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Improvement in OEE in Ball Manufacturing Industry: A Case Study

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Abstract: ***The manufacturing systems and their functions are becoming more difficult in the generation of lean manufacturing in any industry. In its mission of obtaining maximum productivity the work done will depict the increase in availability and performance rate in some of its important machines, which will eventually result in higher OEE (Overall Equipment Efficiency). The present paper reports a case study for the improvement of OEE of machine (NH-141) with the help of TPM approach. In this case study the aim was to minimize the setup time and increase the performance of the machine which will improve the OEE. From the past records, the OEE of machine (NH-141) was found 60%. The TPM approach is used to fulfill the objectives. From this approach 5S, JH and Kaizen were effectively applied on the machine. The improvement in setup time is achieved by the implementation of SMED. The OEE of the machine (NH-141) is successfully improved from 60% to 83%.***
Keywords: OEE, TPM, SMED, Productivity Improvement, 5S

I. INTRODUCTION

Nowadays a company must have a vision of satisfying its customers to gain best profit. Every industry has its own automotive systems in which three things must be concerned priorly i.e. Availability, Productivity and Quality. To maintain this three things well a proper observation for reducing product rejection and wastage, Defect less part production, Improvement in skills of workers and reducing downtime of machine should be taken care. [1]

In this context TPM is an ingenious method for equipment maintenance that controls effectiveness breakdowns and promotes autonomous operator maintenance though everyday activity. [2] It helps to reduce the cycle time and downtime which is majorly caused by breakdown of the machine. TPM will emphasize the overall efficiency of machine which will be measured by OEE percentage. [3] [4] [5] [6]

OEE is a matric that helps out in measuring the productivity of the machine before and after implementation. [7] OEE losses helps us to look into areas that causes downtime in the machine and eliminate the reasons that it causing machine to reach its productivity at its peak level. [8] [9] [10] [11]

A. Company Introduction

NHB Ball & Roller Ltd. Company having 2 manufacturing plants with TS 16949 & ISO 14000 certification located in the state of Gujarat, India. NHB is manufacturing balls in the range of 1.9mm to 26.988mm using various raw material types like Aluminum, Brass etc. The products manufactured at NHB can be found in the most demanding applications like Automotive, Industrial, Electrical, Medical, Cosmetics etc.

B. Problem Introduction

As here the implementation 5S was not up to the mark. There is a presence of lean wastages like motion, inventory, waiting for material, waiting for coolant. Here the operating procedure is actually good but the downtime is more in means of breakdown, setup time and ball spillage. Here the setup time takes more time for changing the cutting settings for an operator. Production efficiency of final product is very low.

II. AIM AND OBJECTIVES

A. Aim

1) To improve in OEE of machine NH-141 using TPM approach.

B. Objective

1) To reduce setup time.
2) To reduce future breakdown.

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III. METHODOLOGY

A. *Pillars of TPM*

1) *5S:* The base of TPM is 5S. 5S is basically five Japanese words: Seiri, Seiton, Seiso, Seiketsu, and Shitsuke. Translating into English, the five S's are translated as Sort, Set in Order, Shine, Standardize, and Sustain. [12]
2) *Autonomous Maintenance:* The ability of machines to be easily maintained by operator level staff. When autonomous maintenance is evident, the technical staff only come in for periodic and schedule maintenance because breakdowns are very rare. [13] The main objective of Jishu Hozen is to empower the employee to make a daily conscious effort to maintain the performance of equipment and processes. [14] [15] [16] [17]
3) *Kobetsu Kizen:* Continuous Improvement is very much necessary for every equipment or machine to overcome the future possibility of breakdown or time loss. Kaizen can be very helpful in regarding to make the machine or working area more accurately and proper. This will eventually reduce the lead time
4) *Planned Maintenance:* For better customer satisfaction every industry have the aim that all machines and equipment's are trouble free and no breakdowns are occur. Planned maintenance is enterprising approach which uses trained maintenance staff to train the operators to better maintain their equipment. [18] [19] [20] Objective of Planned Maintenance are to achieve and maintain availability of machines, less maintenance cost, improve reliability and maintainability of machines, zero equipment failure and break down and ensure availability of spares all every time. [21]
5) *Quality Maintenance:* It is considering towards receiving customer satisfaction through delivery of best quality product. Through focused improvement defects are eliminated from the process after recognizing the parameter of machine which affects the product quality. [22] [23] [24]
6) *Education & Training:* Keeping up the speed with this global competition is the key for sustaining, therefore learning new things and knowing the right method to do in the right way is very important. For calculating OEE, operators must fill the log book exactly with noting down the down time and writing the time in front of the correct loss. [25] [26] [27]
7) *Safety, Health and Environment:* Safety is very important in any prospect of working. Industries now has started to take more time in anxiety for employee's health and therefore good health they are providing good environment to work. Employees staying healthy will be available for their maximum time and will be giving 100% in things that they do, which will indirectly help the industry. [28] [29] [30]
8) *Office TPM:* Office TPM should be started after activating four other pillars of TPM (JH, KK, QM, and PM). Office TPM must be followed to improve productivity, efficiency in the administrative functions and identify and eliminate losses. This includes analyzing processes and procedures towards increased office automation. [31] [32]

IV. OBSERVATION AND ANALYSIS

A. *5S Implementation*

1) *1S Sort:* First of all sorting process start with removing old and unnecessary parts and damaged parts. Also tools and spanners are kept at proper place. At writing table some unnecessary papers are removed.
2) *2S Set in Order:* In this step all spanners are kept in descending order. Die and punch also kept in labeled boxes.
3) *3S Shine:* The surrounding area around the machine and machines are cleaning with JH activity time mentioned for all workers.
4) *4S Standardize:* Now place for everything so everything in its place. Thus place for every items are standardize.
5) *Sustain:* Audit for 5S are begun to conduct and scores are also displayed on the board. MMM board is available to display the activity for machines.

B. *Autonomous Maintenance*

Autonomous maintenance is also called Jishu Hozen.

1) *Cleaning and Inspection:* Everyday machine and its surrounding kept clean by operator and its team. In all three working shift this time allotted. By cleaning every day the unwanted problems can be easily seen and solve according to it. It also can avoid future stoppage of machine. To highlight the problems red tag and white tag are used. In unclean situations white tags are used which were basically removed within 24-48 hours. Other than that red tags were used which are need to discuss with team member and solved before target date.
2) *Improvement for Easy Access and Clean:* After implementation of step 1 operator need to clean Hard to access and source of contamination area of machine NH-141.

3) Implementing Cleaning and Lubricating Standard: After implementation of step 2 machine undergoes Cleaning, Lubrication, Retightening and Inspection (CLRI) Check sheet.

C. Kobetsu- Kizen

The following are the activities that are helped saving time and fatigue of operator.

1) Kaizen – 1

a) Problem: When the pressure is lower than 2 kg/cm^2, ball is punched twice in the machine.

KAIZEN NO	01
DEPARTMENT	HEADING
LOCATION	NH-141

JH STEP 1	
DATE	16/10/ 2019

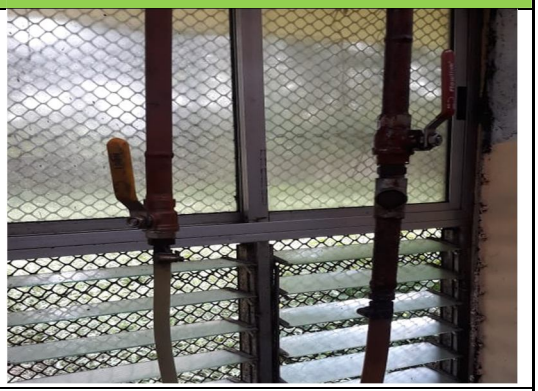
Kaizen Theme	Maintain Air Pressure
Kaizen Idea	Pipe separated
Before	After
	
Results/Benefits	Air Pressure Maintained and reduction in shell defect.

Table-1 Kaizen sheet 1

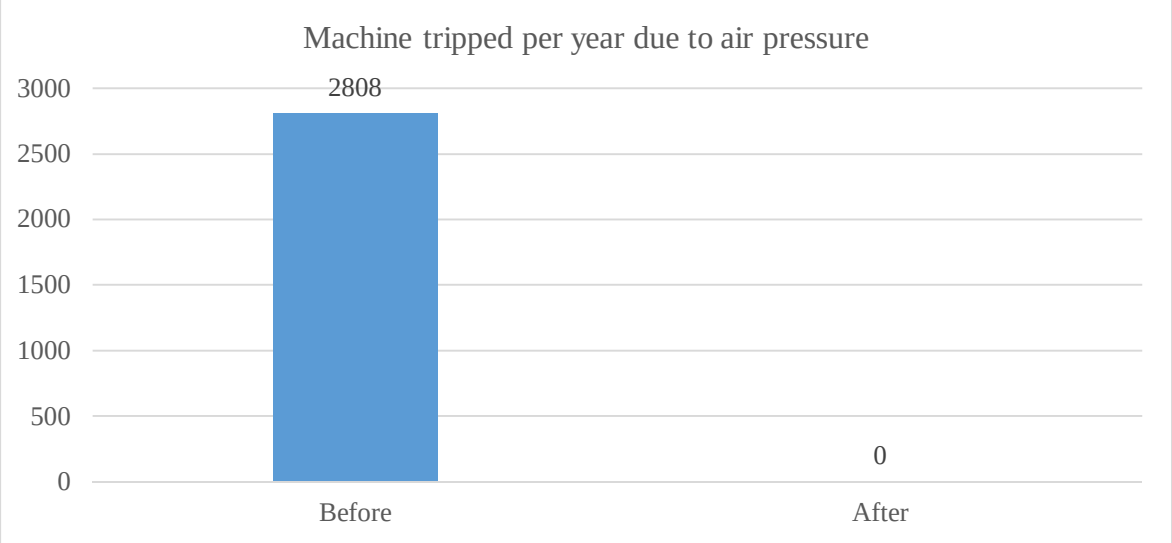


Table 2 Comparison of machine tripping before and after applying kaizen-1

2) Kaizen-2

a) Problem: Water drainage issue.

KAIZEN NO	02
DEPARTMENT	HEADING
LOCATION	NH-141

JH STEP 1	
DATE	16/10/ 2019

Kaizen Theme	Reduced drainage of water
Kaizen Idea	Gap increased
Before	After
	
Results/Benefits	Water drainage reduced

Table 3 Kaizen sheet 2

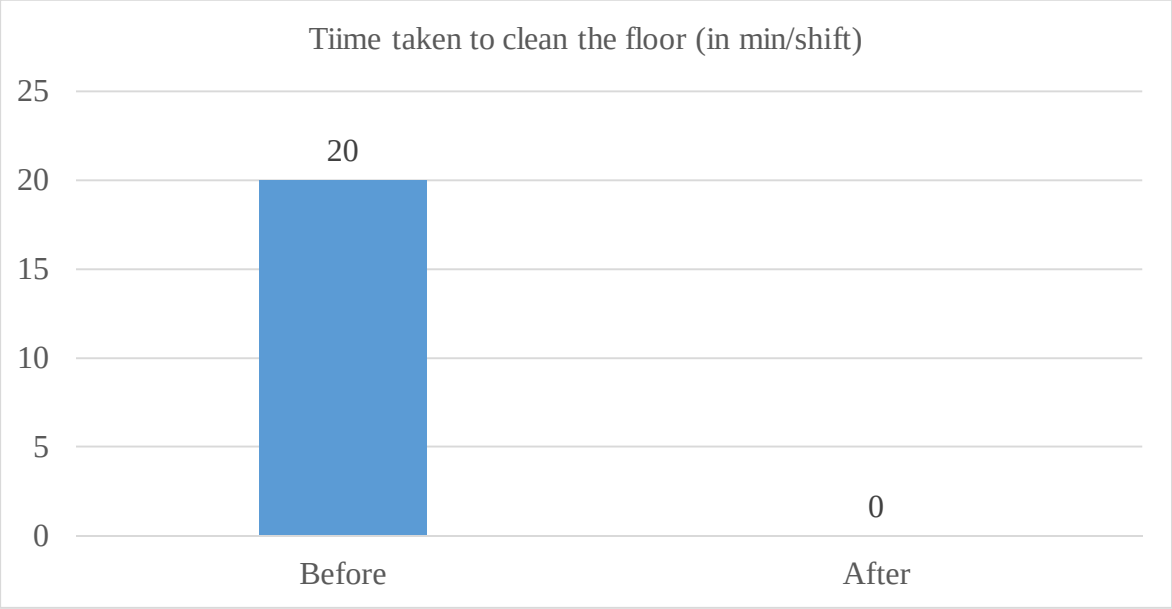


Table 4 Comparison before and after implementing kaizen 2

3) Kaizen-3

a) Problem: Worker need to take care during cleaning.

KAIZEN NO	03
DEPARTMENT	HEADING
LOCATION	NH-141

JH STEP 1	
DATE	16/10/2019

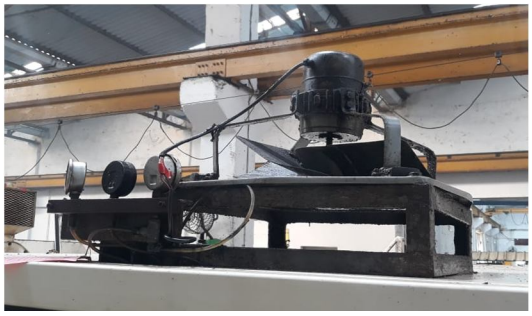
Kaizen Theme	Elimination of accident
Kaizen Idea	Add guard on exhaust fan
Before	After
	
Results/Benefits	Safety improved

Table 5 Kaizen sheet 3

Following are the kaizens for Increasing the Availability time.

4) Kaizen Theme: Reduction in setup time

a) Idea: Following the proper procedure by not giving importance to non-value added activities

b) Improvise Procedure

i) Bring the new batch of wire near to machine before finishing of previous batch.

ii) After loading the new batch empty stand is moved to inventory area.

c) Benefit: Availability time improved.

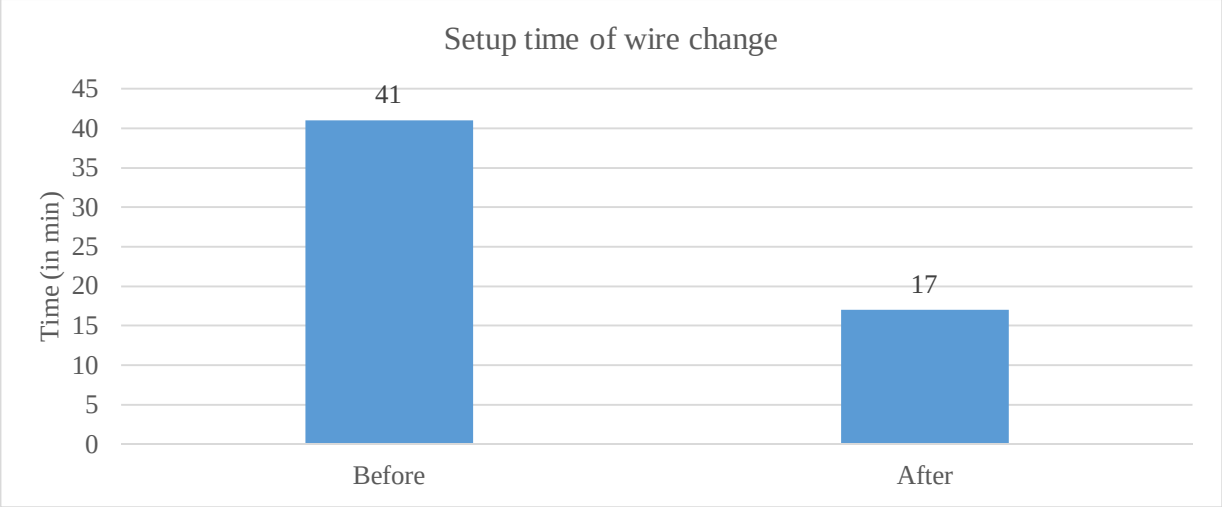


Table 6 Comparison before and after implementing kaizen 4

5) *Kaizen Theme*: Reduction in wire change occurrence

a) *Idea*: Getting wire coil from 1 ton to 2 ton

b) *Benefit*: More available time

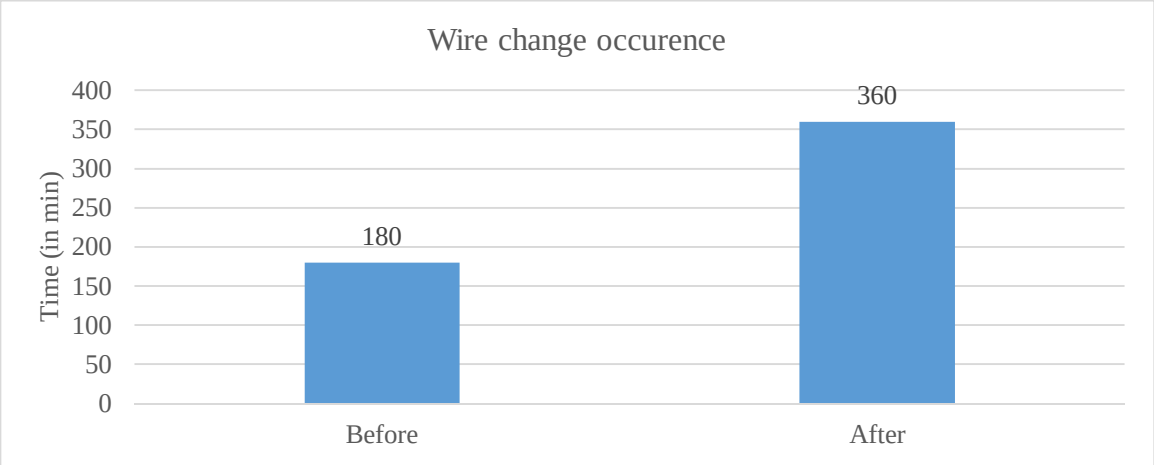


Table 7 Comparison before and after implementing kaizen 5

D. Poka Yoke

Poka yoke is the Japanese word which means “mistake proofing”. The poka yoke devices are mainly of two types (1) Prevention type (2) Detecting type.

Tool board is suggested for mistake proofing. It is prevention type poka yoke which will prevent the operators if they try to put spanners at wrong place.

Fig.1 Poka yoke of spanner board

E. OEE (*Overall Equipment Effectiveness*)

OEE is mainly used as a performance indicator of any equipment. OEE can be calculated by the product of availability rate, quality rate and production rate. [33]OEE can be applied at some several level within the manufacturing industry. (1) OEE can be used as a benchmark of machine. In this current OEE can be compared with the future OEE and then decide that improvement is done or not. (2) OEE can be compared within the line. In this machine OEE can be compared with the other machine and thereby highlighting any poor performance. (3) Compare OEE of every machine in each line and identify which machine performance is poor, and therefore indicate where to focus. [34]

NH -141 Machine is the machine because raw material is directly inserted in this machine so availability and performance rate are depend on this machine. After gaining more information about the OEE and how operator is writing downtime is being analyzed. It

is found that operators are not knowing well where to write the downtime. After teaching them they know where to write downtime in correct type of loss.

Now in next stage the data of OEE of different months are analyzed. In which downtime, setup time etc. are more in JULY 2019 .Then the motive was to find out the most recent breakdown occurrences due to what reasons and remedies that can be given to prevent in future days to a certain level.

After implementing 5S, Autonomous maintenance and Kobetsu kaizen improvement can be seen on the machine. More tags were kept and proper maintenance is done to the machine which results increase in OEE from 60% in July 2019 to 83% in March 2020.

1) Downtime sheet of September 2019

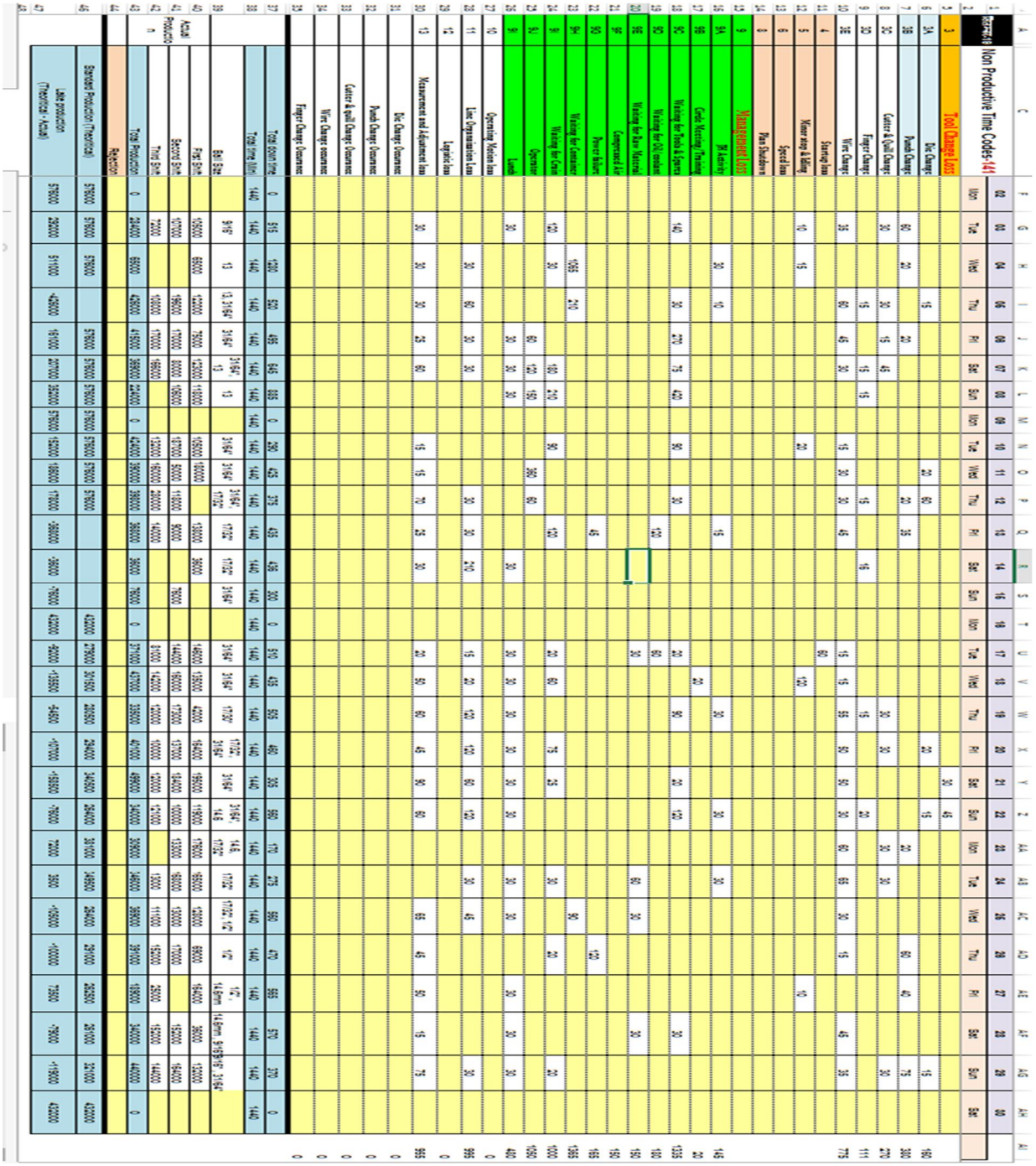


Fig.2 Downtime sheet of September 2019

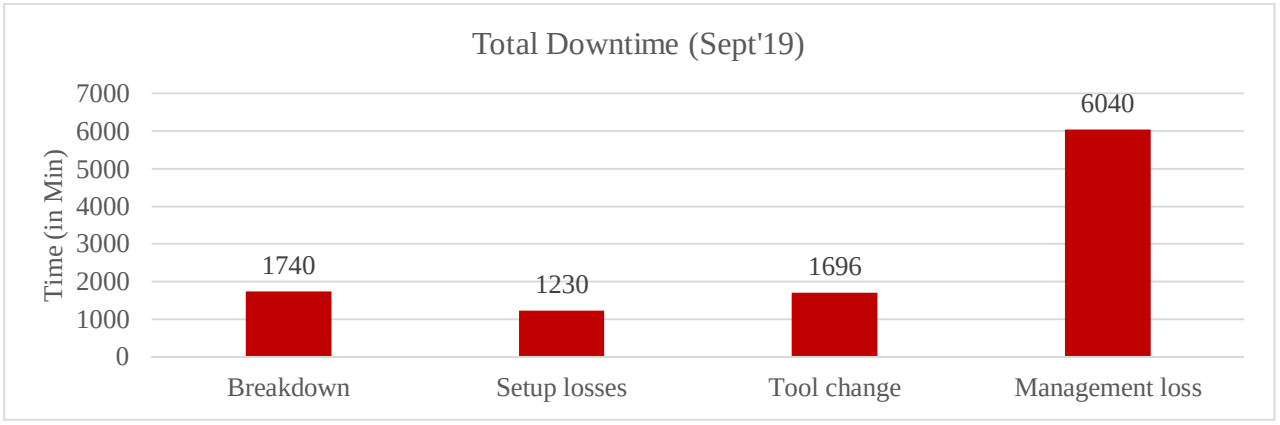


Table 8 Downtime of Sept'19

2) Downtime sheet of March 2020

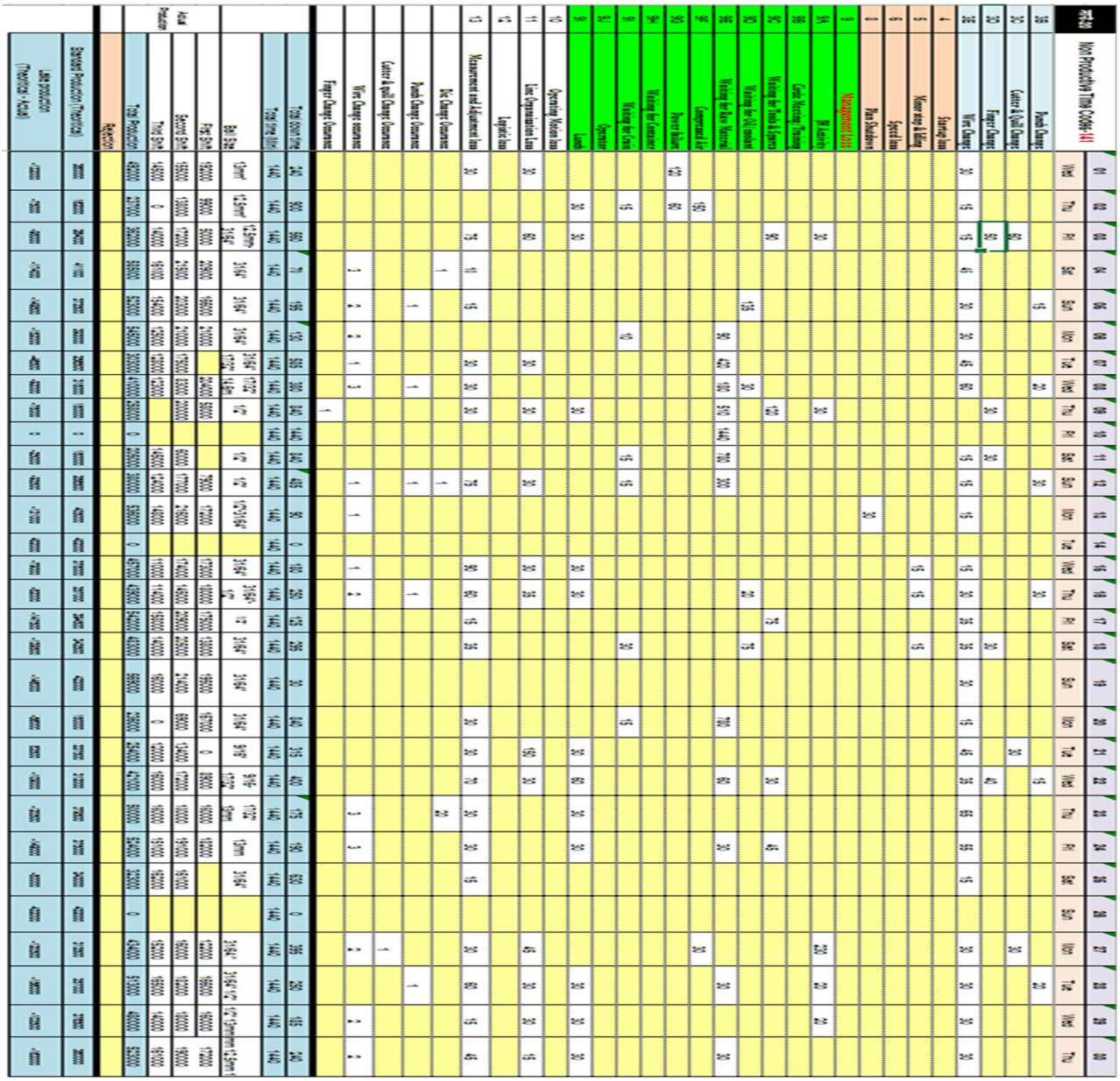


Fig.3 Downtime sheet March'20

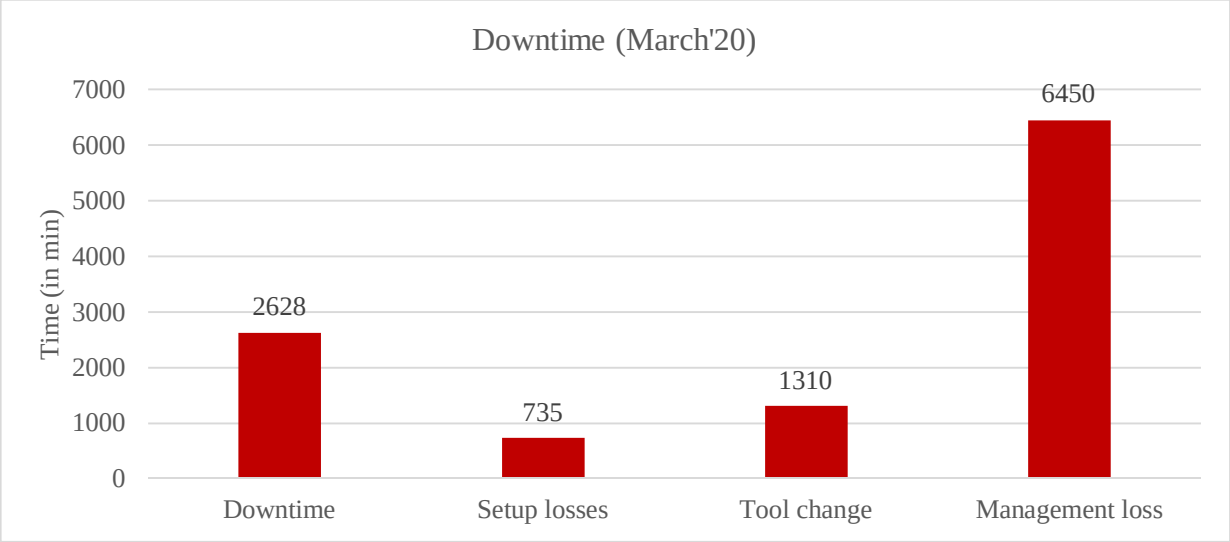


Table.9 Downtime of March'20

V. CONCLUSION

The Overall Equipment Effectiveness (OEE) of the machine (NH-141) is successfully increased from 60% to 83%. To gain this target, the basic 5S steps were initiated. The autonomous maintenance (JH) was performed to analyze, to improve and to maintain the activities regarding the machine done by the worker. To decrease the maintenance time and to increase the availability time Kaizen is used. To reduce setup time SMED is implemented. Initially the setup time was counted around 41 minutes which was further reduced to 17 minutes.

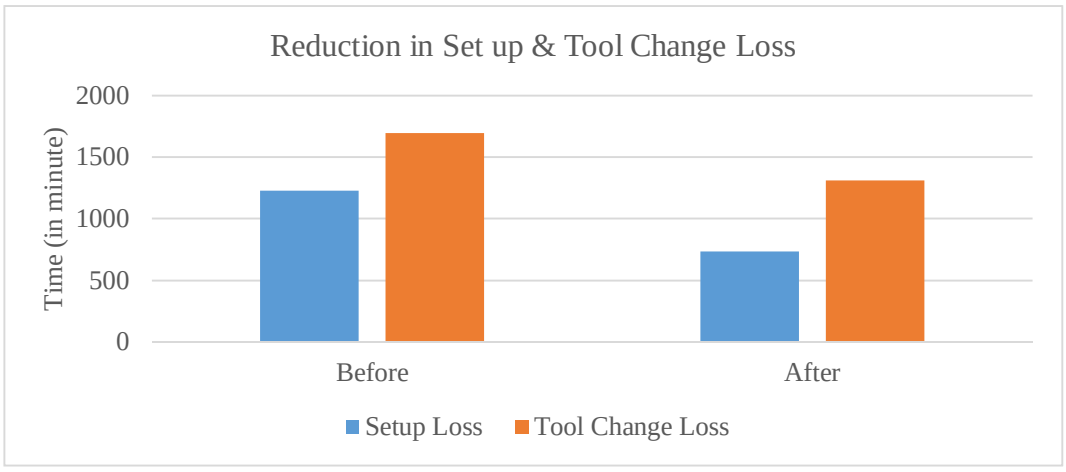


Table.10 Reduction in Set up & Tool change loss after implementing kaizens

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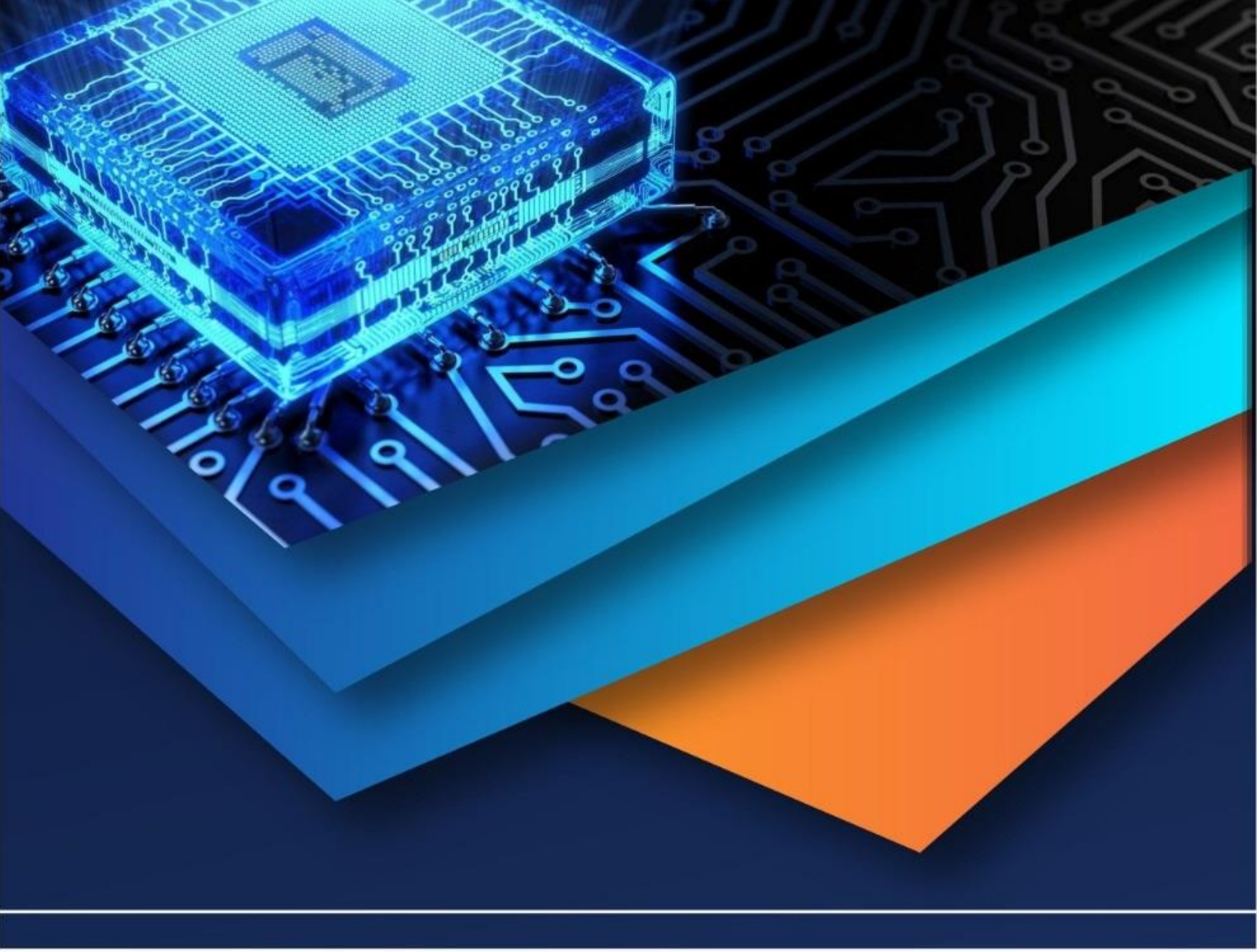

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