects Identified

The minor defects in SPM line are identified and shown in table.

Table: Defects Identified

S.NO	DEFECTS
1.	Door signal not come.
2.	Center height observed.
3.	Bore step & taper problem.
4.	Z axis not working.
5.	Air not available.
6.	Over temperature.
7.	Over temperature.
8.	Flash & cutting coolant not come.
9.	Over travel alarm.
10.	Spindle belt damaged problem.

6.1.3 OEE for SPM Line before TPM & 5S Strategy Implementation

PERIOD	A min	B Min	C min	D min	E min	F	G	H sec	I	J	K	OEE	REMARKS
1Week	8640	540	8100	1080	7020	86.66%	100	60	85.47%	10	90%	65.79%	Minor stoppages
2Week	8640	540	8100	1120	6980	86.17%	92	60	79.08%	5	94%	63.86%	Tool damaged
3Week	8640	540	8100	1050	7050	87.03%	95	60	80.08%	3	96%	66.81%	Minor stoppage
4Week	8640	540	8100	1420	6680	82.46%	88	60	79.04%	4	95%	61.54%	Spindle coolant motor fan damaged
OEE Average												65.00%	

A= Gross Available Time.
B=Planned Down Time.
C=Running Time (A-B).
D=Down Time.
E=Operating Time (C-D).
F=Availability(E/C×100).
G=Output.
H=Theoretical Cycle Time.
I=Performance(H×G/E×100).
J=Rejects During Operating Time.
K=quality(G-J/G×100)

Overall Equipment Effectiveness

OEE = F × I × K

6.2 DATA COLLECTION FOR CNC MACHINE LINE

6.2.1 Categories of Defects

There are three categories of defects:

1. Critical defects
2. Major defects
3. Minor defects

Critical defects shut the machine down and prevent it from running altogether. Usually a broken machine will contain only one major defect that can be corrected with normal troubleshooting and repair skills.

Major defects impair the machine's performance but usually won't stop it form running. It may run more slowly or produce product with a lower quality level.

Minor defects by themselves seem to do harm. This probably because one can observe a machine with several minor defects and notice that it appears to be running just fine.

Minor defects don't seem to matter at the moment. But minor defects left unattended may affect machine performance in many ways. So some of the minor defects are to be eliminate before improving the autonomous maintenance.

6.2.2 Defects Identified

S.NO	DEFECTS
1.	conveyor to be clamped
2.	Oil leak from chuck pressure hose line
3.	Chuck, tail stock pressure gauges to be changed
4.	Hydraulic oil return to tank hose to be changed
5.	Hydraulic oil pump seal leak
6.	X- axis movement slightly jerk.
7.	Spindle motor fan and fins to be cleaned
8.	Conveyor side plate cover screws to be fixed
9.	Oil filter to be cleaned
10.	Oil leak from pipe

The minor defects in CNC machine line are identified and shown in table.

6.2.3 OEE for CNC Lathe Machine Line Before TPM & 5s Strategies Implementation

PERIOD	A min	B min	C min	D min	E min	F	G	H sec	I	J	K	OEE	REMARKS
1WEEK	8640	540	8100	1300	6800	83.95%	110	50	80.88%	7	93%	61.75%	Minor stoppages
2 WEEK	8640	540	8100	1420	6680	82.46%	100	50	74.85%	6	94%	57.03%	Rework
3 WEEK	8640	540	8100	1255	6845	84.50%	120	50	87.65%	8	93%	67.96%	Minor stoppages
4 WEEK	8640	540	8100	1120	6980	86.17%	115	50	82.37%	9	92%	64.87%	Tool damaged
OEE Average												63.00%	

A= Gross Available Time.
B=Planned Down Time.
C=Running Time (A-B).
D=Down Time.
E=Operating Time (C-D).
F=Availability(E/C×100).
G=Output.
H=Theoretical Cycle Time.
I=Performance(H×G/E×100).
J=Rejects During Operating Time.
K=quality(G-J/G×100)

Overall Equipment Effectiveness

OEE = F × I × K

CHAPTER 7

IMPLEMENTATION OF TPM & 5S STATERGIES AND ITS IMPACT

CHAPTER – 7

IMPLEMENTATION OF TPM & 5S STATERGIES AND ITS IMPACT

7.1 Autonomous Maintenance Strategies under TPM for SPM Line

7.1.1 Actions for Defects Identified

For the defects that have been identified and presented in the previous chapter, the following actions proposed and implemented as shown in table.

Table: Actions for Defects Identified

S.NO	DETAILS OF DEFECT	ACTION TAKEN
1.	Door signal not come.	Adjusted and tight properly.
2.	Center height observed.	Due to M/C accident so center height changer, center height set in 30micron upward.
3.	Bore step & taper problem.	Z axis keeper plate and gib removed cleaned and fixed now step nil ,M/c is running.
4.	Z axis not working.	Z axis drive timing belt new changed.
5.	Air not available.	Incoming air ok, air hose cleaned check.
6.	Over temperature.	230v new fan replaced and checked.
7.	Over temperature.	Pannel A/c was not cooling so spare A/c fixed.
8.	Flash & cutting coolant not come.	Coolant impeller and delivery line removed, cleaned and refixed.
9.	Over travel alarm.	Production requirement x axis vale changed.
10.	Spindle belt damaged problem.	Belt refixed and Spindle on.

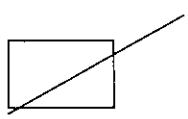
7.1.2 Precautionary Measures with One Point Lessons

For TPM activities to be successful, an awareness on the part of each employee of his/her own skill level is necessary. This enables them to recognize areas in which they lack

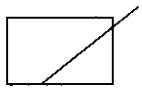
certain skills. This helps in training the employee to develop specific skills in which they lack. The employee is then given a skill-specific lesson, each lasting not more than ten minutes. These lessons are called "one-point lessons".

7. 1.2 One Point Lessons

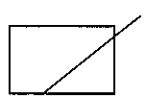
a) One Point Lesson for Maintaining the Work Place

SAKTHI AUTO COMPONENTS LIT ERODE	DIVISION: MACHINE SHOP M /C NAME: SPM M/C NO : SM0002	SHEET NO: 1	PREPARED BY: K.KARTHIKEYAN APPROVED BY: SUPERVISOR
BASIC KNOWLEDGE 			
Always clean up chips and oil that scattered on the floor and around the machine			
EFFECTS: Good Working Condition.			
TRAINER: Supervisor		TRAINER: Worker	

b) One Point Lesson for safety purpose (SPM)

SAKTHI AUTO COMPONENTS LID ERODE	DIVISION: MACHINE SHOP M /C NAME: SPM M/C NO : SM0002	SHEET NO: 2	PREPARED BY: K.KARTHIKEYAN APPROVED BY: SUPERVISOR
BASIC KNOWLEDGE 			
Do not adjust the regulating valves with out good reason because the maker has already adjusted them. If they must be adjusted check safety before doing so.			
EFFECTS: **Safety**			
TRAINER: Supervisor		**TRAINER: Worker**	

c) One Point Lesson Worker Safety

SAKTHI AUTO COMPONENTS LIT Erode	DIVISION: MACHINE SHOP M /C NAME: SPM M/C NO : SM0002	SHEET NO: 3	PREPARED BY: K.KARTHIKEYAN APPROVED BY: SUPERVISOR
BASIC KNOWLEDGE 			
Every morning before beginning work, check that there are no programs misses. If any program misses then that will lead to accidents or damage.			
EFFECTS: Safety			
TRAINER: Supervisor		TRAINER: Worker	

7.1.3 OEE FOR SPM Lines after Implementation of Autonomous Maintenance and One Point Lessons

PERIOD	A Min	B Min	C Min	D Min	E Min	F	G	H Sec	I	J	K	OEE
1Week	8640	540	8100	800	7300	90.12%	115	60	94.52%	2	98	82.90%
2Week	8640	540	8100	750	7350	90.74%	110	60	89.79%	1	99	79.29%
3Week	8640	540	8100	800	7300	90.12%	112	60	92.05%	2	98	81.14%
4Week	8640	540	8100	700	7400	91.35%	115	60	93.24%	2	99	83.15%
											OEE average	81.62%

A= Gross Available Time.
B=Planned Down Time.
C=Running Time (A-B).
D=Down Time.
E=Operating Time (C-D).
F=Availability(E/C×100).
G=Output.
H=Theoretical Cycle Time.
I=Performance(H×G/E×100).
J=Rejects During Operating Time.
K=Quality(G-J/G×100)

OEE Average 81.62%

Overall Equipment Effectiveness

OEE = F × I × K

7.2 Autonomous Maintenance Strategies under TPM for CNC Machine Line

7.2.1 Actions for Defects Identified

For the defects that have been identified and presented in the previous chapter, the following actions proposed and implemented as shown in table.

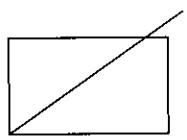
Table: Actions for Defects Identified

S.NO	DETAILS OF DEFECT	ACTION TAKEN
1.	conveyor to be clamped	Additional support plate provided
2.	Oil leak from chuck pressure hose line	Hose connection checked and tighten
3.	Chuck, tail stock pressure gauges to be changed	New pressure gauges are fixed
4.	Hydraulic oil return to tank hose to be changed	New hose fixed
5.	Hydraulic oil pump seal leak	Pump body new changed
6.	X- axis movement slightly jerk.	Spindle is tightened
7.	Spindle motor fan and fins to be cleaned	Cleaned
8.	Conveyor side plate cover screws to be fixed	Fixed
9.	Oil filter to be cleaned	Dusts are removed from the filter
10.	Oil leak from pipe	Corrected

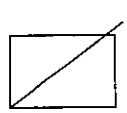
7.2.2 Precautionary Measures with One Point Lessons

For TPM activities to be successful, an awareness on the part of each employee of his/her own skill level is necessary. This enables them to recognize areas in which they lack certain skills. This helps in training the employee to develop specific skills in which they lack. The employee is then given a skill-specific lesson, each lasting not more than ten minutes. These lessons are called "one-point lessons".

(a) One Point Lesson for to Maintain the Pressure

SAKTHI AUTO COMPONENTS LIT EORDE	**DIVISION : MACHINE SHOP M/C NAME : CNC HEID LATHE M/C NO: CNC001**	**SHEET NO :1**	**PREPARED BY K.KARTHIKEYAN APPROVED BY : SUPERVISORS**
BASIC KNOWLEDGE 			
Theme **The maximum pressure for the chucking equipment indicated in the hydraulic chart must not be exceed.**			
TRAINER : Supervisor **TRAINER : Worker**			

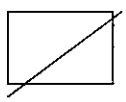
(b) One Point Lesson for Predicting the Abnormalities

SAKTHI AUTO COMPONENTS LIT ERODE	**DIVISION: MACHINE SHOP M /C NAME: CNC HEID LATHE M/C NO : CNC0001**	**SHEET NO: 2**	**PREPARED BY: K.KARTHIKEYAN APPROVED BY: SUPERVISOR**
BASIC KNOWLEDGE 			
THEME **While operating in the machine observe the TPM signals like abnormal noise, smoke, crack, etc...**			
TRAINER: Supervisor		**TRAINER: Worker**	

(c) One Point Lesson for safety purpose (CNC)

SAKTHI AUTO COMPONENTS LIT ERODE	**DIVISION: MACHINE SHOP** **M /C NAME: CNC HEID LATHE** **M/C NO : CNC0001**	**SHEET NO: 3**	**PREPARED BY: K.KARTHIKEYAN** **APPROVED BY: SUPERVISOR**
BASIC KNOWLEDGE			
THEME **Don't operate the machine with door opening**			
TRAINER: Supervisor		**TRAINER: Worker**	

(d) One Point Lesson for Proper Dress Code

SAKTHI AUTO COMPONENTS LIT ERODE	**DIVISION: MACHINE SHOP** **M /C NAME: CNC HEID LATHE** **M/C NO : CNC0001**	**SHEET NO: 4**	**PREPARED BY: K.KARTHIKEYAN** **APPROVED BY: SUPERVISOR**
BASIC KNOWLEDGE 			
THEME **While operating in the machine observe the TPM signals like abnormal noise, smoke, crack, etc…**			
TRAINER: Supervisor		**TRAINER: Worker**	

7.2.3 OEE for CNC Machine line after implementation of Autonomous Maintenance & one point lessons

PERIOD	A Min	B Min	C Min	D Min	E Min	F	G	H Sec	I	J	K	OEE
1WEEK	8640	540	8100	900	7200	88.88%	130	50	90.27%	2	98	78.46%
2 WEEK	8640	540	8100	800	7300	90.12%	135	50	92.46%	1	99	82.70%
3 WEEK	8640	540	8100	750	7350	90.74%	128	50	87.07%	2	98	77.76%
4 WEEK	8640	540	8100	600	7500	92.59%	135	50	90%	1	99	81.25%
											OEE Average	80.33%

Overall Equipment Effectiveness

OEE = F × I × K

A= Gross Available Time.
B=Planned Down Time.
C=Running Time (A-B).
D=Down Time.
E=Operating Time (C-D).
F=Availability(E/C×100).
G=Output.
H=Theoretical Cycle Time.
I=Performance(H×G/E×100).
J=Rejects During Operating Time.
K=quality(G-J/G×100)

7.3 Autonomous Maintenance Check List, Analysis & Benefit

Under the TPM & 5s concept, strategies have bee developed a check list has been prepared to improve the OEE pf the production linear. The list and observations made are shown in table.

Table: Autonomous Maintenance Checklist & Observations

S.no	criteria	Sub assembly	Where	What	How	Time	Res	Remark	freq
1.	Inspect & Tight	Operator Panel	Front side	Electric switch	Hand	2 min	Operation	To avoid forced b/d	Daily
2.	Inspection	Machine	Front	Lamp	Visual	1 min	Operation	To know the alarm and machine status	Daily
3.	Inspection	Hydraulic	Machine back side	Oil level check and filling	Visual	2 min	Operation	Avoid b/d	Daily
4.	Inspection	Hyd. motor	Machine back sid	Unusual noise	Ear	2 min	Operation	Avoid b/d	Daily
5.	Cleaning	Panel	Machine back side	Filter	Clean	2 min	Operation	To imp the cooling	Week
6.	Inspection	Panel	Inside electric panel	Check	Hand	1 min	Operation	To check the cooling system	Week
7.	Cleaning	Inside	X and z axis	Chips	By brush	5 min	Operation	To avoid b/d	Week

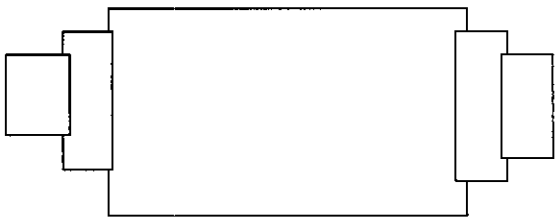
8.	Inspection	Lub. tank	Inside tank	Float	Hand and visual	10 min	Electric	Oil level come down watch alarm on the screen	6 month
9.	Cleaning /inspecting / tightening	Electric panel	Inside panel	Electric lines	Hand and visual	30 min	Electric	To avoid forced b/d	6 month
10.	Cleaning	Lubricant unit	Machine right side	Filter and tank	Air	1 hrs	Mechanical	Improve lubrication system	6 month
11.	Cleaning	Spindle motor fan	Machine left side	Cooling fan	Dry cloth and air	30 min	Operation	To improve cooling and avoid forced break down	6 month
12.	cleaning /inspection / tightening	Overall machine	All area	Lubricant	Manual	8 hrs	Meco peelectric	Preventive maintenance	6 month

Using the Collected Data, Analysis has been made and benefits have been indicated.

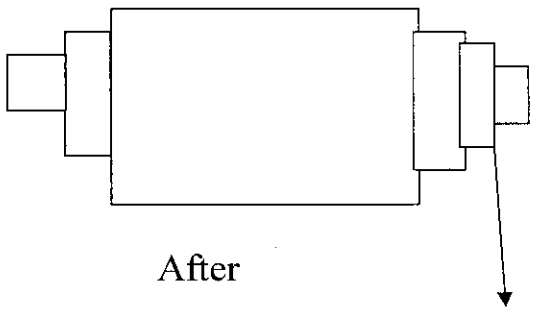
7.3.1 Data Collection for Avoid Final Step Turning

SAKTHI AUTO COMPONENTS LIT ERODE	DIVISION: MACHINE SHOP M /C NAME: CNC HEID LATHE M/C NO : CNC0001	SHEET NO: 1	PREPARED BY: K.KARTHIKEYAN APPROVED BY: SUPERVISOR
Objective: Avoid the final step turning operation			
Initial status: More time taken for final step turning			
Analysis Why : the machining time is more Why: Excess material is removed during turning operation Why: Excess stock is available for turning operation			
Counter measure : new rotor drawing was made and given to the vendor			
Benefits: previously the time taken for turning operation is 40.6 min Now the time taken for turning operation is 25 min Time saved 40.6min -25min=15.6 Machine hour rate is Rs350/= Average production per week is 90nos Total time savings per month=90*15.60/60=23.4hrs Total cost savings per month= 23.4*350=Rs 8,180/- Result interms of : P Q D C S M Cost saved per month is Rs 8,180/- Responsibility : supervisor			

P =Productivity, Q=Quality, D=Delivery, C= Cost, S=Safety , M= Morale



Before



After

Introduced step

(b) Data collection for To Avoid Rework

SAKTHI AUTO COMPONENTS LIT ERODE	DIVISION: MACHINE SHOP M /C NAME: CNC HEID LATHE M/C NO : CNC0001	SHEET NO: 2	PREPARED BY: K.KARTHIKEYAN APPROVED BY: SUPERVISOR
Objective: Avoid the rework (run out correction)in 12 series rotor			
Initial status: Frequently run out occurred in 12 series rotor operation			
Analysis Why : Turning insert blended Why: Excess material is removed during final turning operation Why: Excess stock is available for final turning operation			
Counter measure : new rotor drawing is made with a step and given to the vendor			
Benefits : rotor run out is rectified Before due to run out rework cost per hour is120 90nos .per week Result interms of : P Q D C S M Cost saved per month is Rs 10,800/= Responsibility : supervisor and production dept			

P =Productivity, Q=Quality, D=Delivery, C= Cost, S=Safety , M= Morale

(c) Data collection for to avoid poor finish

SAKTHI AUTO COMPONENTS LIT ERODE	DIVISION: MACHINE SHOP M /C NAME: CNC HEID LATHE M/C NO : CNC0001	SHEET NO: 2	PREPARED BY: K.KARTHIKEYAN APPROVED BY: SUPERVISOR
Objective: Avoid the poor finishing			
Initial status: More marks on the work piece			
Analysis Why : The tool is jerking Why: The turret head is jerking Why: The bearing was damaged Why: The life of the bearing is over			
Counter measure : New bearing is fixed . every 6 month check the bearing condition			
Benefits : rework and poor finishing is avoided Result interms of : P Q D C S M Cost saved per month is Rs 10,800/= Responsibility : supervisor and production dept			

P =Productivity, Q=Quality, D=Delivery, C= Cost, S=Safety , M= Morale

7.4 5s Strategies Implementation

7.4.1 Proposed 5s Strategies Format

A format has been prepared to monitor the implementation of 5s strategies in the organization. The format is as shown in table.

P-2335

Table: 5s Strategies Monitoring Format

Sakthi Auto component limited	Department :										
	Auditee:										
CELL NO	5S RATING FOR THE MONTH OF SEPTEMBER -2006										
	1s – sort out		2s-set in order		3s- shine		4s- standardize		5s – sustain		Area of improvement (points for improvement)
	1week	2week	1week	2week	1week	2week	1week	2week	1week	2week	
	3week	4week	3week	4week	3week	4week	3week	4week	3week	4week	
*** -EXCELLENT ** -GOOD * - AVERAGE ? – BELOW AVERAGE							1 Week Auditor Name and Sign				2 Week Auditor Name and Sign
							3 Week Auditor Name and Sign				4 Week Auditor Name and Sign

7.4.2 5s Strategies Audit Summary Report

As per the 5s strategies monitoring format that was shown earlier, data was collected, analysed and graded as shown in table.

SAKTHI AUTO COMPONENTS LIT ERODE	**5S AUDIT SUMMARY REPORT**										
CELL NO	1s		2s		3s		4s		5s		Remark
1 (planning and warehouse –fdy)	1week	2week	1week	2week	1week	2week	1week	2week	1week	2week	
	* *	* *	* *	* *	* *	* *	* *	* *	* *	* *	
	3week	4week	3week	4week	3week	4week	3week	4week	3week	4week	
	* *	* *	* *	* *	* *	* *	*	* *	* *	* *	
2(inspection –fdy) Inspection processing area	1week	2week	1week	2week	1week	2week	1week	2week	1week	2week	
	* *	* *	* *	* *	*	*	* *	*	*	*	
	3week	4week	3week	4week	3week	4week	3week	4week	3week	4week	
	* *	* *	* *	* *	*	* *	*	*	*	*	
3 (inspection – fdy)x-ray,ut&magnaflux	1week	2week	1week	2week	1week	2week	1week	2week	1week	2week	
	* *	* *	* *	* *	* *	* *	* *	* *	* *	* *	
	3week	4week	3week	4week	3week	4week	3week	4week	3week	4week	

	* *	* *		* *	* *	* *	* *	* *	* *	* *	
4 (inspection fdy- hardness checking)	1week	2week	1week	2week	1week	2week	1week	2week	1week	2week	
	* *	* *	* *	* *	* *	* *	* *	* *	* *	* *	
	3week	4week	3week	4week	3week	4week	3week	4week	3week	4week	
	* *	* *	* *	* *	* *	* *	* *	* *	* *	* *	
5 (quality assurance –fdy)	1week	2week	1week	2week	1week	2week	1week	2week	1week	2week	
	* *	* *	* *	* *	* *	* *	* *	* *	* *	* *	
	3week	4week	3week	4week	3week	4week	3week	4week	3week	4week	
	* *	* *	* *	* *	* *	* *	* *	* *	* *	* *	
6(maintenance- fdy"b")	1week	2week	1week	2week	1week	2week	1week	2week	1week	2week	
	* *	* *	* *	* *	* *	* *	* *	* *	* *	* *	
	3week	4week	3week	4week	3week	4week	3week	4week	3week	4week	
	* *	* *	* *	* *	* *	* *	* *	* *	* *	* *	

7(production – disa)	1week	2week	1week	2week	1week	2week	1week	2week	1week	2week	
	* *	* *	* *	* *	* *	* *	* *	* *	* *	* *	
	3week	4week	3week	4week	3week	4week	3week	4week	3week	4week	
	* *	* *	* *	* *	* *	* *	* *	* *	* *	* *	

*** * * - EXCELLENT * * - GOOD * - AVERAGE ? – BELOW AVERAGE**

1s- sort out, 2s-set in order, 3s–shine , 4s–standardize, 5s–sustain

CHAPTER 8

COMPARISIONS – BEFORE & AFTER IMPLEMENTING TPM & 5S STRATEGIES

CHAPTER -8

COMPARISIONS – BEFORE & AFTER IMPLEMENTING TPM & 5S STRATEGIES

8.1 Comparison of Downtime in SPM Line:

Comparison of down time for four weeks has been shown in the following table and histograms.

PERIOD	DOWN TIME in minutes	
	BEFORE	AFTER
Week 1	1080	800
Week 2	1120	750
Week 3	1050	800
Week 4	1420	700

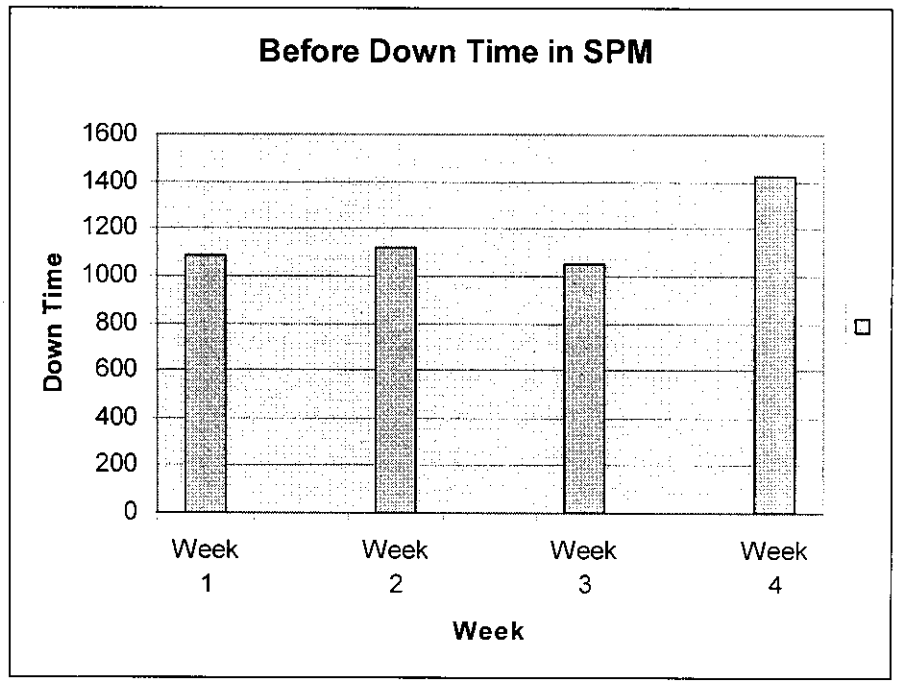


Fig. 8.1 (a)

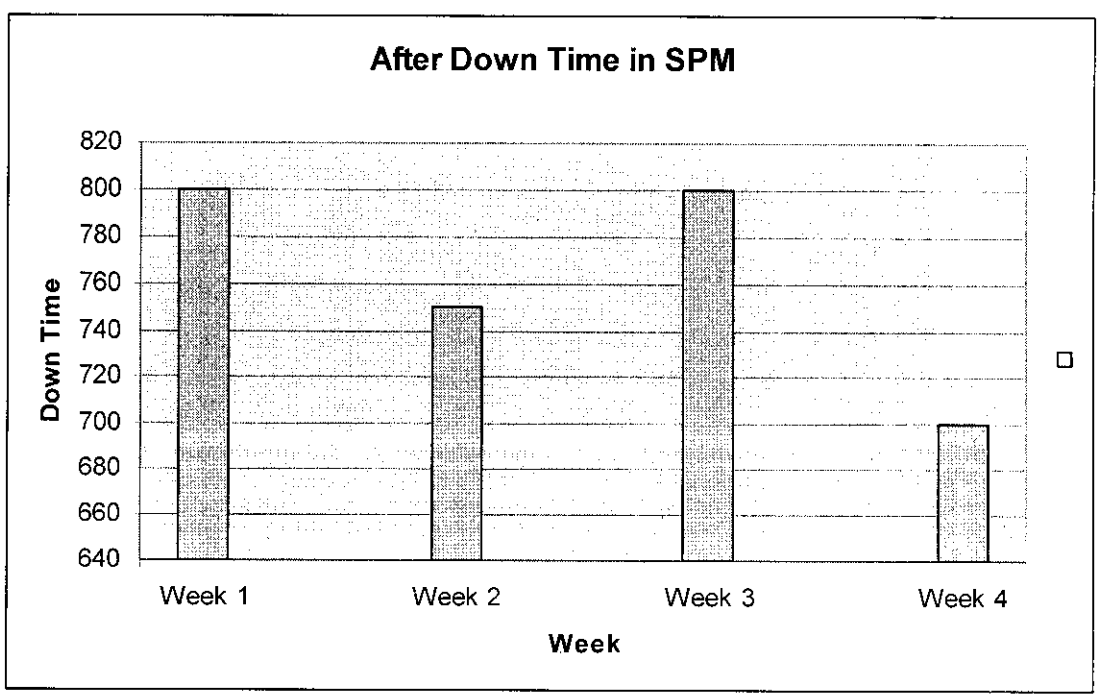


Fig 8.1 (b)

8.2 Comparison of Downtime in CNC Machines Line:

Comparison of down time for four weeks has been shown in the following table and histograms.

PERIOD	DOWN TIME (IN MINUTES)	
	BEFORE	AFTER
Week 1	1300	900
Week 2	1420	800
Week 3	1255	750
Week 4	1120	600

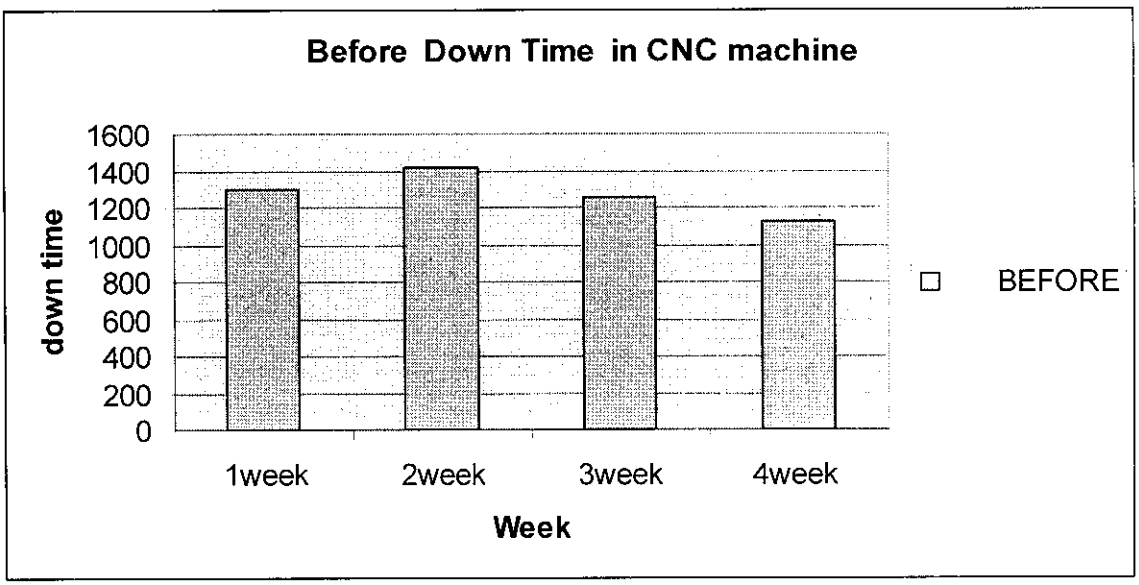


Fig 8.2 (a)

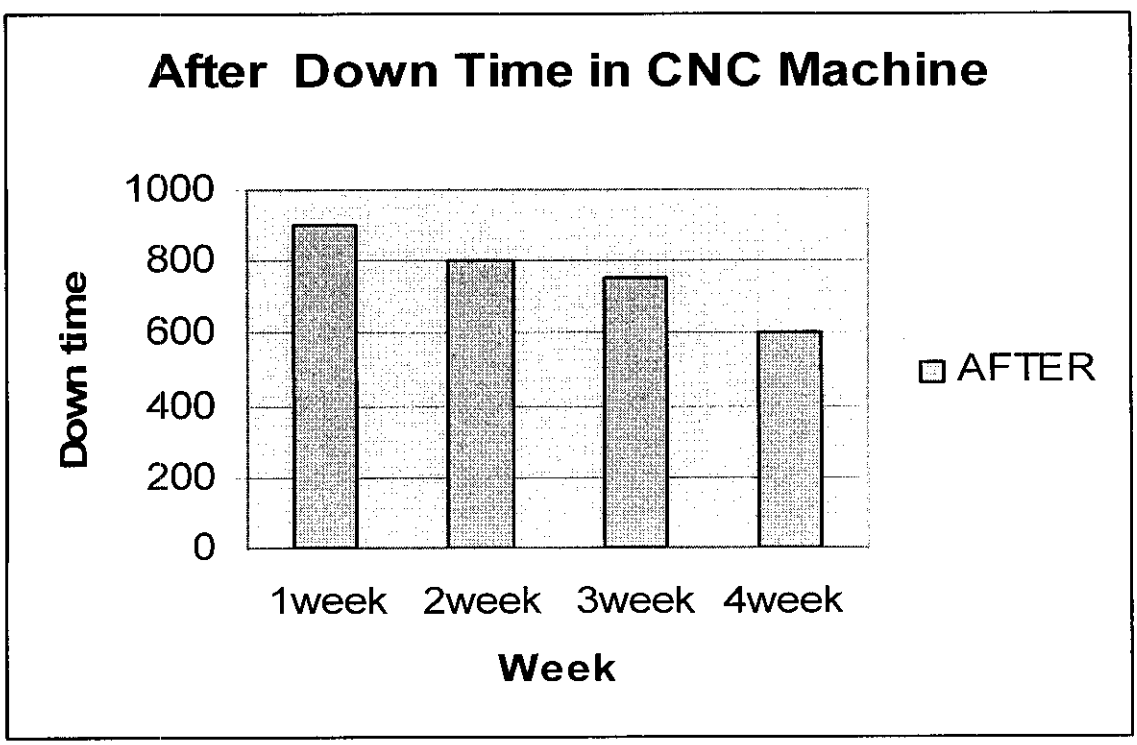


Fig 8.2 (b)

CHAPTER 9

RESULTS & SUGGESTIONS

CHAPTER 9

RESULTS & SUGGESTIONS

9.1 Result

- With the implementation of TPM and 5s strategies, the entire approach of maintenance has shifted from a conventional approach to a scientific approach.
- Autonomous maintenance has drustically improved employee involvement at the grass root level due to which the morale job satisfaction and skill set of the employees have improved leading to reduction in defects/rejections, reduction in equipment breakdowns and so on.
- All of this has led to improve the situation as follows. Overall equipment effectiveness (OEE) values before and after implementation of TPM and 5s strategies have been shown in table for the production lines considered.

Production line	OEE Values	
	Before	After
Special purpose machine line	65.00%	81.62%
CNC machine line	63.00%	80.33%

9.2 Suggestions

- During the course of the project certain critical observations were made for which suggestions have been furnished.
- Employees resist to accept changes and many-a-times resist change due to over determination, narrow focus, group inertia, threatened expertise, threatened power, problems in resource allocation habit, fear of the unknown, lack of awareness, lack of communication etc.,

- Hence for effective autonomous maintenance implementation, the above resistances posed by employees are to be minimized through implementation of one or a combination of the following techniques to manage resistance to change.
- Individuals / groups are to be educated adequately to adopt to change.
- Proper and meaningful information has to be communicated to the concerned persons.
- Organizational members at all levels are to be made to design the needful changes. This will make them accept changes with high commitment.

CHAPTER 10

CONCLUSION

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CONCLUSION

The barriers that existed in improving productivity of the production lines at M/s Sakthi Auto Components Ltd., were successfully identified and the situation was considerably improved by implementing autonomous maintenance TPM strategies and 5s concepts. The overall equipment effectiveness (OEE) of the considered two production lines namely special purpose machines line and CNC machines line improved by 16.62 and 17.33 percentages respectively due to the implementation of TPM and 5s strategies. This will also have a considerable impact on improving the economic life of the equipments, achieving consistency in product quality, minimizing break downs, prevention of accidents and reduced rejection, all of which will have a continuous impact on achieving higher productivity levels. All of this can be sustained through the conduct of regular educational programs.

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PAPER PRESENTATION

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2. K.Karthikeyan, Prof.S.Bhaskar (2008)," An Audit of 5s Concepts and Total Productive Maintenance in an Automobiles Industry (SACL)" ,2ndNational Conference on Advances in Mechanical science at Kumaraguru College of Technology in Coimbatore,27th and 28th March.