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Case Study of a Manufacturing unit of West Bengal by using JavaScript for Calculation of Overall Equipment Effectiveness

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ABSTRACT: In today's fast moving competitive business the TPM is highly accepted and implemented, still company faces challenges in maintenance of organization. This paper developed an important TPM model for a manufacturing unit in West Bengal. The aim of this paper was to build up an effective TPM model to improve the overall equipment effectiveness. Past record of company and questionnaire were used to collect data for the case study. Direct survey provided cause of lay off time. Original plant OEE was calculated at 39.90% which is below 45% of the standard OEE. JavaScript programme has been used for mathematical calculations of Availability ratio, Quality ratio, Performance ratio and OEE. In this paper, the planned TPM usage model depends on area improvement analysis of Overall equipment effectiveness for appropriate execution of TPM

Keywords: Availability, Execution, Overall Equipment Effectiveness, Performance, Total Productive Maintenance.

I. INTRODUCTION

The Total Productive Maintenance (TPM) idea presents quantitative metric OEE for measuring the equipment effectiveness in a manufacturing line. It is an outstanding technique developed from the idea of preventive maintenance for manufacturing plant maintenance and management. Overall equipment effectiveness measures the gap between the actual performances. By estimating OEE and undisclosed losses, we will increase the significance on the most proficient method to improve our production process efficiently. OEE incorporates three estimating measurements, for example, accessibility, execution, and quality. Enhancement in production effectiveness is an important factor in process industry. Quality rate gives a thought that how proficiency is used [1-2]. TPM demonstrated a methodology for bringing changes in different level of management. It includes operational and upkeep staff cooperating as a group to diminish wastage, limit vacation and improve final result quality. In spite of the fact that there are various books and case considers that contribute to the advantages of TPM [3-5]. TPM execution in this organization has conveyed the Overall Equipment Effectiveness (OEE) estimation as a pointer of proper utilize of machine. Anyway for the business to deliver products of the correct quality and right amount for the clients and ready to convey them at the proper time, its plant must work proficiently and precisely [6]. The reason of this paper was to survey the current support arrangement of the organization, decide the present OEE and achievement components of TPM to be used in the model for successful execution. In light of CBM (condition based maintenance) research was conducted to improve execution, cost decrease or potentially expanding benefit, of the item range and attributes fabricated in the manufacturing industry [7-14].

II. METHODOLOGY

For this present study, the Plant OEE is seen to examine the current effectiveness of the plant and investigates the region related to the issue which causes the low OEE. For the improvement of OEE of the Plant TPM columns are executed through the edge model and after the usage of TPM for a half year investigation is performed to accomplish the improvement in OEE. Math Type has been used for mathematical equations.

Calculation of OEE:

$$\text{Availability}(\%)= \frac{\text{Actual Run Time}}{\text{Schedule Run Time}}\times 100$$

$$\text{Performance Rate}(\%)= \frac{\text{No. of items yield}}{\text{Target No. of items}}\times 100$$

$$\text{Quality Rate}(\%)= \frac{\text{No. of items yield- Defected items}}{\text{No. of items yield}}\times 100$$

$$\text{OEE}= \text{Availability}\times\text{Performance Rate}\times\text{Quality of Rate}$$

III. RESULT AND DISCUSSION

The present study data has been collected from Agastya Buoyant, West Bengal using interview, company record data and direct observation. Meetings were held with the working personnel, administrators and different representatives. The present study focused on the major two points;

– Company is following idea of TPM or not.
– Important element that encourage the implementation of TPM

Observations achieved directly gives power to analysts to gather information without depending on the respondents' eagerness and capacities.

The present study gathered information utilizing planned surveys, organized meetings, organization records and direct perceptions. This information was then examined utilizing JavaScript and Origin sheet.

Availability:

```
import java.util.*;
class AVAILABILITY
{
  static String a[][]= new String[7][3];
  static int i, j;
  static double tt = 0,td = 0,ans;
  public static double AVAIL()
  {
    Scanner in = new Scanner(System.in);
    a[1][0] = "Jan";a[2][0] = "Feb";a[3][0] = "Mar";a[4][0] = "Apr";a[5][0] = "May";a[6][0] = "Jun";
    a[0][0] = "MONTH";a[0][1] = "PROJECTED TIME (Hrs)";a[0][2] = "LAYOFF TIME";
    System.out.println("INPUT : Enter data in \nPROJECTED TIME LAYOFF TIME");
    for (i = 1;i < 7;i++)
    {
      for( j = 1; j < 3; j++)
      {
        a[i][j] = in.next();
      }
    }
    for( j = 1; j < 3; j++)
    {
      for(i = 1;i < 7;i++)
      {
        if ( j == 1)
          tt = tt + Double.parseDouble(a[i][j]);
        else
          td = td + Double.parseDouble(a[i][j]);
      }
    }
    ans = (tt - td)/tt;
    return(ans);
  }
public static void main()
  {
    System.out.println("OUTPUT :");
    ans = AVAIL();
    for (i = 0;i < 7;i++)
    {
      for( j = 0; j < 3; j++)
      {
        System.out.print(a[i][j]+" ");
      }
      System.out.println();
    }
    System.out.println("Availablity Percentage = "+ ans*100);
    System.out.println("Availablity Ratio = "+ ans);
  }
}
```

Quality Rate:

```
import java.util.*;
class QUALITY
{
  static int i, j;
  static double s = 0,ans;
  static String a[][]= new String[7][3];
  public static double QT()
  {
    Scanner in = new Scanner (System.in);
    a[1][0] = "Jan";a[2][0] = "Feb";a[3][0] = "Mar";a[4][0] = "Apr";a[5][0] = "May";a[6][0] = "Jun";
    a[0][0] = "MONTH";a[0][1] = "DEFECTIVE PIECE";a[0][2] = "DEFECTIVE PIECE %";
    System.out.println("INPUT : Enter data in \nDEFECTIVE PIECE DEFECTIVE PIECE PERCENTAGE");
    for (i = 1;i < 7;i++)
    {
      for( j = 1; j < 3; j++)
      {
        a[i][ j] = in.next();
      }
    }
    for(i = 1;i < 7;i++)
    {
      s = s + Double.parseDouble(a[i][2]);
    }
    ans = 100 – s/6;
    return(ans);
  }
  public static void main()
  {
    ans = QT();
    System.out.println("OUTPUT :");

    System.out.println("Availablity Percentage = "+ ans);
    System.out.println("Availablity Ratio = "+(ans/100));
  }
}
```

Performance efficiency :

```
import java.util.*;
class PERFORMANCE
{
  static String a[][]= new String[7][3];
  static int i, j;
  static double t1 = 0,t2 = 0,ans;
  public static double PERF()
  {
    Scanner in = new Scanner(System.in);
    a[0][0] = "MONTH ";a[0][1] = "PRODUCTION ";a[0][2] = "TARGET ";
    a[1][0] = "Jan";a[2][0] = "Feb";a[3][0] = "Mar";a[4][0] = "Apr";a[5][0] = "May";a[6][0] = "Jun";
    System.out.println("INPUT : Enter data in \nPRODUCTION TARGET PRODUCTION");
    for (i = 1;i < 7;i++)
    {
      for( j = 1; j < 3; j++)
      {
        a[i][j] = in.next();
      }
    }
    for( j = 1; j < 3; j++)
    {
      for(i = 1;i < 7;i++)
      {
        if ( j == 1)
          t1 = t1 + Double.parseDouble(a[i][j]);
        else
          t2 = t2 + Double.parseDouble(a[i][j]);
      }
    }
    ans = t1/t2;
    return(ans);
  }
  public static void main()
  {
    ans = PERF();
    System.out.println("OUTPUT :");
    for (i = 0;i < 7;i++)
    {
      for( j = 0; j < 3; j++)
      {
        System.out.print(a[i][j]+" ");
      }
      System.out.println();
    }
    System.out.println("Performance Percentage = "+ ans*100);
    System.out.println("Performance Ratio ="+ ans);
  }
}
```

Overall Equipment Effectiveness (OEE):

```
import java.util.*;
class OEE
{
  public static void main()
  {
    double x, y, z, ans;
    x = AVAILABILITY.AVAIL();
    y = QUALITY.QT()/100;
    z = PERFORMANCE.PERF();
    ans = x * y * z;
    System.out.println("OUTPUT :");
    System.out.println("Availablity Ratio = "+ x);
    System.out.println("Quality Ratio = "+ y);
    System.out.println("Performance Ratio = "+ z);
    System.out.println("OVERALL EQUIPMENT EFFECTIVENESS = "+ ans);
  }
}
```

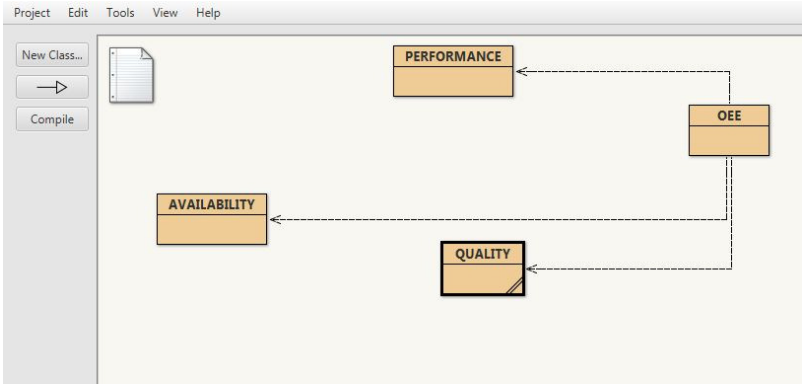

Fig. 1. Loop Model for OEE.

```
Options
INPUT : Enter data in
PROJECTED TIME  LAYOFF TIME
Jan  500 153.46
Feb  750 201.22
Mar  710 150.40
Apr  760 153.31
May  755 180.18
Jun  725 200.16
INPUT : Enter data in
DEFECTIVE PIECE  DEFECTIVE PIECE PERCENTAGE
Jan  1100 11.4
Feb  1850 13.4
Mar  2600 13.6
Apr  4200 21.1
May  2200 13.9
Jun  2000 13.5
INPUT : Enter data in
PRODUCTION  TARGET PRODUCTION
Jan  10000 25000
Feb  13000 25000
Mar  18000 25000
Apr  19000 25000
May  17000 25000
Jun  16000 25000
OUTPUT:
Availablity Ratio(x)=0.7526833333333333
Quality Ratio(y)=0.8551666666666666
Performance Ratio(z)=0.62
OVERALL EQUIPMENT EFFECTIVENESS= x*y*z= 0.3990752122777777
```

Fig. 2. Calculation of OEE.

Input data has been taken from company Agastya Buoyant, West Bengal for the calculation of Availability ratio, Quality ratio, Performance ratio and Overall equipment effectiveness. In this study, the data has been taken for six months from January to June which has been shown in Fig. 2. For the calculation of OEE we have used JavaScript language. Loop model has been shown in Fig. 1**.** Calculated result for Availability ratio, Quality ratio, Performance ratio and Overall equipment effectiveness was 75.26%, 85.51%, 62% and 39.90% respectively. We have achieved real plant OEE less than 48% from world class OEE [15].

Evaluation of the present support framework showed the organization was suffering from different issues like less availability, delayed personal time and disappointment of employee. Fig. 4 shows the components influencing effective TPM execution in a flowchart algorithm. It also helps in execution of OEE. TPM usage and these components are the principle challenges for all type of manufacturing industry. In this way, the planned TPM usage model depends on area improvement analysis, reasons for improvement and analyzed result of OEE for proper execution of TPM.

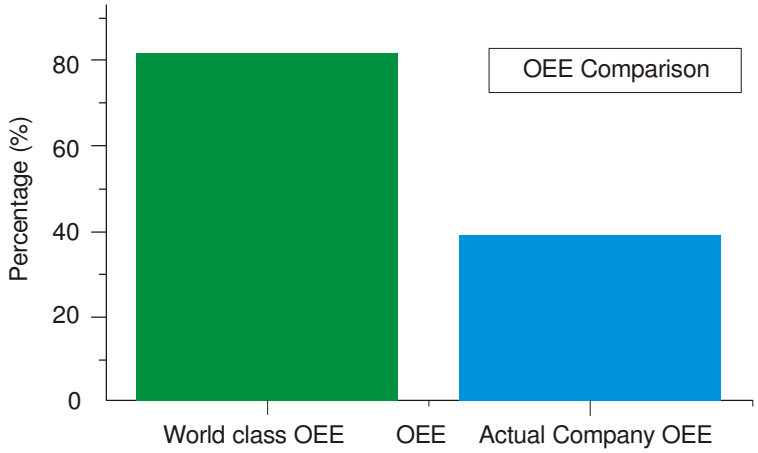

Fig. 3. Relation between world Class OEE and Actual company OEE.

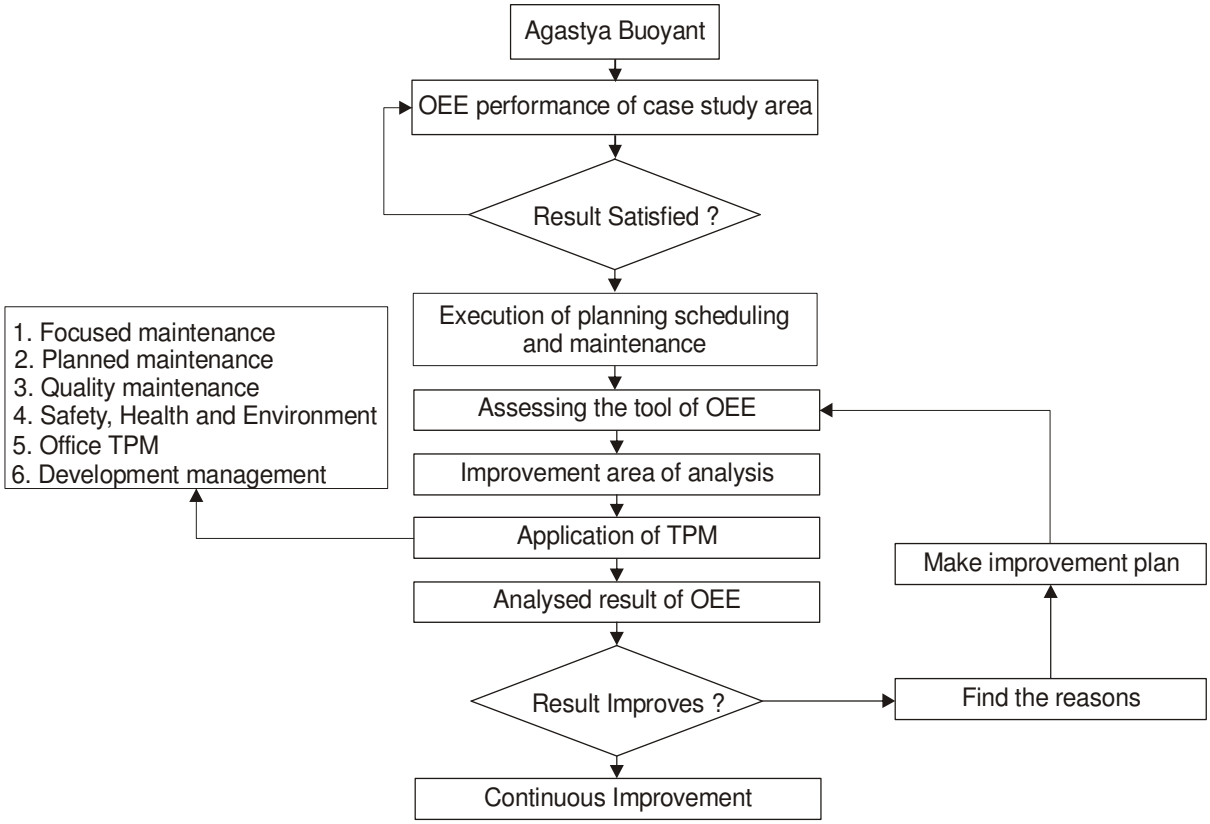

Fig. 4. Flow Chart for TPM Execution.

IV. CONCLUSION AND FUTURE SCOPE

This paper evaluated the maintenance systems of the organization. It recognized the drawbacks in the system, decided the major points to be remembered for the TPM model for compelling usage. OEE was determined and compared with the world class OEE. The exploration in this manner presumed that TPM can be utilized as a device to improve OEE of the organization. The analysts thus suggested the following:

– Application of TPM will reduce losses and it will help the organization to lead in the competitive market.

– TPM also helped the organization to build good productivity and also manage current financial fluctuation.

– Extensive training of employee will help the effectiveness of the work and maximize the efficiency of organization.

Market is changing rapidly in competitive market scenario thus there is extensive requirement of TPM application for new and old organization to sustain in business, change the mindset of employee, and for better coordination between different departments in company.

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Conflict of Interest: The author declares that there is no conflict of interest between author and company.

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